SIBERIAN BRANCH OF THE RUSSIAN ACADEMY OF SCIENCES
INSTITUTE OF ARCHAEOLOGY AND ETHNOGRAPHY

ARCHAEOLOGY, ETHNOLOGY & ANTHROPOLOGY OF EURASIA

Volume 45, No. 1, 2017

DOI: 10.17746/1563-0110.2017.45.1 *Published in Russian and English*

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Volume 45, No. 1, 2017

Founded in January, 2000
A quarterly journal in Russian and English

Founders
Siberian Branch of the Russian Academy of Sciences
Institute of Archaeology and Ethnography of the Siberian Branch of the Russian Academy of Sciences

Mass media registration certificate
No. 018782 issued May 11, 1999

Editors of the original Russian texts
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Russian texts translated by
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P. Magnussen

IAET SB RAS Publishing
Postal address:
Institute of Archaeology and Ethnography
Pr. Akademika Lavrentieva 17,
Novosibirsk, 630090, Russia
Tel.: (383) 330-83-66
E-mail: eurasia@archaeology.nsc.ru

DOI: 10.17746/1563-0110.2017.45.1.003-014

A.P. Derevianko[1], M.V. Shunkov[1], L. Bulatović[2], K.K. Pavlenok[1, 3], V.A. Ulyanov[1, 4], M.B. Kozlikin[1], and A.V. Kandyba[1]

[1]Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia
E-mail: derev@archaeology.nsc.ru; shunkov@archaeology.nsc.ru; pavlenok-k@yandex.ru;
vladul@front.ru; kmb777@yandex.ru; arhkandyba@gmail.com
[2]Public Institution "Museums and Galleries",
Mark Milanova 4, 32000, Podgorica, Montenegro
E-mail: hajhel@t-com.me
[3]Novosibirsk State University,
Pirogova 2, Novosibirsk, 630090, Russia
[4]Lomonosov Moscow State University,
Leninskie Gory, Moscow, 119991, Russia

New Findings on the Middle Paleolithic of the Eastern Adriatic: The Earliest Settlement at Bioče, Montenegro*

Excavations of undisturbed Pleistocene deposits at the Bioče rock shelter layers 4 and 3 by the joint Russian-Montenegrin expedition yielded the first evidence of Middle Paleolithic occupation. Primary reduction techniques are described, and a typology of the lithic industry is proposed. The techniques were quite simple, including parallel, multidirectional, and centripetal flaking suggestive of the Levallois tradition. Flakes were mostly small, short, and robust, with a straight profile. Most tools are single or double side-scrapers. Atypical end-scrapers, spurred and notched-denticulate tools, and flakes with irregular retouch are few. The closest technological and typological parallels are with Crvena Stijena layers XXII–XVIII, correlating with MIS 5c-b. This industry is based on Levallois and radial/discoid cores; elongated blanks are few. The most frequent tools are side-scrapers and backed knives. Finds from Bioče span a long period of occupation and testify to cultural evolution, suggesting, for the first time, that this site may be a key to understanding the cultural processes taking place during the Middle Paleolithic of the region.

Keywords: *Eastern Adriatic, Pleistocene, Middle Paleolithic, Bioče rock shelter, stratigraphy, lithic industry, chronology.*

Introduction

The Balkan Region, occupying a strategic location in the transition area between Europe and the Near East, plays a major role in the study of the Middle Paleolithic of the European continent. It has water boundaries in the west, south, and east (the Adriatic, Ionian and Black Seas), while the location of its northern boundary varies according to which factors (geographic or territorial and administrative) are taken into consideration. The studies published in recent years draw this boundary along the Drava, Sava, and Danube rivers (Reed, Kryštufek, Warren, 2004; Dogandžić, McPherron,

*Supported by the Russian Science Foundation (Project No. 14-50-00036).

Mihailović, 2014). The Balkans are characterized by a considerable physiographic diversity. The peninsula is dominated by dissected landscapes confined mainly to the valleys of large rivers and foothills. Being the most resource-rich, such landscapes were of the greatest interest to Paleolithic populations (Stepanchuk, Sapozhnikov, 2010). According to recent studies, the Balkans could have been a unique refugium for vegetable, animal and, therefore, human communities in the global cooling periods during the Pleistocene (Dogandžić, McPherron, Mihailović, 2014). This territory, then, with its resource-rich landscapes and refugium conditions, was probably used by humans and animals as a migration corridor, and is one of the most promising areas for obtaining new data on the Stone Age in Eurasia.

The Balkan Region can be conventionally divided into three main zones, varying in paleoecological characteristics: the coasts of the Adriatic and Ionian Seas; mountain ranges (the Dinar highlands, the Dalmatian Mountains, the Carpathians, the Rhodopes, and Pindus); and lowlands in the north that pertain to the common paleoecological zone with plains of the Lower Danube and the Black Sea (Furlan, 1977). Such Paleolithic sites as Bacho Kiro, Temnata, and Kozarnika (Bulgaria), Asprochaliko, Klissoura (Greece), Krapina, Vindija (Croatia) were discovered here. For a wide variety of reasons, including political ones, the coastal zone of the Balkans cannot be considered thoroughly studied in terms of Stone Age archaeology. After full-scale excavations of the Crvena Stijena site (Montenegro) in 1950–1970, this zone did not attract the attention of a wide range of researchers for a long time; therefore the issues of the Paleolithic in this region have not been fully included in the Central European problematics (Crvena Stijena, 1975). However, the landscape and climatic conditions facilitated the formation of peculiar manifestations of material culture here that are narrowly localized geographically. The coastal zone is separated from the internal areas of the peninsula by the Dalmatian mountain group and the Dinar highlands, which were natural barriers hampering the cultural contacts of the earliest population (Karavanić, 2007). In these conditions, the inhabitants of the coastal zone elaborated specific adaptation strategies reflected in their material culture. This determines the importance of this Balkan area for studying the Middle Paleolithic cultures of southeastern Europe and the Eurasian continent as a whole.

All Middle Paleolithic sites of the Eastern Adriatic contain material remains of the labors of Neanderthals. The disappearance of the Neanderthal population in the region, as shown by materials from the Crvena Stijena site (Morley, Woodward, 2011), may be likely related to the Campanian Ignimbrite eruption (about 40 ka BP). The earliest evidence of the presence of anatomically modern humans in the area under consideration is the Aurignacian site of Sandalja II in Istria (Croatia), for which site dates close to 32 ka BP are the oldest (Karavanić, Smith, 2013). Thus, according to the published anthropological data, the gap between the episodes of presence of Neanderthals and modern humans in the region is more than 5000 years. None the less, no transitional complexes have been found in the long coastal area from the Klissoura-1 site on the Peloponnesian peninsula in southern Greece to the Fumane site in northern Italy (Mihailović, Mihailović, Lopičić, 2011; Dogandžić, McPherron, Mihailović, 2014); and none of the known Middle Paleolithic industries has features suggesting local formation of the Upper Paleolithic traditions.

In the last decade, the intensity of the studies in the region has markedly increased, owing especially to the research conducted by Russian archaeologists in Montenegro (Derevianko, Bulatović, Tsybankov et al., 2010; Derevianko, Bulatović, Baković, Tsybankov et al., 2011; Derevianko, Bulatović, Baković, Agadžanjan et al., 2012; Derevianko, Bulatović, Pavlenok et al., 2014; Derevianko, Pavlenok, Kandyba et al., 2014; Derevianko, Pavlenok, Kandyba, 2015; Derevianko, Bulatović, Ulyanov et al., 2015). The Russian-Montenegrin expedition paid particular attention to studying the Bioče settlement, which may be rightly classified as one of the most informative objects of the region (Derevianko, Pavlenok, Kandyba, 2014; Derevianko, Pavlenok, Kandyba et al., 2014). This site, where occasional excavations have been carried out from time to time, has been known since 1980s (Đuričić, 2006). During the most recent phase of studies, in the lowest unit of the deposits (layers 3 and 4), which was earlier considered to be sterile, artifacts we discovered; and a totally new view has been formed of the stratigraphic situation at the site and the dynamics of the changes in the material complexes.

Bioče rock shelter: location, history of research

The Bioče village, to which the site owes its name, is located in a small valley, surrounded by mountains, at the confluence of the Morača and Mala Reka rivers (Fig. 1). The rock shelter itself is located along the left shoulder of the Morača valley at the foot of a limestone massif, at an elevation of about 40 m above the modern river's edge (Fig. 2) (Derevianko, Bulatović, Tsybankov et al., 2010).

The first exploratory trench at the site was excavated in 1986, following which the site was periodically studied until 1997. As a result of these works, a 4-meter deep series of deposits was opened over an area of 18 m^2; however, the base of the bedrock was not reached.

The sequence of Pleistocene deposits was divided into three series (I–III) by L. Đuričić (2006), who was the first researcher of this site. Series I, with a noticeable humus proportion, contained ash and coal interlayers. The bulk of the archaeological and osteological materials was found in these deposits. Series II consisted of clay and sand layers, with numerous partings of calcareous rock. Series III included archaeologically sterile clay layers. Earlier, the entire lithic industry of the site was recognized to be of one type, and to correspond to the characteristics of the regional micro-Mousterian facies of the Middle Paleolithic, which existed during MIS 3. The industry is dominated by Levallois flaking technique products, on which mainly small side-scrapers, Mousterian points, rocklets, and atypical end-scrapers were manufactured. Đuričić assigned the Bioče industry to the Levallois-Mousterian facies.

During the first year of work, when the walls of the old trench were cleaned, the Russian-Montenegrin expedition managed to establish that a considerable proportion of the site's deposits had been severely disturbed by combat actions during World War II (Derevianko, Bulatović, Tsybankov et al., 2010). A new excavation unit at the site was set up deep under the rock shelter, where undisturbed cultural deposits were discovered. They were unearthed through the entire sequence to the bedrock's base.

Fig. 1. Location of the Bioče rock shelter.

Fig. 2. Bioče rock shelter. General view.

Stratigraphic and cultural sequence

As a result of the work carried out in 2010–2015, four main lithological units were distinguished in the site section, which was more than 5 m thick (Fig. 3) (Derevianko et al., 2015).

Four additional units (1.1–1.4) were traced in layer 1. They are represented by medium

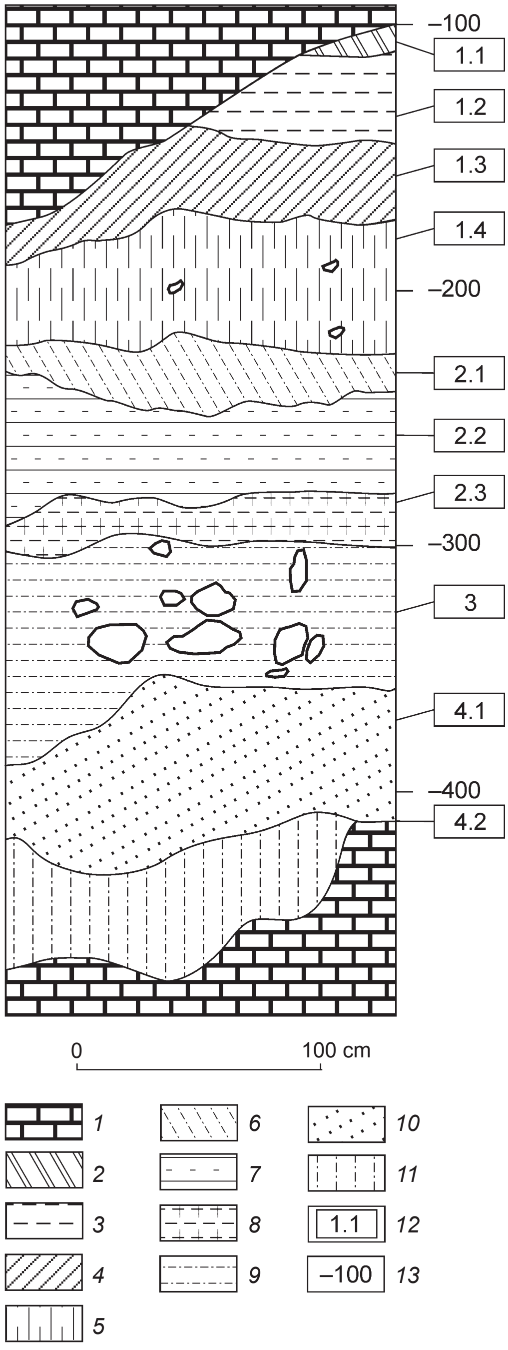

Fig. 3. Structure of the section of Pleistocene deposits at Bioče. *1* – limestone bedrock; *2* – medium-textured sandy and crushed stony loam, having an intense brown color with a reddish shade; *3* – brownish-black light loam, rich in humus; *4* – rubble-crushed stony thickness with light-loamy filler, having a dark brown color with a reddish shade; *5* – light loam, rich in humus, having an intense brownish-black color; *6* – fine rubble-crushed stony horizon of erosion pavement with sandy-loam filler of porous type; *7* – uneven-grained, gray-colored and gray-brown sandy loams and sands; *8* – gray-colored, fine-grained sandy loams enriched by fine rubble-crushed stony material at the top; *9* – reddish-brown heavy loam, saturated with highly-fractured grit and rubble in the upper part; *10* – reddish-brown heavy loams; *11* – packed plastic reddish-brown heavy loams with inclusions of grit and fine rubble; *12* – layer number; *13* – benchmark.

and light loams of different shades (from reddish to brown), which are saturated with humus and rock debris to different extents. According to the results of preliminary radiocarbon dating of bone and coal samples from layers 1.2 and 1.4, the accumulation of these deposits took place from 40 to 32 ka BP (Derevianko, Pavlenok, Kandyba, 2014).

The major part of the archaeological material (about 90 % of the total number of finds at the site) was discovered in layer 1. Among the cores, radial ones for producing small flakes are most abundant. Orthogonal shapes are typologically close to them. Unifacial single-platform cores are dominated by longitudinal pieces, including isolated cores with volumetric fronts. Simple shapes of end-cores with trial spalls are encountered. A distinctive feature of the material complex from layer 1 is the "microlithism" of the toolkit: only few items have a maximum size exceeding 5 cm. Taking into account this feature, the assemblage of Bioče can be referred to as "micro-Mousterian". The predominant category of tools includes side-scrapers—most frequently, single longitudinal ones. Atypical end-scrapers represent another major category. Among the knives, which are third most numerous, single-edged longitudinal items are common. Pointed and combination tools are few.

Layer 2 is divided into three parts (2.1–2.3). Its filling consists mainly of gray-colored sandy loams and uneven-grained sands in the upper and middle part of the layer, while the lower part is composed of light loams.

Products of the radial reduction technique are widely represented in the layer industry. At the same time, all forms typical of the layer 1 industry are present, and also pieces reflecting development of other stone working techniques, such as mass-produced average-sized blades, and also elongated points and carefully retouched side-scrapers and knives, which are manufactured on the basis of these.

Layers 3, 4.1, and 4.2, which form the lower part of the section, obviously, correspond to series III of the sequence of Pleistocene deposits according to the observations of Đuričić (2006). Deposits in this part of the section are represented by heavy reddish-brown loams, with various degrees of saturation with detrital material.

The stratigraphy of the site deposits reflects a prolonged process of sedimentation. Ancient intra-cave deposits (layer 4.2) formed as a result of chemical erosion of the limestone bedrock lie at the section base, obviously. This process could have proceeded even before the opening of the karst cavern. The angular displacement between the dip and strike of the layer 4.2 textures and the overburden deposits suggests the break in sedimentation that preceded the accumulation of layer 4.1. The presence of aleurite lenses in layer 4.1 points to the formation of sediments under conditions of a low-flow water reservoir with a relatively stable hydrological regime. In terms of its origins, layer 3 is sediment of layer 4.1 that experienced intense mechanical destruction in a dry or poorly moistened ground condition, accompanied by a substantial input of detrital material under subaerial conditions. Such a drastic change of setting is probably related to the opening of the karst cavern. From this point on, landscape and climatic changes started playing a leading part in the dynamics of the formation of loose deposits.

The arrangement of the archaeological materials in the deposits is indicative of the almost permanent presence of humans in the niche during the formation of the cultural layers of the two upper units, which precluded the accumulation of sterile sediments. As a result of successive accumulation of the remains of numerous visits (layers 1 and 2), stratigraphically monotonous cultural gigantic layers were formed. Rare stone items, which do not form pronounced occurrence horizons, are recorded in a "suspended" state in layers 3 and 4.1. Meanwhile, the materials of layer 4.1 are localized solely in its near-superface part.

Analysis of the entire body of data allows the conclusion to be drawn that the loamy fill of layer 3 is similar in its content to the substance of layer 4.1, though different from the latter in its crumbly structure, lack of lens-stratified texture, and in the saturation with detrital material received from the shelter walls. Formation of layer 4.1 proceeded predominantly in a low- or moderate-flow subaqueous setting, typical of closed karst caverns, which was replaced by subaerial conditions characteristic of dry (open, blown) caverns. Most probably, after intra-cave sediments had dried out (the beginning of layer 3 formation), the space under the Bioče rock shelter became comfortable for visits and habitation by Paleolithic humans. In light of this, the artifacts from layer 4.1 should be considered as received from layer 3 as a result of trampling.

Archaeological materials from layers 3 and 4.1

The lithic industry from layer 3 totals 310 items (Table 1). Almost one third of the collection consists of production waste in the form of chips and scales. Taking into account small flakes that were not used to manufacture tools, waste accounts for 68 % of the collection.

Core-shaped items comprise 16 pieces, including 3 core-shaped fragments and a completely exhausted core. Typologically definable cores (13 items) represent several reduction strategies (Table 2), among which the prevailing one can barely be distinguished.

Three cores are single-platform and unifacial. The platforms of two items were prepared by several deep transverse spalls. Average-sized oval flakes were detached from them (Fig. 4, *14*, *18*). Several large flakes were detached from the third item without preliminary preparation of the core (Fig. 4, *23*). Reduction of the longitudinal core to produce elongated spalls was performed from one asymmetrically convex platform along two adjacent sides (Fig. 4, *24*). A longitudinal alternative core has two opposite wide fronts with negative scars from shortened detachments, of average and small size, that were spalled in reversed directions (Fig. 4, *17*). A bidirectional core shows negatives of counter-oriented small detachments on adjacent surfaces (Fig. 4, *12*).

Two artifacts are assigned to the category of orthogonal. The detachment of blanks was performed along one (Fig. 4, *13*) or two adjacent (Fig. 4, *19*) fronts after reorientation of the core, the latter being due to the formation of defects on the main front.

The only Levallois core in the collection was made on a small pebble (Fig. 4, *16*). A large spall removing the major portion of the front was detached from a smooth striking-platform. Negative scars of small shaping centripetal detachments are preserved along the perimeter.

Spalls for shaping the striking-platform occupy 3/4 of the blank perimeter on one radial core, and 1/2 of the blank perimeter on the second core. The fronts of both items are covered by negatives of small centripetal detachments. A similar centripetal method of flaking blanks is represented by a bifacial discoid core (Fig. 4, *20*).

A set of technical spalls (see Table 1) consists mainly of the decortication products (primary and secondary spalls of different size). Average-sized flakes prevail. Three artifacts are defined as longitudinal marginal spalls.

The category of blank spalls is dominated by average-sized flakes (3–5 cm) represented by 41 pieces (see Table 1). Characteristic of this category is a smooth striking-platform. Among the flakes, there is a series of tools with roughly faceted striking-platforms suggestive of the Levallois technique. Implements with

Table 1. **Main categories of stone tools from layers 3 and 4.1 at Bioče**

Products of primary reduction	Layer 3		Layer 4.1	
	pcs.	%	pcs.	%
Core-shaped items	16	5.2	4	11.8
Including:				
cores	13	4.2	3	8.8
core-shaped fragments	3	1.0	1	2.9
Primary spalls	6	1.9	1	2.9
Including:				
large	1	0.3	0	0.0
medium	5	1.6	1	2.9
Secondary spalls	12	3.9	3	8.8
Including:				
large	1	0.3	1	2.9
medium	8	2.6	2	5.9
small	3	1.0	0	0.0
Flakes	163	52.6	13	38.2
Including:				
large	5	1.6	0	0.0
medium	41	13.2	2	5.9
small	117	37.7	11	32.4
Technical spalls	4	1.3	0	0.0
Including:				
longitudinally marginal	3	1.0	0	0.0
indeterminate	1	0.3	0	0.0
Chips	73	23.5	3	8.8
Scales	21	6.8	8	23.5
Complete blades	4	1.3	0	0.0
Split pebbles	10	3.2	2	5.9
Split boulder	1	0.3	0	0.0
Total	310	100.0	34	100.0

Table 2. **Cores from layers 3 and 4.1 at Bioče**

Core type	Layer 3		Layer 4.1	
	pcs.	%	pcs.	%
Longitudinal	2	13	1	25
Transverse	1	6	–	–
Longitudinal adjacent	1	6	–	–
Bidirectional adjacent	1	6	–	–
Longitudinal alternative	1	6	–	–
Multidirectional	1	6	2	50
" bifacial	1	6	–	–
Levallois for production of flakes	1	6	–	–
Radial	2	13	–	–
Discoid	1	6	–	–
Exhausted	1	6	–	–
Core-shaped fragment	3	19	1	25
Total	16	100	4	100

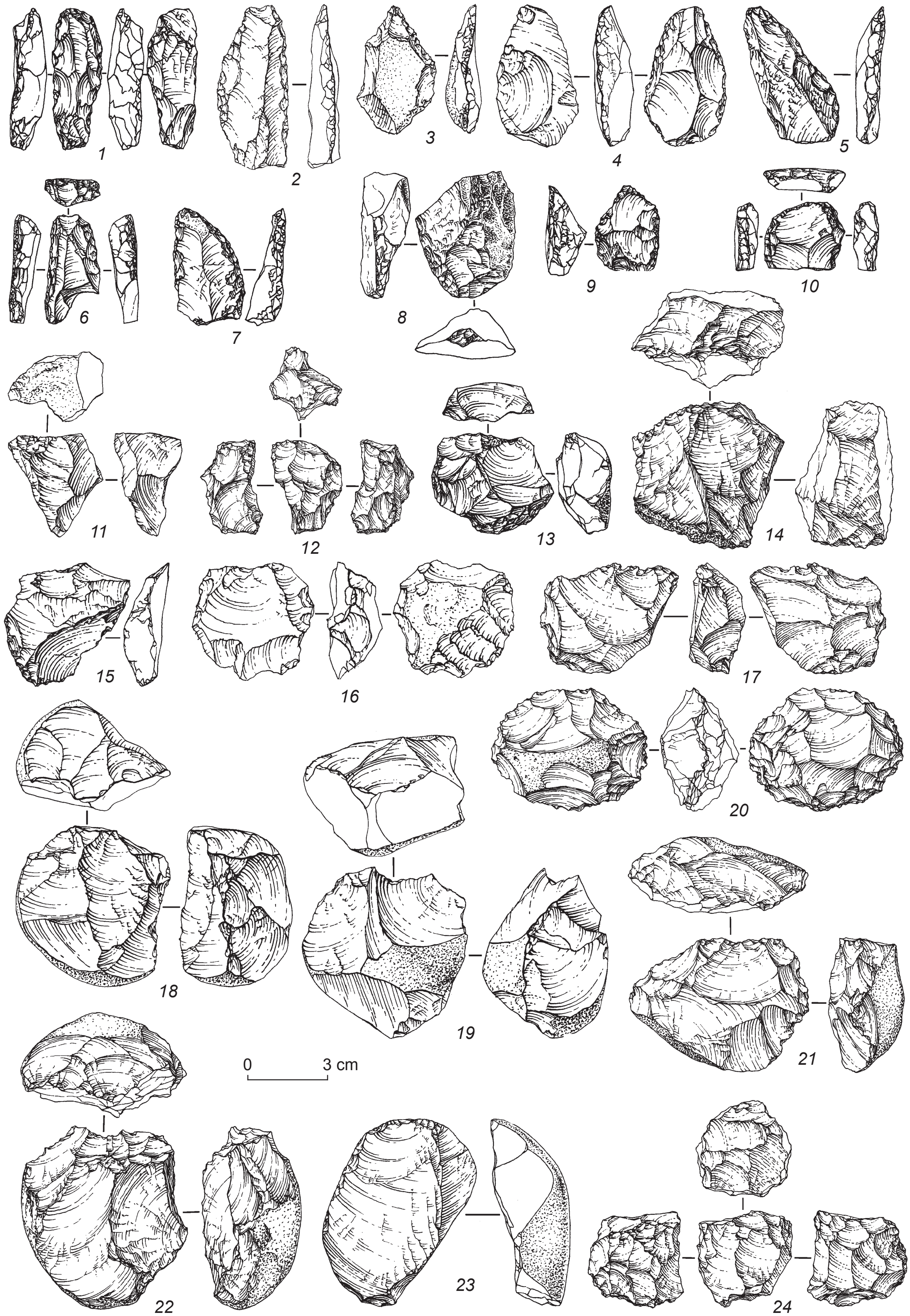

Fig. 4. Lithic industry from layers 3 and 4.1 at Bioče.

dihedral platforms, which occur (although infrequently) in flakes and blades, are morphologically close to them. Obviously, rare spalls with linear/point-like platforms should be considered accidental. Pieces with natural platforms are associated only with decortication spalls.

Faceting of spalls generally corresponds to the methods of reduction that are represented by accompanying cores. One third of the items have longitudinal faceting. Spalls with multidirectional faceting are half of this. Detachments with smooth, radial or convergent faceting are less representative. Bidirectional faceting is recorded on one blade.

Half of the toolkit is composed of side-scrapers of various types (Table 3). Single-edged side-scrapers are made on flakes in a longitudinal manner (Fig. 4, *8*, *15*). They differ in the degree of the edge's convexity, in the presence or absence of a back, and one specimen is distinguished by an arrangement of its facets. Retouch in the majority of items is dorsal, abrupt, marginal, medium- or fine-faceted. One side-scraper can be assigned to the category of bifacial, longitudinal, and convex. An area of natural surface performs the function of a back. The edge is prepared by fine, continuous, abrupt, marginal, bifacial retouch.

Characteristic of double side-scrapers are convex edges (Fig. 4, *1*, *6*). Two tools are treated by dorsal abrupt and vertical scalar, invasive, large-faceted retouch, owing to which the items have acquired oval elongated shapes, and a resemblance to limaces. One of the tools shows traces of a series of small flattening spalls from a longitudinal edge to the ventral surface. A longitudinal straight dorsal side-scraper is shaped on a blade. The edges are treated by stepped vertical medium- and fine-faceted invasive retouch. The collection includes a longitudinal straight-convex side-scraper made on a blade as well (Fig. 4, *2*). It has dorsal abrupt retouch, marginal on one edge, and invasive scalar on the other.

Two side-scrapers are treated by dorsal abrupt marginal scalar retouch along 3/4 of their perimeters. A longitudinal edge of one implement has a negative scar from a large spall of ventral thinning-out (Fig. 4, *4*).

A longitudinal straight dorsal knife with a natural back is made on a small robust flake. The working edge is pointed by semi-abrupt medium-modified, large-faceted, invasive retouch.

Atypical end-scrapers (2 pieces) are made on flakes (Fig. 4, *9*, *10*). The edges, straight in one case and convex in the other, are prepared by dorsal, vertical, strongly-modified, medium- and fine-faceted marginal retouch.

Spurred tools total 3 items. The working member is located on the distal edge (Fig. 4, *3*) or at the corner between the distal and longitudinal edges of the blank. The spur is separated by means of deep dorsal (2 pieces) or ventral notches.

Table 3. **Tools from layers 3 and 4.1 at Bioče**

Tool type	Layer 3		Layer 4.1	
	pcs.	%	pcs.	%
Side-scraper, single longitudinal straight	1	5	–	–
" with a natural back	1	5	–	–
Side-scraper, single longitudinal convex	1	5	–	–
" with a natural back	–	–	1	33
" with bifacial retouch	1	5	–	–
Double side-scraper, longitudinal straight	1	5	–	–
" convex	2	10	1	33
" straight-convex	1	5	–	–
Side-scraper with retouch along 3/4 of its perimeter	2	10	–	–
Longitudinal straight knife with a natural back	1	5	–	–
Atypical end-scraper	2	10	–	–
Spurred tool	3	14	–	–
Notched-denticulate tool	1	5	–	–
Retouched fragment	1	5	–	–
Retouched flake	2	10	1	33
Tool fragment	1	5	–	–
Total	21	100	3	100

The working edge of a notched-denticulate tool on the middle marginal spall is represented by a series of shallow notches separated by slightly protruding dents.

The collection comprises flakes with episodic dorsal and ventral retouch, a piece with irregular retouch, and a fragment of a tool.

In layer 4.1, 30 artifacts have been found, a half of which was represented mainly by small flakes. One third of the collection consists of fragments and scales. Four core-like shapes (three cores and a fragment), four decortication spalls, and two average flakes may be classified as informative items.

Two multidirectional (Fig. 4, *21*, *22*) and one longitudinal (Fig. 4, *11*) cores reflect strategies of the industry of layer 3. The characteristics of platforms and spall faceting are also in exact accordance with those in materials of the overlying layer, which confirms the expediency of interpreting items from layers 3 and 4.1 within a single assemblage.

The toolkit consists of 3 items. A single, longitudinal, convex side-scraper with a natural back is made on a longitudinally marginal blade. The working edge of the tool is shaped by dorsal, stepped, abrupt, strongly-modified, medium- and fine-faceted invasive retouch (Fig. 4, *5*). A double, longitudinal, convex side-scraper on the middle leaf-shaped flake is treated by dorsal, abrupt, marginal, different-sized retouch (Fig. 4, *7*). The last item is an average-sized spall with small portions of ventral retouch.

Brief description of Middle Paleolithic assemblages of Montenegro

Seven Paleolithic localities are known in the territory of Montenegro; however, Middle Paleolithic materials were recorded at only three of them: Crvena Stijena, Mališina Stijena, and Bioče. The major source of information on that epoch is provided by collections from the site of Crvena Stijena (Crvena Stijena, 1975; Baković et al., 2008), located not far from the boundary between Montenegro and Bosnia and Herzegovina. The thickness of loose deposits at the site is more than 20 m. In different years, researchers have distinguished 30 cultural layers comprising archaeological material from the Lower Paleolithic (pre-Mousterian) to the Bronze Age. 20 layers, with a total thickness of more than 10 m, were assigned to the Middle Paleolithic.

The materials from layers XXXI–XXV of Crvena Stijena allow us to relate the beginning of the Middle Paleolithic in this region to MIS 6, or an earlier period (Mihailović, 2014). Throughout the duration of MIS 6 (186–128 ka BP), a cold and dry climate was typical of the Balkans (Tzedakis, Hooghiemstra, Palike, 2006). Forest vegetation was preserved only in small refugiums with sufficiently humid climates and without extreme temperature fluctuations. Archaeological collections of the site suggest that roughly shaped cores made by means of the Levallois or centripetal flaking technique were used in primary reduction. The toolkit is dominated by side-scrapers; denticulate and notched implements are also widely represented. Other categories of tools are less representative. According to D. Mihailović (2014), during this prehistoric period, the Balkans were, obviously, merely a transit corridor connecting Central and Northwestern Europe with Southwest Asia.

Interglacial epoch MIS 5e (128–118 ka BP) was the warmest period for the last 450 thousand years (Abrantes et al., 2012). Evergreen forests with pistachios *Pistacia* and holm oaks *Quércus ílex* grew in Southeastern Europe at that time, as well as elm-trees *Ulmus* and hornbeams *Carpinus*. In the sequence of the Crvena Stijena deposits, layer XXIV, nearly 3 m thick, which consists of several ash horizons saturated with bones and artifacts, pertains to this period (Crvena Stijena, 1975). Primary reduction was dominated by the Levallois technique. The tools were predominantly side-scrapers made on Levallois blanks and *éclat débordant* spalls, as well as retouched spalls (Mihailović, 2014).

The gradual cooling that started approximately 118 ka BP caused alternation of cool (MIS 5d, 5b) and warm (MIS 5c, 5a) climatic phases. A favorable climate of warm phases close to that of MIS 5e facilitated active distribution of Neanderthal populations in the region. During cold phases, when the role of pine-birch and herbal vegetable communities increased (Tzedakis, Bennett, 2005), a demographic decline, obviously, took place.

The archaeological collection of layer XXIII of Crvena Stijena (MIS 5d stage) is very unimpressive.

The materials from layers XXII–XX, which are indicative of the use of Levallois and radial/discoid cores, pertain to the MIS 5c stage. Here, few elongated blanks are present among the spalls. The toolkit is represented mainly by side-scrapers. These are dominated by transverse varieties, some of which are treated by Quina retouch. Among other types of tools, Mousterian points and backed knives should be mentioned. Several atypical end-scrapers occur in layer XXI (Mihailović, 2014).

Layer XIX yielded only rare uninformative artifacts.

The materials of layer XVIII are related to stage MIS 5b. The characteristics of this lithic industry are very close to those of industries from layers XXII–XX; however, according to M. Brodar (1962), notched-denticulate implements are numerous in the toolkit.

Scarce materials from layer XVII pertain to stage MIS 5a. Primary reduction is characterized by a Levallois core, a combination core, and a bidirectional core. The toolkit is for the first time dominated by denticulate shapes rather than by side-scrapers. Tools of other types are few and, among these, narrow blades and points with abrupt retouch along the longitudinal edge are noteworthy.

The subsequent stage MIS 4 (75–58 ka BP) was distinguished by strong cooling that was accompanied by a dominance of steppe vegetation in Central and Southern Europe. The evidence of human activities in the Crvena Stijena deposits of this period (layer XVI) is minimal (Crvena Stijena, 1975; Morley, Woodward, 2011), as it is throughout the entire territory of the Balkans (Mihailović, 2014).

The situation changed drastically about 58 ka BP (MIS 3 stage), when forest vegetation spread as the climate was becoming warmer and more humid (Panagiotopoulos et al., 2014). The geochronological position of layers XV–XIII of Crvena Stijena is not quite clear; layer XII, with a ^{14}C-date of 40,777 ± 900 ka BP (Vogel, Waterbolk, 1972), most certainly belongs to MIS 3. During this period, the subsistence strategies of local inhabitants underwent dramatic changes: totally new techniques came into use in the practice of production. The cores made by the Levallois and radial techniques were reduced down to the limit. Layers XV, XIV and XII contain flattened cores with negatives from the detachment of blades. Simple longitudinal side-scrapers prevail among the tools, and atypical end-scrapers are especially abundant in layers XIV and XIII (Mihailović, 2014).

In general, the materials of Middle Paleolithic layers XXXI–XVII of Crvena Stijena are defined as Mousterian Charantian-like tools with traces of the Levallois technique (Excavation…, 1982). Cultural layers of the final stage of the Middle Paleolithic (XVI–XII) were assigned to the regional micro-Mousterian facies (Mihailović, 2014).

The site of Mališina Stijena in northern Montenegro has only been studied fragmentarily. The site is located in a vast rocky depression on the left bank of the Ćehotina River. During archaeological excavations of the site in 1980–1984 and 1986–1987, it was possible to identify layers of the middle and final stages of the Upper Paleolithic. The Middle Paleolithic layers (3b13–3b16 in the southern part of the site, and 9–14 in the western part) with a total thickness of 0.5 to 1.0 m, were studied within an area of about 6 m^2. Only the most general information on the type of lithic industry is available (Radovanović, 1986). The excavators point to the prevailing use of centripetal flaking in primary reduction, with minor incidence of the Levallois technique. Notched-denticulate items are most widely represented among the tools. Apparently, to determine the place of this site in the regional Paleolithic structure, additional studies are needed.

Preliminary chronology of materials of Bioče layers 3 and 4.1 within the context of the Middle Paleolithic in Montenegro

Materials of the lower unit of the Bioče site deposits are rare (especially compared to collections of the middle and top parts of the section); however they allow us to get an idea of the stone-working trend among first inhabitants of the site. Quite simple parallel, multidirectional, and centripetal flaking patterns were used for primary reduction based on pebble raw materials. There also is vivid evidence of the use of Levallois technique. Reduction was performed to produce small, sufficiently wide, and robust flakes with straight profiles. Single and double side-scrapers were the predominant category of the toolkit. Atypical end-scrapers, spurred and notched-denticulate tools, and flakes with irregular retouch are few. All categories of tools (including blade-based tools) are represented in the overlying layers, which can be explained by the preservation of the original specialization of the site.

The results of analysis of the dynamics of the Bioče industry (taking into account stratigraphic observations) give grounds for distinguishing several technocomplexes marking the episodes of the site's occupation by human communities practicing various stone-working techniques. According to key indicators, the industry of the lower part of Bioče section may belong to stages MIS 5c-b. The industries of this period, judging by the finds from layers XXII–XVIII of Crvena Stijena, are characterized by the use of Levallois and radial/discoid cores. Noteworthy is also the availability of a few elongated blanks among the spalls from these layers. Similarly to the industry from the lower units of deposits in Bioče, the toolkit of layers XXII–XVIII in Crvena Stijena includes side-scrapes and backed knives. Also, layer XXI contained several atypical end-scrapers. The possibility of such an age-assessment of the lower part of the Bioče section (in the absence of absolute dating results) is also raised by the presence of narrow blades and points with abrupt retouch along the longitudinal edge in a scanty collection of layer XVII of Crvena Stijena (stage MIS 5a). Such shapes determine the appearance of the industry of Bioče layer 2 overlying the cultural strata of the lower deposits. Thus, there are sufficient grounds to assign the material complex of the lower part of the Bioče section to the cultural tradition that became established in the Middle Paleolithic of the region during MIS 5 (Crvena Stijena, 1975; Baković et al., 2008; Mihailović, 2014).

The obtained results allow a conclusion to be drawn about the cultural and chronological variability of the Bioče assemblages, and suggest that this site is considerably older than previously thought. This last circumstance supplies a reason for using Bioče as a reference object in cultural and chronological reconstructions along with Crvena Stijena materials.

References

Abrantes F., Voelker A., Sierro F.J., Naughton F., Rodrigues T., Cacho I., Ariztegui D., Brayshaw D., Sicre M.-A., Batista L. 2012
Paleoclimate variability in the Mediterranean region. In *The Climate of the Mediterranean Region*. London: Elsevier, pp. 1–86.

Baković M., Mihailović B., Mihailović D., Morley M., Vusovic-Lucic Z., Whallon R., Woodward J. 2008
Crvena Stijena excavations 2004–2006, preliminary report. *Eurasian Prehistory*, vol. 6 (1/2): 3–31.

Brodar M. 1962
Crvena Stijena 1958 i 1959. *Glasnik Zemaljskog muzeja u Sarajevu*. N. S., vol. XVII: 15–20.

Derevianko A.P., Bulatović L., Baković M., Agadžanjan A.K., Vislobokova I.A., Pavlenok K.K., Kandyba A.V., Chekha A.M. 2012
Issledovaniye skalnogo navesa Bioche (Chernogoriya) v 2012 godu. In *Problemy arkheologii, etnografii, antropologii Sibiri i sopredelnykh territorii*, vol. XVIII. Novosibirsk: Izd. IAE SO RAN, pp. 46–50.

Derevianko A.P., Bulatović L., Baković M., Tsybankov A.A., Ulyanov V.A., Kandyba A.V. 2011
Issledovaniye skalnogo navesa Bioche (Chernogoriya) v 2011 godu. In *Problemy arkheologii, etnografii, antropologii Sibiri i sopredelnykh territorii*, vol. XVII. Novosibirsk: Izd. IAE SO RAN, pp. 34–40.

Derevianko A.P., Bulatović L., Pavlenok K.K., Kandyba A.V., Kozlikin M.B., Ćulović G., Chekha A.M. 2014
Kharakteristika materialnykh kompleksov stoyanki Bioche (po itogam rabot 2014 goda). In *Problemy arkheologii, etnografii, antropologii Sibiri i sopredelnykh territorii*, vol. XX. Novosibirsk: Izd. IAE SO RAN, pp. 27–31.

Derevianko A.P., Bulatović L., Tsybankov A.A., Ulyanov V.A., Kandyba A.V., Krivoshapkin A.I., Baković M. 2010
Issledovaniya skalnogo navesa Bioche (Chernogoriya) v 2010 godu. In *Problemy arkheologii, etnografii, antropologii Sibiri i sopredelnykh territorii*, vol. XVI. Novosibirsk: Izd. IAE SO RAN, pp. 52–57.

Derevianko A.P., Bulatović L., Ulyanov V.A., Pavlenok K.K., Kozlikin M.B., Kandyba A.V., Anoikin A.A., Ćulović G. 2015
Stratigrafiya otlozheniy skalnogo navesa Bioche (Chernogoriya). In *Problemy arkheologii, etnografii, antropologii Sibiri i sopredelnykh territorii*, vol. XXI. Novosibirsk: Izd. IAE SO RAN, pp. 49–52.

Derevianko A.P., Pavlenok K.K., Kandyba A.B. 2014
Finalnoye mustye Vostochnoi Adriatiki: Kamennaya industriya stoyanki Bioche. In *Trudy IV (XX) Vseros. arkheol. syezda v Kazani*, vol. I. Kazan: Otechestvo, pp. 56–58.

Derevianko A.P., Pavlenok K.K., Kandyba A.V., Kozlikin M.B., Chekha A.M. 2014
Mikromustye Balkanskogo poluostrova: K istorii izucheniya voprosa. *Vestnik Novosib. Gos. Univ*. Ser.: Istoriya, filologiya, vol. 13 (5). Iss.: Arkheologiya i etnografiya: 17–26.

Dogandžić T., McPherron S., Mihailović D. 2014
Middle and Upper Paleolithic in the Balkans: Continuities and discontinuities of human occupations. In *Palaeolithic and Mesolithic Research in the Central Balkans*. Belgrade: Serb. Archaeol. Soc., pp. 81–94.

Đuričić L. 2006
A contribution to research on Bioče Mousterian. *Journal of the Serbian Archaeological Society*, vol. 22: 179–196.

Excavation in the Bacho Kiro Cave – Final Report. 1982
Warsaw: Panstwowe wydawnictwo naukowe.

Furlan D. 1977
The climate of southeast Europe. In *Climates of Central and Southern Europe. World Survey of Climatology*. Amsterdam: Elsevier, pp. 185–235.

Karavanić I. 2007
Le Moustérien en Croatie. *L'Anthropologie*, vol. 111: 321–345.

Karavanić I., Smith F.H. 2013
Alternative interpretations of the Middle/Upper Paleolithic interface at Vindija Cave (Northwestern Croatia) in the context of Central Europe and the Adriatic. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 41 (4): 11–20.

Mihailović D. 2014
Palaeolithic in the Central Balkans: Cultural Changes and Population Movements. Belgrade: Serb. Archaeol. Soc.

Mihailović D., Mihailović B., Lopičić M. 2011
The Paleolithic of Northern Serbia. In *The Prehistory of Banat I: The Palaeolithic and Mesolithic*. Bucharest: The Publ. House of the Romanian Acad., pp. 77–101.

Morley M.W., Woodward J.C. 2011
The Campanian Ignimbrite (Y5) tephra at Crvena Stijena Rockshelter, Montenegro. *Quaternary Research*, No. 75 (3): 683–696.

Panagiotopoulos K., Böhm A., Leng M., Wagner B., Schäbitz F. 2014
Climate variability over the last 92 ka in SW Balkans from analysis of sediments from Lake Prespa. *Climate of the Past*, No. 10: 643–660.

Radovanović I. 1986
Novija istrazhivaња paleolita i mezolita u Tsrnoj Gori. *Glasnik Srpskog arkheoloshkog drushtva*, No. 3: 63–76.

Reed J.M., Kryštufek B., Warren J. 2004
The physical geography of the Balkans and nomenclature of place names. In *Balkan Biodiversity: Pattern and Process in the European Hotspot*. Dodrecht: Springer Sci., pp. 9–22.

Stepanchuk V.N., Sapozhnikov I.V. 2010
Paleolit Balkan i Severnogo Prichernomorya: Vzaimodeistviye ili nezavisimoye sosushchestvovaniye? In *Terra cognoscibilis: Kulturnoye prostranstvo mezhdu Balkanami i Velikoi Stepyu v epokhu kamnya – bronzy*. Odessa: SMIL, pp. 11–39. (Materialy po arkheologii Severnogo Prichernomorya; iss. 11).

Tsrvena Stijena. 1975
Nikšić: Nauchno delo.

Tzedakis P., Bennett K. 2005
Interglacial vegetation succession: A view from southern Europe. *Quaternary Science Reviews*, No. 14: 967–982.

Tzedakis P., Hooghiemstra H., Palike H. 2006
The last 1.35 million years at Tenaghi Philippon: Revised chronostratigraphy and long-term vegetation trends. *Quaternary Science Reviews*, No. 25: 3416–3430.

Vogel J.C., Waterbolk H.T. 1972
Groningen radiocarbon dates X. *Radiocarbon*, No. 14: 6–110.

Received January 25, 2016.

DOI: 10.17746/1563-0110.2017.45.1.015-024

I.D. Zolnikov[1–3], A.A. Kartoziya[2, 3], A.V. Vybornov[1, 2], V.S. Slavinsky[1], A.A. Tsybankov[1], and I.A. Grachev[4]

[1]Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia
E-mail: zol@igm.nsc.ru; vb.anton@gmail.com; vybornov@archaeology.nsc.ru; slavinski@yandex.ru; tsybankov@yandex.ru
[2]Novosibirsk State University,
Pirogova 2, Novosibirsk, 630090, Russia
E-mail: kartoziya-444@mail.ru
[3]Institute of Geology and Mineralogy, Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Koptyuga 3, Novosibirsk, 630090, Russia
[4]Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), Russian Academy of Sciences,
Universitetskaya nab. 3, St. Petersburg, 199034, Russia
E-mail: lugavka@mail.ru

Geomorphology and Quaternary Sediments at Archaeological Sites Near Anzhevka, Krasnoyarsk Territory*

Archaeological and geomorphological studies at several sites near the village of Anzhevka contribute to the understanding of the cultural and chronological situation in the region during the Quaternary. They are especially relevant to intermediate regions such as the Kansk-Rybinsk Basin, situated between the Baikal, Angara, and Yenisei drainages. Rescue excavations in 2015 on the right bank of the Kan River, near Kansk, yielded numerous finds relating to the Quaternary, and to the origin of the modern topography of that basin. Excavated sites near Anzhevka include Nefteprovod-1 and -2 and Ryabchikov Klyuch-1, all spanning the period from the Upper Paleolithic to recent centuries, and including five geomorphological segments with different types of Quaternary deposits. The main type of landscape at Ryabchikov Klyuch-1 is sharp-crested dissected, and that at Nefteprovod-1 and -2 is defined by structural denudation. The latter occupies the right wall of the Kan River valley, raised and divided into neotectonic blocks differing in elevation. The nature of the sections is determined by geomorphological segmentation: the Quaternary sequence begins from alluvial sediments, and in certain areas between the pre-Quaternary sediments and the subaerial cover, the alluvium is absent. Cultural layers are deposited in the upper unit, as represented by the subaerial cover's differing in various areas, because of local alluvial erosion and eolian deflation. Studies show the peculiar nature of the geomorphology and sediments of the area, different from those at Strizhovaya Gora, which is located 3.5 km downstream the Kan River.

Keywords: Krasnoyarsk Territory, Kansk-Rybinsk Basin, Kan River, Late Pleistocene, Holocene, geomorphology, Quaternary.

*Supported by the Russian Science Foundation (Project No. 14-50-00036).

Introduction

Archaeological studies in Eastern Siberia have long focused on several regions with high concentrations of archaeological sites, such as the Minusinsk Basin, the Yenisei and Angara drainages, and the Lake Baikal area. These are large riverine and lacustrine regions where human subsistence activities were especially intense. Of special interest are adjacent peripheral zones, with tributaries of major rivers and lakes, and watersheds such as mountain ranges and their offshoots. The term "peripheral" in this context is related to the intensity of archaeological studies, rather than to actual historical importance. Human occupation of such zones was often affected by specific factors that may be relevant to understanding the relative chronology and cultural history in this macroregion.

The Kansk-Rybinsk Basin represents one such region on the archaeological map of Eastern Siberia and North Asia in general. Hydrologically and orographically, the basin is associated with the Angara, Yenisei, and Baikal drainages. Archaeological studies have been conducted here since the early 20th century. Investigations carried out by the Joint Archeological Expedition of Irkutsk State University (N.A. Saveliev, A.G. Generalov, and others) constitute an important component of the research. The expedition discovered over 100 archaeological sites spanning the period from the Paleolithic to the Middle Ages. Stationary excavations conducted at several sites made it possible to establish cultural and chronological periodization for specific sites, and for the whole region. Main publications were focused on the Late Paleolithic, Mesolithic, Neolithic, and the Bronze Age. Special attention was paid by the Irkutsk scholars to multidisciplinary examination of the sites, including geomorphological analysis and the study of Quaternary sediments. This approach can be very helpful for understanding the distribution of archaeological materials over a large area under complex and heterogeneous conditions.

A.G. Generalov proposed merging all archaeological sites on the right bank of the Kan River, from the village of Anzhevka to Strizhovaya Gora (5–6 km), into a single geo-archaeological experimental area (2000: 15–16). In 2015, the archaeological team from the Institute of Archaeology and Ethnography SB RAS excavated several sites in this area: on the right bank of the Kan River, southeast of Kansk, within administrative boundaries of the Ilansky Municipal District of the Krasnoyarsk Territory (Vybornov, Grachev, Zolnikov et al., 2015; Vybornov, Slavinsky, Tsybankov et al., 2015). According to records, the sites are currently designated as Nefteprovod-2 (NP-2), Nefteprovod-1 (NP-1), and Ryabchikov Klyuch-1 (RK-1). They were discovered and investigated in 1972 by the Irkutsk State University Expedition led by N.A. Saveliev. In 1989, they were examined by L.Y. Bleynis from Krasnoyarsk. In 2011–2015, the team from Siberian Federal University (Krasnoyarsk) continued the study under the supervision of E.V. Knyazeva and P.V. Mandryka. The sites were named in various ways: Smolenka, Novosmolenka, and Nefteprovod, with various numerical designations. In 2015, it was proposed that they be included into the Anzhevka complex (the Anzhevka village is now abandoned). Assemblages and isolated finds span the period from the Paleolithic to recent centuries. Archaeological materials at the sites occur in a complex geomorphological context. The description and interpretation of the topography and Quaternary deposits will enrich the geological information relating to the middle stretch of the Kan River.

Geomorphology of the region

According to the state geological mapping database (Geologicheskaya karta…, 1968, 1978; Gosudarstvennaya geologicheskaya karta…, 2009), the region under study lies at the northeastern margin of the Antsir-Beloyar anticline located at the junction of the geological structures of the folded zone of the Yenisei Range and the southwestern periphery of the Siberian platform. The formation of Quaternary deposits in the region was affected by geological structure and neotectonics.

A fragment of the geological map at a scale of 1 : 200 000 clearly shows a band of the Kan River valley up to 10 km wide, inversely overlying the Antsir-Beloyar anticline (Fig. 1, *1*). To the northeast, in the zone of Jurassic sediments (Fig. 1, *4*), the Kan anticline is traceable, extending from the northwest to the southeast and composed of Devonian sediments (Fig. 1, *2*). A diagonal fault up to 35 km long runs along the southern margin of the anticline (Fig. 1, *3*). Along this fault, the

Devonian rocks disrupted the Jurassic mass, causing a 300–3000 m vertical displacement. Since the Cretaceous-Paleogene periods were characterized by tectonic quiescence accompanied by the formation of weathering crust, post-Jurassic deformations can definitely be attributed to the period of Alpine folding and dated to the Cenozoic, primarily Neogene-Quaternary chronostratigraphic interval (Tabatsky, 1982; Tsykin, 2011).

During the Quaternary, the right wall of the Kan valley was subjected to irregular block-differentiated vertical movements associated with neotectonic uplift of the Kan anticline. This caused the formation of heterogeneous linearly-alternating local compression and tension structures situated diagonally (northwest to southeast) and mirrored by the terrain. The Mokhovaya ridge represents the most eminent morphological structure. It is located 4 km north of the study area, and is within the boundaries of the Kan anticline; a neotectonic bench 250 m high delimits its southwestern margin. As topographic maps and high resolution satellite show, several spatially adjacent geomorphological benches smaller in height and length run from the ridge to the right bank of the Kan River.

According to the geomorphological map (Geologicheskaya karta…, 1968), the region is characterized by two categories of relief: erosive-accumulative and structural-denudational. The first is represented by the southern portion of the region that is occupied by the valley-terrace complex of the Kan River. The second occupies the right wall of the valley, raised and divided into neotectonic blocks varying in elevation. Five segments, differing in their geological and geomorphological structure, have been recorded at the Anzhevka archaeological complex and the contiguous area (Fig. 2).

Segment 1 is alluvial. It includes surfaces of the floodplain and of the first fluvial terrace of the Kan River. This segment extends as a narrow (up to 100 m wide) strip along the southern and southwestern margins of the study area. The floodplain and fluvial terraces are rock-defended. Bedrocks of the pre-Quaternary basement are exposed in several places on the bank and bottom of the Kan River. Alluvial surfaces date to the Holocene. Thin subaerial cover (several tens of centimeters thick) envelops floodplain sediments of the first terrace.

The rest of the study area belongs to the category of structural-denudational relief, and consists of four

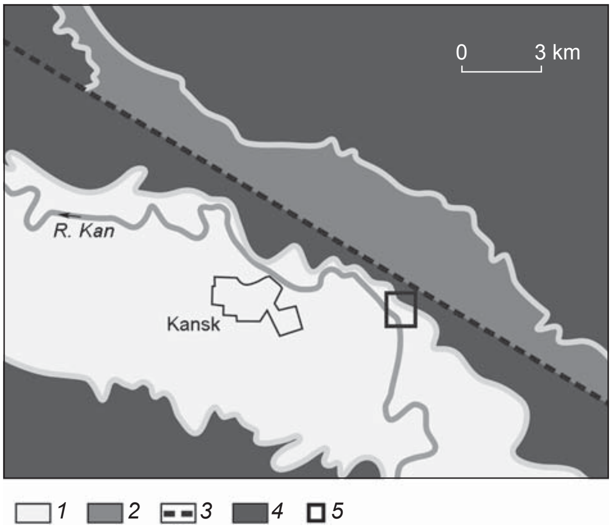

Fig. 1. Geological structure of the region on a fragment of geological map (after (Geologicheskaya karta…, 1968)).
1 – River Kan valley composed of Quaternary deposits and located on the Antsir-Beloyar anticline; *2* – Kan anticline composed of Devonian sediments; *3* – fault; *4* – Jurassic sediments; *5* – study region.

geomorphological segments differing in landform features and in terms of geological history in the Late Pleistocene and Holocene.

Segment 2 is a flat-topped ridge. It occupies the eastern portion of the region. The ridge is approximately 3 km long; however, the study area covers a fragment that is just 220 m long (Fig. 2). The long axis has a sublatitudinal orientation. The geomorphological profile along A–B line (Fig. 3, *1*), obtained by tachometric survey, illustrates the shape of the flat-topped ridge in cross-section. The subhorizontal plain surface of the ridge is approximately 120 m wide; the hade of the southern bench is 30° and that of the northern bench, about 20°. The elevation of the surface above the level of the Kan River is 41 m. Multiple landslides are visible on the southern bench. Some of them overlay each other, which points to repeated movements of loose materials down the slope. This landform is a miniature copy of Mount Mokhovaya. This is a neotectonic horst driven out of the bedrock basement of the first fluvial terrace, and raised above the terrace platform to an elevation of over 20 m. The northern, western, and southern slopes of the flat-topped ridge are represented by neotectonic benches, partially smoothed by slope processes and bearing materials of later landslides.

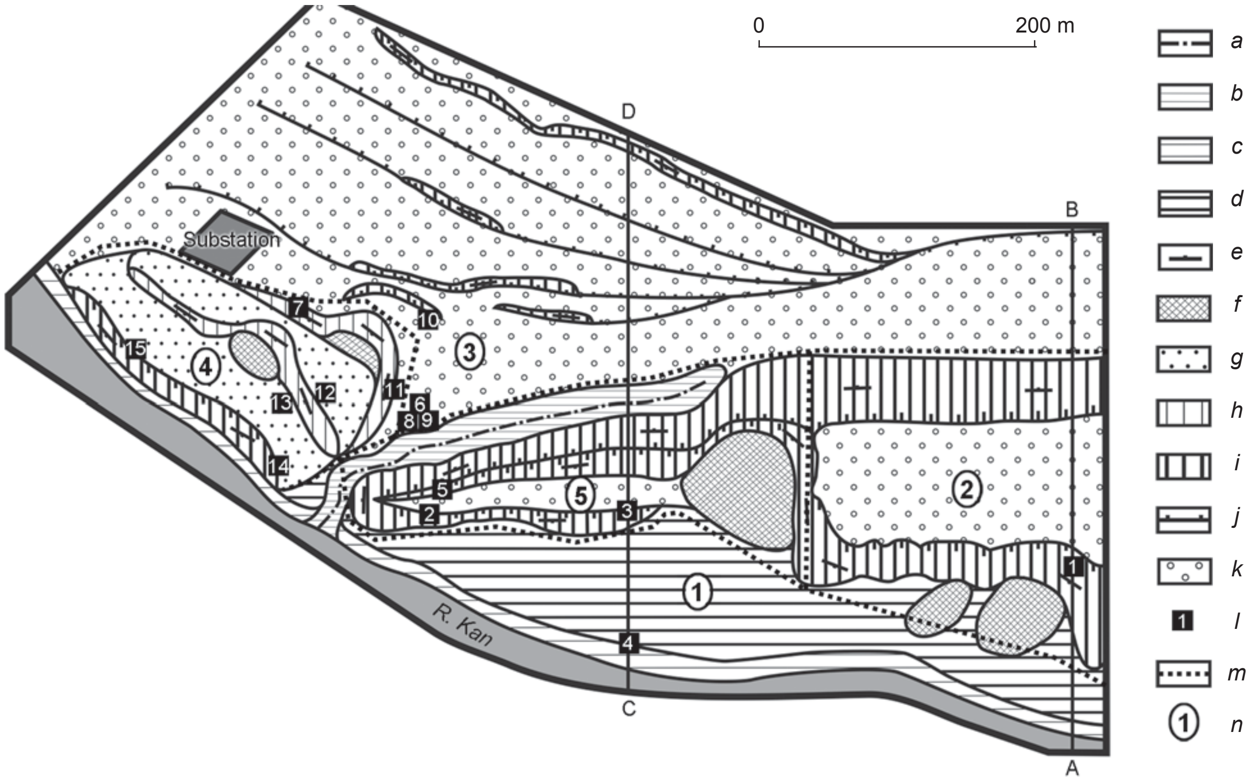

Fig. 2. Geomorphological scheme of the study region.
a – stream; *b* – stream valley; *c* – floodplain; *d* – first fluvial terrace; *e* – exposure of slopes; *f* – small landslide bodies; *g* – platforms of landslide blocks; *h* – rupture planes of landslide blocks; *i* – tectonic benches; *j* – low-amplitude tectonic benches; *k* – surface of the gently undulating plain; *l* – test-pits and sections: 1 – control section, 2–5 – Ryabchikov Klyuch-1 (No. 1–4), 6–11 – Nefteprovod-1 (No. 1–6), 12–15 – Nefteprovod-2 (No. 1–4); *m* – boundaries of the geomorphological segments; *n* – numbers of the segments.

Segment 3 is a gently undulating plain. This segment apparently belongs to the watershed surface formed by subaerial cover. The surface is subhorizontal; in the southeastern fringe only, it gently dips toward the thalweg of the Bezymyanny stream, which delimits it. Geomorphological profile along C–D line (Fig. 3, *2*), obtained by tachometric survey, shows small ridges complicating the watershed's surface pattern. As can be clearly seen in the right part of the drawing, these small ridges actually represent a series of step-like surfaces with subhorizontal platforms and rather steep and low benches: three of them slope to the north, and one to the south. The southern bench is 8 m high. It forms a natural geomorphological boundary between segment 3 and the Anzhevka archaeological complex in general. The inside of the watershed is a graben composed of a series of blocks descending stepwise toward the fault surfaces in the south-to-north direction (C–D profile shows three such blocks). The graben's axis and the faults are oriented sublatitudinally in the eastern part of the region, and diagonally (northwest to southeast) in its western part (Fig. 2).

Segment 4 is a ridged-landslide. In the southwestern part of the study region, the watershed segment adjoins asymmetric ridges formed by asequential landslides varying in size (Fig. 2). All back edges and margins of the landslides are parallel, and oriented diagonally from the northwest to the southeast. Such an orientation parallels neotectonic macrostructures, in particular, a neotectonic bench (250 m high) of the Mokhovaya ridge, and faults on the watershed surface of segment 3. Northeastern slopes are milder and wider. They represent fragments of the watershed's surface declined and raised on shorter and steeper southwestern slopes, where landslide materials have been mixed. Three large landslides are complicated by smaller ones. In general, the segment represents a series of landslide bodies varying in size and moved from the southern margin of segment 3 (watershed plain).

Segment 5 is sharp-crested dissected. In the central part of the study region, segments 1–4 join, and thus form a zone characterized by a complex geological and geomorphological structure. This zone comprises two adjacent sharp-crested ridges stretching sublatitudinally: northern and southern (Fig. 2). The southern margin of the dissected segment is contoured by a bench descending under the platform of the first fluvial terrace of the Kan River; from the north, it is edged with a thalweg of the stream (Fig. 3, *2*). The northern ridge extends from the northern bench of the horst and inclines to the west. Its southern slope bears scars of asequential landslides. The southern end of the ridge changes its orientation (20° southward) and joins the southern ridge inclined to the east. The latter forms a scrap with steep slopes on the west, and "sinks" in the platform of the first fluvial terrace of the Kan River on the east. In terms of the kinematics of neotectonic block movements, the ridges represent landslide plates removed from the western margin of the horst (segment 2) and separated from it by a dip complicated by a landslide.

The analysis has revealed the principal geomorphological features of the region. The scheme (Fig. 2) shows areas of subaerial deposits and its fragments, separated from one another by neotectonic shifts and landslides (surfaces of gently undulating plain on neotectonic blocks and platforms of landslide blocks). Those areas include old ground surfaces and underlying stratigraphic sequences. There are neotectonic benches, rupture planes of landslide blocks, and low-amplitude neotectonic benches, which dissect stratified deposits including culture-bearing horizons.

Quaternary sediments

Examination of test-pits and geological sections made it possible to reveal a generalized stratigraphic sequence, to construct a correlation scheme of sections, and to combine a composite stratigraphic column (Fig. 4). In the control profile (locus 1 in Fig. 2) on the southern slope of a gentle ridge, the structure of horst was exposed. Stratigraphic sequence comprising three units of sediments overlying the Paleozoic basement were recorded there (from bottom to top).

Unit 1, pre-Quaternary sediments:

Stratum 1. Black humus loam with a layer of lumpy, silty sand 0.2 m thick. The stratum is 1.8 m thick. Genesis: pre-Quaternary paleosol.

Stratum 2. Light gray silty sand forming parallel layers and including humus material from the underlying stratum. A fine-lumped parting is present. The stratum is 0.6 m thick. Genesis: weathering crust redeposited by slope-wash processes.

Unit 2, alluvial sediments:

Stratum 3. Gray sandy gravel-shingle beds interlayered with coarse-grained sand. The cleavage is crude and medium oblique. The stratum is 3.6 m thick. Genesis: riverbed facies of alluvium.

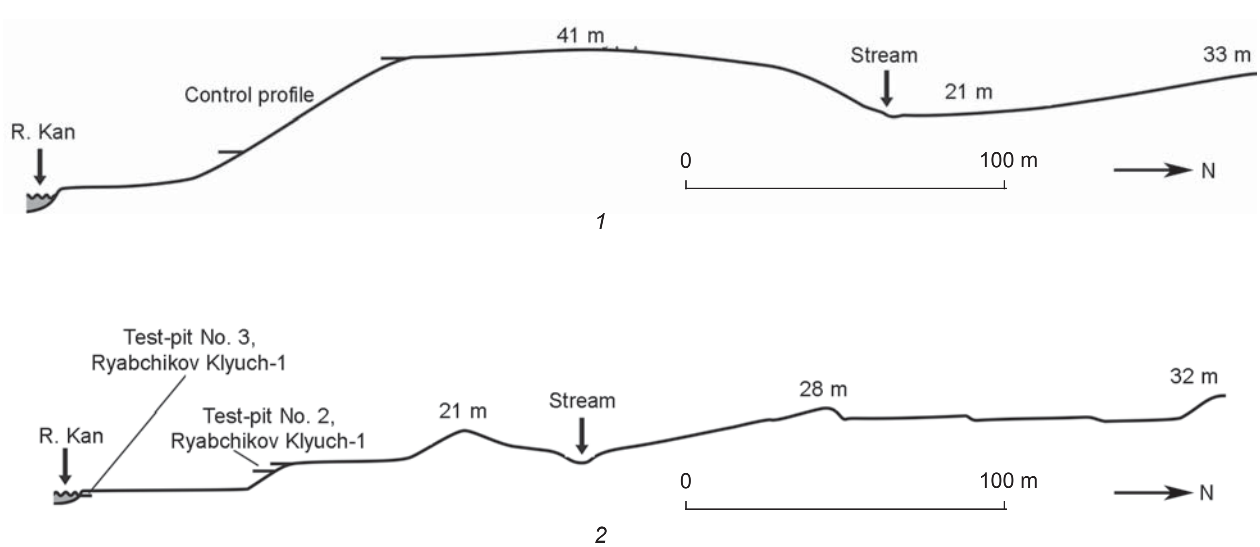

Fig. 3. Geomorphological profiles along A–B (*1*) and C–D (*2*) lines in Fig. 2 (elevation above the Kan River is indicated).

Stratum 4. Light, yellowish-gray medium- and coarse-grained sands forming subhorizontal and parallel thin beds. The cleavage is fine and small. Sand grains diminish in size in the upper portion of the stratum. The stratum is 2.5 m thick. Genesis: floodplain facies of alluvium.

Unit 3, subaerial:

Stratum 5. Light gray straw-tinted carbonized silty sand. The stratum is 2.8 m thick. Genesis: subaerial loess-like cover.

In the control profile, the principal sequence of sediments was traced. Then the structure of each

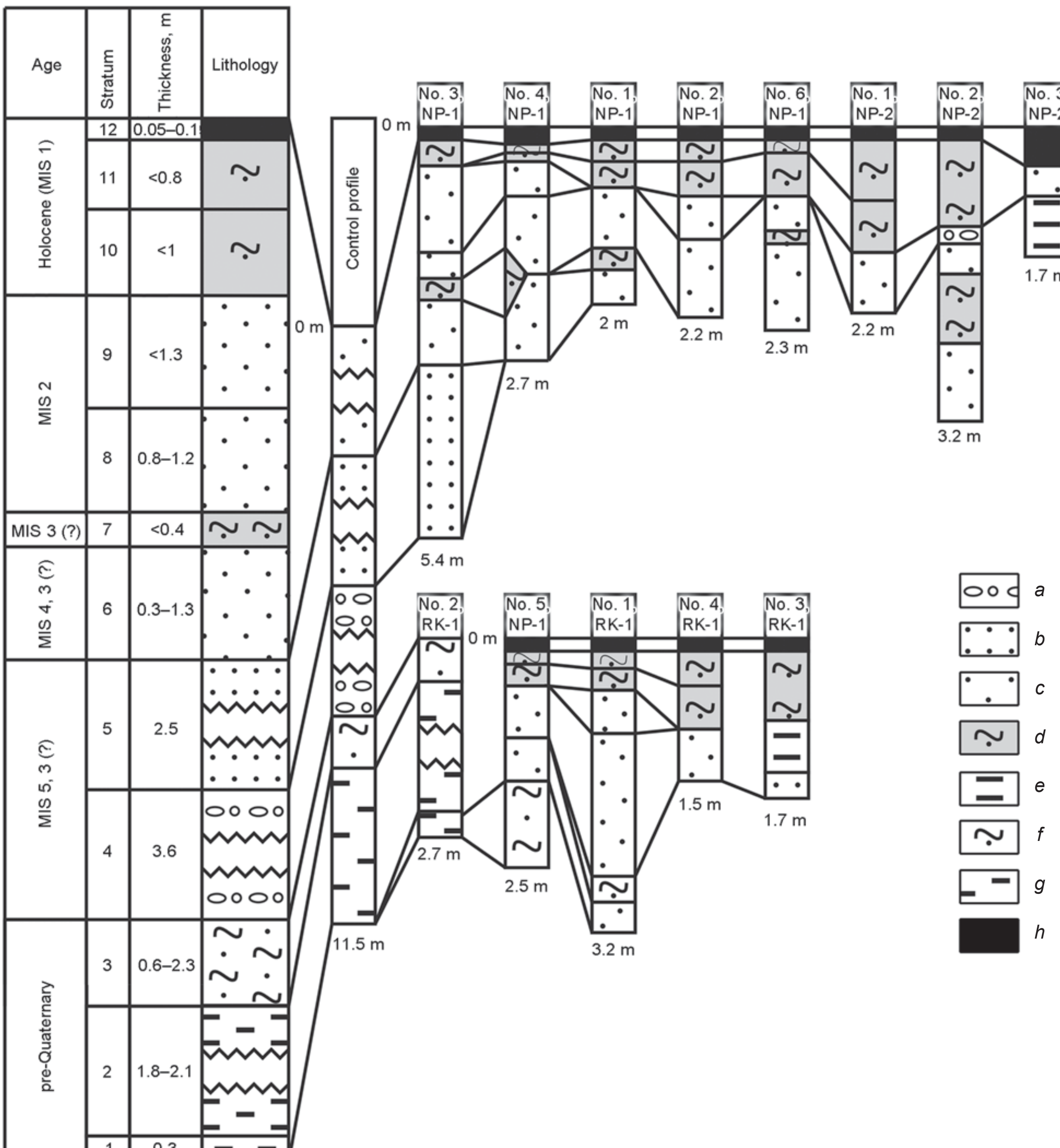

Fig. 4. Correlation between single sections and the composite stratigraphic column.
a – alternation of gravel-shingle and sand; *b* – washed silty sand; *c* – unstratified eolian silty sand; *d* – unstratified sandy loam; *e* – stratified loams and clays of the floodplain alluvium; *f* – weathering crust redeposited by slope-wash processes; *g* – humus loam; *h* – modern soil.
RK – Ryabchikov Klyuch; NP – Nefteprovod.

stratigraphic unit was examined in more detail in other sections (Fig. 4). We will now describe the composite section bottom-to-top according to the units of the principal sequence, with additional observations relating to the most representative exposures.

Fragments of Paleozoic-Mesozoic bedrock of the basement, represented by light gray conglomerates, mixtites, sandstones, aleurolites, etc., are exposed not only in the basement of the flat-topped ridge (near locus 1 in Fig. 2), but also in the lower part of the coastal cliff delineating landslide bodies (near locus 15 in Fig. 2), and also on the southern slope of the sharp-crested ridge (near locus 3 in Fig. 2).

In riverine blocks dissected by neotectonics, pre-Quaternary (possibly Neogene) loose sediments mark the boundary between the Paleozoic basement and the cumulative cover of Quaternary alluvium. In the control section, the thickness of these sediments totals 2.4 m, including paleosol (1.8 m) and slope-wash silty sand (0.6 m). The elevation of the sediments varies from 22.1 m to 24.5 m above the river level. In test-pit No. 2 RK-1 (locus 3 in Fig. 2) at an elevation of 9.5 m above the water's edge, they are 2.7 m thick (paleosol, 2.4 m; slope-wash silty sand, 0.3 m). In test-pit No. 5 NP-1 (locus 10 in Fig. 2), the visible thickness of slope-wash silty sand underlying the subaerial cover is up to 1 m (paleosol was not exposed).

The uppermost portion of the Quaternary unit is occupied by the alluvial member, which will not be described in detail here. It should be noted, however, that in the study area that includes archaeological excavations, alluvial sediments, represented by thin parallel subhorizontal beds of light gray, medium-grained sand of the floodplain facies (visible thickness, up to 2 m), were discovered in test-pit No. 3 NP-1 (locus 8 in Fig. 2). Because no alluvium was found between the pre-Quaternary deposits and the subaerial complex in the more northerly test-pit No. 5 NP-1, the back edge of the alluvial bed must pass along the southern fringe of geomorphological segment 3. This boundary is apparently represented by a gentle dropping of the southeastern margin of the plain watershed-surface and by the sharp contrast with ridged-landslide segment 4. Shifting of the landslide plates of segment 4, composed of subaerial loam and sand, along the gravel and pebble alluvium seems to be the most probable. North of the back edge of the alluvial bed, landslides are absent; instead, fault and subsidence deformations of geomorphological segment 3 (graben) can be observed. Judging by the height of the Paleozoic basement and the alluvial deposits relative to those in the floodplain and on the first terrace, the vertical uplift of the blocks is estimated at 20 m for the horst, and at 10 m for the sharp-crested ridges. Because the alluvial deposits are above the river level, the age of the uplifts is considered to be post-sedimentational.

Of special relevance to archaeological studies is the structure of the upper sequence, i.e., of the subaerial cover, because it contains culture-bearing horizons. The profiles reveal some facies variation, and occasional absence of certain layers owing to local slope-wash erosion and, more often, to eolian deflation. We will now describe the subaerial member from bottom to top.

Stratum 1. Gray straw-tinted silty sand, unstratified, carbonized, with veins of oxide iron. The stratum is 0.3–1.3 m thick. Genesis: loess-like eolian sediments.

Stratum 2. Dark gray sandy loam with a low content of humus. The stratum is 0–0.4 m thick (wedging out in some places). Genesis: paleosol. This stratum contains Upper Paleolithic artifacts.

Stratum 3. Light straw-colored brownish silty sand, unstratified, carbonized, with veins of oxide iron. The stratum is 0.8–1.2 m thick. Genesis: loess-like eolian sediments.

Stratum 4. Light gray fine- and medium-grained unstratified sands. The stratum is 0–1.3 m thick. The stratum is traceable on the northern slope of the stream's valley. Genesis: eolian sediments.

In test-pit No. 4 NP-2 (locus 15 in Fig. 2), a bed of gravel and pebbles 3–5 cm thick can be traced at this level. Solifluction loam, comprising gravel and pebbles 20–30 cm thick, overlies this bed. These units mark the descent of the landslide plate up to the moment when its frontal part collapsed into the Kan river and was eroded by water. This local erosion and solifluction horizon has not been included in the composite section because it mirrors a local event relevant to one of the landslides of geomorphological segment 4.

Stratum 5. Brownish-gray to brown sandy loam with reticulate texture. The stratum is 0–1.0 m thick. Genesis: paleosol (illuvial carbonate horizon with deflated eluvial and humus horizons). This stratum contains artifacts of the Neolithic–Bronze Age.

Stratum 6. Humus sandy loam, varying in color from gray to dark gray. The stratum is 0–0.8 m thick. Genesis: paleosol. This stratum contains artifacts of the Iron Age and the medieval period.

Stratum 7. Modern soil. The stratum is 0.05–0.10 m thick.

Correlation of the horizons recorded in the test-pits located in various geomorphological segments made it possible to construct a composite geological section in stratigraphic order (from bottom to top) (Fig. 4).

Paleozoic-Mesozoic bedrock of the basement represented by light gray conglomerates.

Stratum 1. Dark vinous humus loam with grit, gravel, and sand from the bedrock basement. The stratum is 0.3 m thick.

Stratum 2. Black humus unstratified loam with numerous charcoal inclusions. The stratum is 1.8–2.1 m thick. Genesis: pre-Quaternary horizon of paleosols.

Stratum 3. Light gray lumpy silty sands forming parallel horizons and including material from the underlying layer. The stratum is 2.3 m thick. Genesis: weathering crust redeposited by slope-wash processes.

Stratum 4. Gravel-shingle bed with sand, large- and medium-crossbedded. The stratum is 3.6 m thick. Genesis: riverbed facies of alluvium.

Stratum 5. Gray sands, medium- and coarse-grained in the lower part, and fine-grained in the upper part; medium parallel-bedded. The stratum is 2.5 m thick. Genesis: floodplain facies of alluvium.

Stratum 6. Gray straw-tinted silty sands, unstratified, carbonized, with veins of oxide iron. The stratum is 0.3–1.3 m thick. Genesis: loess.

Stratum 7. Dark gray sandy loam with a low content of humus. The stratum is 0–0.4 m thick. Genesis: paleosol horizon. This stratum contains Upper Paleolithic artifacts.

Stratum 8. Gray, straw- and brown-tinted silty sands, unstratified, carbonized, with veins of oxide iron. The stratum is 0.8–1.2 m thick. Genesis: loess.

Stratum 9. Gray fine- and medium-grained unstratified sands. The stratum is 0–1.3 m thick. Genesis: eolian.

Stratum 10. Brownish-gray to brown sandy loam with reticulate texture. The stratum is 0–1 m thick. Genesis: paleosol horizon. This stratum contains artifacts of the Neolithic–Bronze Age.

Stratum 11. Humus sandy loam with color varying from light gray to dark gray. The stratum is 0–0.8 m thick. Genesis: paleosol horizon. This stratum contains artifacts of the Iron Age and the medieval period.

Stratum 12. Modern soil. The stratum is 0.05–0.10 m thick.

Interpretation of results

The exact age of the subaerial complex with archaeological finds can be assessed only by radiocarbon analysis. However, based on the analysis of altiplanation terraces in the Yenisei basin (Zolnikov et al., 2013), the possible age variation range of sediments in the composite section can be evaluated (Fig. 4). A very thick subaerial complex (6.3 m), which includes several paleosols, and a very thick alluvial member (6.1 m) are compatible with the idea that the deposits represent a stratigraphic parallel to the third fluvial terrace and begin with the Kazantsevo (Eemian) horizon. If so, the age of the subaerial cover would fall within the interval from the Early Zyryanka glaciation (MIS 4) to the Holocene (MIS 1). At the same time, the Karga interglacial (MIS 3) age of the alluvial member is quite probable because it is unlikely that it forms basal layer III of the regional cyclo-climatic terrace with a single surface. Even within this region, it is evident that the neotectonic processes had uplifted the alluvial deposits at different elevations (10–20 m), suggesting that the alluvial member is actually younger and may date to the Karga interglacial (MIS 3). In this case, the subaerial cover formed in the interval from the Late Karga period to the Holocene.

Several geological objects, absent in the correlation scheme and composite section, are also noteworthy since they are relevant to archaeological studies. These are primarily geological boundaries that separate landslide plates and neotectonic blocks. Also, we should mention the local 3–5-cm-thick gravel-pebbled layer in test-pit No. 2 (locus 15 in Fig. 2), and 20–30-cm-thick solifluction loam interbed with gravel and pebble inclusions, resulting from water erosion of one of the landslides. In the course of excavations, we also observed local deformations in the lower part of the subaerial unit within geomorphological segment 4.

Slopes of the sharp-crested ridges in segment 5 reveal an enveloping accumulation of debris composed of Paleozoic rocks. There are no outcrops at higher altitudes within several kilometers. Notably, those plate-like ridges are fragments of a flat-topped horst of geomorphological segment 2. Cleavage and faulting were rapid and apparently were caused by a seismic event, as evidenced by a large landslide and a gap between the flat-topped ridge and the sharp-crested ridges. The debris collapsed from higher levels following an abrupt foundering of blocks. This scenario is supported by the partial absence of Quaternary deposits on the sharp-crested ridges, and by nearby outcrops of Paleozoic rocks.

The reconstructed neotectonic history of the region and the principal features of its geological structure are critical for the likelihood of discovering the archaeological sites. The most prospective areas are platforms of landslide plates and neotectonic blocks with a continuous sequence of uninterrupted subaerial horizons, as well as watershed surfaces. Variously sized tectonic benches and displacement planes of landslide blocks are unlikely places for archaeological sites because original deposits have been disrupted. Therefore, vertical clearings at those places would reveal only pre-Holocene horizons.

Conclusions

The comparison of composite sections at the Anzhevka and Strirzhovaya Gora complexes of sites (Generalov, 2000: 16–19, fig. 3) shows that their structures are the same: Paleozoic basement; pre-Quaternary loose sediments; alluvial and subaerial members. In fact, the thickness of those members is similar within both complexes. However, the number of subaerial layers differs considerably owing to facies variation whereby eolian sands, slope-wash sands, loess-like silty sands, and ephemeral paleosols occur in various combinations. At the same time, archaeological data suggest that at Strizhovaya Gora, the bottom of the subaerial layer includes Paleolithic habitation horizon dating to the Late Sartan glaciation, whereas at the Anzhevka complex, the Paleolithic horizon is in the middle of the subaerial unit and, based on the lithic industry, has been tentatively correlated with the Late Karga interglacial or Early Sartan glaciation. The age of the subaerial cover is very different at both clusters. One can hardly agree with Generalov, who claimed that the narrow strip of land stretching along the right bank of the Kan River and spanning several low terraces situated at 10 m, 15 m, and 20 m above the water edge is geologically homogeneous (Ibid.: 16). New data attest to intense neotectonic processes and landslides causing considerable vertical displacement of variously-sized blocks during the Late Quaternary. Therefore, correlation of sediments belonging to various blocks on the basis of altitude is unwarranted. The region in question was very heterogeneous in geological and archaeological terms.

In sum, studies at the Anzhevka complex of archaeological sites have revealed five geomorphological segments. The principal type of terrain at Nefteprovod-1 and -2 sites is defined by structural denudation, documented on the right wall of the Kan River valley, which is uplifted and separated into blocks, neotectonically differentiated according to elevation. The area where the culture-bearing layer, dating to the Upper Paleolithic, is situated at a low level is within the ridged-landslide segment. Our results suggest a revision of views relating to the Anzhevka archaeological complex and supplement our knowledge of the geomorphology of the right bank of the Kan River, previously described on the basis of the sites of Strizhovaya Gora (situated downstream the Anzhevka complex) and Brazhnoye (upstream).

References

Generalov A.G. 2000
Geoarkheologicheskiy obyekt Strizhovaya gora (stratigrafiya, khronologiya, tipologiya, tekhnologiya). Irkutsk: Izd. Irkutsk. Gos. Univ.

Geologicheskaya karta SSSR masshtaba 1 : 200 000. 1968
Seriya Eniseiskaya: List O-46-XXXVI: Obyasnitelnaya zapiska. V.N. Moskalev, L.P. Lyashenko, V.V. Dedova (comp.). Moscow: Nedra.

Geologicheskaya karta SSSR masshtaba 1 : 1 000 000: 1978
List O-46 (47): Obyasnitelnaya zapiska. E.K. Kovrigina, N.S. Podgornaya (comp.). Krasnoyarsk: VSEGEI.

Gosudarstvennaya geologicheskaya karta Rossiyskoi Federatsii masshtaba 1 : 1 000 000 (tretye pokoleniye). 2009
Seriya Angaro-Eniseiskaya: List O-46: Obyasnitelnaya zapiska. V.K. Zuev, L.K. Kachevsky, G.I. Kachevskaya, V.V. Komarov, O.A. Minaeva, L.A. Markovich, T.N. Shatalina, L.Y. Potapenko (comp.). St. Petersburg: Kartograf. fabrika VSEGEI.

Tabatsky I.M. 1982
Neotektonicheskiye struktury Eniseiskogo kryazha i prilegayushchikh okrain Sibirskoi platformy. In *Zakonomernosti razvitiya relyefa Severnoi Azii*. Novosibirsk: Nauka, pp. 115–121.

Tsykin R.A. 2011
Geologiya rossypei Severo-Eniseiskogo zolotorudnogo raiona. *Journal Sib. federal. univ.* Ser.: Inzheneriya i tekhnologii, vol. 4 (3): 243–262.

Vybornov A.V., Grachev I.A., Zolnikov I.D., Kartoziya A.A., Markovsky G.I., Slavinsky V.S., Slepchenko S.M., Tsybankov A.A. 2015
Spasatelnye arkheologicheskiye raskopki na mestonakhozhdenii Ryabchikov Kliuch-1 pod gorodom Kanskom v 2015 godu. In *Problemy arkheologii, etnografii i antropologii Sibiri i sopredelnykh territorii*, vol. XXI. Novosibirsk: Izd. IAE SO RAN, pp. 567–570.

Vybornov A.V., Slavinsky V.S., Tsybankov A.A., Grachev I.A., Grevtsov Y.A., Zhuravkov S.P., Lysenko D.N., Makarov N.P., Markovsky G.I., Matveyev V.E., Stasyuk I.V., Tomilova E.A., Fokin S.M. 2015
Spasatelnye arkheologicheskiye raskopki pod gorodom Kanskom v 2015 godu. In *Problemy arkheologii, etnografii i antropologii Sibiri i sopredelnykh territorii*, vol. XXI. Novosibirsk: Izd. IAE SO RAN, pp. 571–574.

Zolnikov I.D., Deyev E.V., Tsybankov A.A., Slavinsky V.S., Postnov A.V., Chupina D.A. 2013
On the supposedly young age of Angara alluvial sediments based on the findings of salvage excavations in the flooding area of the Boguchany Hydroelectric Plant. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 41 (4): 38–49.

Received January 14, 2016.

DOI: 10.17746/1563-0110.2017.45.1.025-035

A.R. Agatova[1, 2], R.K. Nepop[1, 2], and I.Y. Slyusarenko[3, 4]

[1]Institute of Geology and Mineralogy, Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Koptyuga 3, Novosibirsk, 630090, Russia
E-mail: agatr@mail.ru; rnk@igm.nsc.ru
[2]Ural Federal University,
Mira 19, Yekaterinburg, 620002, Russia
[3]Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia
E-mail: slig1963@yandex.ru
[4]Novosibirsk State University,
Pirogova 2, Novosibirsk, 630090, Russia

Archaeological Sites as Markers of Hydrosystem Transformation in the Kurai and Chuya Basins, Southeastern Altai, in the Late Pleistocene and Holocene. Summary of Findings and Paleogeographic Reconstructions*

This paper is the second in a series of publications on various aspects of the relationships between man and environment in the highlands of southeastern Altai. In these studies, we assess the impact of climatic changes (evidenced by processes of glaciation and deglaciation, the emergence of ice-dammed and residual lakes, soil and peat formation, and seismic activity) on the succession of sedentary and nomadic cultures, and on the ranges of their distribution, in the Late Pleistocene and Holocene. Geochronological data on the evolution of Late Pleistocene ice-dammed lakes and Holocene residual lacustrine systems within the Kurai and Chuya intermountain basins, including our new findings based on geomorphological, geoarchaeological, and geochronological approaches, were summarized in the first paper of the series. Using Paleolithic sites for assessing the time in the Late Pleistocene when the Chuya paleolake emptied is unwarranted, because their estimated age limits are wide, many are likely redeposited, and most finds are random. However, analysis of the spatial distribution of in situ sites spanning the period from the Late Bronze Age to the Middle Ages has provided evidence regarding the transformation of Holocene hydrosystems. New radiocarbon dates indicate a substantial decrease of the Sartan glaciation before 14 ka cal BP, and desiccation of the last ice-dammed lakes within the Kurai and Chuya basins before 10 ka cal BP. The absence of Early Holocene archaeological sites in those areas may be due to the wide distribution of residual lakes in the bottoms of those depressions at that time.

Keywords: *Intermountain depressions, ice-dammed lakes, hydrosystem transformation, archaeological sites, Late Paleolithic, radiocarbon dating, Late Pleistocene, Holocene, southeastern Altai.*

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*Geomorphological studies, including radiocarbon dating, were performed under Public Contract (Project No. 0330-2016-0015) and supported by the Russian Foundation for Basic Research (Projects No. 15-05-06028 and 16-05-01035); archaeological studies were supported by the Russian Science Foundation (Project No. 14-50-00036).

Introduction

Landscapes forming under the influence of geological structure, relief, climate, hydrosystem, soil cover, and biocenosis have always affected the existence of humans as a biological species. These factors determine their ranges of distribution, their ways of life, the dynamics of their social processes, their religions, and the territorial organization of their societies. In turn, archaeological sites can serve as markers of ecosystem transformation.

The southeastern part of the Altai Mountains (the Russian territory of the Altaian upland, the south Siberian mountains) was populated as early as the Late Paleolithic (Derevianko, Markin, 1987). An arid climate, a wide distribution of permafrost rocks, and an extremely low density of population facilitate preservation of the rich archaeological heritage of this region, which was one of the centers of ancient civilizations, and was located at the intersection of trade, military, and migration routes between the East and the West.

In 2016, we commenced a series of publications devoted to the analysis of new data on the relationships between man and environment in the highlands of southeastern Altai. In these studies, we assess the impact of climatic changes (as evidenced by processes of glaciation and deglaciation), the emergence of ice-dammed and residual lakes, soil- and peat-formation, and seismic activity, on the succession of sedentary and nomadic cultures; and on the ranges of distribution of these cultures in the Kurai and Chuya depressions during the Late Pleistocene and Holocene. In the first article (Agatova, Nepop, Slyusarenko et al., 2016), we discussed the issues of the existence of the Holocene lake basins closely related to the evolution of the Late Pleistocene glacio-lacustrine system within the Kurai and Chuya intermountain areas. This paper summarizes geochronological data on the evolution of Late Pleistocene ice-dammed lakes and Holocene residual lacustrine systems, taking into account our new findings based on comprehensive geomorphological, geoarchaeological, and geochronological studies.

The use of the geoarchaeological approach is based on the idea that unfavorable factors have a much greater impact in determining the distribution-range of people than favorable living environments have. The latter may not be fully utilized, either because of low population density, or for socio-economic reasons. Thus, confinement of *in situ* archaeological sites to certain forms of relief and landscapes generally points to favorable conditions for their development by people. This allows analysis of the locations of sites attributable to various cultures to be employed in assessing parameters of water reservoirs in the basins at various time-slices; the time and character of their emptying; and also the ages (*terminus ante quem*) of terraces and proluvial cones in the main Chuya valley.

This paper discusses the possibility of using Paleolithic sites in order to date the emptying of the last Chuya ice-dammed lake in the Late Pleistocene; and archaeological localities from the Late Bronze Age to the Middle Ages, in order to reconstruct hydrological changes in the Chuya and Kurai basins in the Holocene. The analysis conducted points to the need for a thorough study of the occurrence and spatial arrangement of the sites, so as to use them as arguments for or against a particular view of the chronology and character of natural processes.

Archaeological sites of the Kurai-Chuya system of basins

The bottom of the Chuya basin lies in the range 1750 to 2000 m a.s.l., while that of the Kurai basin is at 1500 to 1650 m a.s.l. The framing ridges reach an elevation of 3900–4300 m a.s.l. and represent one of the present-day glaciation centers of Altai. The basins are separated by the Chagan-Uzun massif, an independent tectonic block characterized by high seismotectonic activity during the Late Pleistocene and Holocene. The existence of archaeological cultures in the Kurai and Chuya basins is directly related to the climate-responsive evolution, in the Late Pleistocene and Holocene, of the hydrological system of these depressions.

The most ancient sites, which were dated to the Late Paleolithic (45–10 ka BP) by their techno-typological characteristics, have been identified in the Chuya depression, where 20 localities of stone tools are currently known (Derevianko, Markin, 1987; Okishev, Borodavko, 2001; Slavinsky et al., 2011). Notably, no archaeological objects belonging to the period between the Paleolithic and the Bronze Age have been found either within the Kurai-Chuya system and its mountain framing, or in the adjacent areas of Altai and Tuva. The majority of southeastern Altai sites are attributed to the Bronze Age (late 4th–early 1st millennium BC), Scythian (late 9th–3rd centuries BC), Xiongnu (2nd century BC–the first half of the 5th century AD), and Old Turkic (late 5th–11th centuries AD) epochs. Sites of the Kyrgyz period (the second half of the 9th–11th centuries AD) and the Mongolian (12th–14th centuries AD) are much rarer. During the Kyrgyz Khaganate and the Mongol Empire, Altai was located on their periphery, and was not even mentioned in historical chronicles. There are no archaeological or written sources containing information on the population of southeastern Altai in the 15th–16th centuries AD (Molodin, 2002; Epokha…, 2006; Tishkin, 2007).

In the territory under consideration, Pazyryk sites of the Scythian epoch, for which bulk radiocarbon and dendrochronological dates were obtained, are best studied in terms of absolute dating (Evraziya…, 2005; Panyushkina et al., 2007; Slyusarenko, 2010). A series of ^{14}C-dates are available for archaeological sites of the Xiongnu and Turkic epochs (Kubarev V.D., Zhuravleva, 1986; Kubarev G.V., 2005: 139; Orlova, 1995; Kubarev G.V., Orlova, 2006; Panyushkina et al., 2007; Gutak, Rusanov, 2013; Agatova, Nepop, Bronnikova et al., 2016), and there is a single date for the Afanasievo burial ground of the Bronze Age (Stepanova, 2009). The sites of Kyrgyz and Mongolian periods within the Kurai and Chuya basins and their mountain framing are not characterized by absolute dates.

At present, the eastern and southern parts of the Chuya basin, where a huge number of sites belonging to various cultures are concentrated, are the best-studied (Kubarev V.D., 1987, 1991, 1992; Bourgeois et al., 2000, Gheyle, 2009; and others). A number of objects in the Kurai depression have been described, including Pazyryk mounds of the Scythian period (Kubarev V.D., Shulga, 2007: 170–190), Bulan-Koba burials of the Xiongnu epoch (Soenov, Ebel, 1998; Soenov, 2003: 13–22; Slyusarenko, Bogdanov, Soenov, 2008), and mounds attributed to the Kyrgyz period (Martynov, Kulemzin, Martynova, 1985). In the Chuya River valley, between depressions, archaeological localities are known in the mouth of the Kuektanar (Kuyakhtenar) River: Late Paleolithic surface-finds (Derevianko, Markin, 1987: 11–12), iron-smelting furnaces dated to the 6th–10th centuries by their typological characteristics (Zinyakov, 1988: 46–49), and Kyrgyz artifacts interpreted as traces of settlement (Hudiakov, 1990). Mapping of a number of archaeological sites in the central part of the Chuya basin, in the east of the Kurai basin, and in the Chuya valley between them (including the mouth of the Kuektanar) was carried out in the course of studying the evolution of Holocene limnosystems in this area (Agatova, Nepop, Bronnikova et al., 2016; Agatova, Nepop, Slyusarenko et al., 2016).

Evolution of the hydrosystem of the Kurai and Chuya basins in the Late Pleistocene and Holocene

Pre-Holocene period of hydrosystem development

Current views on the time of the last emptying of the Late Pleistocene ice-dammed lakes in the Kurai and Chuya basins. The chronology and character of the emptying of the Late Pleistocene lakes within the Kurai and Chuya intermountain basins determine the possibility of finding the most ancient archaeological sites in this territory. However, owing to the complexity of the chronometric dating of glacial and glaciolacustrine deposits, and the inconsistency of the dates obtained by various methods, there is no consensus so far on the age of the glaciations and the chronology of the emptying of the ice-dammed lakes. Radiocarbon dates used for age characterization of lakes in the basins are obtained mainly from charcoal fragments (>45,000 cal BP (Beta-147107) (Okishev, Borodavko, 2001), 30,000 ± 1112 cal BP (25,300 ± 600 (MGU-IOAN-65)) (Razrez…, 1978: 130)); or from organic remains in wave-built and catafluvial deposits (36,588 ± 883 cal BP (32,190 ± 260 (Beta-137035)) (Okishev, Borodavko, 2001), 40,820 ± 1100 (35,870 ± 490 (Beta-159972)) (Herget, 2005: 36), 24,814 ± 610 (20,750 ± 220 (SOAN-4971) ((Vysotsky, 2009) and 39,851.5 ± 1101.5 cal BP (34,750 ± 480 (SOAN-7802)), the date was provided by A.N. Nazarov), which suggests possible erosion and redeposition of more ancient organic remains*. It has not been until recently that OSL-dates of immediate lacustrine deposits in the Kurai basin have been obtained. These dates demonstrate repeated emergence of various ice-dammed lakes in the Late Pleistocene, such as 62,500 ± 6800, 18,200 ± 1100 (Baryshnikov et al., 2015: 106, 112), and 14,400 ± 1400 BP (RIS0-142565) (Zolnikov et al., 2016). According to the results of dating using cosmogenic nuclides (^{10}Be) of boulders in the Chuya and Kurai depressions, the last desiccation of these depressions, which was the most disastrous, took place about 16–15 ka BP (the breakup time of the Sartan (Late Würm) glaciation) (Reuther et al., 2006). A.N. Rudoy also considers the lake-emptying related to the Sartan glaciation to have been the most disastrous. Relying on radiocarbon dates of plant remains from lacustrine deposits in the frost-mounds on the bottoms of basins (Rudoy, 1988; Butvilovsky, 1993), he substantiates the final desiccation of the Kurai and Chuya basins as occurring later than approximately 11 and 5 ka BP, respectively (Rudoy, 2005: 128–129). P.A. Okishev and P.S. Borodavko (2001) reconstruct three limno-stadials in the period of 46 to 13 ka BP from the results of radiocarbon (Razrez…, 1978; Butvilovsky, 1993; Okishev, Borodavko, 2001) and thermoluminescent (Sheinkman, 1990) dating, and propose that isolated lakes existed in the depressions during the last of them. According to these

*The article discusses calibrated dates; radiocarbon age and laboratory number are given in brackets.

researchers, gradual (non-disastrous) level-recession of the Pleistocene lakes determines the chronology of the Paleolithic sites in the Chuya basin. The idea that the last disastrous floods in the Chuya and Katun valleys were of Sartan (Late Würm, 18–25 ka BP) age has lead G.Y. Baryshnikov and A.M. Maloletko to the conclusion that a search for archaeological objects older than 25 ka BP along the valleys of the main Altai rivers is pointless; and that such finds will only be encountered beyond the limits of disastrous water flows (1998: 114). Later, OSL dating has allowed clarification of the time of the debris-flow passage across the upper Biya River valley, which proved to be more ancient: 35–40 ka BP (Baryshnikov, Panin, Adamiec, 2016). In contrast, I.D. Zolnikov and A.A. Mistryukov attribute the last disastrous emptying of the lake that existed in the Chuya valley to the Late Würm (70–60 ka BP), using the Paleolithic sites found here as one of the chronological benchmarks (2008: 52–53).

In general, it is exactly the poor availability of chronometric data and, as a consequence, the complexity of reconstructing the Late Pleistocene geological history of southeastern Altai, that force the geologists to refer to archaeological materials. However, to avoid mistakes in paleogeographical constructions, areal locations of sites and the character of their occurrence should be subjected to detailed analysis in each particular case.

The possibility of using Paleolithic sites of the Chuya basin to date the emptying of Late Pleistocene ice-dammed lakes. When ancient archaeological sites of southeastern Altai are used as chronomarkers, the central problem is the absence of numerical evaluations of their ages. Pointing to a certain techno-typological heterogeneity of Chuya lithic industries, A.P. Derevianko and S.V. Markin attribute these to the Late Paleolithic (45–10 ka BP) (1987: 46–54), and this circumstance seems to close the discussion of the existence of the disastrous emptying of the ice-dammed lakes in the Chuya and Kurai basins at the end of the Late Pleistocene. At the same time, 3 of 20 Late Paleolithic sites identified in the Chuya basin (Ibid.; Okishev, Borodavko, 2001; Slavinsky et al., 2011) have not been characterized at all, owing to isolated finds, and only four of them stratified (Yustyd I and II, Boguty I, Toldytyurgun). Furthermore, absolute dating of the layers accommodating artifacts was not conducted. It must be especially emphasized that all stratified sites suitable for dating, including those comprising the most ancient artifacts showing the Levallois reduction technique, are located higher than 2100 m a.s.l., the upper paleolacustrine level, which is the most pronounced in relief. The majority of the other sites are below 2100 m a.s.l., and all of them are represented by surface finds (Fig. 1), sometimes with obvious traces of downhill shifting (Torgun) or exposure to a water environment (Barburgazy). The Kuyakhtenar locality in the Chuya River valley (1725–1730 m a.s.l.) is the lowest of them. No trend has been observed in the distribution of the few surface finds (28 spec.) concentrated on the surface of a 10–11-meter terrace among sand dunes (Derevianko, Markin, 1987: 11–12). The Kuyakhtanar-2 site, where surface finds include five lithic artifacts, has been discovered not far from this place, on sand dunes as well (Slavinsky et al., 2011: 469). Radiocarbon dating of paleosols and fluvio-lacustrine deposits conducted by the authors in the area of the Paleolithic finds (Agatova, Nepop, Slyusarenko et al., 2016: Fig. 2, 3, tab. 1) implies that formation of the cover subaerial complex did not start until the Holocene, and that fluctuations of the Chuya bed and active erosion of ancient lacustrine sediments took place during the last third of the Holocene, which indicates a highly probable redeposition of stone material. Partial redeposition of artifacts on the stratified site of Yustyd II was also noted by Derevianko and Markin (1987: 36). The discovery of "Upper Paleolithic-like stone tools (end-scrapers)", along with remains of grasses and branches aged 5453 ± 391 cal BP (4765 ± ± 120 (SOAN-2345) (Rusanov, Orlova, 2013: 146–149)) in deposits of Lake Dzhangyskol (the Kurai basin) by V.V. Butvilovsky, also confirms a high probability for redeposition of Paleolithic artifacts in intermountain areas and valleys of ridges. In our opinion, in view of the above, it would be inappropriate to use the majority of Paleolithic sites in the Chuya basin for direct dating of the existence of the last large ice-dammed lake therein. At the same time, a number of characteristics of the Bigdon site, the most representative in terms of collected materials and the area of their spread, point to a post-lacustrine or "inter-lacustrine" time for its existence.

Bigdon is located at an elevation of 1998 m a.s.l. near the southern foot of the Kurai ridge, on a flattened surface of proluvial cone separated from the ridge by a parallel graben-like depression. The ancient inhabitants of the Chuya basin did not use bedrocks (as indicated in the article by Derevianko and Markin (1987: 16–17)), but dropstones, i.e. blocks brought to the depression by icebergs during the existence of one of the Late Pleistocene lakes with a level not lower than 2000 m a.s.l. (Fig. 2, B, C). Such numerous fields of dropstones along the southern foot of the Kurai ridge in the Chuya basin have been described by G.G. Rusanov (2008). The Chechketerek Paleolithic site is attributed to another field of this type. The discovery of more than 750 items made of the same rock in the immediate vicinity of the blocks (Derevianko, Markin, 1987: 18)

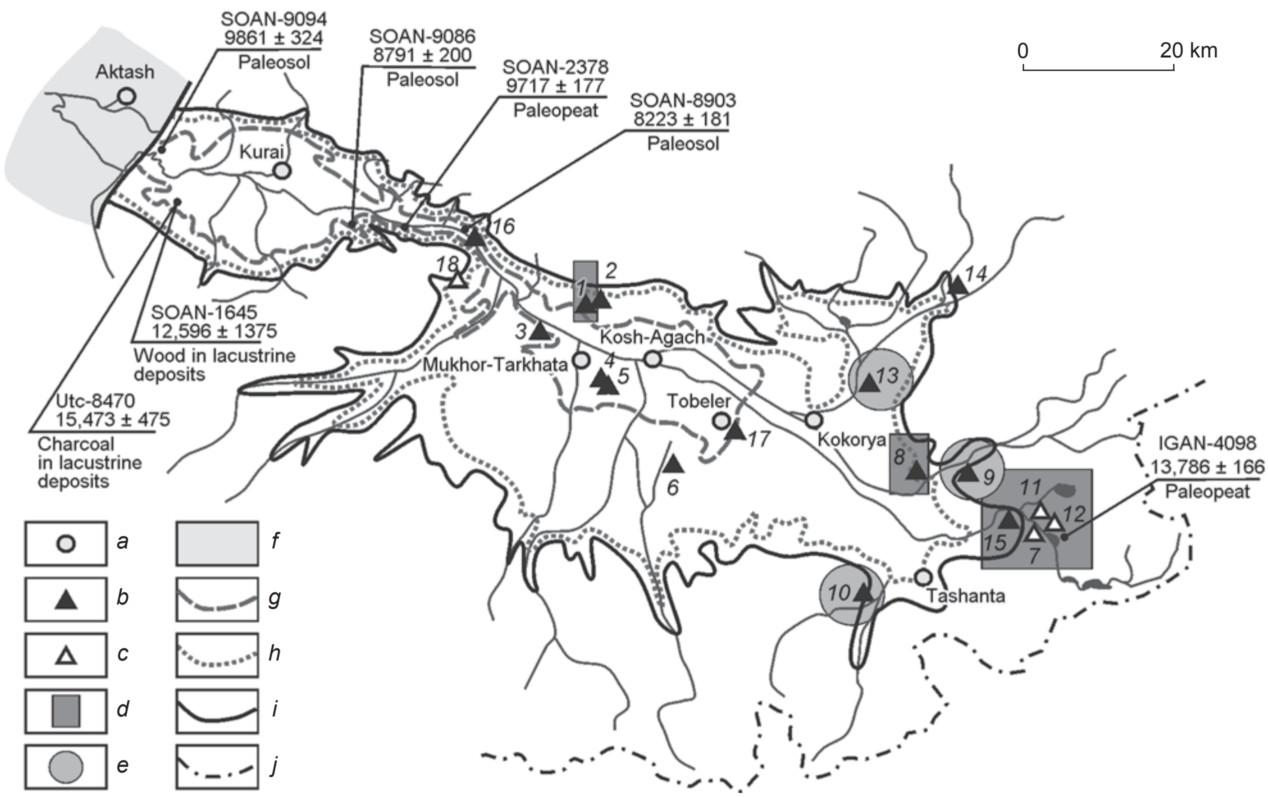

Fig. 1. Relation between the Late Paleolithic sites and the levels of paleolakes in the Kurai-Chuya system of basins, and basic radiocarbon dates (calibrated at σ) characterizing the development of landscapes in these basins at the end of the Late Pleistocene and in the Early Holocene.

a – settlements; *b* – localities of surface finds; *c* – stratified objects; *d* – localities with Levallois flakes; *e* – non-characterized localities with single artifacts; *f* – ice dam; *g*–*i* – level of paleolake a.s.l.: *g* – 1800 m, *h* – 2100 m, *i* – 2250 m; *j* – state border of Russia.

Localities: *1* – Bigdon; *2* – Chechketerek; *3* – Torgun; *4* – Mukhor-Tarkhata I; 5 – Mukhor-Tarkhata II; *6* – Chaganburgazy; *7* – Boguty I; *8* – Barburgazy; *9* – Yustyd-Barburgazy; *10* – Ulandryk; *11* – Yustyd I; *12* – Yustyd II; *13* – Kyzyl-Shin; *14* – Maltalu; *15* – Yustyd – left bank; *16* – Kuyakhtenar; *17* – Ters-Akan; *18* – Toldytyurgun. *1*–*17* – after: (Derevianko, Markin, 1987); *18* – after: (Okishev, Borodavko, 2001).

indicates the *in situ* location of the Bigdon site and its functioning after the emptying of a unified Kurai-Chuya lake, across which icebergs moved, or after the recession of its level below 1998 m. The Bigdon upland is formed by lacustrine wave-built terraces (Fig. 2, A); however, it is difficult to determine at this point whether they emerged before or after the existence of this archaeological site. Derevianko and Markin point to a certain "blownness" of the faces of tools (Ibid.: 18); however, establishing exactly wind-blown rather than water treatment of artifacts requires a special analysis. The location of the site, at an elevation of approx. 2000 m, is not exclusive of the synchronous or subsequent existence of an ice-dammed lake with a lower level.

In general, despite the signs of redeposition of many Paleolithic materials to lower hypsometric levels, even their present-day location (up to 1770 m a.s.l. at Mukhor-Tarkhata I) does not rule out the possibility that a lake with a level below 1770 m a.s.l. existed in the Chuya basin at the end of the Late Pleistocene to the beginning of the Holocene.

Therefore, despite the numerous Paleolithic sites, these cannot be used for determining the time of emptying of ice-dammed lakes with levels up to 2100 m (which is well pronounced in the relief of the Kurai and Chuya basins at the wave-built level), because of the surface character of the stone material lying below this mark, the probable redeposition of most of the finds, and the complexity of their absolute dating. All four stratified sites of the Chuya basin are located higher than 2100 m a.s.l.; so, they can serve only as markers of the existence and emptying of the deeper lakes proposed by some researchers. In this case, however, it is necessary to solve the issue of the possible redeposition of artifacts.

Evolution of the hydrosystem in the Kurai and Chuya basins. The accumulated geological data allow the identification of the main boundaries of decrease in Sartan glaciation in southeastern Altai, and of the

Fig. 2. Late Paleolithic site of Bigdon.
A – lake terraces simulating the surface of piedmont proluvial cone where the site is located; B, C – dropstones (as can be seen clearly in photograph B, the fragments are not the products of destruction of bed-rocks, which do not crop out in this part of the Chuya basin).

existence of the related dammed lakes (Fig. 1). The results of radiocarbon dating of charcoal from deposits at Lake Dzhangyskol, and from an adjacent bog in the Eshtykkel locality of the Kurai basin, are indicative of the absence of Sartan glaciers at the foot of the Northern Chuya Ridge (1754 m a.s.l.) 15 ka BP (13,050 ± 150 (Utc 8470) (Blyakharchuk et al., 2008)). The radiocarbon date of 13,786 ± 166 cal BP obtained by us for the peat horizon overlying the moraines in the Boguty River valley (the Chikhachev ridge) (11,910 ± 70 (IGAN-4098)) unambiguously indicates that they retreated above 2500 m a.s.l. in the eastern framing of the Chuya basin before 14 ka BP (Agatova, Nepop, Bronnikova et al., 2016; Agatova, Nepop, Slyusarenko et al., 2016). Thus, the reconstruction of extensive glaciation of southeastern Altai for the time-slice of approx. 14 ka BP, based on assessments of snowline depression (Rudoy, 1995), is, in our opinion, inconsistent with this time boundary.

By that time, in all likelihood, the lower ice-dam in the western part of the Kurai basin, near the mouth of the Maashey River (at about 1460 m a.s.l.), did not exist either. Such conclusions are compatible with the results of cosmogenic isotope dating of dropstone boulders in both depressions that indicate desiccation of them about 16–15 ka BP (Reuther et al., 2006)*. The discovery of wood in the deposits of Lake Dzhangyskol (10,960 ± ± 550 (SOAN-1645) by V.A. Panychev (Rusanov, Orlova, 2013: 142)) suggests growth of forest vegetation along the southern periphery of the Kurai basin at an elevation of not lower than 1754 m as early as about 12,596 ± 1375 cal BP. A considerable degradation by the beginning of the Holocene of the glaciers in southeastern Altai, and the adjacent region of western Tuva, is indicated by discovery of paleowood aged 11,347 ± 470 cal BP (9880 ± 115 (SOAN-8753)) above the modern forest boundary in the Katun Ridge at 2600 m a.s.l. (the date is provided by A.N. Nazarov), and aged 10,380 ± 200 cal BP (8900 ± 95 (SOAN-8116)) in the Mongun-Taiga mountain group at 2640 m a.s.l. (Nazarov, Solomina, Myglan, 2012). The destruction of the ice dam near the mouth of the Maashey River, and full desiccation of the Kurai basin even before

*At the same time, there is evidence of the possible existence of a lake in the Kurai basin after 15 ka BP (Carling et al., 2011). The existence of the lake upwards of the mouth of the Maashey River (in the mouth of the Baratal River) at 1470 m a.s.l. about 14,400 ka BP is attributable exactly to the ice dam (Zolnikov et al., 2016).

the Holocene, are most clearly evidenced by the date of paleosol on the surface of the talus cone formed after emptying of the lake in the Chuya valley 3.5 km above the dam location at an elevation of 1470 m. This paleosol is dated to 9861 ± 324 cal BP (8770 ± 140 (SOAN-9094)) (Fig. 1) (Agatova, Nepop, Slyusarenko et al., 2016: Fig. 4)).

The second dam (ice and then landslide-moraine) was formed in the Chuya valley at the mouth of the Kuektanar River, in an area between the basins. An abrasion level of 1800 m a.s.l. is well pronounced above and below the dam along the valley. The Sukor landslide, on the left bank of the overlying moraine of the Kuektanar glacier, is eroded, and also terraced to an elevation of 1800 m. These facts point to the formation, and partial erosion (up to 1750–1760 m a.s.l.), of the landslide-moraine dam even before the emptying of the lake, the initial level of which was not lower than 1800 m a.s.l. Apparently, at that time, it was unified for both basins, was impounded near the mouth of the Maashey River, and existed in the pre-Holocene period (the collapse of the giant Sukor landslide at the end of the Late Pleistocene was proposed by Butvilovsky as well (1993: 164)). A similar conclusion about a later destruction of the Maashey ice-dam at the final stage of glaciation was drawn after studying sections of glacial deposits in the Kuektanar area (Zolnikov, Mistryukov, 2008: 66). The wide occurrence of lacustrine sediments along with Late Pleistocene-Holocene ostracod fauna in the Chuya basin in the range of elevations from 1760 to 1800 m a.s.l. (Rusanov, 2010) does not conflict with this conclusion (though Rusanov himself believes that the lake that left these remains in the Chuya basin was impounded by a dam in the mouth of the Kuektanar, and that this dam was partially eroded only in the subboreal period of the Holocene). Judging by the composition of single palynomorphs and redeposited pollen of Neogene vegetation, the lacustrine deposits overlying a moraine below the mouth of the Kuektanar River (Agatova, Nepop, Slyusarenko et al., 2016: Fig. 3) were accumulated in the Late Pleistocene*. The pre-Holocene time of disastrous flood passage across the Chuya valley that resulted in the formation of a large-boulder pack in the upper part of a 15-meter terrace in the mouth of the Sukhoi stream is evidenced by the radiocarbon dates of overlying sediments of a small landslide-dammed lake: 9717 ± 177 and 8308 ± 110 cal BP (8700 ± 65 (SOAN-2378), 7530 ± 60 (SOAN-2379)) (Butvilovsky, 1993: 165).

Development of hydrosystem in the Holocene

First half of the Holocene. After the emptying of the ice-dammed lake, common for both basins, that occurred even before the Holocene and not later than 8 ka BP, the "Kuektanar dam" could have impounded the Chuya basin lake with the water surface no higher than 1750–1760 m a.s.l. (the crest height of the highest moraine line); but, apparently, lower, since the Chuya incision into the dam already existed, though it was not as high as it is today. By 8223 ± 181 cal BP (7440 ± 95 (SOAN-8903) (Agatova, Nepop, Bronnikova et al., 2016)), soil had been formed at the surface of lacustrine deposits overlying the moraine at an elevation of 1730 m (Butvilovsky attributes this paleosol horizon to 7452 ± 133 and 6131 ± 150 cal BP 6565 ± 80 (SOAN-1692B), 5330 ± 80 (SOAN-1692C) (1993: 208)). Thus, as early as 8 ka BP, only a local moraine-dammed lake with the water's edge below 1800 m a.s.l. (which is lower than the bottom of the Chuya basin) could have existed in the mouth of the Kuektanar River. No traces of any other dam capable, as supposed by Rusanov (2010), of impounding a lake with a level of 1800 m a.s.l. up to the subboreal period of the Holocene (4500–2500 BP) have been established by us here (though a later destruction of such a dam is not impossible). Obviously, after the emptying of the unified Kurai-Chuya lake, several relatively vast water reservoirs with a thermophilic Late Pleistocene-Holocene ostracod fauna could have been preserved in local depressions of the Chuya basin within this level. Marls, aleurites, and clays rich in calcium carbonate, characterized by this fauna, lie in the central part of the depression, near the Ortolyk, Kosh-Agach, and Tobeler villages (Devyatkin, 1965; Butvilovsky, 1993: 168; Rusanov, 2010).

Radiocarbon dates of paleosols at the base and at the top of clastic sediments accumulated in the water environment near the slope foot of the Chuya valley, below the mouth of the Baratal ravine (western part of the Kurai basin) (Agatova, Nepop, Slyusarenko et al., 2016: Fig. 4) allow us to state that 10,000–6500 BP a water reservoir with a level not lower than 1480 m a.s.l. existed again in the Kurai depression—at least in its western part. The dam could barely have been of ice, since no later than 7000 BP, forest vegetation was restored apically in the trough within mountain framing of the basins, and glaciers no longer exceeded their

*This proposal does not conflict with two TL-dates of lacustrine sands in the mouth of the Kuektanar (Sheinkman, 1990, 2002); but, at the same time, correct comparison of data is difficult owing to the absence of exact indication of the location and depth of sampling, changes of the dates themselves and their errors in the articles of various years.

present-day size; or, possibly, degraded fully (Nazarov, Solomina, Myglan, 2012; Agatova et al., 2012).

About 8700 BP, the level of the lake in the Kurai depression (or possibly, a system of lakes) could not have been higher than 1720 m a.s.l., and the lake did not enter into the Kurai basin, which is evidenced by our radiocarbon date (SOAN-9086) of the lowest of the paleosols overlying alluvial-proluvial sediments in the Arydzhan River valley at this elevation (Agatova, Nepop, Bronnikova et al., 2016). Information is available about the same age of the terrace level of 1610 m a.s.l. in the northern part of the Kurai depression (Carling et al., 2011).

Thus, in the first half of the Holocene, lacustrine systems of the Kurai and Chuya basins developed actually in isolation, being connected only by the Chuya River. By the time of the erection of the Borotal-1 group of Pazyryk mounds (Kubarev V.D., Shulga, 2007: 180–185), the position of its bed near the mouth of the Baratal River was already close to the modern one (Agatova, Nepop, Slyusarenko et al., 2016). Despite the softer climate of southeastern Altai in the first half of the Holocene, as compared to that of our day (Butvilovsky, 1993; Blyakharchuk et al., 2008; Agatova et al., 2012; Agatova, Nepop, Bronnikova et al., 2016; Nazarov, Solomina, Myglan, 2012), no archaeological sites dated to this period are known in the Chuya and Kurai depressions. In our opinion, their absence may be due to a wide distribution of residual lakes on the bottoms of those basins at that time.

Second half of the Holocene. The evolution of the residual lakes on the bottom of the Chuya basin in the second half of the Holocene is characterized by three radiocarbon dates of lacustrine and alluvial deposits, and by *in situ* location of archaeological sites. The results of radiocarbon dating of buried male bones from Afanasievo burial ground Tarkhata I, located 16 km southeast of the Mukhor-Tarkhata village (Mukhor-Tarkhata I after: (Larin, Mogilnikov, Surazakov, 1994)*) (4514 ± 270 cal BP (3985 ± 60 (SOAN-6028) (Stepanova, 2009)), confirm that the water level in the basin could not have been higher than 1927 m a.s.l. at that time. According to Rudoy (1988), the age of plant-remains (leaves, stems, twigs) in the lacustrine deposits from a depth of 0.6 m exposed in a frost mound near the Tobeler village, at an elevation of about 1780 m, 4174 ± 270 cal BP (3810 ± 105 (SOAN-2106)), indicates that the ice-dammed lake no longer existed in the Chuya basin at that time. Rusanov (2010) treated this date as the time of accumulation of the upper pack of deposits in the lake impounded by already partially eroded landslide-moraine dam in the mouth of the Kuektanar River. In our opinion, the date may characterize lacustrine sedimentation in one of the local water reservoirs in the central part of the basin, since the "Kuektanar dam", by that time, had stopped fulfilling its role long ago. The location of rock fills attributed to the Late Bronze Age–the beginning of the Early Iron Age near the Mukhor-Tarkhata village (Agatova, Nepop, Slyusarenko et al., 2016) gives unambiguous evidence that at the time of their formation (approx. 3 ka BP), the water-level in the center of the depression no longer exceeded 1770 m a.s.l. In the Scythian epoch, it could not have been higher than 1764 m a.s.l. at this place, as confirmed by the erection of Pazyryk mounds. The location of similar sites at the same elevation in the western part of the Chuya basin, and formation of a paleosol horizon at an elevation of 1951 m on the Yustyd River floodplain about 2150 ± 146 cal BP (2130 ± 25 (SOAN-8423)), are indicative of the local character of the lakes that existed in the depression.

Later than 1437 ± 270 cal BP (1540 ± 40 (SOAN-7412)), deposition of clays, with ostracods usual for shallow waters with unstable depths (including the stratigraphically significant species *Candona stagnalis* typical of the Holocene) started 3.5 km southeast of Kosh-Agach, at an elevation of approx. 1764 m. In section, they replace lacustrine sands having Late Pleistocene-Holocene ostracod fauna that characterizes first several meters of the water body depths (Rusanov, 2010). At the same time, in the 6th–7th centuries, as confirmed by radiocarbon dates 1480 ± 62, 1402 ± 106, 1337 ± 51 cal BP (1610 ± 10 (AA-69267), 1474 ± 40 (AA-69265), 1425 ± 40 (AA-69264) (Panyushkina et al., 2007)), 1425 ± 113 cal BP (1535 ± 60 (SOAN-5919) (Kubarev G.V., Orlova, 2006)), Old Turkic population expanded into the lower areas of the Chuya basin down to an elevation of 1753 m a.s.l. (funerary enclosures in the Chagan-Uzun River valley). The body of presented data can be interpreted as recession of level and breakup of still sufficiently large lakes, with preservation, up until now, of their relics in the local lows of the depression. However, it is not improbable that a series of shallow water reservoirs were formed on the basin's bottom later than 1500 BP, after the desiccation period, the duration of which can barely be estimated as yet. Nevertheless, despite the ambiguous interpretation of geological data, the presence of lacustrine deposits in a considerable area suggests that the basin could not have been fully developed by nomads during the lacustrine stage of the evolution of its landscapes.

*In this case, the name of this burial ground is the same as the earlier name of the Paleolithic site located no further than 1.5 km southeast of the Mukhor-Tarkhata village (Derevianko, Markin, 1987: 25).

The non-disastrous character of the probable desiccation or recession of the level of the Chuya depression lakes during the period between the Scythian and Turkic epochs follows from the location of both Pazyryk and Old Turkic sites on the Chuya River terraces, and on proluvial cones of its tributaries at a distance of no more than 200–1000 m from the bed in the Chuya graben and in the Kurai basin. This also points to a pre-Scythian time of possible disastrous floods (Agatova et al., 2014; Agatova, Nepop, Bronnikova et al., 2016). The emptying of the local lake in the mouth of the Kuektanar occurred no later than the construction of iron-smelting furnaces here (6th–10th centuries), wherein charcoal aged 1696 ± 122 cal BP (1775 ± 35 (SOAN-5040) (Gutak, Rusanov, 2013)) and 1152 ± 143 BP (1250 ± 65 (SOAN-9091) (Agatova, Nepop, Slyusarenko et al., 2016)) was used, i.e. long before the Mongolian earthquake of 1761. Consequently, it could not have caused the emptying of this lake, as was proposed by E.A. Rogozhin and S.G. Platonova (2002: 107).

After the breakup of the lacustrine system, the river network remained mobile. Migrations of river-bed, and periodic floods, have been recorded in the sediments of the mouths of Tydtuyaryk (Schlütz, Lehmkuhl, 2007), Kuektanar, and Sokpanda rivers (Agatova, Nepop, Slyusarenko et al., 2016: Fig. 2, 3). Exactly in the zone affected by floods and re-winnowing of sandy deposits, surface finds of the Late Paleolithic (Derevianko, Markin, 1987: 11) and artifacts of the Kyrgyz culture have been discovered (Hudiakov, 1990), in the vicinity of the mouth of the Kuektanar River. The almost complete destruction of the iron-smelting furnaces indicates a high rate of retreat of the Chuya's right bank since their construction.

Desiccation and fluctuations of the level of residual lakes determined changes of microclimate in the depressions, and entailed reduction of the local erosion basis and transformation of fluvio-lacustrine system: formation of the Chuya River bed connecting the residual lakes, incision of its tributary beds and formation of their mouths within the bottoms of basins, deflation of exposed lacustrine deposits, pedogenesis, and colonization by vegetation. These processes could have influenced the ranges of distribution of nomadic peoples, their economic cycle and diet, and caused new communications to be established. The subsequent appearance of permanent settlements (Chagan-Uzun, Ortolyk, Kosh-Agach, and others) on the bottoms of Chuya and Kurai depressions became possible only because of the desiccation of basins as well. It cannot be excluded that the names of some of them (*ortolyk* means "island" in the Turkic language) are reminiscent of the times when nomads needed not only horses, but also boats to move across the depressions.

Conclusions

The upper time-boundary of the emptying of the ice-dammed lakes in the Kurai and Chuya basins of southeastern Altai cannot be unambiguously assessed now, because of the lack of absolute dates for the Paleolithic sites and the wide range of their possible existence, their probable redeposition, and the surface character of most finds. The use of products of iceberg transportation as cores suggests a post-lacustrine (or "inter-lacustrine") age for the Bigdon and Chechketerek Late Paleolithic sites in the Chuya depression.

New radiocarbon dates give an idea of a substantial decrease of the Sartan glaciation before 14 ka cal BP, and the emptying of the last ice-dammed lakes within the Kurai and Chuya basins in the pre-Holocene period (before 10 ka cal BP). The absence of Early Holocene archaeological sites in those depressions may be due to a wide distribution of residual lakes on the bottoms of the basins at that time; however, the landslide-moraine dam in the mouth of the Kuektanar River did not impound the lakes in the Chuya basin as early as 8 ka BP. In the second half of the Holocene, starting from the Late Bronze Age, hydrosystem transformation proceeded without disastrous consequences for humans; however, it determined the areas suitable for their habitat.

In general, using archaeological sites has introduced considerable clarity into reconstructions of the changes in the limnosystems of the Kurai and Chuya basins, which were previously based on geological data alone.

Acknowledgements

The authors are grateful to A.N. Nazarov (Siberian Federal University, Krasnoyarsk) for providing two unpublished radiocarbon dates, and to K.N. Solodovnikov and N.N. Seregin (Altai State University, Barnaul) for their help in searching for the necessary information on a number of archaeological sites.

References

Agatova A.R., Nazarov A.N., Nepop R.K., Rodnight H. 2012
Holocene glacier fluctuations and climate changes in the southeastern part of the Russian Altai (South Siberia) based on a radiocarbon chronology. *Quaternary Science Reviews*, vol. 43: 74–93.

Agatova A.R., Nepop R.K., Bronnikova M.A., Slyusarenko I.Y., Orlova L.A. 2016
Human occupation of South Eastern Altai highlands (Russia) in the context of environmental changes. *Archaeological and Anthropological Sciences*, vol. 8 (3): 419–440.

Agatova A.R., Nepop R.K., Slyusarenko I.Y., Myglan V.S., Barinov V.V. 2016
Archaeological sites as markers of Neopleistocene-Holocene hydrological system transformation in the Kurai and Chuya basins, Southeastern Altai: Results of geomorphological and geoarchaeological studies. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 44 (4): 26–34.

Agatova A.R., Nepop R.K., Slyusarenko I.Y., Myglan V.S., Nazarov A.N., Barinov V.V. 2014
Glacier dynamics, palaeohydrological changes and seismicity in southeastern Altai (Russia) and their influence on human occupation during the last 3000 years. *Quaternary International*, vol. 324: 6–19.

Baryshnikov G., Agatova A., Carling P., Herget J., Panin A., Adamiec G., Nepop R. 2015
Russian Altai in the Late Pleistocene and the Holocene: Geomorphological catastrophes and landscape rebound. Barnaul: Publ. House of Altai State Univ.

Baryshnikov G.Y., Maloletko A.M. 1998
Arkheologicheskiye pamyatniki Altaya glazami geologov, pt. 2. Barnaul: Izd. Alt. Gos. Univ.

Baryshnikov G., Panin A., Adamiec G. 2016
Geochronology of the Late Pleistocene Catastrophic Biya Debris Flow and the Lake Teletskoye Formation, Altai Region, Southern Siberia. *International Geology Review*, vol. 58 (14): 1780–1794.

Blyakharchuk T., Wright H., Borodavko P., van der Knaap W.O., Ammann B. 2008
The role of pingos in the development of the Dzhangyskol lake-pingo complex, central Altai Mountains, southern Siberia. *Palaeogeography, Palaeoclimatology, Palaeoecology*, No. 257: 404–420.

Bourgeois I., Cammaert L., Massart C., Mikkelsen J.H., Van Huele W. 2000
Ancient Nomads of the Altai Mountains. Brussels: Royal Museums of Art and History.

Butvilovsky V.V. 1993
Paleogeografiya poslednego oledeneniya i golotsena Altaya: Sobytiyno-katastroficheskaya model. Tomsk: Izd. Tom. Gos. Univ.

Carling P.A., Knaapen M., Borodavko P., Herget J., Koptev I., Huggenberger P., Parnachev P. 2011
Palaeoshorelines of glacial Lake Kuray-Chuja, south-central Siberia: Form, sediments and process. *Geological Society of London*, spec. publ., No. 354: 111–128.

Derevianko A.P., Markin S.V. 1987
Paleolit Chuiskoi kotloviny. Novosibirsk: Nauka.

Devyatkin E.V. 1965
Kainozoiskiye otlozheniya i neotektonika Yugo-Vostochnogo Altaya. Moscow: Nauka.

Epokha eneolita i bronzy Gornogo Altaya. 2006
Pt. 1. A.P. Pogozheva, M.P. Rykun, N.F. Stepanova, S.S. Tur. Barnaul: AzBuka.

Evraziya v skifskuyu epokhu: Radiouglerodnaya i arkheologicheskaya khronologiya. 2005
A.Y. Alekseyev, N.A. Bokovenko, S.S. Vasiliev, V.A. Dergachev, G.I. Zaitseva, N.N. Kovalyukh, G. Kuk, Y. van der Plikht, G. Possnert, A.A. Sementsov, E.M. Skott, K.V. Chugunov. St. Petersburg: Teza.

Gheyle W. 2009
Highlands and Steppes. An Analysis of the Changing Archaeological Landscape of the Altay Mountains from the Eneolithic to the Ethnographic Period. Ghent: Ghent Univ.

Gutak Y.M., Rusanov G.G. 2013
O vozraste zhelezoplavilnykh pechei urochishcha Kuyakhtanar (Gornyi Altai). *Vestnik Sib. Gos. Industrial. Univ.*, No. 2 (4): 18–20.

Herget J. 2005
Reconstruction of Pleistocene Ice-dammed Lake Outburst Floods in the Altai-mountains, Siberia. *Geological Society of America*, spec. publ., vol. 386.

Hudiakov Y.S. 1990
Kyrgyzy v Gornom Altae. In *Problemy izucheniya drevnei i srednevekovoi istorii Gornogo Altaya*. Gorno-Altaysk: GANIIIYAL, pp. 186–201.

Kubarev G.V. 2005
Kultura drevnikh tyurok Altaya (po materialam pogrebalnykh pamyatnikov). Novosibirsk: Izd. IAE SO RAN.

Kubarev G.V., Orlova L.A. 2006
Radiouglerodnoye datirovaniye drevnetyurkskikh pamyatnikov Altaya. In *Sovremennye problemy arkheologii Rossii*, vol. II. Novosibirsk: Izd. IAE SO RAN, pp. 139–141.

Kubarev V.D. 1987
Kurgany Ulandryka. Novosibirsk: Nauka.

Kubarev V.D. 1991
Kurgany Yustyda. Novosibirsk: Nauka.

Kubarev V.D. 1992
Kurgany Sailyugema. Novosibirsk: Nauka.

Kubarev V.D., Shulga P.I. 2007
Pazyrykskaya kultura (kurgany Chui i Ursula). Barnaul: Izd. Alt. Gos. Univ.

Kubarev V.D., Zhuravleva A.D. 1986
Keramicheskoye proizvodstvo khunnov Altaya. In *Paleoekonomika Sibiri*. Novosibirsk: Nauka, pp. 101–119.

Larin O.V., Mogilnikov V.A., Surazakov A.S. 1994
Raskopki mogilnika Mukhor-Tarkhata I. In *Arkheologicheskiye i folklornye istochniki po istorii Gornogo Altaya*. Gorno-Altaysk: GANIIIYAL, pp. 61–70.

Martynov A.I., Kulemzin A.M., Martynova G.S. 1985
Raskopki mogilnika u poselka Aktash v Gornom Altae. In *Altai v epokhu kamnya i rannego metalla*. Barnaul: Alt. Gos. Univ., pp. 147–172.

Molodin V.I. 2002
Gornyi Altai v epokhu bronzy. In *Istoriya Respubliki Altai*. Vol. 1: Drevnost i srednevekovye. Gorno-Altaysk: Inst. altaistiki im. S.S. Surazakova, pp. 97–142.

Nazarov A.N., Solomina O.N., Myglan V.S. 2012
Dinamika verkhnei granitsy lesa i lednikov Tsentralnogo i Vostochnogo Altaya v golotsene. *Doklady Akademii nauk*, vol. 444 (6): 671–675.

Okishev P.A., Borodavko P.S. 2001
Novye materialy k istorii Chuisko-Kuraiskoi limnosistemy. *Voprosy geografii Sibiri*, iss. 24: 18–27.

Orlova L.A. 1995
Radiouglerodnoye datirovaniye arkheologicheskikh pamyatnikov Sibiri i Dalnego Vostoka. In *Metody estestvennykh nauk v arkheologicheskikh rekonstruktsiyakh*, pt. II. Novosibirsk: IAE SO RAN, pp. 207–232.

Panyushkina I., Sljusarenko I., Bikov N., Bogdanov E. 2007
Floating larch tree-ring chronologies from archaeological timbers in the Russian Altai between about 800 BC and AD 800. *Radiocarbon*, vol. 49 (2): 693–702.

Razrez noveishikh otlozheniy Altaya. 1978
Moscow: Izd. Mosk. Gos. Univ.

Reuther A., Herget J., Ivy-Ochs S., Borodavko P., Kubik P.W., Heine K. 2006
Constraining the timing of the most recent cataclysmic flood event from ice-dammed lakes in the Russian Altai-Mountains, Siberia, using cosmogenic in situ 10Be. *Geology*, No. 34: 913–916.

Rogozhin E.A., Platonova S.G. 2002
Ochagovye zony silnykh zemletryaseniy Gornogo Altaya v golotsene. Moscow: Izd. OIFZ RAN.

Rudoy A.N. 1988
O vozraste tebelerov i vremeni okonchatelnogo ischeznoveniya lednikovo-podprudnykh ozer na Altae. *Izvestiya Vsesoyuznogo geograficheskogo obshchestva*, vol. 120 (4): 344–348.

Rudoy A.N. 1995
Geomorfologicheskiy effekt i gidravlika pozdnepleistotsenovykh iokullaupov lednikovo-podprudnykh ozer Yuzhnoi Sibiri. *Geomorfologiya*, No. 4: 61–76.

Rudoy A.N. 2005
Gigantskaya ryab techeniya (istoriya issledovaniy, diagnostika i paleogeograficheskoye znacheniye). Tomsk: Tom. Gos. Ped. Univ.

Rusanov G.G. 2008
Maksimalnyi uroven Chuiskogo lednikovo-podprudnogo ozera v Gornom Altae. *Geomorfologiya*, No. 1: 65–71.

Rusanov G.G. 2010
Izmeneniye klimata Chuiskoi kotloviny Gornogo Altaya po faune ostracod. *Uspekhi sovremennogo estestvoznaniya*, No. 10: 20–25.

Rusanov G.G., Orlova L.A. 2013
Radiouglerodnye datirovki (SOAN) Gornogo Altaya i Predaltaiskoi ravniny. Biysk: Alt. Gos. akademiya obrazovaniya.

Schlütz F., Lehmkuhl F. 2007
Climatic change in the Russian Altai, southern Siberia, based on palynological and geomorphological results, with implications for climatic teleconnections and human history since the middle Holocene. *Vegetation History and Archaeobotany*, No. 16: 101–118.

Sheinkman V.S. 1990
Pleistotsenovoye oledeneniye gor Sibiri: Analiz i novye dannye. *Materialy glyatsiologicheskikh issledovaniy*, iss. 69: 78–85.

Sheinkman V.S. 2002
S-S technique of TL dating: Testing on the Dead Sea shore, practice in Gorny Altai, and paleogeographic implications. *Archaeology, Ethnology and Anthropology of Eurasia*, No. 2 (10): 22–37.

Slavinsky V.S., Postnov A.V., Markovsky G.I., Basova N.V., Zolnikov I.D., Rybin E.P. 2011
Rezultaty razvedki pamyatnikov paleolita v Altaiskom krae i Respublike Altai v 2011 godu. In *Problemy arkheologii, etnografii, antropologii Sibiri i sopredelnykh territorii*, vol. XVII. Novosibirsk: Izd. IAE SO RAN, pp. 469–472.

Slyusarenko I.Y. 2010
Dendrokhronologicheskoye datirovaniye arkheologicheskikh pamyatnikov skifskoi epokhi Altaya. Cand. Sc. (History) Dissertation. Novosibirsk.

Slyusarenko I.Y., Bogdanov E.S., Soenov V.I. 2008
Novye materialy gunno-sarmatskoi epokhi iz Gornogo Altaya (mogilnik Kuraika). In *Izucheniye istoriko-kulturnogo naslediya narodov Yuzhnoi Sibiri*, iss. 7. Gorno-Altaysk: AKIN, pp. 42–58.

Soenov V.I. 2003
Arkheologicheskiye pamyatniki Gornogo Altaya gunno-sarmatskoi epokhi (opisaniye, sistematika, analiz). Gorno-Altaysk: Izd. Gorno-Alt. Gos. Univ.

Soenov V.I., Ebel A.V. 1998
Issledovaniya na mogilnike Kuraika. In *Drevnosti Altaya: Izv. laboratorii arkheologii*, No. 3. Gorno-Altaysk: Izd. Gorno-Alt. Gos. Univ., pp. 113–135.

Stepanova N.F. 2009
Problemy absolyutnoi i otnositelnoi khronologii pamyatnikov afanasyevskoi kultury Gornogo Altaya. In *Rol estestvenno-nauchnykh metodov v arkheologicheskikh issledovaniyakh*. Barnaul: Izd. Alt. Gos. Univ., pp. 154–159.

Tishkin A.A. 2007
Sozdaniye periodizatsionnykh i kulturno-khronologicheskikh skhem: Istoricheskiy opyt i sovremennaya kontseptsiya izucheniya drevnikh i srednevekovykh narodov Altaya. Barnaul: Izd. Alt. Gos. Univ.

Vysotsky E.M. 2009
K vozrastu formirovaniya relyefa priustyevoi chasti Kuraiskoi vpadiny (Gornyi Altai). In *Fundamentalnye problemy kvartera: Itogi izucheniya i osnovnye napravleniya dalneishkih issledovaniy: Materialy VI Vseros. soveshch. po izucheniyu chetvertichnogo perioda (g. Novosibirsk, 19–23 okt. 2009 g.)*. Novosibirsk: Izd. SO RAN, pp. 137–138.

Zinyakov N.M. 1988
Istoriya chernoi metallurgii i kuznechnogo remesla drevnego Altaya. Tomsk: Izd. Tom. Gos. Univ.

Zolnikov I.D., Deev E.V., Kotler S.A., Rusanov G.G., Nazarov D.V. 2016
Novye rezultaty OSL-datirovaniya chetvertichnykh otlozheniy doliny verkhnei Katuni (Gornyi Altai) i prilegayushchei territorii. *Geologiya i geofizika*, vol. 57 (6): 1184–1197.

Zolnikov I.D., Mistryukov A.A. 2008
Chetvertichnye otlozheniya i relyef dolin Chui i Katuni. Novosibirsk: Parallel.

Received December 12, 2015.
Received in revised form December 16, 2016.

DOI: 10.17746/1563-0110.2017.45.1.036-048

Jaehoon Lee
University of Houston-Clear Lake,
Campus Box 24, 2700 Bay Area Blvd., Houston, TX 77058, USA
E-mail: jaehoonfl@hotmail.com

Agricultural Practice on the Korean Peninsula Taking into Account the Origin of Rice Agriculture in Asia

Based on Carl Sauer's hypothesis that agricultural activity may have first occurred around 6500 BP with the domestication of tropical plants, rice was long thought to have originated in Southeast Asia, where the climate is very warm and humid with plenty of rainfall. While the study of rice cultivation in Asia has been seriously undertaken because rice agriculture is associated with the origin and spread of pottery culture in the region, which is important in discussions regarding Northeast Asian population movements during the emergence of the Neolithic period, many new archaeological sites with evidence of older cultivated rice have been discovered throughout the 1980s and 1990s in China. Agricultural scientists now generally consider the middle-lower Yangtze River and Yunnan regions in China, which are actually farther north than Southeast Asia, as the cradle of the earliest rice cultivation. The dates and geographic location of rice cultivation were challenged even further after some carbonized rice hulls were excavated from the village of Sorori, in central South Korea. In this paper, some theoretical arguments related to the transition period from foraging to farming systems in Korean archaeology are introduced, and some arguments regarding the origin of rice, which is currently the most important crop for Northeast Asian peoples, are discussed. Based on a brief survey of research results, ecological conditions of Northeast Asia, the biological uniqueness of rice, and archaeological evidence for rice cultivation from the Sorori site in Korea, it is suggested that temporal and spatial frames for the early history of rice cultivation need to be expanded.

Keywords: *Rice, Sorori, cultivation, farming.*

From foraging to farming

The shift from foraging to farming was one of the most profound dietary changes in the history of modern humans (*Homo sapiens*). This transition is remarkable in light of the benefits and drawbacks that resulted, not only for human health but also for the social systems of Neolithic peoples. However, it is still not clearly understood when, where, and how agricultural production began. The impact of the transition from foraging to farming in human societies is also not clear. It is, however, reasonable to assume that people began cultivating some crops before they started full-scale farming.

While cultivation and sedentary life do not appear always to have gone hand in hand (Arnold, 1996; Kelly, 1995), mixed patterns of subsistence between foraging and farming might have occurred in the early stages of food production (Bender, 1975: 9). This type of mixed pattern might have occurred during the Neolithic period in Northeast Asia as well. In fact, in many ethnographic cases, hunter-gatherers have as many subsistence strategic options as food-producers do; for instance, they have their own systems of controlling animals and plants, as well as adapting to environmental and cultural conditions (Ibid.: 1). It is therefore highly likely that "the people who first domesticated and cultivated millets were 'affluent' hunters and gatherers who lived in permanent settlements and relied on a rich variety of wild plants and animals in addition to millets" (Smith, 1995: 136). Therefore, defining the difference between foraging and farming styles has mostly depended on differences in the scale of food collecting between these two subsistence systems (Hutterer, 1983: 173).

The introduction of pottery has always been considered intrinsically linked to the emergence of farming and sedentism, and this process has long been believed to have been initiated during the postglacial and Early Holocene period throughout much of the world. The origin of rice and rice cultivation in Asia have been subjects of intense interest because they are associated with the origin and spread of pottery culture in the region, and in turn directly connected with many arguments regarding cultural contacts among ancient peoples during the Neolithic period in Asia. In the case of the Korean peninsula, there is no strong evidence yet for Early Neolithic developments in the region. But many arguments and theories regarding Neolithic origins apply to the late Korean Neolithic period, when a new pottery style and more intensified farming and sedentism appeared.

Rice was long thought to have been first cultivated around 6500 BP in Southeast Asia, where the climate is very warm and humid with a monsoon rainfall pattern. But throughout the 1980s and 1990s, many newly excavated archaeological sites showed evidence of earlier rice cultivation (10,000–8000 BP) in China. Agricultural scientists generally suggest that the center of rice cultivation was in the middle-lower Yangtze River and Yunnan regions in China, geographical locations which are actually farther north than Southeast Asia. This has caused scholars to reevaluate the theory of Carl Sauer, who considered Southeast Asia as a cradle of the earliest agriculture. The dates and geographic location of rice cultivation have been challenged even further because carbonized rice hulls radiocarbon-dated to 17,000–13,000 BP have been excavated from two sandy peat soil layers in the village of Sorori, in central South Korea (Kim et al., 2013; Cheongwon Sorori…, 2000; Lee, Woo, 2001, 2003, 2004). However, because no association was found with any human material culture, and given its high latitude and unusually old chronology, some agricultural scientists have not been convinced of the archaeological importance of the site. This paper surveys some theoretical overviews and arguments regarding the Korean agricultural transition, along with a brief retrospective on studies of rice cultivation in Asia.

The Korean agricultural transition

Some attempts have been made by Korean archaeologists to explain the transition period from hunting and gathering to farming in Korea. According to J.-J. Lee (2001b: 21), those attempts are mainly based on theories emphasizing either migration or population pressure. As with other regions in the world, a simple process theory based on migration and diffusion, concepts popular in the culture-history school up until the early 1960s, had dominated archaeological discourse in explaining prehistoric cultural change in Korea.

While all the basic and main chronological frameworks and archaeological models of the culture-history school are still well accepted in describing prehistoric Korea, some are now under debate. Most studies from the 1960s and 1970s used migration theory to connect Korean Neolithic Chulmun and Bronze Age Mumun pottery cultures to continental areas such as China and Siberia (see (Kim J.-B., 1975; Kim J.-H., 1964; Kim W.-Y., 1967)). These studies emphasize direct population movements from other regions onto the Korean peninsula and focus on the initial moment for the emergence of farming and on the migration routes of the farmers. While this approach echoes Braidwood's natural-habitat hypothesis (Braidwood, 1960; Courses…, 1962), it does not provide detailed explanations for the transition process or reasons for the change to farming (Lee J.-J., 2001b: 19).

Another theory, population-resource imbalance, has been applied by Choe (1982, 1991), Choe and Bale (2002) and Norton (1996, 2007), who argue that changing environments and/or increased population size resulted in a population resource imbalance that eventually forced a shift to agriculture in Korea. According to Choe (1982, 1991), environmental changes creating a colder climate between 5500 and 4000 BP disrupted the equilibrium condition between the population and its resources, eventually resulting in resource depletion that brought about the first cultivating of plants. Norton (1996, 2007), however, emphasizes only resource depletion caused by sedentism from the Late Neolithic period (4000–3000 BP) rather than stressing any environmental factors. According to him, settlements created population increases and food shortages. These hypotheses again lack any direct evidence for increasing population pressure (Lee J.-J., 2001a: 28). In other words, there is no direct evidence to support the earlier models that environmental change or a population increase could be a direct cause for the transition to agriculture in Korea, although there is environmental and archaeological evidence to suggest climate and population changes (Ibid.; Lee G.-A., 2011: s324).

In contrast, J.-J. Lee (2001a, 2001b) suggests that social demand theory might best explain the appearance of the Mumun agriculturalists of the Bronze Age period on the Korean peninsula, where increasing social complexity caused resource stresses during the late Chulmun period. She combines population-resource imbalance with the social approach, emphasizing socioeconomic competition among hunter-gatherers to produce food surpluses (Lee J.-J., 2001a: 312–322). According to J.-J. Lee, environmental changes and/or population increase during the Middle Neolithic period resulted in some structural change in population movements inside the Korean peninsula, which created "a certain degree of resource stress", and causing the Korean Chulmun pottery people to gradually learn "the benefits of agriculture as a storable supplement that could support the accumulation of wealth" (Ibid.: 324–325). She states that while there is no obvious explanation for the population increase in southern Korea, she hypothesizes that the Mumun pottery people of the northern peninsula, who had advanced technological and social complexity, moved down to the southern peninsula (Ibid.: 324). Therefore, although she emphasizes two theories, social demand and population-resource imbalance, J.-J. Lee suggests that the main cause for the development and spread of the Korean agricultural transition in the southern peninsula is population migration.

According to J.-J. Lee (2001b: 22–23), there are three possible scenarios that might have occurred in Korea. The first consists of population movements with a quick spread of farming culture. The second scenario, as originally suggested by K. Nelson (1992, 1999), is early secondary diffusion and long-term cultural adaptation along with the increasingly important status of farming. And the third possibility is that there were different adaption scenarios based on different environmental situations on the Korean peninsula. J.-J. Lee also suggests the possibility of a combination of migration and cultural diffusion in certain regions, and notes that these multi-causational models should have been considered in approaches to the transition period from hunting and gathering to farming in Korea.

As seen in the examples of the studies above, many current Korean scholars do not accept the idea of the total population replacement theory that is usually associated with Braidwood's theory in the era of the culture-history school, although the concept of migration is still of central importance in explanations. In other words, Korean archaeologists have focused on investigating whether there was primary diffusion by the movement of new populations, or secondary or cultural diffusion without population movement from the outside. In general, as seen above, Korean scholars have emphasized the ideas of secondary diffusion and native evolution more than population replacement theories.

Given new archaeological data along with increasing amounts of new data for environmental changes in the Holocene, it is expected that a more detailed and reliable explanation for the spread of farming to Korea and the interaction process during the transition to farming will be proposed in Korean archaeology.

Archaeology and rice cultivation in Asia

While many topics related to the origin of an agriculture economy are still subjects of great debate in Asian archaeology, it is incontestable that today rice is widely cultivated in these tropical and temperate regions. The origin of rice culture and its spread are pertinent to various academic fields. Although the precise time and place of rice domestication will perhaps never be known, there have been many discoveries of rice at archaeological sites in Asia over the last several decades.

Many early botanists and rice specialists believed that the earliest rice cultivation occurred in regions within geographical areas that had a variety of food sources during the year (Sauer, 1952). Sauer, who popularized the main theories on the origins of agriculture, rejected Southwest Asia as a cradle of the earliest agriculture. He instead suggested Southeast Asia as the region for the earliest agriculture, while many scholars thought Southeast Asia was only a very early center of the shift from foraging to farming. This was thought to be so because Southeast Asia has regions where food availability and agricultural production were naturally favored. It is believed that the earliest rice cultivators might have settled down near the edge of the uplands on gently rolling hills and close to freshwater resources (Sauer, 1947, 1952). However, many archaeologists dismiss this hypothesis because archaeological evidence for agriculture in Southeast Asia appears later than in Southwest Asia and China.

Many rice specialists before the 1970s supposed that the original home of Asian cultivated rice was in northern India. There, rice had a wide distribution with many varieties of rice species (Tang, 2004: 18). Another area discussed by scholars as an origin for rice cultivation was the south foothills of the Himalayan Mountains (see (Chang T.-T., 1976)). This area stretches from India to the mountain ranges of mainland Southeast Asia, including southwestern China. The area also provides a diversity of cultivated species of rice. Again, archaeological evidence from the area has not supported the earliest existence of cultivated rice. Some of the earliest evidence for cultivated rice from mainland Southeast Asia, in northeastern Thailand, is found at Non Nok Tha and Ban Chiang. At the Non Nok Tha site (dating 2300–2000 BC by AMS), pottery is tempered with rice chaff. At the coastal site of Khok Phanom Di (dating 2000 BC), in southern Thailand, rice-tempered pottery was also found (Glover, Higham, 1996: 422). Some scholars speculate that the occurrence of cultivated rice varieties in the later layers of the site might have been the result of trade between local hunter-gatherers and inland farmers (Higham, 2002: 77).

Although some wild rice from the Ganga valley in India is dated between 11,000 to 10,000 BP (Wenming, 2002: 152), and rice from the Xom Trai site in Vietnam is dated between 19,000–17,000 BP (Glover, Higham, 1996: 421), chronological dates for the archaeological evidence of cultivated rice from these sites are not reliable (Crawford, 2005; Crawford, Chen, 1998). No archaeological evidence has yet been found in the region to indicate the existence of cultivated rice earlier than that found in China.

Currently, archaeological evidence shows that China has the oldest rice remains and the richest rice culture. Before the 1970s, studies of the origin of rice agriculture had suggested the Yunnan region in southern China as the possible location for the earliest rice cultivation in Asia. Although some scholars still speculate that rice was brought under cultivation in southern China or the Yunnan areas where wild and traditional species of rice existed, rice specialists reject these areas as a center for the mutation of rice, favoring instead the areas between the middle-lower Yangtze River and the upper Huai River. In fact, various archaeological data indicate that the Yangtze River areas began the rice agriculture much earlier than any other areas in China (Yasuda, 2002: 130). The dates of rice from archaeological sites around the region range between 14,000 and 6500 BP (Crawford, 2005; Crawford, Chen, 1998; Fuller, Qin, Harvey, 2008; Fuller et al., 2010; Tang, 2004; Yasuda, 2002, 2008), and the region is at the far northern edge of the range of wild rice today. This suggests that the center of rice cultivation was actually farther north than had been previously supposed. However, since the Yangtze River areas do not provide "enough evidence of wild rice, these theories were often based on circumstantial evidence. One of them was based on ancient records, the second was based on the search for wild rice among cultivated rice and the third was based on ancient climatic evidence" (Wenxu, 2002: 216).

Rice cultivation in Korea

On the Korean peninsula, the oldest cultivated millet and rice discovered are dated between 5500 and 4000 BP as dry-field crops (Ahn, 2008; Choe, 1991: 31; Crawford, Lee, 2003; Lee J.-J., 2001a; Han et al., 2002; Kim W.-Y., 1982: 515; Song, 2001). However, it is believed that these earliest plants did partially contribute to hunter-gather subsistence in the region. While there is no conclusive evidence of domesticated plants and animals during the Early Neolithic period in Korea (Lee J.-J., 2001a), it is believed that the earliest paddy-rice field, dating around 3400–3000 BP, has been excavated on the southern part of the Korean peninsula (Bale, 2001; Crawford, Lee, 2003; Lee G.-A., 2011: s326).

On the Japanese archipelago, where the existence of Jomon agriculture is still a subject of debate (see (Crawford, 2008)), there is increasing evidence that later Jomon populations may have practiced a form of slash-and-burn agriculture with some minor crop cultivation, especially root crops. There was no evidence for paddy-rice cultivation until around 3000–2500 BP (Aikens, Rhee, 1992; D'Andrea et al., 1995; Imamura, 1996), but some rice remains have been found, dating from 4000 to 5000 BP, at a site in western Japan near the southern Korean peninsula (Toyama, 2002: 269).

While it is now generally accepted that Korea was a region of secondary agricultural origins, there are several different models for explaining the diffusion routes of cultivated rice culture from China to Korea and Japan (Fig. 1). Since the northern Korean peninsula has shown evidence of earlier millet cultivation while the southern Korean peninsula shows all later rice-growing evidence, some scholars have insisted that rice culture moved from southern and central coastal

Fig. 1. Discussed rice diffusion routes.

China to Korea and Japan (see, e.g., (Kim W.-Y., 1982; Lindstrom, Uchiyama, 2012: 284)). Another similar theory has considered the Southeast Asian and southern China regions as centers for the rice culture route to Korea and Japan, and this theory is loosely accepted, even though many archaeological sites from the Yangtze River area have reported earlier rice evidence (Ahn, 2010: 92; Takamiya, 2001). However, some scholars (see, e.g., (Ahn, 2010; Choe, 1982)) insist that rice agricultural culture was introduced from the northeastern area of China to the southern Korean peninsula and later into Japan, after rice culture had been introduced into northeastern China, where millet agriculture was dominant. Currently, the southern China and Southeast Asian route theories are not supported, while the other two theories are still under debate.

While the possible earliest paddy field in China may date to 6000–5000 BP (Fuller, Qin, Harvey, 2008), rice discovered at the sites of settled village communities from the Hunan Province and Hubei Province in southern China are dated 8500–8000 BP. Another very famous Chinese Neolithic site, Hemudu, represented a well-established rice agricultural community and is dated 7000–6900 BP (Barnes, 1993; Bellwood, 2005; Crawford, 2005; Chang K.-C., 1986; Fuller, Qin, Harvey, 2008; Fuller et al., 2010; Liu, 1985). Recent arguments as to whether some of the rice from Hemudu should be considered wild or cultivated are discussed in Y. Sato (2002) and D. Fuller et al. (Fuller, Qin, Harvey, 2008). Fuller and others especially argue that there should be more systematic studies to look at wild and cultivated rice variations in China in order to establish evolutionary models that can be used for further spatial and temporal comparisons (Ibid.).

The possibility of earlier agriculture in the Korean Neolithic period has been argued in Korean archaeology for a long time, and the middle-of-the-road view was that the transition period between the Neolithic and the Bronze Age marks the advent of the first agricultural stage in prehistoric Korea. Now, it seems that the time frame will be extended at least a few thousand years earlier. Recently, studies of impressions on pottery are believed to be "an effective method for reconstructing subsistence from sites without plant residue" (Son, Nakamura, Momohara, 2010: 34). This technique, enthusiastically practiced in Japan but not much in Korea yet, found millet impressions on Neolithic pottery sherds dated between 7000 and 6000 BP (Chosun Daily News, 2011). While many sherds bearing the impressed forms of major crops have been described in the site reports, most of these go no further in assessment than a macroscopic examination for reporting purposes (Kim M.-K., 2010: 52). Although many of these sherds were collected from a surface survey, and therefore some chronological issues have been discussed, it is expected that more extended and controlled impression studies could provide us with further valuable information (Ibid.: 53).

An interesting recent update is that a Neolithic site discovered in a sand field near the eastern coastline of South Korea, only about 400 m (437 yards) away from the sea and near the demilitarized zone, has revealed the first ancient farm land with associated residential areas from the Neolithic period in Northeast Asia (Hankyoreh News, 2012). It is also reported that the site is estimated to date from the Middle Neolithic period, around 5000 BP, based on the evidence of pottery sherds, stone arrowheads and carbonized millet, and on an absolute dating of soil. As seen in the case of the theories related to the transition period of Korean agriculture, many discussions around rice diffusion routes are also intertwined with the subject of the identity of the Mumun culture in the Korean Bronze Age.

Sorori rice in Korea

In 1998, it was reported that 59 carbonized rice grains (18 of ancient rice, 41 of quasi-rice) from two peat soil layers of an archaeological site in the village of Sorori in central South Korea were dated earlier than any other rice remains previously found. The carbonized ancient rice was dated to 13,010 ± 190 to 12,520 ± 150 BP, and the quasi-rice to 17,310 ± 310 BP (Kim K.-J. et al., 2013; Lee, Woo, 2003), the oldest examples of cultivated rice that have been excavated in Asia (Lee, Woo, 2001, 2003).

The Sorori site was first found in a 1994 salvage-project survey of Paleolithic tools buried in surface soil at the planned area for the Ochang Industrial Complex. The site is located between 36 and 37 degrees north latitude and at the low hillside of Osung Mt, about 2 km (1.24 miles) from the Mihochun River, which is the upper stream of the Kumkang River (Kim J.-Y. et al., 2003). At the first excavation in 1997–1998, 11 short *japonica* type ancient rice grains and 1 slender smooth ancient rice grain with 2 kinds of quasi-rice were found. Many Paleolithic tools, such as cleavers, scrapers, notches, cores, and flakes, were also found in the upper culture layer (Cheongwon Sorori…, 2000). Questions from archaeologists and rice specialists about the ancient rice led to a second excavation in 2001. Six short ancient rice hulls and some quasi-rices were found, and these confirmed the presence of ancient rice from the site. Most of the rice grains were found in the middle peat layer (14,800–12,500 BP, 32.13–31.36 m above sea level). In the lower peat layer, 1 grain of quasi-rice was found (5 dating samples, 17,300 to 16,300 BP) (Lee, Woo, 2003: 34). The quaternary geological layers were well preserved, and there was the presence of a cultural layer, Paleolithic layers and thick peat layers. However, since there was no cultural evidence in the layers with the rice grains, the significance of the Sorori rice is still being debated among scholars.

Much research indicates that southern regions of Northeast Asia, especially near the Yangtze River area, were 3–4° C warmer and damper during the period of 15,000–7,000 BP than at present (Smith, 1995: 122; Tang, 2004: 20; Zheng, Bao Yin, Petit-Maire, 1998). A study analyzing charcoal from the archaeological sites of the central-southern Korean peninsula indicates cool climatic conditions before 51,000 BP, and warm, and dry conditions at 18,630–16,400 BP (Park, Kim, Lee, 2004). According to one pollen analysis from the Sorori site (Kim J.-Y. et al., 2003: 51–53), the center of the southern Korean peninsula was covered by deciduous forests or mixed forests with warm and wet swamp conditions around 16,680–13,010 BP. Deciduous and broad-leaved forests with warm and swamp vegetation were present up to 9500 BP (Fig. 2). The Sorori site shows that the area finally changed into a swamp environment with *Gramineae* predominant after an interval of cool conditions in the early period. The soil structure of the site was flooded by mud and formed in dry, warm climatic conditions during the Holocene. Another soil analysis from the Jangheungri site, which has comparable geological conditions, indicates a similar result (Ibid.: 54–56). Some coleopteran insect fossils have also been excavated from the Sorori site. The identified species are known to have fed on the roots of wetland plants (Lee, Woo, 2001: 99–104). Therefore, it is possible to suppose that the Sorori site was a wetland environment, and this result corresponds with those of other environmental studies from pollen analysis.

While there is no lithic evidence from the layers with evidence of rice at the Sorori site, many Paleolithic sites besides the Sorori site have been found in the central region of South Korea. The archaeological sites have reported repeated occupations, and human fossils were excavated from one of them (Lee, Woo,

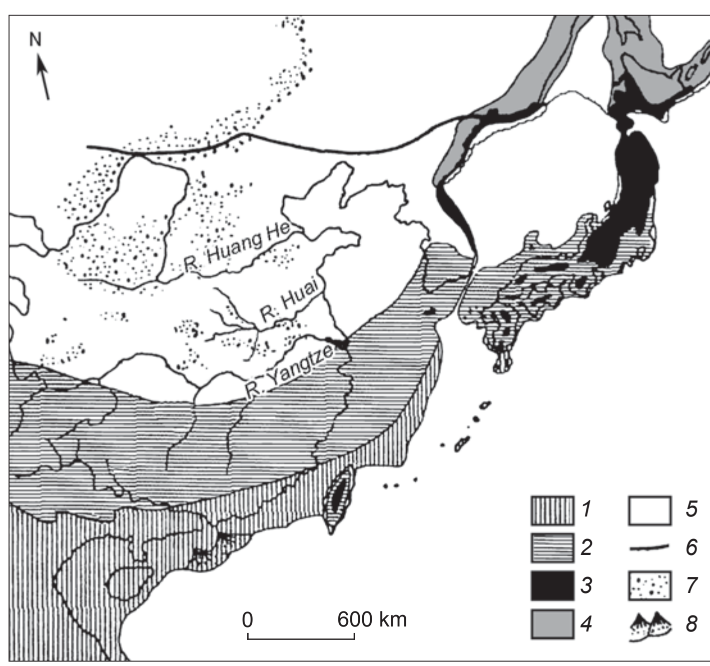

Fig. 2. Phytogeographic zones at the time of the Last Glacial Maximum, 21,000–15,000 BP in East Asia (after (Cohen, 2002: 217, fig. 1; Yasuda, 2002: 217–227)).

1 – broad-leaved evergreen forest of the subtropical temperate zone; *2* – mixed deciduous/broad-leaved forest; *3* – subarctic deciduous forest; *4* – tundra and forest-tundra; *5* – forest and steppe; *6* – edge of the permafrost area; *7* – desert and forest; *8* – alluvial fan.

2004). The lithic evidence from those sites shows that some crucial changes occurred from the Late Pleistocene to the Early Holocene, such as increasing numbers of small and extensively retouched tools around 30,000 BP, and acquisition of raw materials from long distances (Bae, 1992: 17, 1997: 2; Seong, 1998, 2008). All these changes in lithic technology can be interpreted to show that the Late Paleolithic people might have carried out a greater variety of activities than those from earlier periods (Kong, Lee, 2004: 102; Seong, 2008, 2009). Assuming that only some simple stone tools, such as "digging sticks and stone hoes" and "ground-edge slate or flaked chert knives" would have been needed for simple cultivation and harvesting activities (Glover, Higham, 1996: 433), it is possible to suppose that one of the lithic forms from the central region of South Korea, the tanged point (also called a knife-blade), could have been used to cultivate ancient rice at the Sorori site.

Cultivated or wild?

The types of cultivated rice are usually divided into two sub-species: *Oryza sativa* and *Oryza glaberrima*. *O. sativa* is more widely utilized in the world. *O. glaberrima* is popular mostly in Africa. It is believed that the "wild progenitor of *O. sativa* is the Asian common wild rice, *O. rufipogon*, which shows a range of variation from perennial to annual types. That of *O. glaberrima* is *O. barthii* (= *O. breviligulata*), which is an annual grass endemic to West Africa. The two cultigens were domesticated independently. They have discrete differences in key characters and intermediate plants are rare" (Oka, 1991: 58). While scholars still debate the genetic connections among rice species, domesticated rice in Asia (which mainly originated from *O. sativa*) is normally divided into two subspecies: *indica* (called long grain in general) and *japonica* (short grain) (Wenming, 2002: 152). The forms of divergence between these two species are still debated, and the range and habitat of wild species thought to have contributed to the cultivated forms are also investigated by rice specialists researching the distribution of cultivated species. Today, *indica* is grown in most Southeast Asian regions including southern China, while *japonica* is grown in northern China, Korea, and Japan. Thus, it is indicated that *indica* is better adapted to the zone of monsoonal rainfall (tropical and subtropical lowlands), and "is cultivated south of 33 degrees north latitude and up to 2000 meters above sea level. *Japonica* is adapted to shorter growing seasons and colder temperatures north of 33 degrees north latitude and at higher elevations in southern China. Gene flow between *indica* and *japonica* is restricted, so we know that they were established as separate domesticated varieties very early" (Smith, 1995: 127). Currently, archaeological sites with rice evidence from both Southeast Asia and Northeast Asia show the existence of *O. sativa*. Some sites with evidence of the earliest cultivated rice from southern China and the Yangtze River areas show the existence of both *indica* and *japonica* types together. The identification, however, of these types is usually complicated by a substantial overlap in grain size (Ibid.).

The scholars who excavated the Sorori site divide rice grains from the site into two groups of rice and two groups of quasi-rice. Although there are variations in size, including both short and long forms, the grains at the site are very different compared to present-day cultivars (Heu, Lee, Woo, 2003: 62). According to Heu and others, "the variation of short grain type within a limited area, like in this pit, might imply the primitive evolutionary stage… Though we could not see the variations, due to single sample of slender grain, the morphology of long grain is peculiar from those of short and also from those of long grains of present day cultivars" (Ibid.). The quasi-rices, divided into two groups, show that the quasi-rice 1 form includes both smaller and larger grains than current *japonica* cultivars. The other group, the quasi-rice 2 form, shows a size similar to the recommended cultivars of today. Most of the short grains, however, are morphologically similar to those of Ilssan ancient rice (discovered in Korea in 1991, see (Sohn, Shin, Chang, 1992), which does not look exactly like current *japonica* cultivars.

As mentioned, because the Sorori rice was not excavated with any cultural material, scholars have been arguing whether Sorori rice is cultivated or wild (Ahn, 2010). Rice specialists who generally agree that the Sorori rice is a cultivated form base their opinions on morphological features of the rice. According to Sato, "wild rice, *O. rufipogon* has a long bristle on the awn and the density of this bristle is also higher than that of the cultivated rice" (cited after (Yasuda, 2002: 130)). Wild rice also has a brittle rachis and its awn is long (Ibid.). Although the rachis of wild rice is very brittle, facilitating efficient dispersal of seeds, some wild rice would have a tough rachis due to the process of mutations (Ibid.: 141–142; Sato, 2002). It is reported that the rachis form on the Sorori rice is similar to those of current cultivars. According to the result of an experiment by Morishima (Ibid.: 130), a wild rice community changes into the cultivated form of rice after a few generations of cultivation. Prehistoric rice collectors would have unconsciously favored rice species with more stabilized and strong forms so that grains would not be easily dropped on the ground as they grew (Bender, 1975: 53). Although rice from the Sorori site has been determined through DNA analyses to have rather little genetic likeness (39.6 %) to modern wild/raised rice, "the evolutionary relationship of these quasi-rices with rice, including wild species, is not understood yet" (Heu, Lee, Woo, 2003: 62).

Rice biology

As discussed in the previous section, the regions popularly discussed by scholars for the origin of early rice cultivation are mainly considered based on environmental conditions in the areas. In other words, core areas for the earliest rice cultivation are associated with environmental conditions that required no human modification. Sauer (1952) suggested that a reliable water supply must have existed at the area of the earliest rice cultivation. Most rice specialists agree that regions with high temperature, humidity, rainfall, water availability, and a great deal of sunshine were best for the earliest cultivation of rice (Huke, 1976: 37). Current studies indicate that temperature is one of the main factors affecting the growth of the rice plant. Vergara states, "the rice plant exposed to low temperatures at seedling stage may undergo a reversible strain due to the decrease in chemical reactions and physical processes, but recovers when favorable weather comes" (1976: 72). This also indicates that rice itself might have some adaptability to the environment. In fact, rice is currently raised not only at very high latitudes, such as central Czechoslovakia at 50° north latitude and Hokkaido in Japan over 40° north latitude, but also at some high altitude areas of Nepal and India, where the growing season temperatures average much lower than those of Southeast Asia and southern China (Huke, 1976: 38). However, it is necessary to note that rice cultivation in these areas might not have been possible without human effort and ingenuity (Ibid.: 40). Nevertheless, it is in general true that rice is still cultivated in difficult environmental conditions and produces reasonable yields. As seen, rice is grown under more diverse environmental conditions than any other major food crop in the world. All things considered, it might be too early to determine that wild and/or cultivated rice originated solely in tropical or subtropical regions where sufficient water resources combined with high temperatures were available throughout most of the year.

Discussion and conclusion

Southeast Asian regions were favored by some scholars as the cradle of the earliest rice cultivation before many archaeological sites in the Yangtze River region were found to contain not only evidence of cultivated rice, but also well-developed rice-farming societies. Scholars suggesting Southeast Asia and far southern China for the origin of agriculture argue that the geographical range of wild rice did not reach as far north as the Yangtze River. They also point out that "the early rice-farming societies along the Yangtze were already highly developed and that evidence for the first stages of rice cultivation is missing" (Smith, 1995: 119–120). They assert that cultivated forms of rice were introduced from somewhere farther south than the Yangtze regions. Although there is not much evidence for the existence of wild rice in the Yangtze River regions, some types of wild rice have recently been found along the middle and lower Yangtze (Ibid.). However, arguments are still ongoing as to whether these wild types are genetically connected with any of the ancestral species of wild and, later, cultivated rice. While in many cases rice discovered at archaeological sites in Southeast Asia cannot be determined, in the absence of clear chronologies, to have been produced locally or traded, no direct archaeological evidence has been found and proven to support the earliest origin of cultivated rice in Southeast Asia.

According to Sauer's premise, the hunter-gatherers in Southeast Asia knew wild plants well before they began to use them as part of their regular dietary system. A transition from foraging to farming eventually occurred among people inhabiting a place with various types of plants. Sauer supposed that an initial cultivation process might have occurred with garden horticulture rather than field agriculture (1952). He also suggested that the initial stages of agriculture involved root crops which were reproduced as a food resource. He hypothesized that these root crops were first propagated in the wet tropics of Southeast Asia, because the root crops, such as yam, taro, and manioc, are less labor oriented and more stable, although less productive compared with seed crops, such as rice and wheat. While it is now generally agreed that hunter-gatherers in Southeast Asia practiced cultivation activities on tubers or crops before an agricultural system really started, no direct archaeological evidence supporting this hypothesis has been found (Bellwood, 1997: 203). Therefore, Sauer's hypothetical reconstructions of the origin of agriculture in Southeast Asia "were plausible but never testable" (Ibid.).

More historical ecological aspects of the region are now emphasized by some scholars (see (Bailey et al., 1989; Hutterer, 1988; Maloney, 1998)) to discuss, where, when, and why hunter-gatherers in the regions would really need to consider agricultural processes for their subsistence systems. While it has been found out that most tropical soils are relatively poor and not even suitable for agriculture (Hutterer, 1988: 72), Endicott and Bellwood argue that small nomadic foraging groups can survive with wild resources only (1991: 181). Therefore, scholars have focused on environmental conditions of the regions for pre-agricultural people. Thus, it might be true that extensive agricultural systems are not ideal in general in Southeast Asia, except in some regions, such as coastal lowlands, river bottoms, and areas with good volcanic soils, but it is still plausible that small-scale farming activities with basic cultivation processes of rice might have been developed somewhere in Southeast Asia. Sauer's premises are therefore still valuable, although the assumption of a single center for the origin of agriculture and subsequent diffusion processes have been widely criticized. Although current archaeological evidence, rice biology, and agronomical approaches clearly indicate that the beginnings of rice cultivation were not necessarily limited to only one region, further work testing Sauer's premises must be done before abandoning his hypothesis regarding Southeast Asia as the cradle of early agricultural systems.

Currently, because most of the earliest rice sites now known are from China, many scholars agree that the center for the earliest cultivation of rice lies near central and southern China. While all cultural history of Northeast Asia is based on the diffusion theory from China to other regions in Asia, some old arguments for the southern, central, or northern China route for spreading of rice cultivation from China to Korea and Japan are still subjects of debate (Choe, 1982; Chon, 1992; Kim W.-Y., 1982; Nelson, 1982a, b; Takamiya, 2001).

There may not be enough archaeological evidence to evaluate the importance of the Sorori site until more reliable archaeological data have been recovered from the southern Korean peninsula. At the same time, if scholars all agreed that the Sorori rice is a cultivated form, some of our knowledge of rice biology and hypotheses based on it would need to be revised. For instance, it is traditionally supposed that the proper ecological conditions for the growth of wild rice are limited to regions below 30° north latitude, and the area for the earliest development of rice cultivation should be within a region where wild rice forms are known to currently grow. Since we do not have any strong reason to believe that there is only one center of primary agricultural and domestication processes, the origination of agriculture might have occurred independently in different regions of the world (Bender, 1975: 15). It is also possible that mixed farming systems could be coeval. Bender also argued that we need to be careful with our own archaeological bias. According to her, archaeologists who work in regions such as Southwest Asia and Mesoamerica where archaeological finds are usually better preserved, but where there is a lack of indigenous root-crops, tend to favor seed-crops as the origin of agriculture, though seed crops are generally more difficult to cultivate (Ibid.).

By the same token, it might not be necessary for archaeologists or rice specialists to find archaeological sites or regions indicating all genetic variations of rice from the earliest progenitor to current rice forms consumed together in the region. Human beings have various ways of adjusting to all kinds of environmental conditions. Many different factors in ecological and social environmental conditions have been reported to produce change in human behavior as seen in the archaeological record. While all kinds of human societies' possible responses to environmental conditions have been considered as major processes in their cultural history, settlement movements, aside from adaptation and manipulation processes, might have been involved and played major roles in the history of agricultural processes, regardless of the scale of the population in question, or the distance traveled by that population. Rice specialists have to keep in mind that no progenitor form of the Sorori rice has been found. It is also very important to consider that the climatic conditions of the southern Korean peninsula during the last glacial period were similar to those of southern China, which is 5–10° lower latitude than southern Korea (Cohen, 2002: 223). More effort on reconstructing the environmental conditions of the regions, especially the paleoclimatic conditions of the Late Pleistocene, is necessary. There is a need to increase our understanding of the overall regional human ecosystems, with a human ecosystem "defined as an ecological system that includes humans and has multiple (physical, biological, social, and cultural) input and output environments which link to other ecosystems" (Pavao-Zuckerman, 2000: 34).

Although the origin of cultivated rice remains an enigma, we may need to refocus our perspective. Perhaps there is not one single region of early rice cultivation that is the ancestor of all cultivated varieties today. Although as S.-M. Ahn said, "the Sorori rice could have been transported from the warmer southern region around the paleo-Yangtze channel by Paleolithic foragers or migratory birds" (2010: 90), we still need to consider the possibility that there may be multiple origins for domesticated rice. Based on the Sorori rice case, it is probable that earlier cultivated rice could be found near the Yangtze River as well as in regions farther north somewhere in Asia. More approaches which emphasize the historical ecological aspects of the region, and more accumulated archaeological evidence would be essential and necessary for future studies.

Acknowledgements

I would like to thank Yung-Jo Lee, Hugh Popenoe, and Rebecca McSwain for their help on this paper.

References

Ahn S.-M. 2008
Hanbando cheongdonggi sidae-ui jangmul joseong: Jongja yuche-reul jungsim-euro [Crop assemblage of Korean Bronze Age: Focused on crop remains]. *Honam Kogohakpo*, vol. 28: 5–50. (In Korean).

Ahn S.-M. 2010
The emergence of rice agriculture in Korea: Archaeobotanical perspectives. *Archaeological and Anthropological Science*, vol. 2 (2): 89–98.

Aikens C.M., Rhee S.-N. 1992
The emergence of hunter-fisher-gatherers, farmers, and sociopolitical elites in the Prehistory of Pacific Northeast Asia. In *Pacific Northeast Asia in Prehistory: Hunter-Fisher-Gatherers, Farmers, and Sociopolitical Elites*, C.M. Aikens, N.-S. Rhee (eds.). Pullman: Washington State Univ. Press, pp. 3–9.

Arnold J.E. 1996
The archaeology of complex hunter-gatherers. *Journal of Archaeological Method and Theory*, vol. 3 (2): 77–126.

Bae K.-D. 1992
Pleistocene environment and Paleolithic stone industries of the Korean Peninsula. In *Pacific Northeast Asia in Prehistory: Hunter-Fisher-Gatherers, Farmers, and Sociopolitical Elites*, C.M. Aikens, S.-N. Rhee (eds.). Pullman: Washington State Univ. Press, pp. 13–21.

Bae K.-D. 1997
Hanguk seonsasidae seokki munhwa-e daehan yeongu: seokki munhwa-waui jinhwa [A study of stone industries of Korea]. *Hanguk je 4-gi hakhoe*, vol. 11 (1): 1–25. (In Korean).

Bailey R.C., Head G., Jenike M., Owen B., Rechtman R., Zechenter E. 1989
Hunting and gathering in tropical rain forest; is it possible? *American Anthropologist*, vol. 91: 59–82.

Bale M.T. 2001
Archaeology of early agriculture in Korea: An update on recent developments. *Bulletin of the Indo-Pacific Prehistory Association*, vol. 21 (5): 77–84.

Barnes G.L. 1993
China, Korea and Japan: The Rise of Civilization in East Asia. London: Thames and Hudson.

Bellwood P. 1997
Prehistory of the Indo-Malaysian Archipelago (Revised Edition). Honolulu: Hawaii Univ. of Hawaii Press.

Bellwood P. 2005
First Farmers: The Origins of Agricultural Societies. Oxford: Blackwell.

Bender B. 1975
Farming in Prehistory: From Hunter-Gatherer to Food-Producer. New York: St. Martin's Press.

Braidwood R.J. 1960
The agricultural revolution. *Scientific American*, vol. 203 (3): 130–148.

Chang K.-C. 1986
The Archaeology of Ancient China. New Haven: Yale University Press.

Chang T.-T. 1976
The origin, evolution, cultivation, dissemination, and diversification of the Asian and African rices. *Euphytica*, vol. 25: 425–441.

Cheongwon Sorori guseokki yujeok. 2000
[Sorori Paleolithic Site: Progress Report], Lee Y.-J., Woo J.-Y. (eds.). Seoul: Hakyon Munhwasa. (In Korean).

Choe C.-P. 1982
The diffusion route and chronology of Korean plant domestication. *Journal of Asian Studies*, vol. 41 (3): 519–529.

Choe C.-P. 1991
Inllyuhagsang-euro bon hanminjok giwon-e daehan bipanjeok geomto [A critical review of research on the origin of Koreans and their culture]. *Hanguk Sanggosa Hakpo*, vol. 8: 7–43. (In Korean).

Choe C.-P., Bale M.T. 2002
Current perspectives on settlement, subsistence, and cultivation in Prehistoric Korea. *Arctic Anthropology*, vol. 39: 95–121.

Chon Y.-N. 1992
Introduction of rice agriculture into Korea and Japan: From the perspective of polished stone implements. In *Pacific Northeast Asia in Prehistory: Hunter-Fisher-Gatherers, Farmers, and Sociopolitical Elites*, C.M. Aikens, N.-S. Rhee (eds.). Pullman: Washington State Univ. Press, pp. 161–169.

Chosun Daily News. 2011
Busan-seo 7000-nyeon jeon gongmul heunjeok balgyeon [Discovering 7000 yrs old millet replications of impressions from Pusan, S. Korea]. *Choseon Ilbo [Chosun Daily News]*, September 24. (In Korean). http://news.chosun.com/site/data/html_dir/2011/09/24/2011092400113.html?Dep0=twitter&d=2011092400113

Cohen D. J. 2002
New perspectives on the transition to agriculture in China. In *The Origins of Pottery and Agriculture*, Y. Yasuda (ed.). New Delhi: Roli Books Pvt. Ltd, pp. 217–227.

Courses Towards Urban Life. 1962
R.J. Braidwood, G.R. Willey (eds.). Chicago: Viking Fund Publications in Anthropology.
Crawford G.W. 2005
East Asian plant domestication. In *Archaeology of Asia*, M.T. Stark (ed.). Oxford: Blackwell Publishing, pp. 77–95.
Crawford G.W. 2008
The Jomon in early agriculture discourse: Issues arising from Matsui, Kanehara, and Pearson. *World Archaeology*, vol. 40: 445–465.
Crawford G.W., Chen S. 1998
The origins of rice agriculture: Recent progress in East Asia. *Antiquity*, vol. 72 (278): 858–866.
Crawford G.W., Lee G.-A. 2003
Agricultural origins in the Korean Peninsula. *Antiquity*, vol. 77 (295): 87–95.
D'Andrea C., Crawford G.W., Yoshizaki M., Kudo T. 1995
Late Jomon cultigens in northeastern Japan. *Antiquity*, vol. 69 (262): 146–152.
Endicott K.M., Bellwood P.S. 1991
The possibility of independent foraging in the rain forest of Peninsular Malaysia. *Human Ecology*, vol. 19: 151–185.
Fuller D.Q., Qin L., Harvey E. 2008
Evidence for a late onset of agriculture in the Lower Yangzi region and challenges for an archaeobotany of rice. In *Past Human Migrations in East Asia: Matching Archaeology, Linguistics and Genetics*, A. Sanchez-Mazas, R. Blench, M.D. Ross, I. Peiros, M. Lin (eds.). London: Routledge, pp. 40–83.
Fuller D. Q, Sato Y.-I., Castillo C., Qin L., Weisskopf A. R., Kingwell-Banham E. J., Song J., Ahn S.-M., Etten J. V. 2010
Consilience of genetics and archaeobotany in the entangled history of rice. *Archaeological and Anthropological Sciences*, vol. 2 (2): 115–131.
Glover I.C., Higham C.F.W. 1996
New evidence for early rice cultivation in South, Southeast and East Asia. In *The Origins and Spread of Agriculture and Pastoralism in Eurasia*, D.R. Harris (ed.). London: UCL Press, pp. 413–441.
Han C.-K., Kim G.-W., Chon I.-Y, Koo J.-J., Heu M.-H., Kim J.-H. 2002
Okcheon Daecheonni yujeog-ui sinseokkisidae jibjari balgul seonggwa [A report on the excavation of the Neolithic residential site in Daecheonri, Okcheon]. *Hanguk Shinseokgi Yongu*, vol. 3: 55–77. (In Korean).
Hankyoreh News. 2012
East Asia's oldest farmland discovered in Korea. *Hankyoreh News*, June 27. http://english.hani.co.kr/arti/english_edition/e_entertainment/539789.html
Heu M.-H., Lee Y.-J., Woo J.-Y. 2003
Morphological observations on carbonized rice excavated at the Sorori Paleolithic site. In *Je 1-hoe gugje haksul hoeui - Asia seonsa nonggyeong-gwa Sorori byeopssi [The 1st International Symposium: Prehistoric Cultivation in Asia and Sorori Rice]*, Y.-J. Lee, J.-Y. Woo (eds.). Cheongjoo: Chungbuk National University Museum and Chengwongoon, pp. 59–71. (In English, with Korean abstract).
Higham C. 2002
Early Cultures of Mainland Southeast Asia. Chicago: Art Media Resources.
Huke R.E. 1976
Geography and climate of rice. In *Proceedings of the Symposium on Climate and Rice*. Los Banos: The International Rice Research Institute, pp. 31–50.
Hutterer K. 1983
The natural and cultural history of Southeast Asian agriculture: Ecological and evolutionary considerations. *Anthropos*, vol. 78: 169–212.
Hutterer K. 1988
The Prehistory of the Southeast Asian rainforests. In *People of the Tropical Rainforest*, J.S. Denslow, C. Padoch (eds.). Berkeley: University of California Press, pp. 63–72.
Imamura K. 1996
Prehistoric Japan – New Perspectives on Insular East Asia. Honolulu: University of Hawaii Press.
Kelly R.L. 1995
The Foraging Spectrum: Diversity in Hunter-Gatherer Lifeways. Washington D.C.: Smithsonian Institution Press.
Kim J.-B. 1975
Bronze artifacts in Korea and their cultural-historical significance. In *The Traditional Culture and Society of Korea: Prehistory*, R.J. Pearson (ed.). Occasional Papers of the Center for Korean Studies (3). Honolulu: University of Hawaii, pp. 130–191.
Kim J.-H. 1964
Hanguk minjok hyeongseongsa [History of the formation of the Korean race]. In *Hanguk munhwasa daegye 1 [A General Introduction to Korean Civilization]*. Koryodaehakkyo Minjok Munhwa Yonguso, vol. I. Seoul: Koryodaehakkyo, pp. 317–430. (In Korean).
Kim J.-Y., Lee Y.-J., Yang D.-Y., Kim J.-C., Bong P.-Y., Park J.-H. 2003
Quaternary geology and vegetation environment of Sorori Palaeolithic site – in comparison to Jangheungri site in Jinju Sorori Paleolithic site. In *The 1st International Symposium: Prehistoric Cultivation in Asia and Sorori Rice*, Y.-J. Lee, J.-Y. Woo (eds.). Cheongjoo: Chungbuk National University Museum and Chengwongoon, pp. 47–57. (In English and Korean).
Kim K.-J., Lee Y.-J., Woo J.-Y., Jull A. J. T. 2013
Radiocarbon ages of Sorori ancient rice of Korea. *Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms*, vol. 294: 675–679.
Kim M.-K. 2010
Yeongsangang yuyeok chogi byeonongsa-ui jeongae [Intensification of rice agriculture in the Yeongsan River drainage basin indicated by pottery impression, pollen, and carbonized rice]. *Hanguk Kogo Hakpo*, vol. 75: 46–71. (In Korean).
Kim W.-Y. 1967
Amnokkang yuyeog-ui jeulmuntogi munhwa [The comb pattern pottery culture along the reaches of the Yalu River]. *Paeksan Hakpo*, vol. 3: 99–108. (In Korean).
Kim W.-Y. 1982
Discoveries of rice in Prehistoric sites in Korea. *Journal of Asian Studies*, vol. 41 (3): 513–518.
Kong S.-J., Lee Y.-J. 2004
Lindustrie lithique du Paleolithicque dans la region Jungwon de la Coree. In *Paleoenvironnement Et Culuture Paleolithicque De La Region Jungwon, Coree (2004 Korean – French Paleolithic Workshop*), Y.-J. Lee, T.-S. Cho (eds.). Cheongjoo: Institute for Jungwon Culture Chungbuk National University, pp. 101–114. (In French, with Korean and English abstract).

Lee G.-A. 2011
The transition from foraging to farming in Prehistoric Korea. *Current Anthropology*, vol. 52 (S4): S307–S329.
Lee J.-J. 2001a
From Shellfish Gathering to Agriculture in Prehistoric Korea: The Chulmun to Mumun Transition. Ph.D. Dissertation. Madison: Univ. of Wisconsin-Madison.
Lee J.-J. 2001b
Suryeop-chaejip gyeongje-eseo nonggyeong-euroui jeoni gwajeong-e daehan ironjeog gochal [Theoretical approaches to the transition to agriculture in Prehistoric Korea]. *Youngnam Kogohak*, vol. 28 (June): 1–33. (In Korean).
Lee Y.-J., Woo J.-Y. 2001
Cheongwon Sorori byeopssi chulto totancheung je 2-cha josa [A report of the second investigation of the Sorori peat deposits excavated rice seed in Cheongwon]. In *Chungbuk daehakkyo Banmulgwan Yeonbo [Annual Bulletin of Chungbuk National University Museum]*. Cheongjoo: Chungbuk National University Museum, pp. 87–106. (In Korean).
Lee Y.-J., Woo J.-Y. 2003
The oldest Sorori rice 15,000 BP: Its findings and significance. In *The 1st International Symposium: Prehistoric Cultivation in Asia and Sorori Rice*, Y.-J. Lee, J.-Y. Woo (eds.). Cheongjoo: Chungbuk National University Museum and Chengwongoon, pp. 33–46.
Lee Y.-J., Woo J.-Y. 2004
The Paleolithic culture in the Jungwon Region, Korea. In *Paleoenvironnement Et Culuture Paleolithicque De La Region Jungwon, Coree (2004 Korean – French Paleolithic Workshop)*, Y.-J. Lee, T.-S. Cho (eds.). Cheongjoo: Institute for Jungwon Culture Chungbuk National University, pp. 45–58. (In English, with Korean and French abstract).
Lindstrom K., Uchiyama J. 2012
Inland Sea as a unit for environmental history: East Asia inland seas from Prehistory to future. *Journal of Environmental Biology*, vol. 33 (2): 283–288.
Liu J. 1985
Some observations on the archaeological site of Hemudu, Zhejiang Province, China. *Bulletin of the Indo-Pacific Prehistory Association*, vol. 6: 40–45.
Maloney B.K. 1998
The long-term history of human activity and rainforest development. In *Human Activities and the Tropical Rainforest: Past, Present and Possible Future*, B.K. Maloney (ed.). Boston: Kluwer Academic Publishers, pp. 65–85.
Nelson S.M. 1982a
The origins of rice agriculture in Korea. *Journal of Ancient Studies*, vol. 61 (3): 511–548.
Nelson S.M. 1982b
The effects of rice agriculture on Prehistoric Korea. *Journal of Asian Studies*, vol. 41 (3): 531–543.
Nelson S.M. 1992
The question of agricultural impact on sociopolitical development in Prehistoric Korea. In *Pacific Northeast Asia in Prehistory: Hunter-Fisher-Gatherers, Farmers, and Sociopolitical Elites*, C.M. Aikens, S.-N. Rhee (eds.). Pullman: Washington State Univ. Press, pp. 157–160.
Nelson S. M. 1999
Megalithic monuments and the introduction of rice into Korea. In *The Prehistory of Food: Appetites for Change*, C. Gosden, J. Hather (eds.). London: Routledge, pp. 147–165.
Norton C.J. 1996
Storage and Its Implications for the Advent of Rice Agriculture in Korea: Konam-ri. Master's Thesis. Tucson: Univ. of Arizona.
Norton C. J. 2007
Sedentism, territorial circumscription and the increased use of plant domesticates across Neolithic-Bronze Age Korea. *Asian Perspectives*, vol. 46 (1): 133–165.
Oka H. 1991
Genetic diversity of wild and cultivated rice. In *Rice Biotechnology*, G.S. Khush, G.H. Toenniessen (eds.). Oxon: C.A.B. International (in association with the International Rice Research Institute), pp. 55–81.
Park W.-K., Kim Y.-J., Lee Y.-J. 2004
Reconstruction of vegetation and paleoclimate from the charcoals excavated at the Late Paleolithic Sites in Jungwon Region of Korea. In *Paleoenvironnement Et Culuture Paleolithicque De La Region Jungwon, Coree (2004 Korean – French Paleolithic Workshop)*, Y.-J. Lee, T.-S. Cho (eds.). Cheongjoo: Institute for Jungwon Culture Chungbuk National University, pp. 79–85.
Pavao-Zuckerman M.A. 2000
The conceptual utility of models in human ecology. *Journal of Ecological Anthropology*, vol. 4: 31–56.
Sato Y. 1996
Rice Civilization and DNA Analysis (DNA ga Kataru Inasaku Bunmei). Tokyo: NHK Books. (In Japanese).
Sato Y. 2002
Origin of rice cultivation in the Yangtze River basin. In *The Origins of Pottery and Agriculture*, Y. Yasuda (ed.). New Delhi: Roli Books Pvt. Ltd, pp. 143–150.
Sauer C.O. 1947
Early relations of man to plants. *Geographical Review*, vol. 37 (1): 1–25.
Sauer C.O. 1952
Agricultural Origins and Dispersals. New York: American Geographical Society Press.
Seong C.-T. 1998
Microblade technology in Korea and adjacent Northeast Asia. *Asian Perspectives*, vol. 37 (2): 245–278.
Seong C.-T. 2008
Tanged points, microblades and Late Palaeolithic hunting in Korea. *Antiquity*, vol. 82 (318): 871–883.
Seong C.-T. 2009
Emergence of a blade industry and evolution of Late Paleolithic technology in the Republic of Korea. *Journal of Anthropological Research*, vol. 65: 417–451.
Smith B.D. 1995
The Emergence of Agriculture. New York: Scientific American Library.
Sohn P.-K., Shin S.-J., Chang H. S. 1992
Ilsan 1-jiyeok gogohak josa, Ilsan Saedosi gaebal jiyeok haksul josa bogo 1 [Report on the Study of the Natural Environment and Archaeological Excavation in the Ilsan Area, I]. Kyunggido: Hanguk Sonsamunhwa Yonguso, pp. 207–209. (In Korean).
Son J.-H., Nakamura D., Momohara A. 2010
Bokjebeob-eul iyonghan cheongdonggi sidae togi apheun bunseok [Research on plant impressions found on Bronze Age pottery by means of replication]. *Ya-oe Kogohak*, vol. 8: 5–34. (In Korean).

Song E.-S. 2001

Sinseokki sidae saenggye bangsig-ui byeoncheon-gwa nambu naeryuk jiyeog nonggyeong-ui gaesi [Transition in the subsistence patterns in Neolithic Korea]. *Honam Kogohakpo*, vol. 14: 95–118. (In Korean).

Takamiya H. 2001

Introductory routes of rice to Japan: An examination of the southern route hypothesis. *Asian Perspective*, vol. 40 (2): 209–226.

Tang S. 2004

Origin of rice and its domestication and expansion. In *International Year of Rice 2004 International Symposium, entitled "Rediscovering of Rice: History, Culture, and Economy", May 28, Seoul, Korea*. [s.l.]: pp. 16–28.

Toyama S. 2002

The origin and spread of rice cultivation as seen from rice remains. In *The Origins of Pottery and Agriculture*, Y. Yasuda (ed.). New Delihi: Roli Books Pvt. Ltd, pp. 263–272.

Vergara B.S. 1976

Physiological and morphological adaptability of rice varieties to climate. In *Proceedings of the Symposium on Climate and Rice*, Los Banos: The Intern. Rice Res. Inst., pp. 67–86.

Wenming Y. 2002

The origins of rice agriculture, pottery and cities. In *The Origins of Pottery and Agriculture*, Y. Yasuda (ed.). New Delhi: Roli Books Pvt. Ltd, pp. 150–156.

Wenxu Z. 2002

The bi-peak-tubercle of rice, the character of ancient rice and the origin of cultivated rice. In *The Origins of Pottery and Agriculture*, Y. Yasuda (ed.). New Delhi: Roli Books Pvt. Ltd, pp. 205–216.

Yasuda Y. 2002

Origins of pottery and agriculture in East Asia. In *The Origins of Pottery and Agriculture*, Y. Yasuda (ed.). New Delhi: Roli Books Pvt. Ltd, pp. 119–142.

Yasuda Y. 2008

Climate change and the origin and development of rice cultivation in the Yangtze River Basin, China. *AMBIO: A Journal of the Human Environment*, vol. 37 (Special Edition 14): 502–506.

Zheng Z., Bao Yin Y., Petit-Maire N. 1998

Paleoenvironments in China during the Last Glacial Maximum and the Holocene Optimum. *Episodes*, vol. 21 (3): 152–158.

Received June 23, 2015.
Received in revised form August 5, 2015.

DOI: 10.17746/1563-0110.2017.45.1.049-061

V.V. Bobrov[1, 2], A.G. Marochkin[2], and A.Y. Yurakova[1, 2]
[1]Kemerovo State University,
Krasnaya 6, Kemerovo, 650043, Russia
E-mail: klae@kemsu.ru; yurakova_al@mail.ru
[2]Institute of Human Ecology,
Federal Research Center of Coal and Coal Chemistry,
Siberian Branch, Russian Academy of Sciences,
Pr. Sovetsky 18, Kemerovo, 650000, Russia
E-mail: comcon@yandex.ru

Avtodrom 2—a Late Neolithic (Artyn Culture) Site in the Baraba Forest-Steppe, Western Siberia*

The study addresses cultural and chronological attribution of Avtodrom 2—the largest and best-known Neolithic site in the forest-steppe zone of Western Siberia. The results are summarized of excavations made over eight field seasons (1998, 2004, 2007–2012) in its northeastern part, where dwellings with the Artyn type of pottery and numerous stone implements have been found. We describe ceramics, lithics, habitation and utility structures, and propose attributing them to the Late Neolithic Artyn culture distributed over the forest and forest-steppe parts of the middle Irtysh basin, in Baraba, and partly on the southern Vasyugan. On the basis of radiocarbon and thermo-luminescent analysis of the ceramics, the estimated dates fall within the middle and second half of the 5th millennium BC. The Artyn people maintained ties with those of the Bystrinka (Bystry Kulyogan) culture of the Middle Ob and those of the Kokui culture of the Irtysh and Ishim basins. Cultural affinities with people of the forest-steppe Upper Ob and of the northern Kulunda steppe are explored. The place of the Artyn culture among other Late Neolithic and Early Bronze Age cultures is assessed. This culture belonged to the Late Neolithic stage in the evolution of the autochthonous Ob-Irtysh community.

Keywords: *Avtodrom 2, Artyn culture, Late Neolithic, Middle Irtysh, Baraba forest-steppe, Ob-Irtysh watershed.*

Introduction

One of the problems of current interest in present-day Western Siberian archaeology is accumulation of knowledge about the Neolithic in the forest-steppe landscape zone. Despite the significant body of sources, there is still an ongoing debate about the cultural and chronological attribution of assemblages, as well as about periodization of the Neolithic in the Transurals. The situation is different with the state of knowledge of this period in the forest-steppe Baraba and Ob region. Thanks to the studies of V.I. Molodin, V.I. Matyushchenko, V.F. Gening, and later of V.A. Zakh and A.I. Petrov, a first and significant step in the study of the Neolithic in this region was made from the 1960s–1980s. Some theoretical principles and conclusions of this historiographic period have not lost their importance until now. Almost 30 years have passed since that time, during which active field

*This study was performed under Public Contract No. 33.1175.2014/K.

research has not been conducted at the Neolithic sites. Accordingly, a qualitatively new body of sources needs to be accumulated for solving the problems of the Neolithic in Baraba. The large complex of the settlement of Avtodrom 2 constitutes a part of this body of sources. This article provides a description of the materials of the Artyn culture. In 1970, Gening and his students established the Artyn type of pottery on the basis of materials from the Artyn settlement in the Middle Irtysh basin (Gening et al., 1970), but until now this type has not been studied in sufficient detail.

History of research and description of the site

The settlement of Avtodrom 2 is located on the second terrace above the floodplain on the left bank of the Tartas River (the village of Vengerovo, Vengerovsky District, Novosibirsk Region). It was discovered in 1997 by A.I. Soloviev. The first excavations at this site were carried out in 1998 by the Western-Siberian branch of the North Asian Joint Expedition of the Institute of Archaeology and Ethnography (Siberian Branch of RAS) led by V.I. Molodin (Molodin, Novikov, 1998). From 2004 until the present day, systematic research at this settlement has been conducted by the Kuzbass archaeological expedition of Kemerovo State University and the Institute of Human Ecology at the Federal Research Center of Coal and Coal Chemistry (Siberian Branch of RAS) led by V.V. Bobrov. Over 55 ancient buildings have been identified at the site; they form the northeastern and the southwestern planigraphic groups (Fig. 1). Over 2000 m^2 have been uncovered. The remains of 14 dwellings of the southwestern group and 10 dwellings of the northeastern group have been excavated.

The stratigraphy of the settlement is a bedding of light-aeolian sandy loams, alternating with bands of clay loams of various thickness (Molodin et al., 2003; Bobrov, Marochkin, 2011b). One of such bands with a thickness of up to 0.15 m at a depth of 0.4–0.6 m is the native soil horizon. Materials of the early and late periods of the Bronze Age, the Early Iron Age, and the Late Middle Age have been discovered at this site, but the most representative assemblages are associated with the Neolithic.

It was established that the southwestern group of dwellings constituted a settlement of the Boborykino culture (Avtodrom 2/2) (Bobrov, Marochkin, Yurakova, 2012). Dwellings containing stone tools with Neolithic characteristics and a great amount of pottery fragments of the so-called Artyn type have been found in the northeastern part of the site (948 m^2 have been excavated). The analysis of these materials has made it possible to identify an independent culture of the Late Neolithic period (Bobrov, 2008; Bobrov, Marochkin, 2011a). Despite the fact that the Artyn assemblage of Avtodrom 2 has been actively used for clarifying the cultural and chronological pattern of development in the Neolithic Baraba (Bobrov, Marochkin, 2012), it has not received sufficient attention in the literature, and only preliminary reports have been published (Bobrov, Marochkin, 2008; Bobrov, Marochkin, Yurakova, 2010).

Description of the Artyn complex of the settlement

Excavations in the northeastern part of the site have yielded representative collections of stone tools, ceramic vessels and implements, as well as remains of structures embedded into the ground. No objects of organic material or bone remains have been discovered except for a few small calcified fragments. However, the data obtained make it possible to provide a description of the material culture of the Artyn population in sufficient detail.

Dwellings

The instrumental survey showed that the northeastern group included the remains of at least 30 structures, ten of which have been examined in the process of field research. The attribution of each of them to the Artyn cultural complex has been reliably confirmed in the context of pottery occurrence. All structures were rounded (No. 16, 18, 53, and 54) or amorphous (No. 1, 4, 5, 14, 15, and 55) half-dugouts, 0.05–0.40 m deep. The areas of these structures ranged from 8 to 40 m^2 (Table 1). The dwelling pits in all cases were filled with white sand identical to the cultural layer in the space between the dwellings. The walls of the half-dugouts were both sloping and almost vertical, varying within a single structure (Fig. 2). No signs of entry or remains of hearths and pole structures have been found. Only once were three pits discovered, the purpose of which remains unknown, inside small pit No. 54.

The composition of the findings from the filling in the bottom of the pits in all cases shows a certain pattern: a large amount of pottery (including accumulations found *in situ*) and a relatively small amount of lithic objects (Table 1). Pooled analysis of the spatial distribution of lithic objects confirmed this pattern, showing the occurrence of 78 % of them in the space between the dwellings and only 22 % in the filling and on the bottom

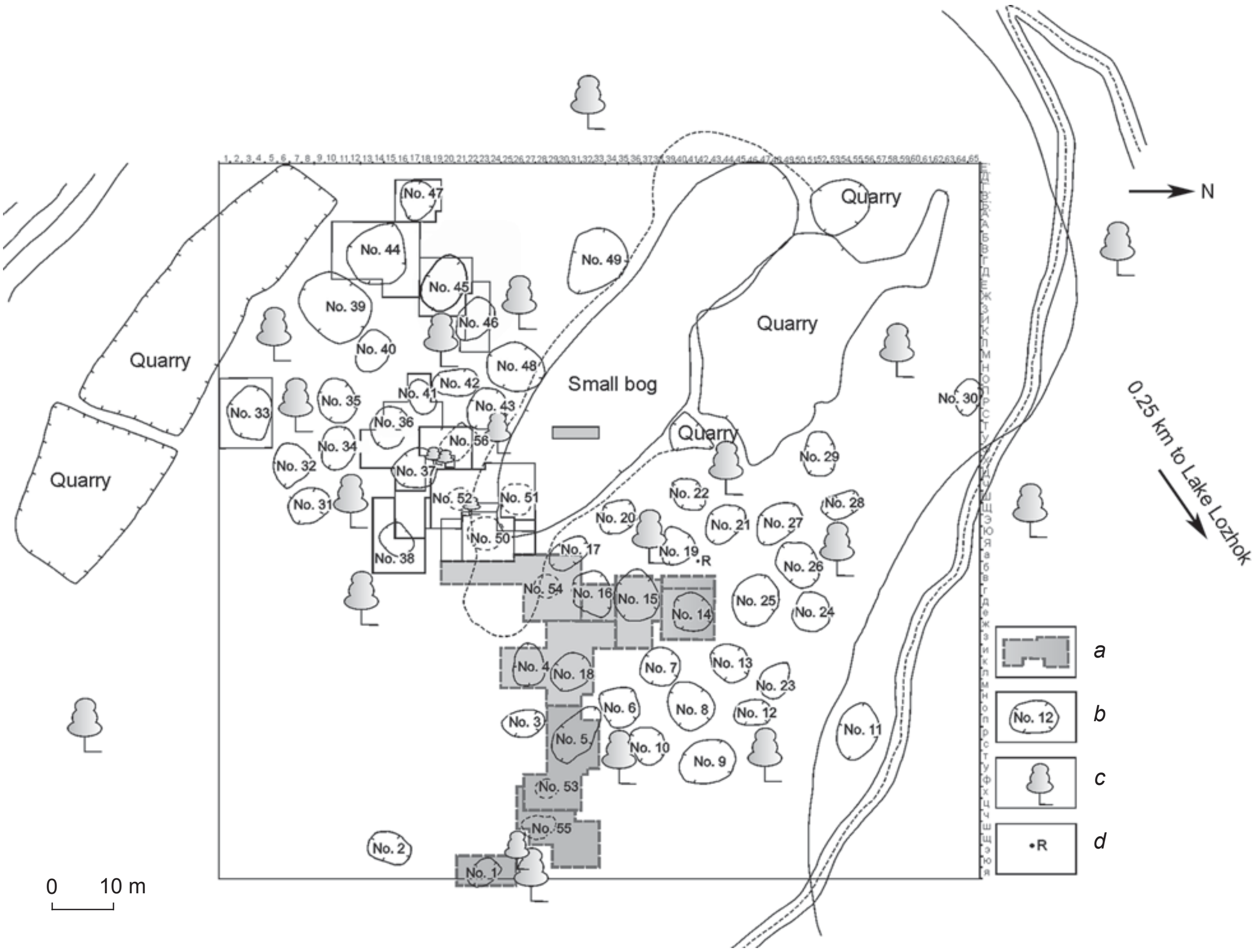

Fig. 1. Map of the Avtodrom 2 settlement.
a – excavations in the northeastern planigraphic group of dwellings, 1998, 2007–2012; *b* – dwelling depressions; *c* – large trees; *d* – datum point.

Table 1. **Description of dwellings of the north-eastern planigraphic group at the settlement of Avtodrom 2**

Number according to the settlement map	Excavation year	Shape of external outline	Walls	Size				Finds, number of items*	
				Depth, m	Length, m	Width, m	Area, m²	Stone	Ceramics
14	1998	Amorphous	Gently sloping	0.40	6.0	6.0	36	22	600
16	2007	Rounded	"	0.30	4.0	3.5	12	33	≥500
4	2008	Amorphous	Vertical	0.24	7.6	6.8/3.1	40	50	≥500
18	2008	Rounded	Gently sloping	0.18	4.8	?	?	10	207
5	2009	Amorphous	"	0.15	5.4	5.2/2.4	19	56	591
53	2009	Rounded	Vertical	0.40	3.2	3.2	8	6	97
15	2010	Amorphous	Various	0.20	6.6	5.8	36	40	1120
54	2010	Rounded	Gently sloping	0.05	3.2	3.2	8	41	201
55	2011	Amorphous	Steep	0.30	4.4	4.1	19	11	216
1	2012	"	Gently sloping	0.15	6.0	6.0	36	8	192

*The total number of finds in the filling and in the bottom of the pits is given.

Fig. 2. Dwelling pit No. 55 (view from the northwest).

of the pits. An exception was dwelling No. 54 which revealed a concentration of waste resulting from stone production and cores inside and in the adjacent areas, and a broken Artyn vessel with 17 blanks-flakes located at the bottom of the pit.

During the first excavations at the site, dwelling No. 14 was identified as an "auxiliary" structure because of its relatively small size (36 m^2) and amorphous outline (Molodin et al., 1998). The data accumulated with time suggest that most of the investigated pits in the northeastern planigraphic group had similar amorphous outlines. Structure No. 14 was one of the largest in terms of enclosed area in this group. It is possible that precisely the area of the structure is the indicator indirectly reflecting the functional purpose of the building. We may propose that some of them, of a relatively large size, were used primarily as dwellings, while smaller buildings (No. 53 and 54) had a production and economic function.

The lack of evidence for entrances and clearly defined hearths in most buildings can be explained by the specific properties of soil in the cultural layer and the impact of sedentary moisture. The dwellings could have been light semi-overground structures erected over small pits and only slightly disturbing the soil strata beyond their borders. At the same time, we cannot speak of a temporary or seasonal summer nature of the settlement. Settlements with the Artyn pottery in the Ust-Tara archaeological microdistrict (the Middle Irtysh region) are represented by large single structures or small groups of structures with an embankment and ditch, which shows their similarity to the Neolithic dwellings from the north of Western Siberia (Ivashchenko, Tolpeko, 2006). However, sites with the same dwellings as those appearing at the settlement of Avtodrom 2 are also known. Thus, the remains of a small semi-overground dwelling with a shallow pit of amorphous outline have been found at the Artyn site.

Ceramics

Pottery. The Artyn ceramic assemblage from the settlement of Avtodrom 2 is the most representative compared to the collections originating from other sites. Excavations in the northeastern part of the settlement have yielded over 7000 fragments and 16 clusters *in situ*. Most of them were found at floor level in dwelling pits (dwellings No. 1, 4, 15, 16, and 54), and some on the "native soil" near dwellings No. 5 and 54. For the statistical description of variability in ornamental décor and morphology of the Artyn pottery from the settlement of Avtodrom 2, a representative sample of pottery materials was taken from the total number of finds. The sample included 473 large fragments (82 fragments of the rim, and 391 fragments of the body) from the collections of 2008–2011. All percentages are given according to this sample.

General morphology. All vessels have a simple shape with pointed or rounded bottom, straight (77 %) or weakly concave (23 %) profile of the rim. According to their size, they can be divided into two categories: large vessels (25–35 cm diameter of the mouth) which dominate, and small vessels (6–12 cm diameter of the mouth), represented only by 3 items. The thickness of the walls, depending on the size, ranges from 3–5 to 6–8 mm reaching 9–11 mm in the bottom area. The edge of the rim is straight (51 %) or has a wavy shape (49 %); the rim is thinned. The so-called bulging (thickening on the inner side of the rim typical of the Transurals pottery assemblages) is completely absent here.

Technological features. The results of research into the Artyn pottery assemblage using natural-scientific methods will appear in a special study. We can visually note the following features. Most large vessels were made using the coiling technique, as is testified to by the separation of coils at their junction. Many junctions show unidirectional traces of organic fiber used for reinforcing the vessel (possibly, grass or wool). The same feature was observed by L.L. Kosinskaya in the pottery from the Artyn site (1982). The surface of the vessels was carefully smoothed and in some cases slightly polished. A large number of fragments show the use of such a technological method as tying the mouth of the vessel with a twisted cord. In the process of firing, it would burn out and leave a hollow trace, although we allow for other interpretations of the function of the method. Hollow traces of cords occur several times among the Artyn materials (Bobrov, Marochkin, Yurakova, 2010; Ivashchenko, Tolpeko, 2006). In addition to the already mentioned sites in the Upper Ob region, they appear in the assemblages of the Koshkino, Boborykino (Zakh, 2009: 170), and Andreyevskoye types. Thus, this method is not culturally specific, but the evidence of its use is so far limited to the chronological range of the Neolithic–the Early Metal Age.

Ornamentation. The outer surface of the vessels is decorated from the rim to the bottom; slanting or straight notches (up to 80 %) and zigzag patterns often decorate the edges of the rims (Fig. 3). On the inner

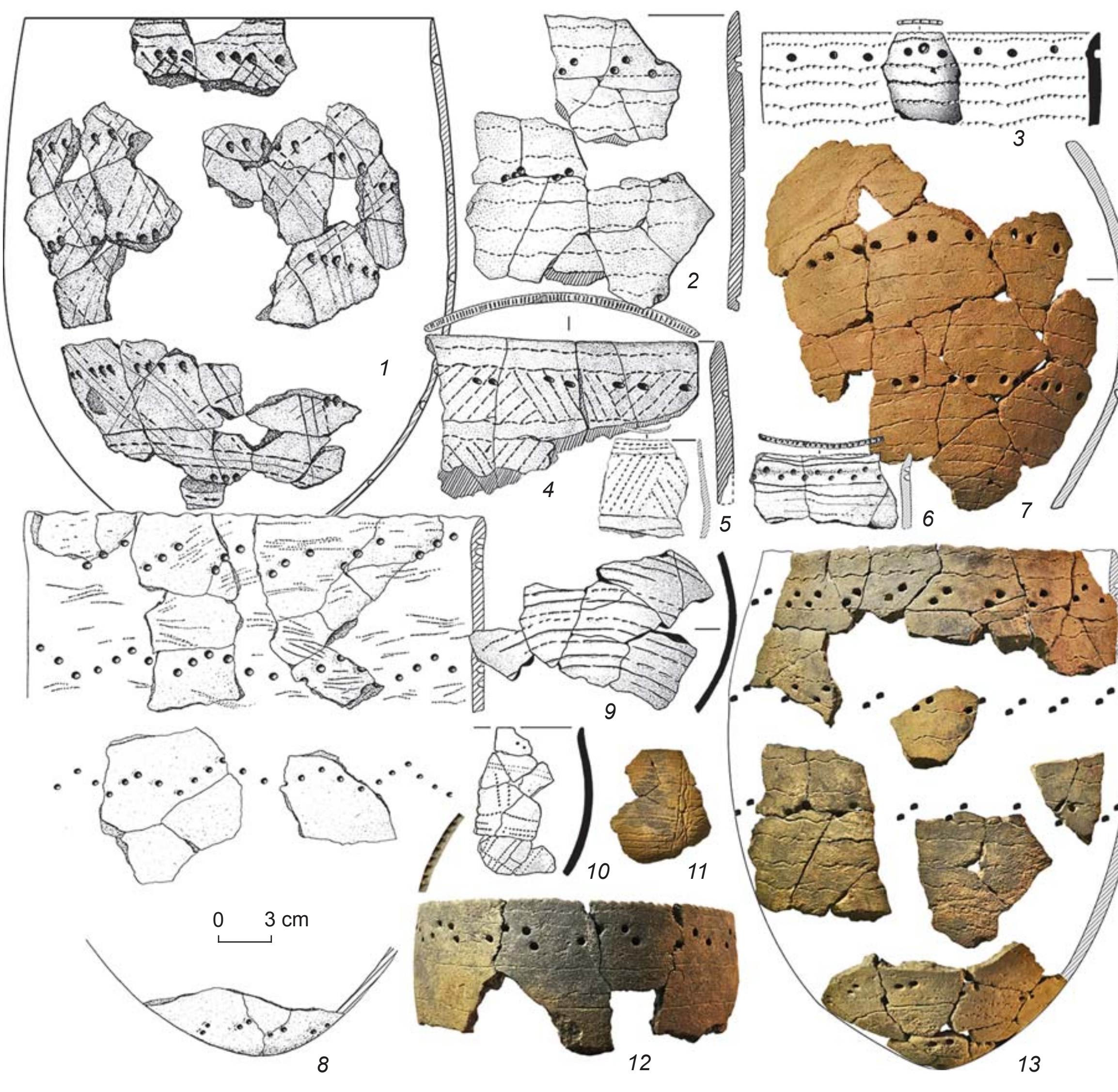

Fig. 3. Pottery complex of the Artyn culture.

surfaces, decoration has not been found. The presence of the ornamental decoration of the edge correlates with its shape: in most cases, décor is typical for straight edges, while wavy edges are decorated only in 27 % of the cases.

The ornamental composition consists of "linear" and pit motifs. First, the linear borders were made, and then the rows of pit impressions were made in free spaces or on top of the existing ornamental rows. The "linear" motifs vary with several parameters: shape (wavy/straight), geometric orientation (horizontal/vertical/slanting), and execution technique (retreating-pricked/incised). One of the specific markers of the Artyn pottery, which appears at other sites of the Artyn cultural space, is a frequent transition from one technique of movement by the ornamenting tool to the other, and their combination both within the same composition and while drawing an individual belt-line. For example, the retreating-pricked technique can be transformed into incising with less frequent detachment of the tool, and vice versa, pricking could be accompanied by a more or less expressed retreating (Bobrov, Marochkin, Yurakova, 2010). The ornamental décor on one partially reconstructed vessel consists of wavy motifs possibly made by a stick with cord coiling (Fig. 3, *8*).

The most common lines in the compositions were horizontal wavy lines (53 %) and straight lines (47 %). The vessels with such decoration form the basic profile of the assemblage (96–98 %). Vessels with decoration combining diagonal and horizontal placement of belts, for example, of "interpenetrating" triangles, are rare (3 %) (Fig. 3, *4*, *5*). Vessels with an ornamental composition which includes vertical lines along with horizontal lines occur in isolated cases and are usually distinguished by being of small size (Fig. 3, *10*, *11*). A vertical dividing belt with an inscribed "wave" forms a unique composition on one such vessel.

Fig. 4. Ceramic abraders.

Pit imprints vary in shape (rounded / semilunar) and method of grouping. Organization of pits within the horizontal belts is extremely diverse: there are single pits forming a straight line, wavy line, or zigzag; two or three pits forming a diagonal line; or four pits in arched shapes. A simple zigzag ("wave") is dominant (Yurakova, 2013). Two methods of grouping are often combined on a single vessel marking its different morphological zones (the rim, the body).

Thus, the typological originality of pottery of the Artyn Neolithic culture from the settlement of Avtodrom 2 is defined by the following features:

– shape of the vessels: simple, with round and pointed bottoms, without clearly defined necks;

– distinctive technique of making the ornamentation with a rounded "stick": the "retreating-pricked-incised" technique with uneven pressure;

– virtual absence of comb stamp imprints;

– restricted set of ornamental elements and their stable combination: simple "linear" borders, rarely a combination of "interpenetrating" triangles, the mandatory presence of pit imprints;

– dominant role of wavy motifs, appearing on the edge of rims and in ornamental belts; and

– various methods of grouping pit impressions.

The described features of the pottery assemblage correlate with observations based on the materials from other sites of the Middle Irtysh region (Artyn, Ust-Tara IV, XXVIII, XXXIII, etc.) which belonged to the circle of the Artyn Late Neolithic culture (Ibid.). The statistical stability of morphological traits of the Artyn pottery, which indicate a specific cultural affiliation, was confirmed by the materials originating from "authentic" sites—the Artyn site and the settlements of Ust-Tara IV and XXXIII.

Ceramic abraders appear in two forms. The first form is represented by rectangular plates (2 objects) with the sizes of 45 × 15 × 10 and 40 × 35 × 9 mm. Traces of wear in the form of a longitudinal recess are visible on one of the lateral faces. The first tablet has a round hole for hanging (Fig. 4, *2*, *4*). Pear-shaped whetstones (2 objects) have the sizes of 69 × 18 × 13 and 44 × 10 × × 7 mm. Traces of wear are visible on both the narrow sides and one wide side. The first object has a hole in its narrow part for hanging (Fig. 4, *1*). One flat side of the second whetstone is destroyed; a retreating-pricked pattern in the form of an oblique grid has survived on the other side (Fig. 4, *3*).

Identical abraders of dense ceramic, both with ornamentation and without, have been found at several

Neolithic settlements of the Ust-Tara archaeological microdistrict in the Middle Irtysh region (Ust-Tara IV, XXXIII) along with pottery of the Artyn type (Ivashchenko, Tolpeko, 2006), and at the site of Serebryanka-1 in the Ishim region (Zakh, 2006: Fig. 57, *1*). Similar objects occur in the Neolithic assemblages in the northern regions of Western Siberia (Poseleniye…, 2006: Fig. 42, *19*).

Stone tools

The study in the northeastern area of the settlement resulted in a representative collection of objects of lithic industry (products of lithic reduction, blanks and tools, utilitarian spalls). The following descriptions include both generalized typological and morphological characteristics of the main categories and the elements of basic statistics for the objects which form the series (the sample from the excavations of 2011): flakes (85 objects), blades (60 objects), and end-scrapers (33 objects). A valid association of the described lithic inventory with the Artyn pottery is confirmed by planigraphy and stratigraphy, including their combined occurrence on the floor of the dwellings.

Cores, products of lithic reduction, and tools made of them. *Cores* (Fig. 5) amount to 11 intact objects and 6 transverse spalls resulting from rejuvenation of the striking platforms. Six cores are single-platform and monofrontal, with height ranging from 21 to 40 mm and negative scars up to 12 mm wide (more frequently, 4–7 mm). Five objects approximately 35 × × 25 × 15 mm in size are of amorphous shape and were intended for flake removal.

Flakes are represented by 474 objects. Up to 87 % of them are random forms. No more than 12 % of objects show the signs of secondary treatment which consists of small continuous retouch along the edge, in 80 % of cases applied on the dorsal side.

Blades (Fig. 6) are represented by 334 objects. Most of them (95 %) have survived in fragments. The intact objects include large blades up to 110 mm long and 20 mm wide with signs of so-called utilitarian retouching. Up to 32 % of blades were retouched. Dorsal retouching is predominant (47.4 %); ventral and alternative retouching amounts to 36.8 and 15.8 %, respectively. More frequently, retouching is applied along one edge (52.7 %), less frequently along two edges (42 %); sometimes one edge and the butt are retouched (5.3 %).

End-scrapers (Fig. 7) are represented by 187 objects. Most of them were made on flakes (78.8 %); a somewhat lesser amount was made on blades and laminar flakes (21.2 %). Sometimes transverse and vertical spalls from the cores were used as end-scrapers. The most frequent types include semi-circular or rounded end-scrapers with a steeply angled working edge and end-scrapers on blades. Other forms of objects (random, subsquare, fan-shaped) are rare; their working edges may vary according to the angle of inclination (from gentle to almost vertical).

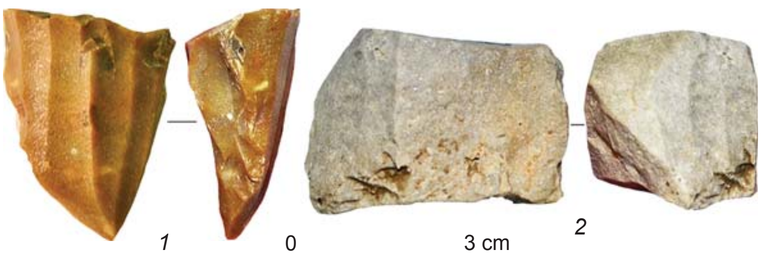

Fig. 5. Cores.

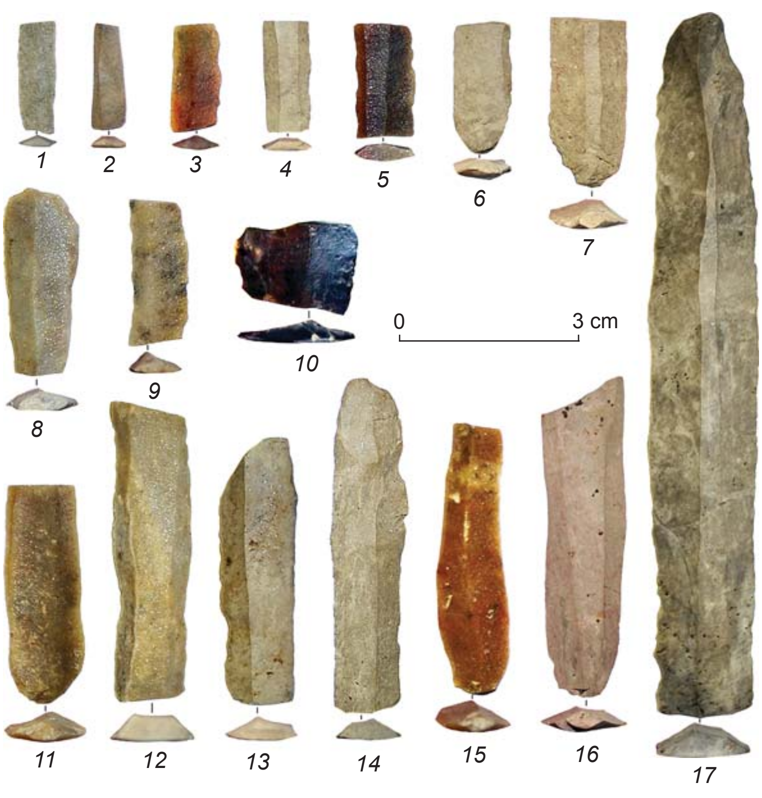

Fig. 6. Blades.

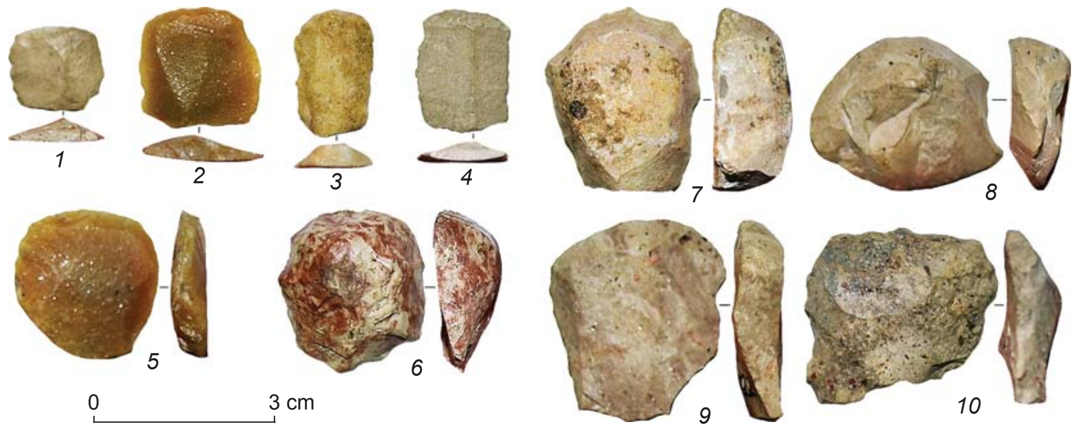

Fig. 7. End-scrapers.

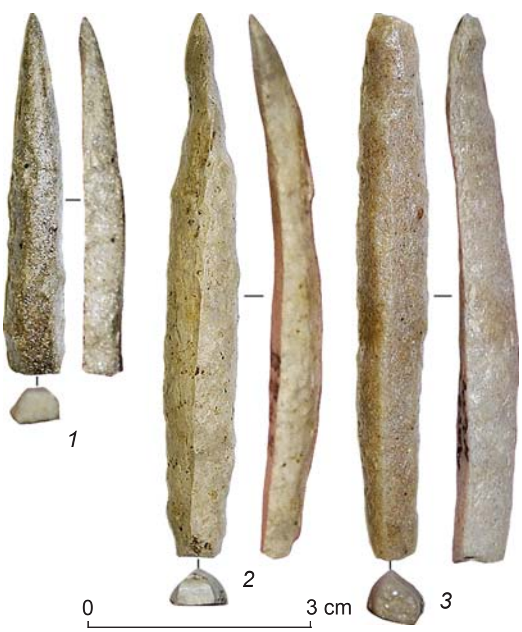

Fig. 8. Piercing tools.

Piercing tools (Fig. 8) are represented by 9 objects, including five intact pieces, three fragments (one fragment of a point, two fragments of the base), and a blank. These tools are made on trapezoidal blades 6–8 mm wide; the length of the ready tools reaches 68 mm. The point is up to 2/3 of the entire length and is usually formed by large continuous dorsal retouching on both side faces. In many instances the tools were polished (due to their use).

Combination tool. It is an end-scraper and a piercing tool made on a large laminar flake. Its gently sloping working edge was formed with several ventral removals; a pointed sharp protrusion was formed by large dorsal retouch on the opposite side. The length of the implement reaches 34 mm; the width of the scraper edge is 20 mm. The implement shows traces of wear.

Arrowheads (Fig. 9) are represented by 22 objects including two blanks. The vast majority of arrowheads were made on blades. They have a leaf-like shape, lenticular cross-section, and concave base. The surface on both sides is covered with undulated retouch on both sides; the edges are additionally retouched, which gives them a saw-like outlook. The dimensions are stable: a length of 16–24 mm and width of 12–14 mm in the middle part. One arrowhead is of willow-leaf shape; it is elongated (59 × 12 mm) and has a straight stem. One more leaf-shaped arrowhead and a blank have straight stems.

Bifacial points are represented by two large blanks.

Abraders and polished implements. *Abraders of fine-grained sandstone* (10 objects) are oblong elongated bars, rhomboid, trapezoidal or amorphous in cross-section. The surviving part of the largest object has a size of 50 × 36 × 21 mm; the surviving part of the smallest object measures 9 × 6 × 5 mm. All of the objects of this type typically show strong wear on lateral planes.

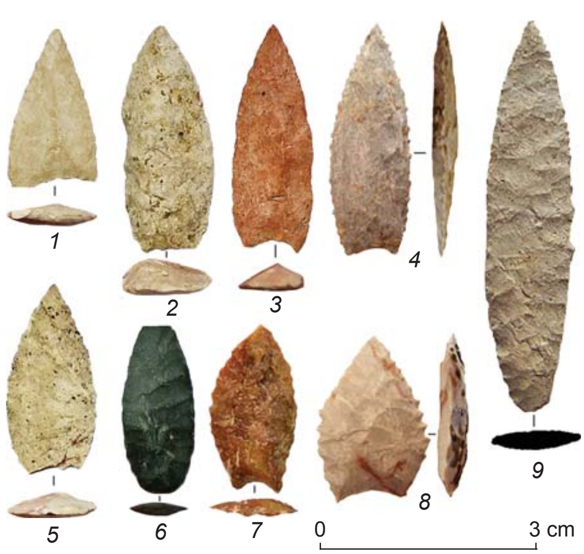

Fig. 9. Arrowheads.

Polished axes-adzes include four intact objects, three large fragments, and two blanks. All are made of gray-green slate. The blanks are larger, measuring 26–35 mm in width and 40–70 mm in length; the future shape of the objects is formed by large removals. The prepared axes are of small size (approximately 50 mm in length), trapezoidal shape, and lenticular in cross-section. All facets of the objects were polished, in some cases, the side edges were treated with large retouch. In addition, 38 spalls from the axes' surfaces have been found.

A polished knife (Fig. 10) is represented by a fragment of a blade 17 mm wide. The blade is concave; it was formed by double-sided polishing. Numerous parallels to this tool are known from the assemblages of the Neolithic and the Early Bronze Age in Western Siberia; such knives are related to woodworking in their function (Kungurova, 1993).

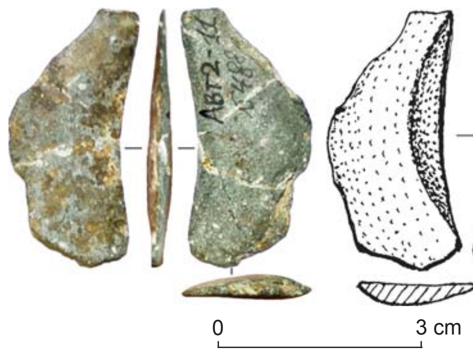

Fig. 10. Polished slate knife.

Objects which are not a part of a series. A *hammerstone*. It is a conic implement in plan; its length is 108 mm, the size of the working surface is 51 × 42 mm.

Fragment of a perforated disk (Fig. 11). Initially the disk had a flattened shape and a hole 15 mm in diameter. Biconical drilling of another hole in the center of the fragment was not completed; apparently, attempts were made to reuse the disk after it was broken. A similar object was found in fully intact state at the settlement of Ust-Tara XXXIII—one of the sites of the Artyn type in the Middle Irtysh region, which indicates that this category of objects was typical for the Artyn assemblages. Perforated discs widely occurred from the Mesolithic to the Early Iron Age over the entire Eurasian area. In chronological and territorial terms, the closest parallels are the disks of the Botai culture (Zaibert, 2011: 238–239).

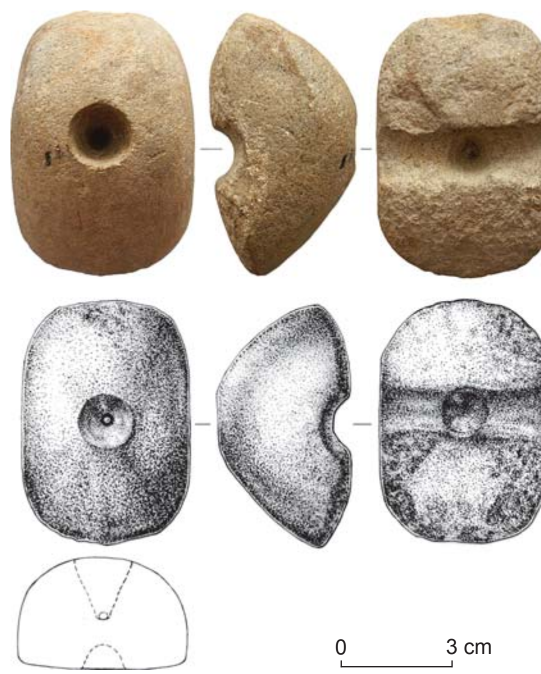

Fig. 11. A fragment of a perforated disc.

Iron-shaped abrader (Fig. 12). The object is a bar, triangular in cross-section, with a size of 69 × 51 × × 35 mm. At the bottom "base" plane it has two narrow longitudinal recesses 4–6 mm long and up to 4 mm deep; in the upper part it has two grooves 13–17 mm wide and 12 mm deep, which are perpendicular to this plane. An incised pattern of parallel wavy lines, which may contain semantic reference to the main ornamental motif of the Artyn pottery and thereby emphasize cultural identity with it, is located on three sides of the object. Such abraders were a specific category of objects found in many cultures of the Neolithic and the Early Bronze Age in Eurasia (Usacheva, 2006); two intact ceramic abraders and several fragments of similar objects have been found in Boborykino dwellings in the southwestern group at the settlement of Avtodrom 2 (Bobrov, Marochkin, Yurakova, 2012).

Fig. 12. A "pad".

In general, the industry is characterized by the predominance of the splitting technique, but with a stable tradition of using polishing for certain categories of implements (borers, axes, and knives). We may speak about the marked similarity, if not their being identical to the lithic series from the Neolithic assemblages of the Ust-Tara archaeological microdistrict (Ivashchenko, Tolpeko, 2006).

Chronology of the Artyn culture and its place in the Late Neolithic of Western Siberia

Initially, the Artyn type of pottery was attributed to the Kokui stage of the Middle Irtysh Neolithic culture and dated to the 4th millennium BC (by association with the Kozlov stage of the Neolithic in the Transurals) (Gening et al., 1970: 15–17). Later, viewing the Artyn pottery within the concept of the Yekaterininskaya culture, A.I. Petrov attributed it to the Artyn Chalcolithic stage (the second half of the 3rd–early 2nd millennium BC) (1986: 6). This concept played a decisive role in the study of the Neolithic and the Early Metal Age in the Middle Irtysh region and Baraba at least until the end of the 1990s and influenced the initial attribution of dwelling No. 14 at the settlement of Avtodrom 2 (Molodin et al., 1998).

In the second half of the 2000s, V.V. Bobrov and the Omsk archaeologists substantiated the attribution of the settlements with the Artyn pottery to the Neolithic in association with the I Ust-Tara complex (Ivashchenko, Tolpeko, 2006) or the actual Artyn culture (Bobrov, 2008). According to the radiocarbon dating of materials from the settlement of Serebryanka-1, the I Ust-Tara complex (the Middle Irtysh region) dated to the second half of the 5th–first half of the 4th millennium BC (Ivashchenko, Tolpeko, 2006: 89–91). Using thermoluminescence analysis, absolute dates for the Artyn pottery from the settlement of Avtodrom 2 had been originally determined as 6500 ± 190, 6400 ± 190, and 6600 ± 200 BP (Komarova, 2010), that is, in the mid-5th millennium BC. Later, in the Isotope Center of the Department of Geology and Geo-Ecology in Herzen State Pedagogical University of Russia (St. Petersburg), a series of new dates was obtained (Table 2).

The chronological range between the early and the later dates is over a thousand years. Nevertheless, we can distinguish two groups of dates obtained on the basis of samples from the layer and dwelling No. 4 (second half of the 6th–mid-5th millennium BC) and from dwellings No. 15 and 18 (second half of the 5th–early 4th millennium BC). We should mention that an identical range of dates has been discovered for certain cultures of the Neolithic and the Early Metal Age in Western Siberia, for example, for the Bystrinka culture (the Surgut region of the Ob) (Poseleniye…, 2006: 61) or the Ust-Tartas culture (the Baraba forest-steppe) (Marchenko, 2009). The need for further accumulation of dates is obvious, and at this stage of research it is advisable to use the average dates and to date the Artyn assemblage from the settlement of Avtodrom 2 and the Artyn culture as a whole to the mid–second half of the 5th millennium BC.

The main circle of sites with the Artyn pottery includes the settlement of Kokui I, Pakhomovskaya Pristan III, Bichili I, Borovlyanka II, Serebryanka-1, Ust-Tara XXVIII, Tukh-Sigat IV, Nizhnyaya Tunuska II, Stary Tartas-5, the Artyn site, Ust-Tara IV, Ust-Tara XXXIII, and Avtodrom 2. The latter four sites contain "authentic" assemblages. This makes it possible to detect the area of the culture, covering forest areas of the Irtysh region, the northwest region of the Baraba forest-steppe, and partially the Vasyugan region (Fig. 13). An interesting suggestion is that the Late Neolithic burial grounds of Protoka and Vengerovo-2A, where the accompanying inventory included pottery close to the Artyn ceramics in terms of morphology and ornamentation, could have belonged to that culture (Polosmak, Chikisheva, Balueva, 1989: Fig. 7, *b*; 9; Molodin et al., 2012: Fig. 2, *1*), but this requires substantiation and additional facts.

Molodin and other Novosibirsk scholars believe that the burial grounds of Protoka and Vengerovo-2A represent "the most eastern–southeastern version of the northern Neolithic province covering the territory of the

Table 2. **Results of the radiocarbon dating of Artyn pottery from the settlement of Avtodrom 2**

Specimen	Occurrence	Date	
		^{14}C, years BP	Calibrated (2σ), years BC
SPb_1276	Space between dwellings	5914 ± 150	5208–4485
SPb_1279	Dwelling No. 4, accumulation *in situ*	5795 ± 100	4857–4447
SPb_1281	Dwelling No. 18	5350 ± 100	4358–3971
SPb_1282	Dwelling No. 15, accumulation *in situ*	5342 ± 100	4353–3970

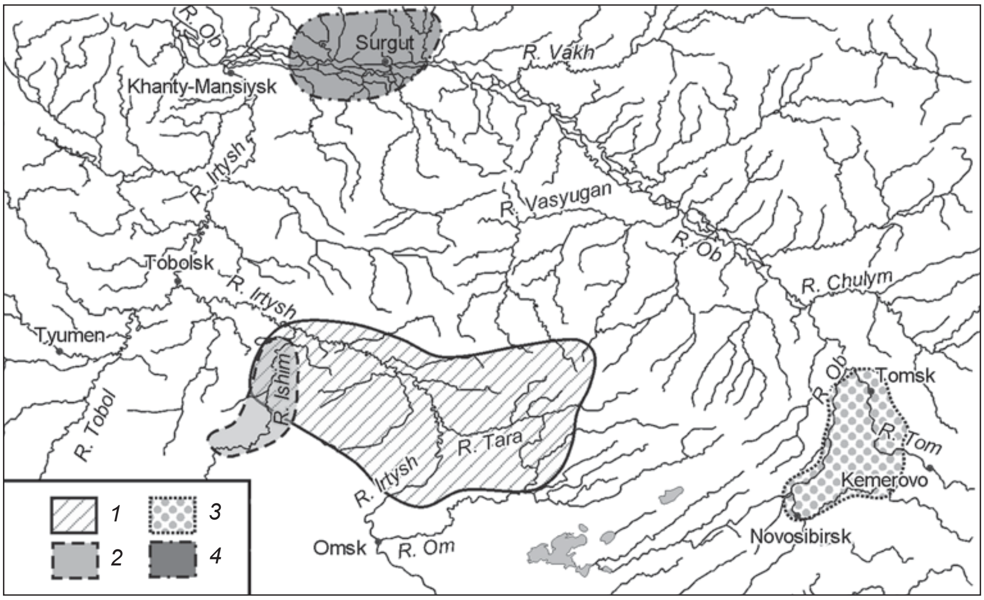

Fig. 13. Areas of the settlements of the Artyn culture (*1*) and the sites of contemporaneous cultural formations: the Kokui (*2*), Kiprino-Irba (*3*), Bystrinka sites (*4*).

taiga belt of Eurasia" (Molodin et al., 2014: 306). This conclusion is based on the similarity of pottery of the Bystrinka culture from the Surgut region of the Ob and the pottery from the Late Neolithic burial grounds of Baraba, as well as a common feature for the dwellings of the Bystrinka culture and the Baraba burial structures—encircling with a ditch (Molodin et al., 2012: 121; 2014: 303). Molodin and his colleagues allowed for "the presence of northern migrants in the local autochthonous environment of the forest-steppe (the Comb-Pit or the Artyn)" (Molodin et al., 2012: 121), but emphasized that the buried persons definitively belonged to the haplogroup A10, autochthonous for Western Siberia and in the Neolithic associated with the "northern Eurasian anthropological formation" (Molodin et al., 2014: 303).

Kosinskaya defined the circle of parallels in the northern Bystrinka assemblages that in her opinion were a part of the Ural-Western Siberian cultural community of the Neolithic (Poseleniye…, 2006: 64). Her position is close to the concept of the Novosibirsk archaeologists. In addition to the assemblages containing pottery with pointed bottoms from the taiga zone of Western Siberia and the forest Transurals, she identified sites of the Kokui type in the Lower Ishim region, materials of the Ust-Tara microdistrict, and the Zavyalovo sites of the Upper Ob region; in terms of morphology, she pointed to similarities even with the Neolithic pottery from the Altai Mountains (Ibid.: 63). However Kosinskaya considered it necessary to look for the origins of the Bystrinka pottery tradition in the southern forest and the forest steppe Ob-Irtysh region (Ibid.: 64).

In our opinion, according to a number of features, the materials from the Artyn settlements are similar to the Bystrinka materials. The parallels include single large dwellings with embankments and ditches (the Ust-Tara archaeological microdistrict), ornamented ceramic abraders, specific features of pottery tradition, manifested (according to the effective definition of Kosinskaya) in rims without bulging, simple wavy patterns, compositions of grouped pits, and lack of geometric ornamentation (Ibid.: 63). However, the range of specific features of the forest-steppe settlements can also be identified sufficiently well, including the presence of light half-dugouts, the predominance of the splitting technique in lithic industry over polishing, and the domination of the retreating-pricked-incised ornament on the pottery. Given the relative synchronicity of the Bystrinka and the Artyn assemblages in the early–mid-5th millennium BC, we may assume both their emergence on the basis of one or several common substrates, and the contacts of individual human groups at the stage of existence of independent cultures.

The problem of correlating the Artyn sites with the populations which V.A. Zakh associated with the Kokui culture identified by him (2006; 2009: 195), deserves special attention. Zakh defined the pottery tradition of the Kokui culture as the "retreating-pricked-comb" tradition, and considered it, along with the Yekaterininskaya culture, to be "the core of emergence of the Comb-Pit community within the Ishim-Irtysh region" (2009: 196). Defining the eastern border of the area of the Kokui culture, Zakh attributed

Avtodrom 2 and the sites of the Ust-Tara microdistrict to this zone. His arguments were based on materials from the settlement of Serebryanka-1, which contained pottery with the "mixed" type of ornamental décor. However, extrapolation of these observations to a wide range of sites requires critical evaluation. Such pottery was found at the settlements of the Ishim region, including Kokui-1 (dwelling II), Serebryanka-1, Borovlyanka-1, and Tyulyashov Bor-2 (Ibid.). Despite some ornamental and morphological similarity of the Artyn and the Kokui pottery, the latter is distinguished by closed jars, a specific shape of the rim ("earlets"), a denser manner of making pricked patterns, and a larger share of comb stamp imprints. In general, we may speak about more sophisticated ornamental compositions which were similar to the "comb" pottery of the Late Neolithic in the Transurals. There are some differences in house building technique: the pits of the Kokui dwellings are of rectangular shape; they have exit-corridors and sometimes two chambers (Ibid.). For further discussion of the problem we propose for the time being to distinguish between the Artyn and the Kokui sites.

Finally, we should mention very close parallels to the Artyn pottery in the materials from the settlements located far to the south and east of the Barabinsk-Irtysh core of the culture. In the Upper Ob region, these are the assemblages from Rodnikovoye, Krokhalevka-4 and -32, and Ordynskoye-1, dated by Zakh to the same chronological period as the Irba sites (2003: Fig. 42). Relatively recently, similar pottery was found in the Kulunda forest-steppe at the settlement of Novoilyinka III dated to the Chalcolithic (Kiryushin, 2015: Fig. 2, 3). K.Y. Kiryushin observed a certain similarity of the Novoilyinka pottery with the materials from the burial ground of Vengerovo-2A, while also pointing to a number of differences including the role of pits in the ornamental composition (Ibid.: 37). Unfortunately, numerous settlement assemblages with a great number of similarities, including the sites mentioned in this article, were left out of the scope of his research. It is possible that these findings reflect possible areas of cultural relations of the Artyn population.

Conclusions

Despite insufficient exploration of the Neolithic in Western Siberia, the results of research over the last two decades have brought the understanding of historical and cultural processes in the Early Holocene to a new level. Thus, we may now speak about a sophisticated, multidimensional process of cultural genesis unfolding already in the Advanced and Late Neolithic, when several communities with the dominance of specific pottery traditions were formed in Western Siberia. The accumulation of empirical material continuously leads to identification of new types of sites and new cultures, often without clear typological distinctions, within these communities (Poseleniye…, 2006: 59). Yet, in the case of the Artyn antiquities, we have sufficient criteria to determine their cultural identity: they consist of a territorial grouping of sites with a typologically uniform set of features in pottery production, lithic industry, and dwelling construction.

The emergence and existence of the Artyn culture seems to have depended not only on the internal processes of development, but also on active interaction with other communities, which is manifested in numerous instances of the typological similarity of individual elements. The subjects of this interaction could have been both the Neolithic human groups and the first groups of the Early Metal Period (the carriers of the Ust-Tartas traditions and the cultures with the Comb-Pit pottery). Their habitation areas and chronologies partly overlap, which indicates their possible coexistence and fits the logic of Molodin's concept of the migrational origin of the local communities in the Early Metal Age (Molodin, 1977; 2001). In this case, the Artyn culture should be regarded as the Late Neolithic stage of the autochthonous Ob-Irtysh cultural community and its local, Irtysh-Baraba variant (Bobrov, Marochkin, 2012: 71).

References

Bobrov V.V. 2008
K probleme kulturnoi prinadlezhnosti pozdneneoliticheskogo kompleksa poseleniya Avtodrom-2. In *Okno v nevedomyi mir*. Novosibirsk: Izd. IAE SO RAN, pp. 110–113.

Bobrov V.V., Marochkin A.G. 2008
Kompleks pozdnego neolita na poselenii Avtodrom 2 v Tsentralnoi Barabe. In *Problemy arkheologii, etnografii, antropologii Sibiri i sopredelnykh territorii*, vol. XIV. Novosibirsk: Izd. IAE SO RAN, pp. 15–20.

Bobrov V.V., Marochkin A.G. 2011a
Artynskaya kultura. In *Trudy III (XIX) Vserossiyskogo arkheologicheskogo syezda*, vol. 1. St. Petersburg, Moscow, Veliky Novgorod: pp. 106–108.

Bobrov V.V., Marochkin A.G. 2011b
Khronostratigrafiya neoliticheskikh kompleksov poseleniya Avtodrom-2. In *Problemy arkheologii, etnografii, antropologii Sibiri i sopredelnykh territorii*, vol. XVII. Novosibirsk: Izd. IAE SO RAN, pp. 14–19.

Bobrov V.V., Marochkin A.G. 2012
Neolit Baraby. In *Materialy nauchnoi sessii Instituta ekologii cheloveka SO RAN 2012 goda*, iss. 4. Kemerovo: pp. 63–73.

Bobrov V.V., Marochkin A.G., Yurakova A.Y. 2010
Keramika artynskoi pozdneneoliticheskoi kultury (po materialam poseleniya Avtodrom-2). In *Kultura kak sistema v istoricheskom kontekste: Opyt Zapadno-Sibirskikh arkheologo-etnograficheskikh soveshchaniy: Materialy XV Mezhdunar. Zap.-Sib. arkheol.-etnogr. konf*. Tomsk: Agraf-Press, pp. 113–116.

Bobrov V.V., Marochkin A.G., Yurakova A.Y. 2012
Poseleniye boborykinskoi kultury Avtodrom 2/2 (severo-zapadnye raiony Barabinskoi lesostepi). *Vestnik arkheologii, antropologii i etnografii*, IPOS SO RAN, No. 3 (18): 4–13.

Gening V.F., Gusentsova T.M., Kondratiev O.M., Stefanov V.I., Trofimov V.S. 1970
Periodizatsiya poseleniy epokhi neolita i bronzovogo veka Srednego Priirtyshya. In *Problemy khronologii i kulturnoi prinadlezhnosti arkheologicheskikh pamyatnikov Zapadnoi Sibiri*. Tomsk: Izd. Tom. Gos. Univ., pp. 12–51.

Ivashchenko S.N., Tolpeko I.V. 2006
Kulturno-khronologicheskaya atributsiya rannikh pamyatnikov Ust-Tarskogo arkheologicheskogo mikrorayona. In *Istoricheskiy ezhegodnik. 2005*. Omsk: Izd. Om. Gos. Univ., pp. 83–91.

Kiryushin K.Y. 2015
Morphology and decoration of ceramics from Novo-ilyinka III—A Chalcolithic settlement in Northern Kulunda, Southwestern Siberia. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 43 (1): 28–39.

Komarova Y.M. 2010
Primeneniye metoda termostimulirovannoi lyuminestsentsii (TSL) dlya datirovaniya arkheologicheskoi keramiki. In *VNKSF-16: Shestnadtsataya Vserossiyskaya nauch. konf. studentov-fizikov i molodykh uchenykh*, vol. 1. Yekaterinburg, Volgograd: Izd. ASF Rossii, pp. 342–343.

Kosinskaya L.L. 1982
Pozdneneoliticheskaya stoyanka Artyn na srednem Irtyshe. In *Arkheologicheskiye issledovaniya Severa Evrazii: Mezhvuzovskiy sbornik nauch. tr*. Sverdlovsk: Ural. Gos. Univ., pp. 18–27.

Kungurova N.Y. 1993
Shlifovannye nozhi Verkhnego Priobya. In *Kultura drevnikh narodov Yuzhnoi Sibiri: Sbornik nauch. st*. Barnaul: Alt. Gos. Univ., pp. 30–33.

Marchenko Z.V. 2009
Radiouglerodnaya khronologiya arkheologicheskikh pamyatnikov epokhi neolita i rannego metalla Barabinskoi lesostepi. In *Rol estestvenno-nauchnykh metodov v arkheologicheskikh issledovaniyakh*. Barnaul: Izd. Alt. Gos. Univ., pp. 140–143.

Molodin V.I. 1977
Epokha neolita i bronzy lesostepnogo Ob-Irtyshya. Novosibirsk: Nauka.

Molodin V.I. 2001
Pamyatnik Sopka-2 na reke Omi (kulturno-khronologicheskiy analiz pogrebalnykh kompleksov epokhi neolita i rannego metalla), vol. 1. Novosibirsk: Izd. IAE SO RAN.

Molodin V.I., Bobrov V.V., Chemyakina M.A., Efremova N.S., Garkusha Y.N. 1998
Issledovaniye neoliticheskogo pamyatnika Avtodrom 2 v Tsentralnoi Barabe – pervye rezultaty. In *Problemy arkheologii, etnografii, antropologii Sibiri i sopredelnykh territorii*, vol. IV. Novosibirsk: Izd. IAE SO RAN, pp. 140–143.

Molodin V.I., Bobrov V.V., Chemyakina M.A., Zharonkin V.N., Krivonogov S.K. 2003
Poseleniye Avtodrom-2 – k voprosu o stratigrafii i kulturnoi prinadlezhnosti. In *Problemy arkheologii, etnografii, antropologii Sibiri i sopredelnykh territorii*, vol. IX, pt. I. Novosibirsk: Izd. IAE SO RAN, pp. 423–427.

Molodin V.I., Mylnikova L.N., Nesterova M.S., Orlova L.A. 2012
Unikalnyi pogrebalno-ritualnyi kompleks epokhi neolita v Barabinskoi lesostepi. In *Problemy arkheologii, etnografii, antropologii Sibiri i sopredelnykh territorii*, vol. XVIII. Novosibirsk: Izd. IAE SO RAN, pp. 117–122.

Molodin V.I., Mylnikova L.N., Nesterova M.S., Pilipenko A.S., Trapezov R.O. 2014
Neoliticheskiy pogrebalnyi kompleks Vengerovo-2a v Zapadnoi Barabe: Rezultaty mezhdistsiplinarnykh issledovaniy. In *Trudy IV (XX) Vseros. arkheol. syezda v Kazani*, vol. I. Kazan: pp. 302–306.

Molodin V.I., Novikov A.V. 1998
Arkheologicheskiye pamyatniki Vengerovskogo rayona Novosibirskoi oblasti. Novosibirsk: Nauch.-proizvodstv. tsentr po sokhraneniyu istoriko-kulturnogo nslediya.

Petrov A.I. 1986
Epokha pozdnego neolita i rannei bronzy v Srednem Priirtyshye. Cand. Sc. (History) Dissertation. Kemerovo.

Polosmak N.V., Chikisheva T.A., Balueva T.S. 1989
Neoliticheskiye mogilniki Severnoi Baraby. Novosibirsk: Nauka.

Poseleniye Bystry Kulyogan 66: Pamyatnik epokhi neolita Surgutskogo Priobya. 2006
L.L. Kosinskaya, A.Y. Trufanov (eds.). Yekaterinburg, Surgut: Ural. Izd.

Usacheva I.V. 2006
Eti zagadochnye "utyuzhki": K voprosu o funktsionalnom naznachenii. *Uralskiy istoricheskiy vestnik*. No. 14: Materialy k II Mezhdunarodnomu Severnomu kongressu: 63–75.

Yurakova A.Y. 2013
Ornamentalnaya traditsiya artynskoi pozdneneoliticheskoi kultury. *Vestnik Kemerovskogo gosudarstvennogo universiteta*. Ser.: Istoriya, vol. 4 (3): 90–96.

Zaibert V.F. 2011
Botai: U istokov stepnoi tsivilizatsii: Kniga-albom. Almaty: Balausa.

Zakh V.A. 2003
Epokha neolita i rannego metalla lesostepnogo Prisalairya i Priobya. Tyumen: Izd. IPOS SO RAN.

Zakh V.A. 2006
Periodization of the Neolithic in the Tobol-Ishim forest zone. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 25 (1): 70–83.

Zakh V.A. 2009
Khronostratigrafiya neolita i rannego metalla lesnogo Tobolo-Ishimya. Novosibirsk: Nauka.

Received August 31, 2015.
Received in revised form October 20, 2015.

DOI: 10.17746/1563-0110.2017.45.1.062-075

A.G. Kozintsev
Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), Russian Academy of Sciences,
Universitetskaya nab. 3, St. Petersburg, 199034, Russia
Saint Petersburg State University,
Universitetskaya nab. 7–9, St. Petersburg, 199034, Russia
E-mail: agkozintsev@gmail.com

A Generalized Assessment of Cultural Changes at Stratified Sites: The Case of Chalcolithic Fortresses in the Northwestern Caucasus

A multivariate method for assessing cultural changes at stratified sites is proposed. The variables are technological properties of ceramics, and occurrences of various categories of flint implements. The method is applied to stratigraphic sequences of Chalcolithic fortresses in the northwestern Caucasus dating to the late 5th–early 4th millennia BC: Meshoko and Yasenova Polyana. The properties of ceramics include hardness (assessed on the Mohs scale), wall thickness, and frequency of fragments tempered with calcium carbonate. For Meshoko, S.M. Ostashinsky's data on the occurrence of implements made of high-quality colored flint, splintered pieces, and the total number of segments, points, inserts, scrapers, and perforators were used as well. Each parameter undergoes regular changes from the lower to the upper units of the sequence: ceramics progressively deteriorate, whereas flint industry becomes more and more sophisticated. These changes occur in parallel. Data were subjected to principal component analysis. The first principal component is regarded as a generalized measure of cultural change. The results support the view of the excavators: changes were caused by the interaction of two cultures differing in origin. The earlier culture, associated with the constructors of the Meshoko fortress, shows no local roots, and was evidently introduced from Transcaucasia. The one that replaced it was significantly more archaic (a few copper tools notwithstanding), and reveals local Neolithic roots. It alone can be termed the culture of ceramics with interior-punched node decoration. The ceramics of Yasenova Polyana, too, indicate cultural heterogeneity and two occupation stages; but cultural changes are more complicated there, probably because the site existed longer, and more than two cultural components were involved.

Keywords: *Chalcolithic, Northwestern Caucasus, Meshoko, Yasenova Polyana, ceramics, lithic industry.*

Introduction

It appears evident that cultural changes at stratified sites can be described more accurately if several quantitative indicators are used jointly, rather than separately. Therefore a single multivariate measure of changes is required. This task is akin to seriation—the arrangement of units in orderly sequences based on resemblance for the evaluation of relative chronology (O'Brien, Lyman, 2002; for details on multivariate seriation see (Peeples, Schachner, 2012)). In this case, however, we are faced with an inverse problem. The chronological sequence of units (layers) is known, whereas the directionality of cultural changes, provided it exists, must be revealed analytically. This approach appears very promising for studying cultural changes at fortified and stratified Chalcolithic settlements in the southern Kuban drainage, northwestern Caucasus, including first of all the fortress of Meshoko, excavated by A.D. Stolyar and A.A. Formozov in 1958–1959 and 1962–1965 (Stolyar, 1964, 2009a–e; Formozov, 1965: 69–70). In 2007, excavations were resumed by S.M. Ostashinsky (2012, 2014). The importance of this site stems from its cultural heterogeneity, which has been apparent ever since the beginning of the excavations. The lower layers contained a burnished Near Eastern type of pottery, mostly plain (less often, decorated with convex curvilinear designs), and a scarce and inexpressive lithic industry. The pottery from the upper strata is coarser, and is decorated mostly with interior-punched nodes; the lithic industry, on the other hand, is far more sophisticated and diverse. There are indications that similar changes were undergone by the culture of another fortified settlement south of the Kuban—Yasenova Polyana. This site, which is broadly contemporaneous with and culturally related to Meshoko, was excavated by P.A. Dietler, A.D. Stolyar, and A.A. Formozov in 1962–1966 (Formozov, 1965: 72, 97; Stolyar, 2009d; Dietler, Korenevsky, 2005–2009).

Already at the initial stage of the excavations, it had become evident that the nature of the cultural changes involved disagrees with the idea of cultural continuity and evolutionary replacement of obsolete technologies by more advanced ones (Stolyar, 1964; Formozov, 1965: 69). To all appearances, two sharply different cultural traditions were involved—but which ones? Stolyar and Formozov linked the lower strata of Meshoko with the Maikop culture, and the upper ones with the Novosvobodnaya culture (Ibid.). Later, settlements such as Meshoko, Yasenova Polyana, Svobodnoye, Zamok, etc. were attributed to the Chalcolithic pre-Maikop culture (Nekhaev, 1991, 1992). This view was challenged by Markovin (1994), Formozov (1994), and Rezepkin (1996, 2000). However, the appearance of radiocarbon dates evidently drew a line under the debate: these suggested that Svobodnoye as well as the lower horizons of Meshoko and Yasenova Polyana date to the second half of the 5th millennium BC, whereas the earliest Maikop and Novosvobodnaya sites are no earlier than 4000 BC (Trifonov, 1996; Zaitseva, Burova, Sementsov, 2004; Korenevsky, 2006; 2012: 63–64; Ostashinsky, 2014). The pre-Maikop age of the lower horizons of Meshoko and similar sites, which correlate with Tripolye BI and BI–BII, as well as with the Skelya (Novodanilovka) culture of the steppes of the northern Black Sea region, is documented by an unfinished cruciform mace head from Meshoko, and a fragment of a similar weapon from the middle layers of that site (Stolyar, 2009d: 161; Ostashinsky, 2012: 54, 56, 59; cf.: Govedarica, 2005–2009); by boar's-tusk plaques from Meshoko (Stolyar, 2009a: Fig. 19; cf.: Stolyar, 1955: Fig. 2); by a fragment of a zoomorphous stone scepter from Yasenova Polyana (Dietler, Korenevsky, 2005–2009: 570; cf.: Korenevsky, 2008); and by certain other finds.

Were cultural changes at Meshoko and Yasenova Polyana gradual or abrupt? This question is all the more important because despite marked cultural heterogeneity, no sterile layers or other boundaries between habitation horizons have been detected at either settlement. To resolve this issue and ensure a more detailed stratigraphic record, at each site control excavations were dug, in which habitation deposits were removed by 4–6 cm thick artificial units, rather than by 15–18 cm thick ones as before (Stolyar, 2009c, d). Finds from control excavation 2 at Meshoko were studied by A.D. Rezepkin (2005), who also examined ceramics from Yasenova Polyana (2000). He concluded that the culture of each of those settlements consisted of at least two components differing in several respects. Their proportion in the lower and upper horizons of either site is different, supporting the observations made by Stolyar, Formozov, and Dietler (see above). This appears to disagree with Rezepkin's view (2005) that "no genetic, cultural differences between them [horizons – *A.K.*] are observed". What he implied, apparently, was the gradual nature of the cultural changes.

Having analyzed the stone tools from Meshoko, Ostashinsky (2009: 236) concluded that "differences in lithic industry between the horizons concern all basic criteria: raw material, reduction technique, and composition of the tool assemblage. The dissimilarity between the lower and upper horizons is striking; in essence, they are not comparable". In Ostashinsky's view, the most likely reason is immigration. He believes that along with upper and lower horizons, intermediate ones can be separated (see also (Poplevko, 2010)).

Given that the units of the stratigraphic sequences are artificial and no boundaries between the layers could be discerned, how many stages in the culture of southern Kuban settlements can be separated on the basis of the technological and typological analysis? How should one interpret the striking differences apparent to everyone?

In 1965 and 1966, as an undergraduate, I took part in the excavations of Meshoko and Yasenova Polyana, under the guidance of A.D. Stolyar. In 1966–1968, I examined the ceramics from these sites; and in 1968, at the Leningrad State University Department of Archaeology I defended my Master's Thesis on that topic. It remained unpublished. In the course of half a century, some of its conclusions have become outdated, whereas others have been upheld by later studies. None of them will be touched upon here. In this article, I will focus on those findings which, in my view, remain nontrivially relevant to the questions raised.

Materials and methods

Virtually all ceramics from Meshoko and Yasenova Polyana available by 1968 were studied at the State

Hermitage Museum. For a quantitative evaluation of the cultural changes at both sites, material from control excavation 1 (1963) at Meshoko and from control excavation 1 (1964) at Yasenova Polyana was used. For comparative purposes, I studied ceramics from other settlements in the northwestern Caucasus: Nizhnne-Shilovskaya, Skala, Khadzhokh grottoes, and Dakhovskaya cave.

Because the ceramics are quite fragmented, owing to the fact that fortresses served as corrals, assessing changes in the size and form of vessels is very difficult. For each of the 14 layers of the control excavation at Meshoko and the 12 layers at Yasenova Polyana, the following parameters were evaluated: (1) average hardness on the Mohs scale, (2) average wall thickness, (3) percentage of fragments tempered with calcium carbonate. For this purpose, fifteen fragments were selected at random from each layer. The Mohs scale is nonlinear: grades 1 (talc), 2 (gypsum), and 3 (calcite) correspond to absolute hardnesses of 1, 3, and 9, respectively. Here, however, this is not critical, because the hardness of most fragments from the southern Kuban sites falls within the small interval from 1.5 (scratched by gypsum) to 3 (about as hard as calcite). I used a microscope with 150x magnification, a magnet, and hydrochloric acid. Color was assessed using E.B. Rabkin's *Atlas of Colors* (1956).

Frequencies of various categories of stone tools from Meshoko (Ostashinsky, 2009) refer to control excavation 2 of 1964, where the thickness of the habitation deposits is maximal and the number of layers is 21 (bottom layers, 22 and 23, are sterile). To compare these data with mine, relating to control excavation 1, where the habitation deposits are thinner and the number of layers is 14, Ostashinsky's data were adjusted in the following way. The number of lithics in layers 2, 5, 8, 11, 14, 17, and 20 of control excavation 2 was distributed equally between the overlying and underlying strata. As a result of this uniform "compression", the number of layers was reduced to 14, as in control excavation 1.

Before statistical analysis, data were transformed to improve normality and stabilize variances. In the case of relative frequencies, Anscombe's transformation was applied (Sjøvold, 1977: 18) using the FREQ function from B.A. Kozintsev's statistical package; in the case of absolute frequencies, the transformation was that of Box-Cox (Box, Cox, 1964) using Ø. Hammer's PAST package (http://folk.uio.no/ohammer/past/).

Data relating to various parameters were integrated using the principal component analysis based on Pearson's correlation coefficients. The first principal component, accounting for the largest share of the total variance, was regarded as a generalized measure of cultural change. Pairwise correlations between the variables and their correlation with the layer number were evaluated with Spearman's rank correlation coefficients. All these calculations were performed using the PAST software. The same package was used to smooth the curves by the three-point moving average method and to calculate exact probabilities for fourfold tables.

Results

Ceramics of Meshoko

Technological parameters. Unlike the Maikop people (Bobrinsky, Munchaev, 1966; Korenevsky, Kizilov, 2015), those of Meshoko used no throwing-wheels, apparently employing the paddle and anvil technique (Poplevko, 2015). The hardness of most fragments is low, ranging from 1.97 in layer 5 to 2.67 in layer 14 (Table 1). Ceramics with such hardness should be considered low-quality by world standards (Shepard, 1956: 114), despite the excellent burnishing practiced during the early period. The distribution of this parameter according to layers shows a significant negative tendency (Fig. 1): hardness progressively decreased on average. The coefficient of rank correlation (r_s) between this parameter and the layer number equals 0.89 ($p < 0.001$).

An indirect indicator of quality is wall thickness. It ranges from 4.3 mm in layer 8 to 7.1 mm in layer 4 (Table 1), increasing on average from the lower to the upper layers ($r_s = -0.71$, $p = 0.005$; Fig. 2).

The third technological parameter is frequency of fragments tempered with calcium carbonate. In certain cases, this is represented by oolitic limestone—amorphous soft grayish inclusions; in other instances, by crushed calcite, whose shiny particles, when examined microscopically, have a rhombohedral form caused by perfect cleavage. An additional proof that paste was heavily (30–40 %) tempered with calcite rather than quartzite, contrary to what Rezepkin (2005) and Poplevko (2015) write, is vigorous reaction with acid. Certain specimens reveal a mixture of oolitic and fragmental limestone. A good preservation of particles indicates firing at temperatures below 750 °C (Bobrinsky, 1978: 80). The color of shards is mostly orange or tawny (O 7/13 – O 6/14 according to Rabkin's tables), owing to oxidizing conditions; less often, brown (O 4/16) or dark gray (P 3/9, P 2/14, P 3/13)*. Calcite temper is yet another indication that those who constructed the Meshoko fortress had migrated from the south. Such temper was registered in ceramics from Ochazhny Grot (Grotto of Hearths) of Vorontsov Cave in Abkhazia (Soloviev, 1958: 143).

Both oolitic and fragmental limestone can occur as natural inclusions in clay, and in this case no tempering is required. However, ceramics from the lower layers contain virtually no other admixtures. The paste is finely levigated

*"O" stands for orange, "P" for purple.

Table 1. **Quantitative parameters of ceramics from Meshoko and Yasenova Polyana**

Layers	Meshoko				Yasenova Polyana			
	Average hardness, units of Mohs scale	Average wall thickness, mm	$CaCO_3$ temper, percent of fragments	First principal component scores	Average hardness, units of Mohs scale	Average wall thickness, mm	$CaCO_3$ temper, percent of fragments	First principal component scores
1	2.00	5.7	53.3	–1.70	2.33	6.1	66.7	0.24
2	2.27	6.1	46.7	–1.44	2.40	5.8	60.0	0.59
3	2.00	6.9	73.3	–2.00	2.27	6.4	73.3	–0.76
4	2.03	7.1	80.0	–1.89	2.27	5.9	66.7	0.63
5	1.97	6.9	73.3	–2.08	2.33	5.8	66.7	1.12
6	2.23	5.4	73.3	–0.48	2.23	5.8	53.3	2.46
7	2.27	5.1	80.0	–0.01	2.10	7.0	66.7	–0.86
8	2.33	4.3	100.0	1.41	2.13	6.4	66.7	–1.13
9	2.40	5.2	100.0	1.00	2.10	6.0	73.3	–0.61
10	2.63	4.9	86.7	1.18	2.07	5.6	33.3	0.50
11	2.43	5.3	100.0	1.01	2.23	6.2	86.7	–1.64
12	2.47	4.5	100.0	1.62	2.20	5.8	100.0	–0.54
13	2.63	5.3	100.0	1.50	–	–	–	–
14	2.67	4.9	100.0	1.85	–	–	–	–

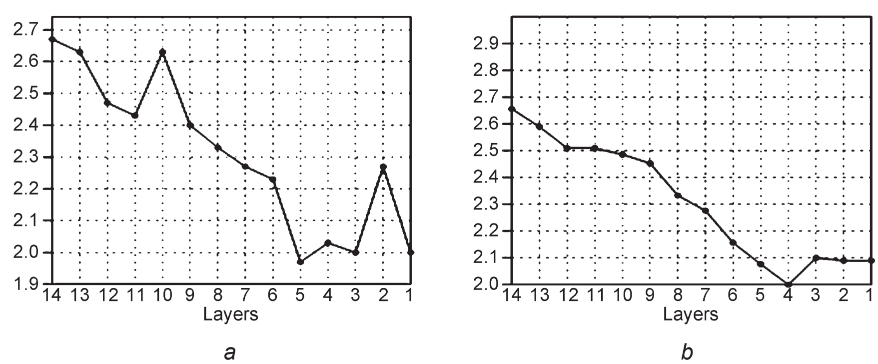

Fig. 1. Average hardness of ceramics in various layers of the Meshoko sequence, units of the Mohs scale.
a – plot based on crude data; *b* – smoothed plot generated by the three-point moving average method.

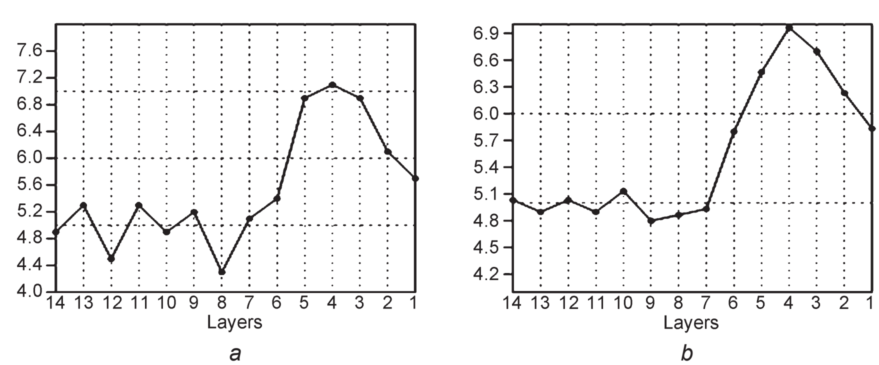

Fig. 2. Average wall thickness in various layers of the Meshoko sequence, mm.
a, *b* – see Fig. 1 for explanations.

and very homogeneous. Apparently limestone was added after the removal of natural inclusions such as sand, etc. The temper was thoroughly ground; the distribution of particles is very uniform. In all shards from the four lower layers, $CaCO_3$ is the only admixture. Its share decreases toward the upper layers (Table 1). The coefficient of rank correlation between the proportion of fragments tempered with limestone and layer number is 0.90 ($p < 0.001$; Fig. 3). Apparently, the main factor causing this change was less and less thorough surface treatment.

While I was unable to find a simple quantitative indicator of surface-treatment quality, there is no

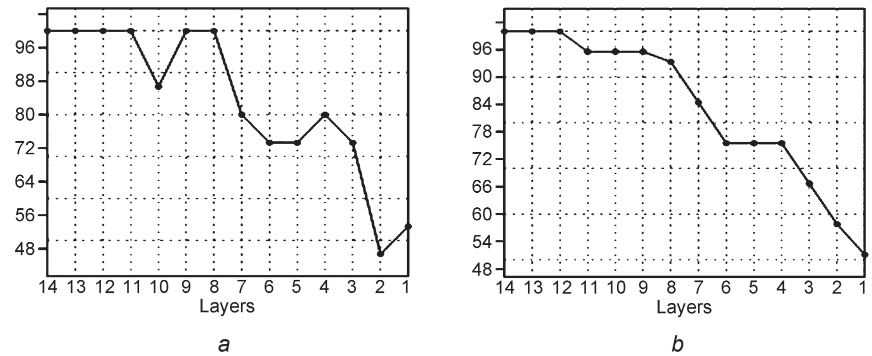

Fig. 3. Proportion of fragments tempered with calcium carbonate in various layers of the Meshoko sequence, percentage.
a, *b* – see Fig. 1 for explanations.

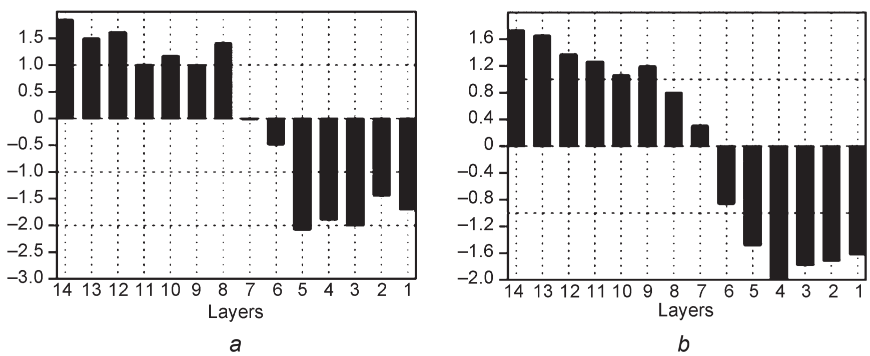

Fig. 4. First principal component based on three technological parameters of ceramics in various layers of the Meshoko sequence.
a, *b* – see Fig. 1 for explanations.

doubt that in this case, too, temporal changes were technologically counterintuitive. Instead of the expected improvement we observe degradation. The changes are especially marked on the interior surface, which, from the very beginning, was polished less thoroughly than the exterior surface, and appears pitted because temper grains had decomposed during firing (no such cavities are present either on the outside or in the fracture).

Beginning from layer 12, cavities become more and more numerous. As a result, the strength of the vessels decreased, causing the need for alternative temper such as fine sand and mica. Toward layer 8, burnishing becomes barely distinguishable, and eventually disappears. The predominant shades are grayish browns (O 5/13), whereas orange (O 7/13) is less common. Toward layer 5, calcite temper disappears, and amorphous limestone is less thoroughly ground: its grains are sometimes as large as 2 mm. Burnishing quality decreases to such an extent that limestone particles, even very coarse ones, often decompose even in the deep parts of the shards (given the low quality of the ceramics, this could not have been caused by higher firing temperatures). Porosity increases considerably, and strength decreases accordingly. Such vessels cannot be used for storing liquids.

In fragments from the two top layers, the decomposition of calcium carbonate is maximal. Sometimes its residues are present as small amounts of yellowish powder in pores. In about half of the cases, amorphous limestone is replaced by hard additions (from sand to grit with particles up to 2.5 mm large). Such ware was probably used for storing liquids. The color ranges from dark gray (P 3/9 – P 3/13) to orange (O 7/13). In layer 3, a fragment of a flat bottom was found (previously, most or all vessels were round-bottomed).

Two fragments from layer 2 contrast with the others. They are very thick (7.5–8.0 mm), and are tempered with hard particles of a different origin: small rounded pebbles, grit, mica, and hematite grains. The inside of each specimen is heavily sooted, probably intentionally. I have observed all these technological properties in ceramics from Nizhne-Shilovskaya, which has been traditionally dated to the earlier (Neolithic) period.

Generalized measure of changes. As seen above, each of the three technological parameters shows regular and highly significant diachronic changes. The correlation between them is accordingly highly significant as well:

Hardness – wall thickness	–0.74 ($p = 0.002$)
Hardness – limestone temper	0.78 ($p = 0.001$)
Wall thickness – limestone temper	–0.71 ($p = 0.005$)

If so, it can be expected that the integration of these parameters into a single generalized measure will allow us to reduce the effect of random fluctuations and reveal the overall tendency. Indeed, the first principal component shows a regular change from the early to the late stages, mirroring the general deterioration of the ceramics over time (Table 1; Fig. 4). It accounts for 79 % of the total variance, and its correlation with layer number is 0.89 ($p < 0.001$)—the same as with hardness and limestone temper. However, the generalized measure should be preferred to each of its constituents, because ignoring the others may distort the actual pattern to some extent.

The plot based on crude principal component scores (Fig. 4, *a*) reveals three stages: the period between layers 14 and 8 evidences slow deterioration; layers 8 to 5, rapid deterioration; layers 5 to 1, slight improvement. These periods are separated approximately because of random fluctuations. However, if the curve is smoothed using the three-point moving average (Fig. 4, *b*), the stepwise nature of the changes disappears, and the general tendency is that of steady regress (except for a small peak on layer 9), with some acceleration, between layers 14 and 4. After that, the quality of the ceramics improves to a small extent.

Northern ties and occupation length. Of special interest is a small group of fragments (about a dozen), sharply differing from others. They were found not in the control excavation, but in layers 2–4 of other excavation areas, where the stratigraphic record is less accurately subdivided. Layers 2–4 in those areas correspond to the middle horizons of the settlement, in which, notably, a fragment of a cruciform mace head was found (see above). The surface of the shards is glossy and somewhat "greasy" to the touch, possibly because an organic solution was added to the paste (Salugina, 2011). The color, both of the surfaces and of the fracture, is dark gray or brownish-gray, sometimes almost black (O 4/16, P 3/9, P 2/14, P 3/13), apparently because organic temper got charred and/or because smoke penetrated inside the pores during firing*.

The principal feature of those fragments is a very considerable number of crushed shells, undoubtedly added as temper. Firing was weak; the calcium carbonate shows no traces of decomposition. Most fragments are decorated with comb imprints—a feature that is quite unusual for Meshoko ceramics. In two specimens they are combined with interior-punched nodes. Three fragments of rims with pits or hatching along the lip belong to the same group. A shard with a "greasy" surface and shell temper was found in layer 11 of the control excavation at Yasenova Polyana. It is decorated with an applied bump, and wedge-shaped imprints (Stolyar, 2009d: 167, fig. 28, *8*). A fragment of rim without shell temper from layer 9 of this control excavation has a thickened edge decorated with oblique imprints of "Wickelschnur" (cord wrapped around a stick) on the lip (Rezepkin, 2000: 233, fig. 8, *17*). The Meshoko sample includes several shards without shell temper but with imprints of a denticulate stamp, sometimes combined with interior-punched nodes or incised lines (Rezepkin, 2005: Tab. 19, *10*, *11*; Dietler, Korenevsky, 2005–2009: Fig. 26, *14–20*). One of them comes from layer 11 in the middle of the stratigraphic sequence in control excavation 2 (1964), where the number of layers is 21.

Shell temper is very rare at Chalcolithic settlements of the piedmont zone south of the Kuban (it was also found in ceramics from the "Neolithic" horizon of Kamennomostskaya cave (Formozov, 1965: 63)*, but is very typical of the steppe zone. Having first appeared in the steppes as early as the Neolithic, in the beginning of the 6th century BC (Kotova, 2015: 58, 63), the tradition of tempering paste with crushed shells became a distinctive feature of Chalcolithic cultures of the steppe and forest-steppe—Sredni Stog (Kotova, 2006b: 158), Khvalynsk (Vasiliev, 2003: 66) and a number of later ones. It is one of the key indicators of the expansion of the steppe tribes. Ceramics very similar to those of Meshoko in technological parameters (gray or black color, abundant shell temper, "greasy" surface) were found at Repin and earlier (apparently Konstantinovsk-type) sites in the Don drainage (Sinyuk, 1981: 14; see also (Formozov, 1954: 138)).

Western researchers of Cucuteni-Tripolye have termed ceramics tempered with crushed shells the "Cucuteni C" type (Schmidt, 1932: 42). This type's first appearance in the Tripolye context is related to the Skelya (Novodanilovka) culture—an early version of Sredni Stog (Videiko, 1994; Rassamakin, 1999; see also (Movsha, 1961; Palaguta, 1998; Manzura, 2000)). The Skelya people migrated to the northwestern Black Sea region from the Lower Dnieper at the Tripolye BI stage (or even at the end of Tripolye A stage) in the second half of the 5th millennium BC, and introduced a ceramic tradition that was alien to Tripolye and more primitive (Palaguta, 1998; for a review of literature see (Kotova, 2006b: 14–17)). It survived in Tripolye at least until the BI–BII stage (late 5th millennium BC), having blended with the local tradition during the Late Tripolye stage.

In the pre-Maikop context of the piedmont settlements, ceramics tempered with crushed shells appears as unusual as in the context of Tripolye. In the more northerly lowland zone adjacent to the steppe, the situation was different. Shell-tempered pottery is quite common at the pre-Maikop settlement Svobodnoye (Nekhaev, 1992: 80), which is somewhat earlier than

*Dark shades of ceramics are often believed to be caused by a reducing atmosphere of baking, whereby ferrous oxide FeO or magnetic oxide Fe_3O_4 are formed. However, ferrous oxide is a very unstable substance; a magnet test of the crushed fragment shows that magnetic oxide plays no role here either. Open fire and primitive kilns seldom if ever provided conditions for a reducing atmosphere. In the vast majority of cases, dark color was caused by the non-oxidizing atmosphere of baking, whereby the organic matter in fuel and/or paste was carbonized (Lucas, Harris, 2012: 374–376).

*Later it is said to reappear at Novosvobodnaya (Popova, 1963: 18; Nikolaeva, Safronov, 1974: 179).

Meshoko (Korenevsky, 2012: 63), and shows marked parallels with the Chalcolithic sites of the steppe. N.S. Kotova (2006a) links the Svobodnoye ceramics with those from the latest Sredni Stog sites on the Don and Seversky Donets, believing that rare instances of interior-punched node decoration in those areas may be due to contacts with the pre-Maikop population of the northwestern Caucasus.

The combination of abundant interior-punched node design with comb imprints suggests that the shell-tempered pottery from Meshoko and Yasenova Polyana may indicate contact, not with Sredni Stog, but with some later culture such as that of the Mikhailovka lower layer—or, more likely, Repin (Sinyuk, 1981: Fig. 2, *4*, *7*; 3, *13*, *19*, and others; Kotova, 2013: 91, 368, fig. 212, *3*; cf.: Rezepkin, 2005: Tab. 19, *10*, *11*). The Repin culture emerged about 3700 BC (Kotova, 2013: 151) at the Tripolye CI stage, whereas the combination of comb and interior-punched node decoration became common for the Cucuteni C ware as early as the Tripolye BII stage (Movsha, 1961). Therefore, the upper radiocarbon dates of Meshoko and Yasenova Polyana do not contradict these parallels. Nor is there disagreement with the lower dates, which are supported by artifacts typical of Tripolye BI. Some of these were in use for a long time (Govedarica, 2005–2009; Korenevsky, 2008: 137; 2016: 52–53). Judging by an unfinished cruciform mace head from Meshoko (Stolyar, 2009d: 161), such artifacts were not relics.

Disagreement arises solely with the opinion of Stolyar (2009e: 204), who asserted that the fortress existed for only 150–200 years. The minimally possible range of calibrated radiocarbon dates (between the nearest points of confidence limits) is 340 years in the case of Meshoko (4040–3700 BC) and nearly 700 years in the case of Yasenova Polyana (4048–3357 BC)—even if the latest, aberrant date is disregarded (Korenevsky, 2012: 63–64).

The lithic industry of Meshoko

Absolute occurrences of various categories of lithics in various stratigraphic units of control excavation 2 are given in Table 2. The frequencies of three of the categories described by Ostashinsky (2009) show a significant correlation with layer number (I lumped segments, points, inserts, scrapers, and perforators into a single category "others" to make it numerically representative). The correlation coefficients (r_s) are as follows (all p-values are below 0.001):

tools made of high-quality colored flint	–0.89
pièces écaillées (splintered pieces)	–0.85
others	–0.83

Diachronic changes in the occurrence of lithics belonging to various categories are plotted in Fig. 5–7. While each of the plots is somewhat peculiar, the progressive sophistication of the lithic industry, both quantitative and qualitative, appears evident. The fourth category, laminar items, shows no significant correlation with layer number (r_s = –0.45, $p > 0.05$) and has been excluded from further analysis. Pairwise coefficients of

Table 2. **Occurrence of various categories of lithics from Meshoko (after (Ostashinsky, 2009), adjusted)**

Layers	Tools made of colored flint	Pièces écaillées	Others	First principal component (lithics)	First principal component (lithics + ceramics)
1	242	12.5	11	1.63	2.37
2	212	12.5	6	1.08	1.78
3	259	21.5	8.5	1.65	2.56
4	248	17.5	10.5	1.73	2.53
5	275	26	13	2.15	2.97
6	228	16	14	1.94	1.76
7	66	3.5	4	–0.16	–0.09
8	66	0.5	7	–0.30	–1.17
9	43.5	1.5	4.5	–0.51	–1.06
10	24.5	1.5	3.5	–0.82	–1.41
11	16	–	3	–1.43	–1.76
12	3	–	–	–2.35	–2.82
13	3	–	–	–2.35	–2.76
14	5	–	–	–2.25	–2.92

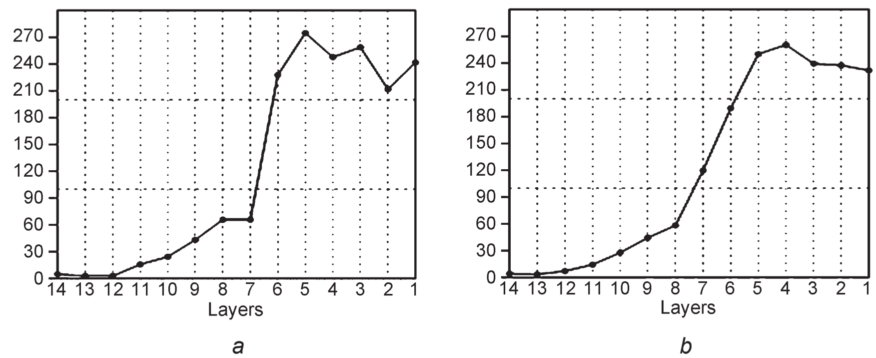

Fig. 5. Occurrence of tools made of high-quality colored flint in various layers of the Meshoko sequence.
a, *b* – see Fig. 1 for explanations.

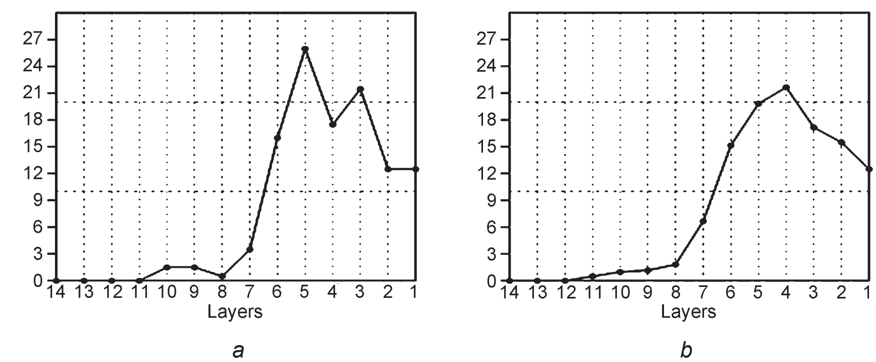

Fig. 6. Occurrence of *pièces écaillées* in various layers of the Meshoko sequence.
a, *b* – see Fig. 1 for explanations.

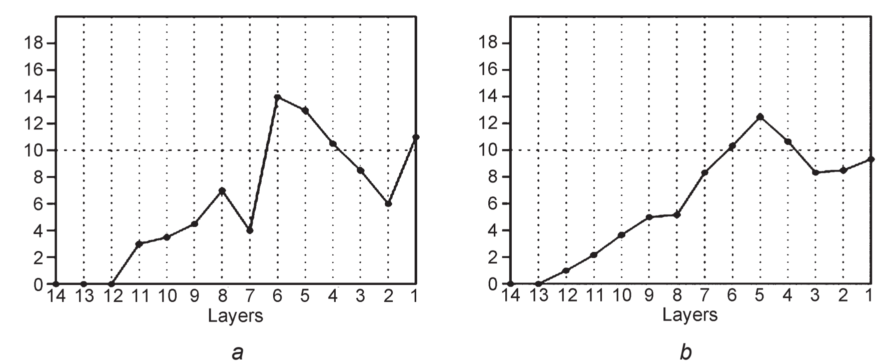

Fig. 7. Total occurrence of segments, points, inserts, end-scrapers, and perforators in various layers of the Meshoko sequence.
a, *b* – see Fig. 1 for explanations.

correlation between the three remaining categories are as follows (all are highly significant):

colored flint – pièces écaillées	0.96
colored flint – others	0.92
pièces écaillées – others	0.88

The generalized measure of changes was calculated in the same way as was done for ceramics. The coefficient of correlation between the first principal component (Table 2; Fig. 8) and layer number is negative and highly significant ($r_s = –0.84$, $p < 0.001$), although its absolute magnitude is no higher than for each category, and even lower than for colored flint. Nevertheless, in this case as in the case of ceramics, the generalized measure must be regarded as more informative than each of its constituents.

The plot based on crude values (Fig. 8, *a*) reveals four periods: in three bottom layers (14 to 12), both the quantitative and qualitative level of the lithic industry is steadily low; layers 12 to 7 show a gradual rise; and layers 6 and 5, an abrupt rise, after which a small regress is observed. The smoothed plot (Fig. 8, *b*) differs from the previous one by demonstrating a steady sophistication of the lithic industry between layers 13 and 5, followed by a slight deterioration as in the previous plot.

The parallel between the evolution of ceramics and that of the lithic industry is obvious: the degradation of pottery is paralleled by the sophistication of lithic industry, and vice versa. In certain cases, the parallel is no less close than that between parameters within a single category—as evidenced, for instance, by coefficients of correlation between the hardness of ceramics, on the one hand, and the occurrence of tools made of colored flint (–0.95) and of pièces écaillées (–0.90), on the other. A very high correlation is also observed between the two independent generalized measures of change ($r = –0.92$). This supports the conclusion formed by virtually all

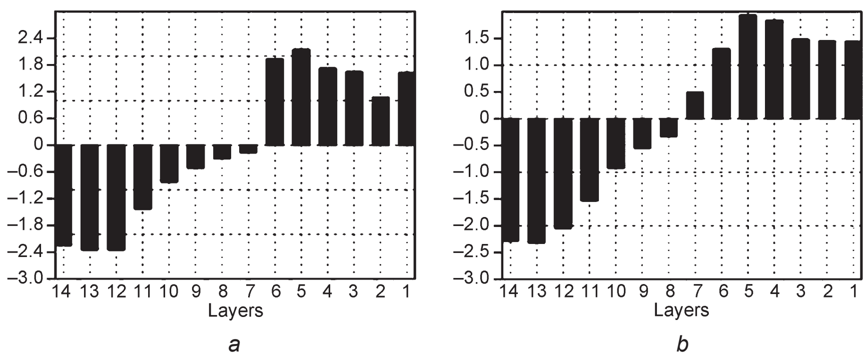

Fig. 8. First principal component based on the occurrence of three categories of lithics in various layers of the Meshoko sequence.
a, *b* – see Fig. 1 for explanations.

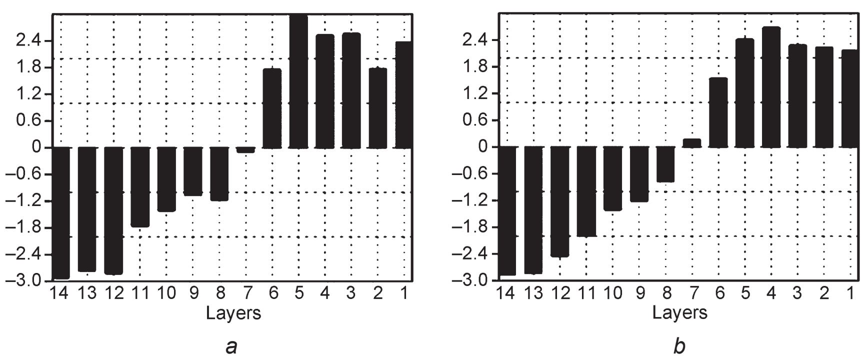

Fig. 9. First principal component based on three technological parameters of ceramics and the occurrence of three categories of lithics in various layers of the Meshoko sequence.
a, *b* – see Fig. 1 for explanations.

researchers who had studied the finds from Meshoko: parallels are caused not so much by technological factors as by historical ones.

Let us calculate the first principal component on the basis of all six parameters (Table 2). It accounts for 83.7 % of the total variance, and the factor loadings (coefficients of correlation with trait values) are as follows:

hardness of ceramics	–0.93
wall thickness	0.82
calcium carbonate temper	–0.86
tools made of colored flint	0.98
pièces écaillées	0.98
others	0.91

The correlation with the occurrence of lithics is somewhat higher than with the technological parameters of the ceramics. The probable reason is that all lithics within the control excavation area were studied, but only part of the ceramics. The correlation of the integral first principal component with the layer number (–0.91) is tighter than with either of the respective measures based on ceramics or lithics separately.

While the plot of the first principal component calculated on the basis of crude data (Fig. 9, *a*) still reveals some chaotic fluctuations, the smoothed plot (Fig. 9, *b*) demonstrates a very clear pattern, which appears to be closest to reality. The two lowest layers indicate stability: a comparatively high quality of ceramics and low quality of lithic industry. After that, over most of the sequence (layers 12 to 4) ceramics progressively deteriorate, whereas the lithic industry becomes more and more sophisticated. During the final period (three upper layers), a reverse tendency, albeit a less distinct one, is observed.

Ceramics of Yasenova Polyana

At Yasenova Polyana, as in Meshoko, no traces of using a throwing-wheel have been detected. Here too, material culture reveals diachronic changes (Stolyar, 2009d: 142–144; Formozov, 1965: 72, 79; Dietler, Korenevsky, 2005–2009; Rezepkin, 2000).

Vessels represented by fragments from the lower (12th) layer apparently resemble those from the lower units of Meshoko in both size and form. They were characterized by round bottoms, gentle outlines, and weakly everted rims. The only temper in any fragments is calcium carbonate in a likewise high proportion. In certain cases, it is a rather coarsely ground oolitic limestone; in others, crushed calcite. Natural inclusions are represented by fine sand, less often by hematite grains. Polishing is barely discernible. The combination of heavy limestone temper with insufficient burnishing of the inside produces the same negative result—the presence of numerous cavities from decomposed particles of temper. The color is usually a dark, brownish-gray (O 4/14, O 5/13, O 5/15); but orange shades occur as well, so the atmosphere of firing was oxidizing in some cases and non-oxidizing in others. Strength is about the same as in layers 9–7 of Meshoko. Fragments from layer 11 reveal different temper (sand and mica in two cases, ground oolite limestone and, much less often, crushed calcite in others). Thoroughly burnished fragments, similar to those from Meshoko layer 10, co-occur with cruder ones, resembling those from layers 6 and 5 of Meshoko.

None of the examined fragments from layer 10 reveals calcite temper; most contain grit and mica, others are heavily tempered with ground amorphous limestone, sometimes making up nearly half of the volume. Burnishing virtually disappears. The color ranges from brownish-gray to relatively bright orange shades. Four shards from layer 9 contained a hard admixture, others were tempered with oolitic limestone. In layer 8, as in overlying horizons, fragments of flat bottoms were found. One third of the fragments are tempered with grit, others with crushed amorphous limestone, which is often completely decomposed.

In layer 7, a fragment of a mug or beaker with a loop-shaped handle attached to the rim was found, reminiscent of vessels from Novosvobodnaya (Rezepkin, 2000: 232, fig. 7, *3*; Dietler, Korenevsky, 2005–2009: 557, fig. 12, *B3*). Surface treatment deteriorates, the temper to clay ratio is the same—1 : 2. In layer 6, nearly half of the fragments contain hard temper, and the surface becomes even coarser. In layer 5, the ratio of hard temper to amorphous limestone is 1 : 2. Grit is very coarse (up to 3 mm in size).

In layer 4, the temper ratio remains the same. Some grit particles are 7 mm in size, attesting to a very low level of technology. In layer 3, nearly three quarters of the fragments are tempered with amorphous limestone; the remainder contain hard temper. The quality of surface treatment is low; firing occurred, as before, under both oxidizing and non-oxidizing conditions. In layer 2, the hard-to-soft temper ratio is 2 : 3, and in layer 1 it is 1 : 2. The surface treatment and the decomposition of limestone differ, as in the underlying layer.

As we see, the ceramics of Yasenova Polyana, too, underwent changes over time; but understanding the nature of these changes is more difficult here than in the case of Meshoko. Only one of the technological parameters, hardness, demonstrates a directional trend, but its direction is opposite to that observed in the case of Meshoko: hardness progressively increases on average (r_s = –0.76, p = 0.004; Fig. 10). The correlation between the remaining two parameters and layer number is insignificant: wall thickness, –0.11; limestone temper, 0.36 (Fig. 11, 12). Accordingly, the correlation between those parameters is small and insignificant:

hardness – wall thickness	–0.11
hardness – limestone temper	–0.04
wall thickness – limestone temper	0.44

But even in such a situation, the generalized measure of change appears useful. The first principal component in this case accounts for only 43.4 % of the total variance as against 79 % in Meshoko, and its correlation between this measure and layer number is insignificant (r = 0.41). However, even the plot based on crude principal component scores (Fig. 13, *a*) makes it clear that the

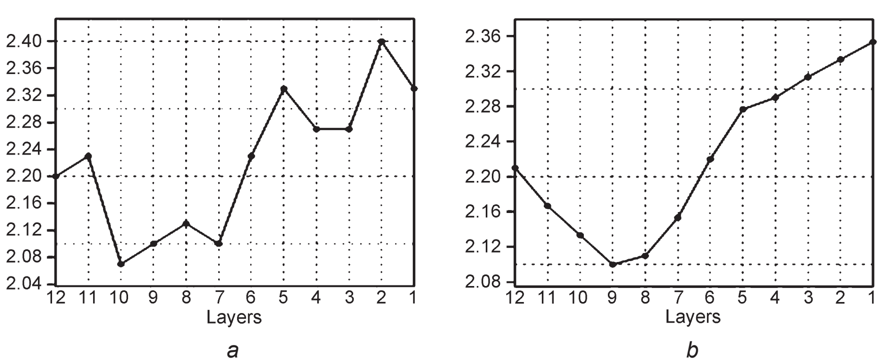

Fig. 10. Average hardness of ceramics in various layers of the Yasenova Polyana sequence, units of the Mohs scale.
a, *b* – see Fig. 1 for explanations.

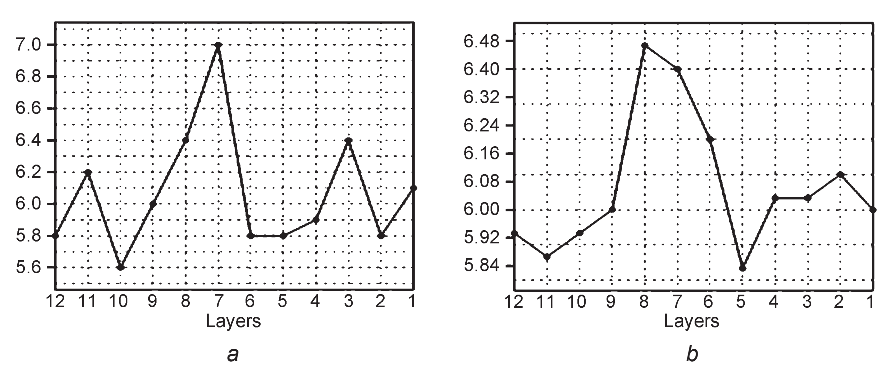

Fig. 11. Average wall thickness in various layers of the Yasenova Polyana sequence, mm.
a, *b* – see Fig. 1 for explanations.

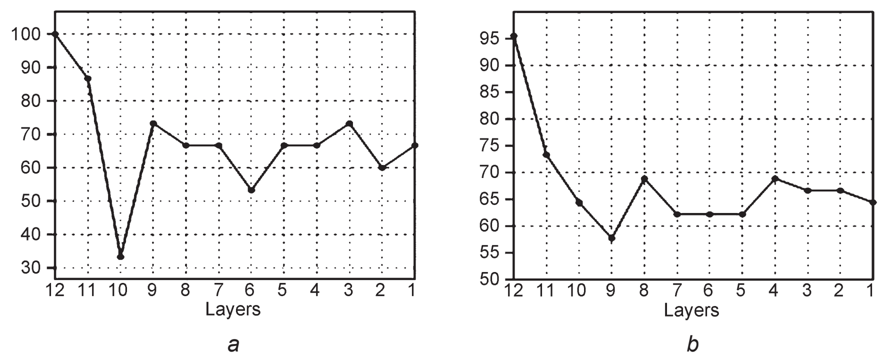

Fig. 12. Proportion of fragments tempered with calcium carbonate in various layers of the Yasenova Polyana sequence, percentage.
a, *b* – see Fig. 1 for explanations.

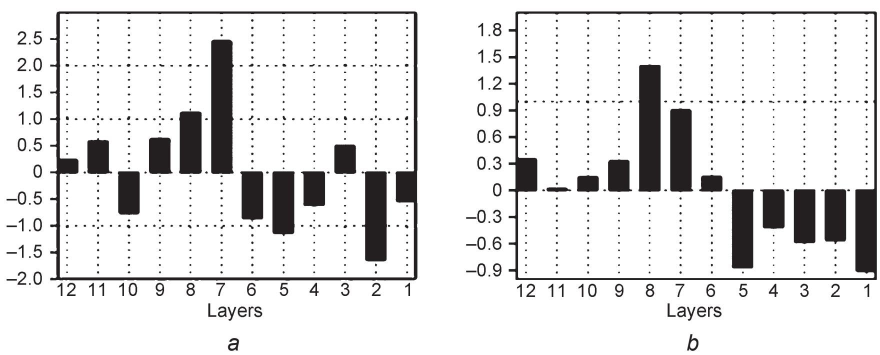

Fig. 13. First principal component based on three technological parameters of ceramics in various layers of the Yasenova Polyana sequence.
a, *b* – see Fig. 1 for explanations.

stratigraphic sequence is subdivided into two halves: layers 12–7, where five principal component scores are positive and only one is negative; and layers 6–1, where the relationship is reversed. The difference does not reach significance level (Fisher's exact test: $p = 0.08$). However, if the curve is smoothed (Fig. 13, *b*), the lower half of the sequence shows only positive values, whereas in the upper half, only one positive score is present ($p = 0.015$). Moreover, it corresponds to layer 6, which turns out to be intermediate between layers 7 and 5 not only stratigraphically but culturally as well.

The general pattern is less distinct here than in the case of Meshoko, and there is virtually no graduality. However, the regular nature of the changes is beyond doubt here as well. Detailed stratigraphic data about the occurrence of the lithics at Yasenova Polyana are unavailable.

Discussion and conclusions

Most researchers have noticed that the culture of Meshoko includes two very dissimilar cultural components. One of them, represented in the lower units of the stratigraphic sequence, is likely of southern origin, as mentioned both by the excavators and by other specialists (see, e.g., (Andreyeva, 1977: 44; Trifonov, 2001)). Being earlier than Maikop, this culture anticipates it in a sense. Like Maikop, it reveals no local roots. The culture that gradually displaced it can be termed the culture of ceramics with interior-punched node decoration—the term that is sometimes erroneously applied to the entire culture of Meshoko and related sites. The later culture is quite different from that of the lower horizons and, paradoxically, is much more archaic, despite a few copper tools, which are absent in the lower layers. This culture shows no southern roots, whereas local ones are quite evident (an unexpected and striking proof of this is the technological parallel between certain shards from the upper layers of Meshoko and the ceramics of Nizhne-Shilovskaya).

Extending the term "culture of ceramics with interior-punched node decoration" to all pre-Maikop sites of northwestern Caucasus, as certain researchers do, is unwarranted. Fragments with this decoration are absent in the three bottom horizons of Meshoko—they first appear only in layer 11 of the control excavation, and initially their number is quite small. The ceramics of Yasenova Polyana display the same regularity: the interior-punched node design is present only on pottery from the middle and upper layers (Dietler, Korenevsky, 2005–2009: 556; Rezepkin, 2000: 226). The same is true of Khadzhokh, though this site has been attributed to the Maikop culture (Rezepkin, 2000: 234).

The introduction of the interior-punched node decoration parallels the gradual degradation of ceramic technology and the sophistication of lithic industry, which, at the late stages of Meshoko, experienced a true renaissance after a complete decline at the early stage. In other words, both cultural components characterize different stages in the evolution of the material culture. Their succession might be considered a natural evolutionary process—as Korenevsky put it, "certain early technological devices growing out of use" (Dietler, Korenevsky, 2005–2009: 576)—if the actual course of events were not the reverse: the culture of the late period was more archaic than the preceding one in terms of both ceramic technology and lithic industry.

What can have caused this unusual phenomenon—the gradual nature of the changes, despite a striking contrast between the two cultural components of Meshoko? The answer must be sought in the nature of the contacts between immigrants from Transcaucasia, who built the southern Kuban fortified settlements, and the natives, against whose raids those fortresses were apparently meant to protect. All the cultural contrast and all the impressive fortification notwithstanding, their relationships were evidently not altogether hostile. Even so, it might be expected that cultural symbiosis would have resulted in the eventual displacement of a more archaic (the leading excavator, in fact, used the term "barbaric", see (Stolyar, 2009b: 75)) culture by a more advanced one. Actually the opposite process is observed. A possible reason is the numerical superiority of the natives over the immigrants. Stolyar (Ibid.: 72) may have been right in suggesting that the latter were eventually assimilated by the former. This, however, is only guesswork.

Before radiocarbon dates of southern Kuban settlements became available, A.A. Formozov (1994: 47–48), arguing against A.A. Nekhaev (1991, 1992), who had claimed that those sites predated Maikop, wrote that the acceptance of this idea would lead to a strange (as Formozov believed) idea of wave-like cultural process whereby certain cultural traits emerged and then disappeared only to reappear later. It looks as though such a process actually occurred. Whereas the people who built the Chalcolithic fortresses in the southern Kuban drainage might be regarded as the first wave of migrants from the south, the Maikop people were the second wave. Like their predecessors, they had to maintain complex relationships with the natives of the northwestern Caucasus and with the steppe tribes—relationships that we don't yet understand properly. Possibly by that time the relationships had become closer and more peaceful; indeed, the Maikop people did not fortify their settlements.

Diachronic changes and cultural heterogeneity do not necessarily result in high correlation between various quantitative traits; such a correlation should be expected only when two components, whose proportion changes over time, are involved. This, to all appearances, is the situation with Meshoko, disregarding a very small steppe component represented by ceramics tempered with crushed shells; this had no effect on the general pattern.

Yasenova Polyana is a more complex site than Meshoko. Firstly, the range of radiocarbon dates is wider there: two of the five pertain to the late 5th–early 4th millennium BC, two fall within the middle and second half of the 4th millennium, and one, even within the 3rd millennium BC (Korenevsky, 2012: 63–64). This agrees with the opinion of Rezepkin (2000) that Yasenova Polyana is at least partly contemporaneous with the Maikop and Novosvobodnaya cultures. Indeed, at Yasenova Polyana, Chalcolithic pottery co-occurs with that reminiscent of Maikop and Novosvobodnaya (Ibid.). Secondly, changes in the technological parameters of ceramics at that site do not match those observed at Meshoko. Thirdly, Yasenova Polyana is a site with a slope stratigraphy, where some displacement of units is possible (Dietler, Korenevsky, 2005–2009: 551–552). In addition, no exact statistics relating to the changes of lithic industry are available. Therefore in this case, on the basis of our analysis, we can only support the idea of the cultural heterogeneity of Yasenova Polyana, separate two approximately equal periods of its occupation, and, for the time being, confine ourselves to these modest conclusions.

Acknowledgements

I am grateful to my teachers, A.D. Stolyar and L.S. Klejn, as well as to S.M. Ostashinsky, A.D. Rezepkin, and O.V. Yanshina for their helpful comments.

References

Andreyeva M.V. 1977
K voprosu o yuzhnykh svyazyakh maikopskoi kultury. *Sovetskaya arkheologiya*, No. 1: 39–56.

Bobrinsky A.A. 1978
Goncharstvo Vostochnoi Evropy: Istochniki i metody izucheniya. Moscow: Nauka.

Bobrinsky A.A., Munchaev R.M. 1966
Iz drevneishei istorii goncharnogo kruga na Severnom Kavkaze. *KSIA*, No. 108: 14–28.

Box G.E.P., Cox D.R. 1964
An analysis of transformations. *Journal of the Royal Statistical Society*, Ser. B, vol. 26 (2): 211–252.

Dietler P.A., Korenevsky S.N. 2005–2009
Poseleniye Yaseneva Polyana kak arkheologicheskiy istochnik po epokhe eneolita i kultury nakolchatoi zhemchuzhnoi keramiki Predkavkazya. *Stratum Plus*, No. 2: 545–577.

Formozov A.A. 1954
Neoliticheskaya keramika nizhnego Podonya. *KSIIMK*, No. 53: 134–138.

Formozov A.A. 1965
Kamennyi vek i eneolit Prikubanya. Moscow: Nauka.

Formozov A.A. 1994
O periodizatsii eneoliticheskikh poseleniy Prikubanya. *Rossiyskaya arkheologiya*, No. 4: 44–53.

Govedarica B. 2005–2009
Kamennye krestovidnye bulavy mednogo veka na territorii Yugo-Vostochnoi i Vostochnoi Evropy. *Stratum Plus*, No. 2: 419–437.

Korenevsky S.N. 2006
Radiokarbonnye daty drevneishikh kurganov yuga Vostochnoi Evropy i eneoliticheskogo bloka pamyatnikov Zamok – Meshoko – Svobodnoye. In *Voprosy arkheologii Povolzhya*, iss. 6. Samara: Nauch.-tekhn. tsentr, pp. 141–147.

Korenevsky S.N. 2008
Simvolika atributov dukhovnoi vlasti epokhi eneolita Vostochnoi Evropy i Predkavkazya – kamennykh zoomorfnykh skipetrov. In *Arkheologiya vostochnoevropeiskoi stepi*, iss. 6. Saratov: Izd. Saratov. Gos. Univ., pp. 135–156.

Korenevsky S.N. 2012
Rozhdeniye kurgana (pogrebalnye pamyatniki eneoliticheskogo vremeni Predkavkazya i Volgo-Donskogo mezhdurechya). Moscow: TAUS.

Korenevsky S.N. 2016
Problemnye situatsii "post-ubeidskogo perioda" v Predkavkazye (4500–3500 let do n.e.). *Stratum plus*, No. 2: 37–62.

Korenevsky S.N., Kizilov A.S. 2015
K voprosu ob izuchenii tekhnologii izgotovleniya keramiki maikopsko-novosvobodnenskoi obshchnosti po metodike A.A. Bobrinskogo. *Samar. nauch. vestnik*, No. 4 (13): 59–71.

Kotova N.S. 2006a
O nachale kontaktov stepnogo i predkavkazskogo naseleniya v epokhu rannego eneolita. In *Voprosy arkheologii Povolzhya*, iss. 6. Samara: Nauch.-tekhn. tsentr, pp. 147–153.

Kotova N.S. 2006b
Ranniy eneolit stepnogo Pridneprovya i Priazovya. Lugansk: Vid. Skhidnoukr. Nats. Univ. im. V. Dalya.

Kotova N.S. 2013
Dereivskaya kultura i pamyatniki nizhnemikhailovskogo tipa. Kiev, Kharkov: Maidan.

Kotova N.S. 2015
Drevneishaya keramika Ukrainy. Kiev, Kharkov: Maidan.

Lucas A., Harris J.R. 2012
Ancient Egyptian Materials and Industries. New York: Courier Corporation.

Manzura I.V. 2000
Vladeyushchiye skipetrami. *Stratum plus*, No. 2: 237–295.

Markovin V.I. 1994
O nekotorykh novykh tendentsiyakh v arkheologicheskom izuchenii drevnostei Severnogo Kavkaza. *Rossiyskaya arkheologiya*, No. 4: 25–42.

Movsha T.G. 1961
O svyazyakh plemen tripolskoi kultury so stepnymi plemenami mednogo veka. *Sovetskaya arkheologiya*, No. 2: 186–199.

Nekhaev A.A. 1991
O periodizatsii domaikopskoi kultury Severo-Zapadnogo Kavkaza. In *Maikopskiy fenomen v drevnei istorii Kavkaza i Vostochnoi Evropy: Mezhdunar. simp. Novorossiysk, 18–24 marta 1991 g.* Leningrad: Izd. LOIA AN SSSR, pp. 29–31.

Nekhaev A.A. 1992
Domaikopskaya kultura Severnogo Kavkaza. *Arkheologicheskiye vesti*, No. 1: 76–96.

Nikolaeva N.A., Safronov V.A. 1974
Proiskhozhdeniye dolmennoi kultury Severnogo Kavkaza. In *Nauchno-metodicheskiy sovet po okhrane pamyatnikov kultury Ministerstva kultury SSSR: Soobshcheniya*, iss. 7. Moscow: Znaniye, pp. 174–306.

O'Brien M.J., Lyman R.L. 2002
Seriation, Stratigraphy, and Index Fossils: The Backbone of Archaeological Dating. NewYork: Springer.

Ostashinsky S.M. 2009
Opisaniye i analiz kremnevoi kollektsii stratigraficheskoi kolonki 1964 g. na poselenii Meshoko. In *Meshoko – drevneishaya krepost Predkavkazya: Otchety Severokavkazskoi arkheologicheskoi ekspeditsii 1958–1965 gg*. St. Petersburg: Izd. Gos. Ermitazha, pp. 224–237.

Ostashinsky S.M. 2012
Materialy raskopok 2007 g. na poselenii Meshoko. *Arkheologicheskiye vesti*, No. 18: 43–66.

Ostashinsky S.M. 2014
Zakubanskaya ekspeditsiya. In *Ekspeditsii: Arkheologiya v Ermitazhe*. St. Petersburg: Izd. Gos. Ermitazha, pp. 222–235.

Palaguta I.V. 1998
K probleme svyazei Tripolya-Kukuteni s kulturami eneolita stepnoi zony Severnogo Prichernomorya. *Rossiyskaya arkheologiya*, No. 1: 5–14.

Peeples M.A., Schachner G. 2012
Refining correspondence analysis-based ceramic seriation of regional data sets. *Journal of Archaeological Science*, vol. 39 (8): 2818–2827.

Poplevko G.N. 2010
Trasologicheskoye i tekhnologicheskoye issledovaniye materialov poseleniya Meshoko iz shurfa I (raskopki S.M. Ostashinskogo v 2007 g.) In *Chelovek i drevnosti: Pamyati Aleksandra Aleksandrovicha Formozova (1928–2009)*. Moscow: Grif i K., pp. 387–411.

Poplevko G.N. 2015
Tehnologiya izgotovleniya keramiki v eneolite – rannem bronzovom veke na Severo-Zapadnom Kavkaze. In *Kavkaz kak svyazuyushcheye zveno mezhdu Vostochnoi Evropoi i Perednim Vostokom (k 140-letiyu A.A. Millera)*. St. Petersburg: Izd. IIMK RAN, pp. 171–176.

Popova T.B. 1963
Dolmeny stanitsy Novosvobodnoi. Moscow: Sov. Rossiya. (Trudy GIM; vol. 34).

Rabkin E.B. 1956
Atlas tsvetov. Moscow: Gos. izd. med. lit.

Rassamakin Y. 1999
The Eneolithic of the Black Sea steppe: Dynamics of cultural and economic development 4500–2300 BC. In *Late Prehistoric Exploitation of the Eurasian Steppe*, M. Levine, Y. Rassamakin (eds.). Cambridge: Oxbow Books, pp. 59–182.

Rezepkin A.D. 1996
K probleme sootnosheniya khronologii kultur epokhi eneolita – rannei bronzy Severnogo Kavkaza i Tripolya. In *Mezhdu Aziei i Evropoi. Kavkaz v IV–I tys. do n.e.: Materialy konf., posvyashch. 100-letiyu so dnya rozhdeniya Aleksandra Aleksandrovicha Iessena*. St. Petersburg: Izd. Gos. Ermitazha, pp. 50–54.

Rezepkin A.D. 2000
Keramicheskiye kompleksy poseleniy Khadzhokh, Skala, Yasenova Polyana In *Sudba uchenogo: K 100-letiyu so dnya rozhdeniya Borisa Aleksandrovicha Latynina*. St. Petersburg: Izd. Gos. Ermitazha, pp. 223–235.

Rezepkin A.D. 2005
Eneoliticheskoye poseleniye Meshoko. In *Materialy i issledovaniya po arkheologii Kubani*, iss. 5. Krasnodar: Izd. Kuban. Gos. Univ., pp. 73–93.

Salugina N.P. 2011
The technology of the Yamnaya (Pit Grave) ceramic production and its relevance to the population history of the Volga-Ural region in the Early Bronze Age. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 39 (2): 82–94.
Schmidt H. 1932
Cucuteni in der oberen Moldau, Rumänien. Berlin, Leipzig: Walter de Gruyter.
Shepard A.O. 1956
Ceramics for the Archaeologist. Washington: Carnegie Institution of Washington.
Sinyuk A.T. 1981
Repinskaya kultura epokhi eneolita – bronzy v basseine Dona. *Sovetskaya arkheologiya*, No. 4: 8–19.
Sjøvold T. 1977
Non-Metrical Divergence Between Skeletal Populations: The Theoretical Foundation and Biological Importance of C.A.B. Smith's Mean Measure of Divergence. Stockholm: Stockholms Univ. (Ossa; vol. 4, suppl. 1).
Soloviev L.N. 1958
Novyi pamyatnik kulturnykh svyazei Kavkazskogo Prichernomorya v epokhu neolita i bronzy – stoyanki Vorontsovskoi peschery. *Trudy Abkhaz. inst. yazyka, literatury i istorii*, vol. 29: 135–184.
Stolyar A.D. 1955
Mariupolskiy mogilnik kak istoricheskiy istochnik. *Sovetskaya arkheologiya*, No. 23: 16–37.
Stolyar A.D. 1964
Poseleniye Meshoko i problema dvukh kultur kubanskogo eneolita. In *Trudy nauchnoi sessii, posvyashchennoi itogam raboty Gosudarstvennogo Ermitazha za 1963 g*. Leningrad: Izd. Gos. Ermitazha, pp. 31–32.
Stolyar A.D. 2009a
Otchet o rabotakh Severokavkazskoi ekspeditsii Gosudarstvennogo Ermitazha v 1958–1959 gg. In *Meshoko – drevneishaya krepost Predkavkazya. Otchety Severokavkazskoi arkheologicheskoi ekspeditsii 1958–1965 gg.* St. Petersburg: Izd. Gos. Ermitazha, pp. 12–39.
Stolyar A.D. 2009b
Otchet o raskopkakh Severokavkazskoi ekspeditsii Gosudarstvennogo Ermitazha v 1962 g. In *Meshoko – drevneishaya krepost Predkavkazya. Otchety Severokavkazskoi arkheologicheskoi ekspeditsii 1958–1965 gg.* St. Petersburg: Izd. Gos. Ermitazha, pp. 62–98.
Stolyar A.D. 2009c
Otchet o rabotakh Severokavkazskoi ekspeditsii Gosudarstvennogo Ermitazha v 1963 g. In *Meshoko – drevneishaya krepost Predkavkazya. Otchety Severokavkazskoi arkheologicheskoi ekspeditsii 1958–1965 gg.* St. Petersburg: Izd. Gos. Ermitazha, pp. 99–135.
Stolyar A.D. 2009d
Otchet o rabotakh Severokavkazskoi ekspeditsii Gosudarstvennogo Ermitazha v 1964 g. In *Meshoko – drevneishaya krepost Predkavkazya. Otchety Severokavkazskoi arkheologicheskoi ekspeditsii 1958–1965 gg.* St. Petersburg: Izd. Gos. Ermitazha, pp. 136–167.
Stolyar A.D. 2009e
Fenomen drevneishei kreposti Meshoko (konets V – nachalo IV tys. do n.e. In *Meshoko – drevneishaya krepost Predkavkazya. Otchety Severokavkazskoi arkheologicheskoi ekspeditsii 1958–1965 gg.* St. Petersburg: Izd. Gos. Ermitazha, pp. 195–207.
Trifonov V.A. 1996
Popravki k absoliutnoi khronologii kultur epokhi eneolita – bronzy Severnogo Kavkaza. In *Mezhdu Aziei i Evropoi. Kavkaz v IV–I tys. do n.e. Materialy konf., posvyashch. 100-letiyu so dnya rozhdeniya Aleksandra Aleksandrovicha Iessena*. St. Petersburg: Izd. Gos. Ermitazha, pp. 43–49.
Trifonov V.A. 2001
Darkveti-meshokovskaya kultura. In *Tretya Kubanskaya arkheologicheskaya konferentsiya: Tezisy dokladov*. Krasnodar, Anapa: pp. 190–194.
Vasiliev I.B. 2003
Khvalynskaya eneoliticheskaya kultura Volgo-Uralskoi stepi i lesostepi (nekotorye itogi issledovaniya). In *Voprosy arkheologii Povolzhya*, iss. 3. Samara: Nauch.-tehn. tsentr, pp. 61–99.
Videiko M.Y. 1994
Tripolye – "pastoral" contacts: Facts and character of the interactions: 4800–3200 BC. *Baltic-Pontic Studies*, vol. 2: 5–28.
Zaitseva G.I., Burova N.D., Sementsov A.N. 2004
Pervye radiouglerodnye daty poseleniya Meshoko. In *Nevsky arkheologo-etnograficheskiy sbornik: K 75-letiyu kand. ist. nauk A.A. Formozova*. St. Petersburg: Izd. SPb. Gos. Univ., pp. 365–368.

Received August 14, 2016.

DOI: 10.17746/1563-0110.2017.45.1.076-082

E.A. Kashina
State Historical Museum,
Krasnaya pl. 1, Moscow, 109012, Russia
E-mail: eakashina@mail.ru

A Dugout from the Don River Exhibited at the State Historical Museum, Moscow: Discovery and Dating

A rare archaeological specimen from the Middle Don River, a large dugout found in 1954, is described. The history of discovery, fieldwork, and conservation are outlined. The key role at all stages belonged to M.E. Voss, who did her best to unearth and preserve the specimen—the first prehistoric dugout to be found, restored, and exhibited in the USSR. She passed away before being able to describe the boat in detail. Its age is still problematic. Though it is exhibited among the Mesolithic, Neolithic, and Chalcolithic finds and has been tentatively dated to the late third or early second millennium BC, certain facts relating to the archaeological context contradict this date, and no radiocarbon analysis has been conducted. A brief review of reportedly Stone Age dugouts from Europe is provided, with reference to discovery, restoration, and exhibition. Most appear to be younger than the Stone Age.

Keywords: *Dugouts, peat-bog sites, Eastern Europe, Western Europe, radiocarbon age, fossilized wood.*

Introduction

The wooden dugout is an essential show-piece of the permanent exhibition in Hall 3 of the State Historical Museum, which hall is devoted to the Mesolithic, Neolithic, and Chalcolithic ages of Russia. The guide's description of the climate situation at the boundary of Pleistocene and Holocene, the evolution of various types of economy, and the directions of the cultural contacts of peoples begins from this dugout. The history of the find is quite interesting in itself; and also, some unsolved problems are connected with the dugout: most prominently, the problem of its dating. I have studied the history of the find in materials from the personal archive of M.E. Voss, researcher of the State Historical Museum, specialist in the Stone and Bronze ages of the forest zone of Eastern Europe. Her investigations from 1930 to 1950 put in place the foundation of modern studies of the Eastern European cultures of hunters-gatherers-fishermen. This vast archive is kept in the Department of Written Sources of the State Historical Museum, and the dugout material totals more than 50 sheets, including the field diary, rough copies of the report, field sketch, and some photographs.

History of the find

In summer of 1954, the Senior Researcher of the First Archaeology Department of the State Historical Museum, Maria E. Voss (for more detailed information about her life and work see (Kashina, Yakushkina, 2015)) received a message from the local historian and lecturer of the Voronezh University, V.A. Afonyushkin, and the researcher of the Voronezh Regional Museum of Local History, D.D. Leonov. They reported that near the village of Shchuchye in the Liskinsky District of the Voronezh Region, after the spring flood, local villagers had found remains of a boat in a coastal landslide of the Don River, at a depth of 5 m from the daylight surface. One of the leading experts on the Stone Age at that time, A.Y. Bryusov, the Head of the First Archaeology Department, immediately made arrangements to excavate and transport the boat to Moscow to exhibit it in the State Historical Museum. Thus, this ancient boat was the first in the USSR to be investigated during the excavation works. The Museum allocated funds for the field works, and in August 1954, Maria Voss, with two colleagues from Voronezh, left for Shchuchye. There, some villagers were hired, an excavation trench 5 × 13 m was established, and for about a week (from August 25 to September 3), excavations were carried out in the wet layer (cleaning of the coastal landslide), with the stratigraphy from the daylight surface recorded in the drawing. Also, 23 soil samples were taken for pollen-analysis. The dugout was cleaned, measured, and photographed in situ. After the primary conservation had been made, the dugout was transported to Moscow. Maria Voss passed away from cancer a year afterwards, and she left only a short typewritten record and made a report to the museum. On the basis of this report, and relying on his own observations and photographs, which are absent in the Voss archive, Afonyushkin wrote an article (1958). Afterwards, the dugout from Shchuchye was described in publications only twice (Okorokov, 1994: 164–167; Zhuravleva, Chubur, 2010), and these articles were based exclusively on the publication of Afonyushkin.

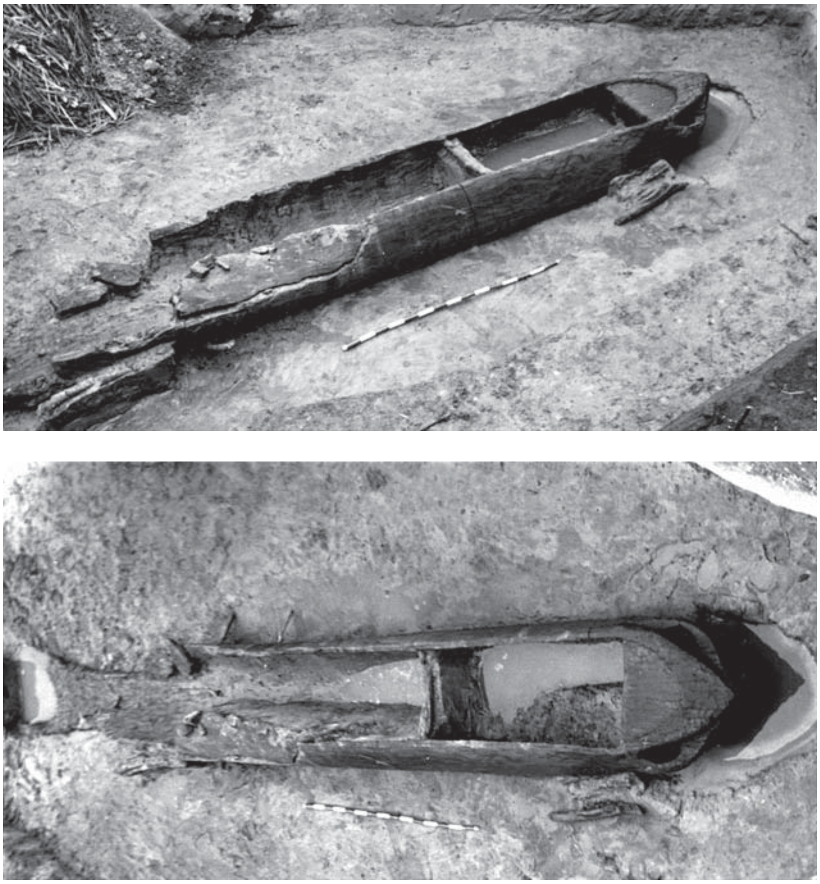

Fig. 1. The dugout found near Shchuchye in 1954 (in situ).

The dugout was noticed by employees of the steamship line in spring, and was probably totally intact; but by the July 1954, it had been seriously damaged by local villagers. The fore part was destroyed up to one-third (Fig. 1)*. When the water receded a little, Afonyushkin covered the boat with soil till Maria Voss's arrival. The length of the dugout was 7.5 m, the width 60 cm, the height 90 cm, the thickness of the boards varied from 4 to 8 cm, the thickness of the bottom was about 20 cm. The material was an oak trunk about 1 m in diameter, processed at its ends (for a more detailed list of dimensions see (Afonyushkin, 1958)). Close to the stern, at the top of the boards, two pairs of holes remained; into one pair of holes, a crossbar with a rounded cross-section 6 cm in diameter was set. An expressive feature of the dugout is the "ears", cut through at the stern. According to villagers, similar "ears" were evident on the destroyed bow. On the pointed stern, there is a solid ledge; allegedly, the one was also on the bow. There are no traces of fire, and no accompanying artifacts were found in the trench. Under the dugout and nearby, there were two fragments of small logs. According to Voss, at least one of them had been deliberately put under the hull. Before the boat was preserved and restored, it showed some traces of processing with a concave (as defined by Voss and Afonyushkin) stone tool (Fig. 2); some wood at the bottom under the stern ledge was not extracted; and there was bark left in the bottom. That's why both researchers concluded that the fabrication of the dugout was not finished, and the boat had never been in use.

Professor of Voronezh University M.N. Grishchenko dated the sandy-silty layer, where the dugout was deposited, to the Subatlantic or Subboreal period (Ibid.). Relying on this opinion and supposing that the bedding (35 thin layers of sand and silt) of the sediments inside and around the dugout indicated its presence in shallow waters of a waterbody without constant current, where

*Illustrations 1–4 kindly provided by the Department of Written Sources of the State Historical Museum archive.

Fig. 2. The stern of the dugout.

Fig. 3. Packaging of the dugout for delivery to Moscow.

wooden debris, sand, and silt were brought every year by flood, Afonyushkin argued: "In conditions of seasonal low-water period, the dugout was partly located below the water-level. Thus, it can be suggested that at the time of the boat's burial, the water-level was lower than today. Such a low water-level of our rivers is typical of the arid subboreal period (3000–2500 BC)" (Ibid.: 84). In this way, the idea that the dugout should be attributed to the boundary between Neolithic and Bronze ages was formed, and reproduced from article to article.

The samples of soil taken during the excavations were sent to a well-known expert on peat and geobotanics, Prof. S.N. Tyuremnov, at the Moscow Institute of Peat. However, because of the decease of Maria Voss and Tyuremnov's moving to Moscow State University in 1959, the results of the analysis were not published, and the samples disappeared (oral report of the Associate Professor of East-European Institute of Peat, L.V. Kopenkina).

The transportation of the dugout from the place of discovery to Moscow was a particular engineering challenge. According to Voss, the waterlogged wood had the consistency of sponge. It was impossible to lift the dugout with a crane using ropes, so it was impregnated with polyvinyl butyral, enveloped in marsh grass, and wrapped with cellophane and canvas cloth (Fig. 3). Then, a case made of oak boards was built around the boat (with a total weight of 1500 t). The case was lifted with a crane, loaded on a barge, and towed to Liski town, whence it was finally delivered by train to Moscow, to the State Historical Museum's yard. Shortly thereafter, a brief article about this unique find was published in *Ogonyok* magazine (Sinelnikov, 1954).

Restoration and exhibition of the dugout in the State Historical Museum

After some consultation with experts and restorers, the Archaeology Department employees impregnated the dugout, which was placed in the museum basement, with phenol-formaldehyde resin, as recorded in the annual reports of the Department for 1955 and 1956 (VAOPI GIM. Inv. 1, No. 1092, 1119). Then it was moved into the building and, initially, installed in Hall 4, dedicated to the Bronze Age (Fig. 4). In 1965, during a regular re-exposition, the boat, with a pedestal, was moved into Hall 3 (Mesolithic–Chalcolithic). The reason for this is difficult to explain. The decision was probably made by V.M. Rauschenbach and I.K. Tsvetkova, followers of A.Y. Bryusov, who was very weak at the time and died in 1966. The pedestal of the dugout has a hidden wheeled base: it can be rolled out into the hall up to two-thirds of its length. This pedestal is still in use (Fig. 5).

By the start of the dugout's exhibition, the lost fore-part had been almost completely restored. It was built as a nearly exact copy of the stern, only slightly narrower. An amorphous piece of wood, attached on top of the bow (it can be clearly seen at Fig. 5 at the left) was probably determined to imitate the remains of a sculptured head of an elk, like on the boats depicted in petroglyphs of White

Sea and Fennoscandia regions. It is known that Bryusov looked for a material prototype of these representations (Klein, 2014: 259) and possibly asked the restorers to make this detail on the boat from Shchuchye.

Along the upper part of the boards on the inside, imitations of holes were made in the form of hollows. According to the records of Voss, only two pairs of holes were certainly noted in the stern part of the boat, and the rest were not reported. Six double bulkheads were inserted into the hollows, and the preserved bulkhead with a rounded cross-section was removed. Its location is currently unknown, it is not mentioned in the museum inventories. Probably the artificial bulkheads served as cross-braces, and were made on the advice of the restorers. The dugout is now exhibited without them. In 1984, when the State Historical Museum was closed for reconstruction, restorers performed another considerable conservation of the boat, using impregnation with polybutyl methacrylate, foam inserts, and painting (Turishcheva, Kozlov, 1999). In 1997, the new exposition was opened, and the dugout was exhibited without a cover for some time; but for safety reasons, it was decided to use the new glass cover.

Other fossilized boats from Liskinsky District

The River Don in Liskinsky District of the Voronezh Region has yielded plenty of fossilized boats. In 1911, close to the mouth of the Ikorets River (ca 4 km north of Shchuchye), villagers found a boat ca 11 m long without "ears", with a "cross-cut" stern and holes in the upper part of the boards. The boat was sawn for cattle bunks, which were in use till the Second World War (OPI GIM. Inv. 487, No. 103) (Afonyushkin, 1958: 89).

In 1956, after the death of Maria Voss, the villagers of Shchuchye reported a find of another boat, only 400 m from the dugout found in 1954. It had also been damaged by the locals at the beginning of archaeological studies (Fig. 6). Afonyushkin published an article about this find (1960), and the boat was taken to the Voronezh museum. At the initiative of A.V. Okorokov in 1994, L.D. Sulerzhitsky estimated its age as 2240 ± ± 40 BP (GIN-8160, uncal.), which corresponds to the Early Iron Age (Okorokov, 1994: 169).

Fig. 4. The dugout in Hall 4 of the State Historical Museum (1956–1965).

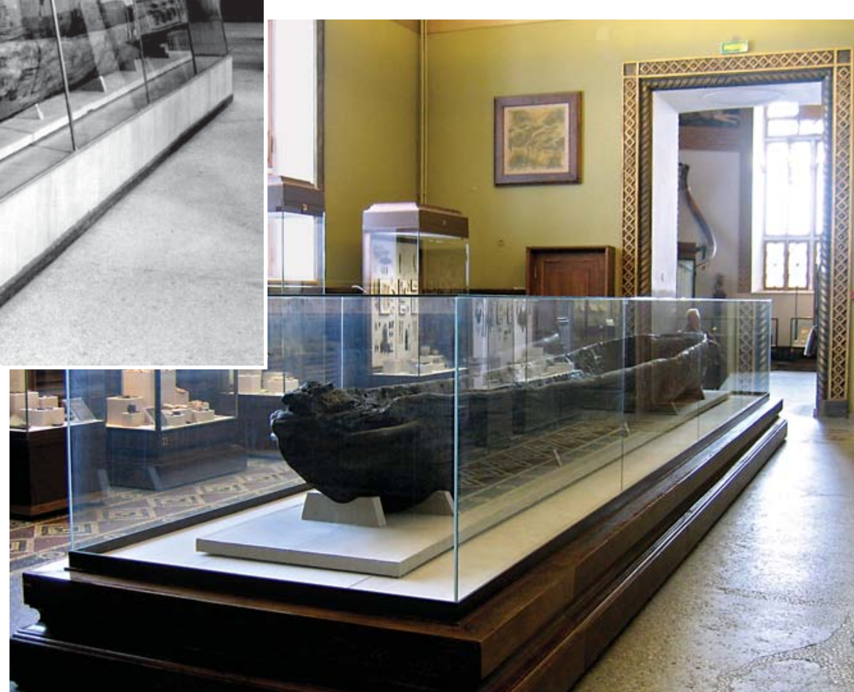

Fig. 5. The dugout in Hall 3 of the State Historical Museum.

Fig. 6. The dugout found by V.A. Afonyushkin near Shchuchye in 1956 (the photograph was obtained by the employees of the First Archaeology Department from Afonyushkin in 1950–1960s).

Afonyushkin himself dated both dugouts to the late third–early second millennium BC, basing this on the fact that the depth of occurrence of both boats was 5 m (1960: 136–137). Now, only a fragment of the bottom is exhibited at the Voronezh Regional Museum of Local History, in the hall of the Neolithic–Chalcolithic.

In 1992, 40 km to the west of Shchuchye, near the village of Uryv-Pokrovka, one more dugout was found (Fig. 7)*. Its length was 9.5 m. This time, the dugout was unearthed (by employees of the Ostrogozhsky Museum of History and Art) without significant damage. There were no funds for conservation, media publishing of the find didn't help, and the director of the museum decided to put the dugout in a steel gas tube and flood it in an artificial reservoir. The dugout is still there.

Issues of dating of the dugout from Shchuchye

After 60 years, the dating of the dugout is still problematic. There are no accompanying artifacts. On the photograph made in 1954, the traces of adze-work can be seen (Fig. 2), the dimensions of which are described by Afonyushkin in detail; but this is insufficient to conclude the use of a stone tool. The boat was repeatedly processed with chemicals, and now has a smooth surface with longitudinal cracks. Therefore, it cannot be now reliably determined by direct visual inspection whether a stone or a metal tool was used. Dendrochronological analysis is most likely also impossible, owing to the conservation effects and to the absence of reference samples for this region. Palynological samples taken many years ago are lost. The radiocarbon method was unknown at that time. Reportedly, Bryusov immediately delivered a piece of wood to the Institute of Forest for elaboration of the conservation strategy; but it is unknown whether it has been destroyed, or is still kept somewhere. Most probably it is also lost, like the single bulkhead. Experts on radiocarbon dating (Y.V. Kuzmin and N.E. Zaretskaya) suppose that there is a hypothetical possibility of using the AMS-method to date a sample taken with a cylindrical

Fig. 7. The dugout found near Uryv-Pokrovka in 1992.

*I thank the Director of the Ostrogozhsky Museum of History and Art, M.I. Pilipenko, and journalist V.T. Kulinchenko for providing the photographs, texts, and oral reports.

drill from the depth of the stern massive, but it is hard to tell if it is possible to clean the sample from admixtures (oral reports).

One can try to determine the relative chronology of the fossilized boats from Liskinsky District by the condition of their wood. Thus, the dugout found in 1911 was very firm. Those found in 1956 and 1992 were extracted from the river with ropes and a crane; and they didn't fall apart. The condition of the find of 1954 was somewhat different: according to the description of Voss in her field diary, the wood "caved in when pressed with a finger" (OPI GIM. Inv. 487, No. 103, fol. 51), one board fell off, and it was impossible to lift the dugout with ropes. Soil scientist M.A. Bronnikova believes that the availability of iron and sulfur in soil-deposits of this microregion could have had a destructive impact on the wood with air penetration; therefore its sponge structure cannot definitely point to a more ancient age of the dugout than the other three (oral report). According to a specialist on fossilized wood, E.K. Kublo, the condition of the "wet" fossilized wood depends on its type, and oak usually remains hard. But what the reason for the different condition of the boats is, she cannot tell (oral report). Notably, only the dugout of 1954 can be reliably considered to be made of oak, because this find was studied by the experts at the Institute of Forest and the Institute of Peat; whereas the data on the wood of the remaining boats are not supported by scientific research.

Thus, radiocarbon dating is the most effective method of estimating the age of fossilized dugouts, because the look of the most ancient samples is similar to that of the recent samples. This method has proved itself in the study of many other boats dating to the Early Iron Age, Middle Ages, Modern and Contemporary periods (Okorokov, 1994: 169–181; Zhuravleva, Chubur, 2010).

Review of the Stone Age dugouts in Western and Eastern Europe

A large body of literature is dedicated to the dugouts of the Stone Age, but there is no recent and complete review of them: the information is scattered over separate articles. The Pesse canoe (Netherlands, 7500 cal BC), 2 m long, made of pine, is believed, as of today, to be the oldest. Then comes a series (several dozen) of remains of boats belonging to the Ertebølle culture of Denmark and Northern Germany, and to the Cortaillod culture of Switzerland, dating to 5000–4000 cal BC. Also, some Meso- and Neolithic dugouts have been found in France and Italy (Andersen, 1987; McGrail, 1987; Lanting, 2000; Klooss, Lübke, 2009). They are made of oak, aspen, or linden, and their length is from 6 to 10 m. Some of them were found during underwater rescue excavations. Construction features of some Danish dugouts include the occurrence of the cut-in stern plank and the clay platform on the bottom for making a small fire, probably for night fishing, especially for eel-fishing. Also, in Denmark, boat-burials have occurred (Grøn, Skaarup, 1991). In Europe, multiple dozens of dugouts relating to Bronze and Early Iron Ages have been found (Lanting, 2000); in the European part of Russia, also, lots of them are known (Okorokov, 1994: 169; Zhuravleva, Chubur, 2010). In the territory of the former USSR, fragments of boats have been found in the Šventoji-1B site (Lithuania, the layer is dated to 3500 BC), and two models (?) ca 50 cm long in the Šventoji-2B site (the layer is dated to 4000–3000 cal BC) (Rimantiene, 2005: 79, 266, 288, 321–322). Two large fragments (one of them more than 2 m long) of dugouts made of aspen or poplar were found in Sārnate, Latvia, also in Neolithic layers. These are not exhibited, and not radiocarbon-dated (Vankina, 1970: 92; Berzins, 2000). Interestingly, in Trans-Urals peat-bogs, no similar finds are known, though lots of oars occur there (Kashina, Chairkina, in press).

Conclusions

Saving, preservation, and museumification of fossilized dugouts represent another issue. All the boats from the Don River, except for the one found near Uryv-Pokrovka, were irreparably damaged by local villagers. From my point of view, the first thing that should be done upon discovery of a fossilized boat is to take several samples for radiocarbon analysis (and to plan distribution of samples to various laboratories); and only after that, take other measures. This demands considerable funds for preservative agents, labor costs and time; and also free space for exhibition with controlled conditions of temperature and humidity. Exactly owing to the lack of funds and free museum space, the Uryv-Pokrovka dugout is still in the tube under water. The same problems exist even in the West. Recently, there was a museum scandal in Germany: it was found out that in the Museum of Stralsund , several fossilized dugouts made of linden are falling apart, because they were not preserved properly (http://www.monoxylon.ch/?s=stralsund&lang=de).

The originality of the dugout investigated by M.E. Voss consists in the complicated execution of the stern (and probably of the bow, which is completely lost), occurrence of the solid ledges, and of four through "ears". No such details are known in any other found sample. Taking into account the date obtained for the "neighboring" dugout found in 1956, it can be suggested that the 1954 find, which was so different in its morphology, relates to another period; but it's hard to tell whether this period was before or after the Early Iron Age. Judging from the context of all fossilized dugouts, those of the Stone Age could have remained only in peat deposits. Thus, the find from Shchuchye most likely doesn't belong to the Stone Age. The main task for its further study is to try to obtain a radiocarbon date using the AMS-method. Then, possibly, the issue of dating this dugout will be finally solved.

References

Afonyushkin V.A. 1958

Drevniy cheln iz sela Shchuchye Voronezhskoi oblasti. *Trudy Voronezh. Gos. Univ.*, vol. 51 (1): 81–89.

Afonyushkin V.A. 1960

Novaya nakhodka drevnego chelna u sela Shchuchye Voronezhskoi oblasti. *Trudy Voronezh. obl. kraeved. muzeya*, No. 1: 134–143.

Andersen S.H. 1987

Mesolithic dug-outs and paddles from Tybrind Vig, Denmark. *Acta Archeologica*, vol. 57 (1986): 87–106.

Berzins V. 2000

The conditions of travel and transport in the Stone Age. In *Muinasaja Teadus: De temporibus antiquissimis ad honorem Lembit Jaanits*, iss. 8. Tallinn: Ajaloo Instituut, pp. 27–48.

Grøn O., Skaarup J. 1991

Møllegabet II – a submerged Mesolithic site and a 'boat burial' from Ærø. *Danish Journal of Archaeology*, vol. 10 (1): 38–50.

Kashina E.A., Chairkina N.M. (in press)

Derevyannye vesla iz torfyanikovykh pamyatnikov Zauralya. *Archaeology, Ethnology and Anthropology of Eurasia*.

Kashina E.A., Yakushkina M.M. 2015

M.E. Voss i Gosudarstvennyi istoricheskiy muzei: Muzeinaya deyatelnost issledovatelnitsy po materialam lichnogo arkhiva. *Uralsky istorichesky vestnik*, No. 3 (48): 37–43.

Klein L.S. 2014

Istoriya rossiyskoi arkheologii: Ucheniya, shkoly i lichnosti, vol. 2. St. Petersburg: Evraziya.

Klooss S., Lübke H. 2009

The terminal Mesolithic and Early Neolithic logboats of Stralsund-mischwasserspeicher: Evidence of early waterborne transport on the German Southern Baltic Coast. In *Between the seas: Transfer and exchange in nautical technology: Proc. of the 11th intern. symp. on the boat and ship archaeology, Mainz, 2006*, R. Bockius (ed.). Mainz: Verl. des Römisch-Germanischen Zentralmuseums, pp. 97–105.

Lanting J.N. 2000

Dates for origin and diffusion of the European logboat. *Palaeohistoria*, vol. 39/40 (1997–1998): 627–650.

McGrail S. 1987

Ancient boats in NW Europe: The archaeology of water transport to AD 1500. London, New York: Longmans.

Okorokov A.V. 1994

Drevneishiye sredstva peredvizheniya po vode. Kaliningrad: Muzei Mirovogo okeana.

Rimantiene R. 2005

Die Steinzeit-fischer an der Ostseelagune in Litauen. Vilnius: Litauisches Nationalmuseum.

Sinelnikov A. 1954

Naiden drevniy cheln. *Ogonek*, No. 46: 17.

Turishcheva R.A., Kozlov A.V. 1999

Restavratsiya drevnego chelna iz kollektsii GIM. In *Restavratsiya muzeinykh tsennostei: Nauchnye i prakticheskiye raboty*. Moscow: GIM, pp. 93–98. (Trudy GIM; iss. 107).

Vankina L.V. 1970

Torfyanikovaya stoyanka Sarnate. Riga: Zinatne.

Zhuravleva Y.B., Chubur A.A. 2010

Srednevekovoye sudostroyeniye v Yugo-Vostochnoi Rusi (basseiny Desny i Oki) po arkheologicheskim istochnikam. In *Voprosy podvodnoi arkheologii*. Moscow: Mosk. podvodno-arkheol. klub, pp. 25–44.

Received May 14, 2015.

DOI: 10.17746/1563-0110.2017.45.1.083-092

I.V. Palaguta[1] and E.G. Starkova[2]
[1]Saint Petersburg Stieglitz State Academy of Art and Design,
Solyanoy per. 13, St. Petersburg, 191028, Russia
E-mail: ipalaguta@yandex.ru
[2]The State Hermitage Museum,
Dvortsovaya nab. 34, St. Petersburg, 190000, Russia
E-mail: astarkova2012@yandex.ru

A House Model from Popudnya, Cucuteni-Tripolye Culture, Ukraine: A New Interpretation*

In 1911, during the excavation of a Cucuteni-Tripolye settlement near Popudnya, now Cherkasy Region, Ukraine, the Polish archaeologist Marian Himner discovered a unique house model reproducing the interior with two anthropomorphic characters. The model was repeatedly discussed in the archaeological literature. However, an analysis of the find, owned by the National Archaeological Museum in Warsaw, and its parallels, using archival photographs of the early 1900s, kindly provided by Polish colleagues, suggests a different interpretation. The model shows the interior of a typical Tripolye dwelling, similar to the interiors of buildings excavated at the settlements of Tripolye BII–CI stage in the Dnieper-Bug interfluve. Contrary to a popular view, there is no "idol" inside. Rather, there are two naturalistically rendered characters, male and female. The woman is grinding grain, and the man is sitting in front of the stove, watching her. The closest three-dimensional "narrative" models come from the Sushkovka and Chichirkozovka settlements, related to the same Tomashovka-Sushkovka local group of sites as Popudnya. This group includes the famous Tripolye giant settlements 300–400 ha in area, with an estimated population of 5–8 thousand. The naturalism of the Popudnya model resembles the naturalistic style of anthropomorphic figurines from settlements of the same group. We suggest that the scene depicted by the model either refers to a specific folkloric or mythological motif or visualizes a benevolent formula relating to the foundations of a household.

Keywords: *Cucuteni-Tripolye culture, house models, anthropomorphic figurines, Tomashovka-Sushkovka sites.*

Introduction

The materials of any archaeological culture include artifacts that most explicitly manifest important aspects of the spiritual life of its carriers, hidden from us by time. Despite the fact that such finds are mentioned in numerous publications, scholars return to them time and again both to analyze them from new viewpoints and to reconsider the previous interpretations.

One of such objects originating in the Tripolye culture, which evolved in the south of Eastern Europe for over a millennium from the late 5th until the early 3rd millennium BC, is the model of a dwelling. This object was found in 1911 at a settlement near the village of Popudnya of Lipovetsky Uyezd of the Kiev Governorate, now Monastyrishchensky District of Cherkasy Region, Ukraine (Fig. 1). This object has been the basis for various interpretations of early agricultural portable art; however,

*Part of work performed by E.G. Starkova is supported by the Russian Foundation for the Humanities (Project No. 13-01-00016).

a number of details and the established circle of parallels make it possible to take a fresh look at this unique work of art of prehistoric Europe.

The Model from Popudnya: discovery and reconstructions

The excavations at the settlement of Popudnya were headed by M. Himner, a young employee of the Prehistoric Museum of the Warsaw Scientific Society, on behalf of Prof. E. Majewski, a member of the Imperial Russian Archaeological Society, who could not participate in the excavations due to poor health (Majewski, 1913a: 226). Thirty five dwellings, arranged in a circle, were discovered at the site covering an area of about 15 hectares; 23 dwellings were excavated (Videiko, 2004: 430). In the system of modern periodization, this settlement belongs to the Tripolye CI period, more precisely, to the first phase of the Tomashovka-Sushkovka local chronological group of sites in the Dnieper-Bug interfluve (Kruts, Ryzhov, 1985).

This clay model of a dwelling stands out from among numerous finds of pottery fragments and several dozen intact vessels, as well as anthropomorphic and zoomorphic figurines. The model was first published by Majewski in 1913 shortly after its discovery (1913a–c) and was described in detail by M. Himner, who at that time was a student at the Sorbonne in Paris, in his graduation thesis. Himner died in 1916 in the First World War. Seventeen years later, his thesis was published in the Warsaw Journal *Swiatowit* and to this date it is the most complete publication of the materials from this site (Himner, 1933). The unique find from Popudnya—the model of a dwelling—had a dramatic destiny. During the Second World War, it was brought to Germany from the destroyed city of Warsaw, then it was returned in 1947, and is now kept in the National Archaeological Museum. It is known that Majewski considered the model from Popudnya an extremely valuable object and fearing for its safety commissioned in 1913 an exact copy from the sculptor S. Roel, which was then exhibited in an exposition (Krajewska, 2009). After the death of Majewski, his wife gave both the original and the copy as a gift to the Prehistoric Museum of the Warsaw Scientific Society, which in 1945 was integrated with the National Archaeological Museum. According to the testimony of the Museum employee M. Krajewska, who alluded to the words of S. Sałaciński, the Head of the Neolithic Department, only the original has survived until the present day; it is unknown what happened to the copy (Ibid.: 40). Unfortunately, the original model was heavily damaged during a fire in the collections of the Warsaw Archaeological Museum in 1991, and was subjected to significant restoration. As a result, only the base remained from the original model, and the interior was almost completely replaced, except for one surviving vessel (Fig. 1, *1–3*).

Scholars have proposed various interpretations of the model, but all of the interpretations were based on the first publications and relied on black-and-white photographs taken by Majewski. In 2013, the present

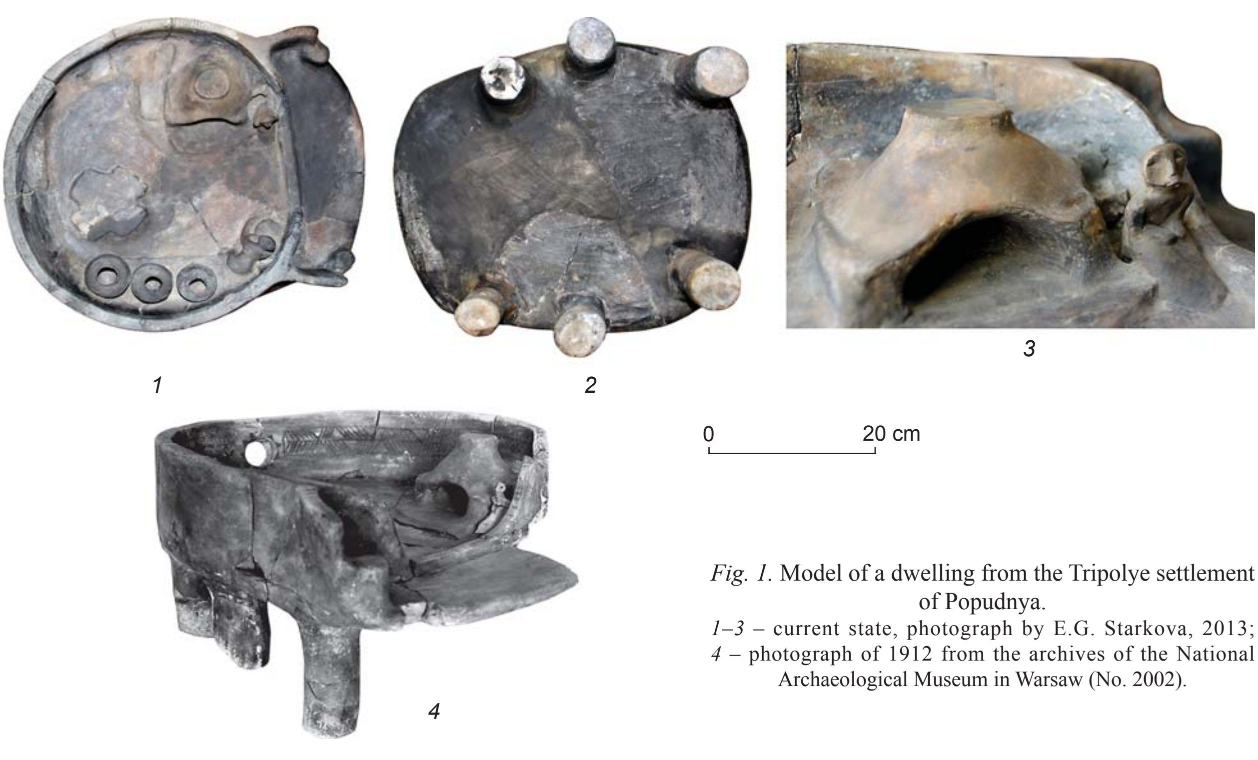

Fig. 1. Model of a dwelling from the Tripolye settlement of Popudnya.
1–3 – current state, photograph by E.G. Starkova, 2013; *4* – photograph of 1912 from the archives of the National Archaeological Museum in Warsaw (No. 2002).

authors had the opportunity to examine, photograph, and make a detailed description of the Popudnya find using the archival photographs from the collection of the Warsaw Archaeological Museum.

The model of the dwelling was discovered in Popudnya in 57 fragments, and the process of its reconstruction was published by Majewski (1913c). This is the largest model found throughout the entire history of research into Tripolye-Cucuteni. Its base is an oval clay platform with rims, which rests on six leg-posts. A small addition is located at the entrance, which is bound on two sides by projections of the walls flattened on top. The size of the platform is 40.5 × 36.0 cm; the total height of the model is 19 cm; the height of the rim is 9 cm; the height of the legs is 10 cm and their diameter is 4.5–5.0 cm. The thickness of the rim ranges from 0.8 to 1.3 cm. The interior surface of the walls was painted with dark brown or black paint, and a series of parallel lines was made on top of the rim (Fig. 1, *4*).

In the black-and-white photographs published by Majewski, the model is shown from two angles: from the top and from the sides. A part of the frontal part and two legs are missing. We may learn about the decoration on the interior surface of the walls only from the descriptions (Majewski, 1913a: 231; Himner, 1933: 152), since it is almost invisible in the photographs. Only a series of cuts can be clearly seen on the top of the rim. Himner wrote that the ornamental decoration resembled woven willow branches, and the window was framed by a pattern of triangular notches on the inside and the outside. Majewski only mentioned in passing the pattern in the form of a fence on the interior surface of the walls. T.S. Passek (1938: 236) later referred to the description of Himner. Thus, the authors only mentioned that the pattern on the interior surface of the rim resembled the representation of wicker weaving. However, two studies of Passek contained a drawing of the model from Popudnya where the ornamental decoration was rendered as a series of diamond shapes (1941: 219, fig. 10; 1949: 95, fig. 5, *4*). This drawing was not made by the author: the caption under the drawing in the article of 1941 indicated "after Buttler-Haberey" (in the study of 1949, the same drawing was reproduced without this reference). This caption refers to the book by W. Buttler and W. Haberey on the settlement of the Köln-Lindenthal Linear Pottery culture, where a photograph of the model from Popudnya clearly showed an ornamental pattern on the upper third of the rim, and triangular cogs filled with black paint, which framed the window (Buttler, Haberey, 1936: Taf. 32). The same pattern on the rim can be seen in the archival photographs of the model in the process of its restoration (Fig. 1, *4*). Thus, it is possible to agree with Himner and Passek that the ornamental decoration on the rim imitated the wicker weaving from which the frame of the wall was made.

The interior of the dwelling contains a stove to the right of the entrance, a cross-shaped elevation measuring 9.5 × 9.2 cm in the center, and three large pear-shaped vessels, attached to an elevation 0.5–0.6 cm in height, which runs along the left wall. The height of the vessels ranges from 3.5 to 4.5 cm; the diameter of their necks is 1.8–1.9 cm. Two of them have several deep parallel incisions in their upper part.

The stove is square in plan with walls 9.6 cm long; it is a domed structure with a flattened rounded top. Two small rounded protrusions were made outside of the stove opening; these protrusions have not been reproduced in the latest restoration of the model. A step is adjacent to the left wall of the stove, which was interpreted as a bench (Passek, 1938: 237). There is also a protrusion at the right wall, but it is small, of subsquare shape and resembles a seat. A low pedestal on which the stove together with the "bench" and "seat" are located, looks similar to the cross-shaped elevation in the center of the dwelling.

A seated anthropomorphic figurine was placed to the right of the entrance, between the stove and the wall. It does not show sexual features; the head was made with three pinches; the eyes are marked with rounded through punctures, which is typical of the Tripolye figurines of the middle and late periods. The posture of the figurine is of particular interest: it is a sitting figure with crossed arms on the chest and crossed legs (Fig. 2, *1*). A note on the position of the legs can be found in the study of Majewski, but he did not comment on it in any way (1913a: 235). Parallels to this posture have not been found among the statuary of the Tripolye-Cucuteni.

The gaze of the figure sitting by the stove is directed at another human figurine kneeling to the left of the entrance (Fig. 2, *4*). Its head is also made with three pinches, and the eyes are rendered with through punctures. The palms with fingers are outlined, which is a rare feature in the traditional Tripolye figurines*. This is clearly the image of a woman: although the posture makes it difficult to determine the gender of the figure, one of the archival photographs taken during the restoration process shows the figurine separately with breasts clearly indicated (Fig. 2, *2*). The character is holding the upper stone of a hand-mill located in a special "trough", fashioned from clay bolsters.

Thanks to the archival photos, we have some idea about the specific features of the manufacturing technique of the model. In the process of its modeling, the craftsman had to solve far more complex technical problems than the problems occurring in forming pottery vessels. In order to prevent subsequent deformation, the plate that served as the base of the model had been previously

*Unfortunately, both figurines, restored after damage from the fire of 1991, were greatly changed and do not show most of the important details.

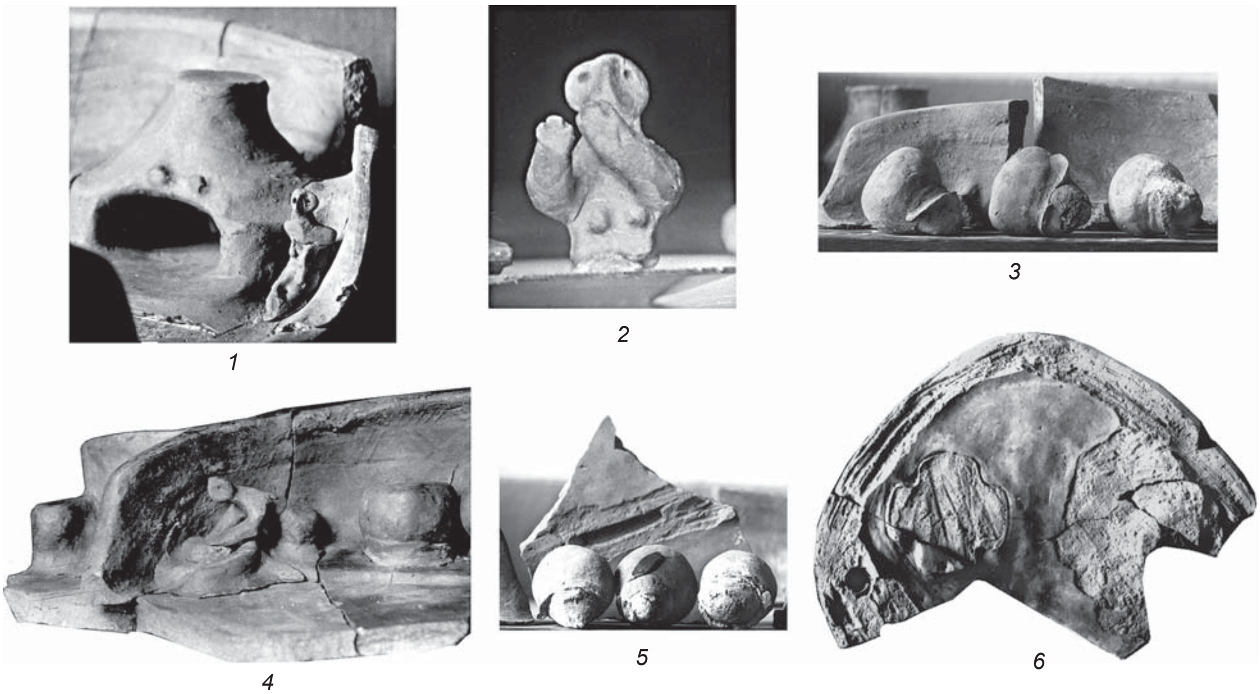

Fig. 2. Fragments of the model before gluing, photograph of 1912 from the archives of the National Archaeological Museum in Warsaw.

1 – anthropomorphic figurine and stove to the right of the entrance (No. 2042); *2* – upper part of the female figurine (No. 2041); *3* – vessels from the interior (No. 2038); *4* – female figurine to the left of the entrance (No. 2030); *5* – vessels from the interior and a fragment of the “entryway” with a groove for attaching the threshold (No. 2039); *6* – platform fragment of the model (No. 2042).

slightly dried. Its surface was intentionally left rough for ensuring a tight connection during the subsequent assemblage (Fig. 2, *6*). A vertical rim was attached to this flat platform, yet without further strengthening of the joint with a ribbon of clay, as was often done in molding large vessels. That is why the structure was later split along the seam. The threshold between the “entryway” and the main room was fashioned after the clay of the rim and the platforms had already dried a bit. Therefore, a special groove was made in advance in the floor for strengthening the threshold (Fig. 2, *5*).

All interior details (the stove, the “bench”, the “seat”, and the low podium), as well as the human figurines, had been made separately, and were successively mounted on the floor of the dwelling. The vessels did not simply stand on the podium; they were inserted into specially made recesses. A spiral band of clay was added at the junction of the vessels and the podium (Fig. 2, *3*, *5*). This band of clay is too bulky for serving as additional strengthening, for which there was no need. It rather served as an imitation of special ledges for holding large vessels, which are sometimes found in the dwellings at the settlements of the Tomashovka-Sushkovka group of sites (Chernovol, 2013: 82). After assembling, the entire model except for the figurines and vessels was covered with a thick layer of liquid clay for smoothening the surface and additional strengthening of the details.

Majewski believed that the model represented “a fence on posts”, where the rounded opening served for visibility and garbage disposal, and a cross-shaped open hearth was located in the center. According to Majewski, the dwelling itself was located to the right of the entrance; there are two projections for fastening the curtains at the entrance of the dwelling. Majewski claimed that due to its small size this hut could only have been used as a shelter, while the main life of the inhabitants took place within the fence, and referred to similar dwellings of rounded shapes, which were represented in ancient Egyptian bas-reliefs (1913a: 233). He interpreted the representations of the seated man and the woman grinding grain as an everyday scene (Ibid.: 235). H. Cehak had a similar opinion; she noted that the sizes of the model, the figurines, and the details of the interior were proportional and made it possible to determine the size of the real dwelling (1933: 207).

Himner also interpreted the model as an open terrace with a hut, surrounded by walls. However, he believed that the figurine at the stove was also female, because in his opinion male figures should have had only one eye (Himner, 1933: 151–154). Unfortunately, he did not provide any parallels to the one-eyed representations of males; most likely, he meant those Tripolye male figurines that really had only one eye (see, e.g., (Monah, 1997: Fig. 200, *4*, 210, *6*, *7*, 211, *7*)). Himner also believed that the rounded window surrounded by triangular cogs had some sacred meaning and was used not for visibility, but rather to catch the ray of the sun as through the holes in the menhirs (Himner, 1933: 154–155).

A radically different interpretation of the model from Popudnya was proposed by Passek in her studies (1938, 1941, 1949: 95–96). She rejected the suggestion of Majewski and Himner that this was "a fence on posts", and interpreted the object as a model of a dwelling with the interior space. Passek correctly interpreted the part that had been formerly called the hut-shelter, as the stove. Passek paid particular attention to the purpose of the figurines and the cross-shaped elevation in the center of the platform. According to her, the figurine to the left of the entrance was a realistic representation of a kneeling woman grinding grain on a milling stone, and the figure to the left of the stove was a cultic female idol, as confirmed by a quote from the study of Himner, where the figurine was called the "idole féminine" (Passek, 1941: 218–219; Himner, 1933: 152). However, wherever Himner wrote about the figurines, he used the term "idole" (1933: 100, 102); he obviously did not distinguish between the notions of "small statue" and "idol", and did not imply any special difference in the meaning. However, Passek claimed that "the presence of two different categories of female representations in the model once again emphasizes the cultic significance of the Tripolye idol, which was placed in the central part of the home near the hearth" (1941: 219). She also saw a direct connection between the "idols" in the models of dwellings and Late Tripolye schematic figurines from Serezlievka, Usatovo, and Krasnogorka, found in burial mounds (Ibid.). This authoritative interpretation of the person near the stove as an "anthropomorphic idol" became firmly established in the literature (Chernysh, Masson, 1982: 248).

If we examine the model, the cross-shaped elevation in its central part, the edges of which were incised with a series of short parallel cuts, is of particular interest. Majewski and Himner believed that it was an open hearth (Majewski, 1913b: 78; Himner, 1933: 152), but later V.E. Kozlovska and T.S. Passek interpreted the cross-shaped elevation as an altar (Kozlovska, 1926: 43; Passek, 1938: 241; 1941: 214).

Details of the interior that are similar to those shown on the model from Popudnya, widely occur among the materials found in the excavations of dwellings at Tripolye-Cucuteni. Thus, cross-shaped elevations have been discovered in at least five dwellings in the settlement of Vladimirovka (Passek, 1949: 83–85). The edges of one of them were decorated with small notches, like on the model from Popudnya (Passek, 1941: 214; Passek, 1949: 83). Judging by the description, some of the cross-shaped podiums had four circles of regular shapes in relief with grooves. The published photograph shows that the "cross" is actually formed by four semicircles (Passek, 1949: 89, fig. 40, 44). Rounded depressions at the edges of the "cross" also occur in the model from the settlement of Cherkasov Sad II (Polishchuk, 1989: 47, fig. 16, *9*). In the later settlement of Talyanki, the décor of four circles is located on elevations of rounded shape (Chernovol, 2008: 174–175, fig. 10).

Passek also pointed out that in one case a cross-shaped elevation with a diameter of 2 × 2 m and a height of about 35 cm was built on a flat rounded earthen base, while in another case, two cross-shaped podiums were found in the same building (1941: 214). Such "altars" in the dwellings might have been located both in the central part of the house and in the entryway (Passek, 1938: 240). A similar cross-shaped structure was also found a dwelling at the settlement of Poduri in Romania, in the layer associated with the period Cucuteni B1–Tripolye BII, but it had only one rounded recess with traces of fire in the center (Dumitroaia et al., 2009: 19–21, 43). The Tripolye settlements of that time also had stoves on cross-shaped pedestals; for example, such structures were found by V.I. Markevich (1981: 86) in Brinzeni III.

Clay elevations in dwellings have been often found in the settlements of the initial Late Tripolye culture, but in most cases they are of subsquare or rounded shape. Many scholars called such elevations altars (Issledovaniye…, 2005: 58, fig. 37; Kruts, Korvin-Piotrovsky, Ryzhov, 2001: 24–25; Shmagly, Videiko, 2003: 88; Tripolskoye poseleniye-gigant…, 2013: 17, fig. 5). Markevich, who published the materials from the Late Tripolye sites of the Northern Moldova, regarded them as places for grinding grain (1981: 36–37, fig. 45).

The representation of the podium for large vessels on the model also corresponds to archaeological finds. Such podiums were typical for the dwellings of the Tomashovka-Sushkovka local group of sites. As a rule, they were also located to the left of the entrance (Chernovol, 2013: 79). An interesting point was noted by T.G. Movsha during the excavation of a clay platform at the settlement of Dobrovody. Having analyzed the composition of clay of the podium and of the vessels themselves, Movsha came to the conclusion that they had been made of the same clay compound and were most likely molded together (1984: 19).

Thus, the model from Popudnya virtually completely reproduces the interior space of the dwellings from the settlements of the Tomashovka-Sushkovka group such as Talyanki, Maidanetskoye, Dobrovody, and others. The interior space there was "distinguished by extreme uniformity" (Chernovol, 2008: 176). The stove was always located to the right of the entrance; the podium with large vessels was located to the left of the entrance, and the clay elevation (“the altar”) was located in the center opposite to the entrance, close to the opposite wall (Kruts, 1990: 45; Kruts, Korvin-Piotrovsky, Ryzhov, 2001: 66–74; Issledovaniye…, 2005: 9–10, 57–59; Shmagly, Videiko, 2003: 88).

Models of dwellings and the associated characters: circle of parallels and cultural context

Up to date, over sixty models of dwellings have been found on the territory of the Tripolye area; about a third of them are chronologically close to the Popudnya model and are associated with the Tripolye CI period (Fig. 3). Problems of typology and classification of these artifacts have been already discussed in the literature (Movsha, 1964; Ovchinnikov, 1997; Gusev, 1996; Yakubenko, 1999). In terms of external appearance, all authors distinguish between open models (without a roof) and closed models (with a roof), with interior details and without them. The configuration of the platform is also taken into consideration in the most detailed classification by S.A. Gusev (1996). According to that classification, the model from Popudnya belongs to type BI_1—open, of rounded shape and with interior details (Ibid.: 18, 28). This type also includes objects originating from the same group of sites of the “Tomashovka type”, such as the giant settlement of Talyanki (Kruts, 2008), Dobrovody (Movsha, 1984; Shatilo, 2005), and a miniature simplified model from Sushkovka in the form of a small bowl on legs, where the only interior detail depicted is the stove (Kozlovska, 1926: 56–57, fig. 3). The form of the object from Cherkasov Sad II (Kodymsky District of Odessa Region, Ukraine) is also simplified. Only the recess in the frontal part and cross-shaped “altar” in the center indicate that this is the model of a dwelling. Because of the “altar”, this find was interpreted as a representation of a cultic structure (Polishchuk, 1989: 48). “Open” models without interior details constitute a wider range of similar objects. Along with “closed” models, they occur at the settlements of Tripolye-Cucuteni of various periods*.

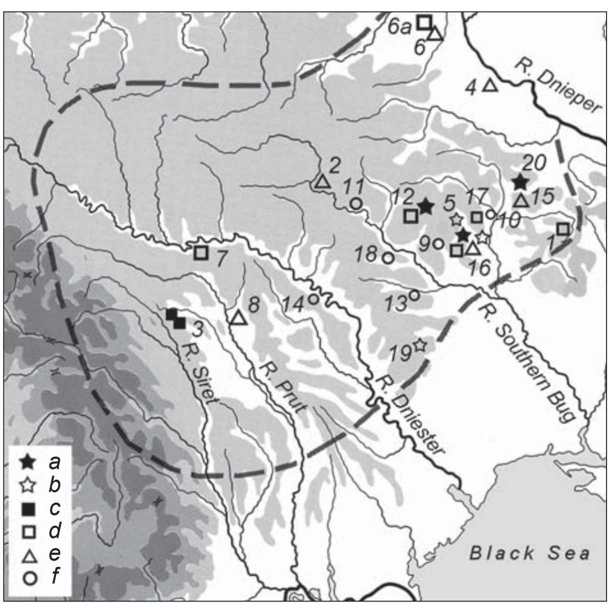

Fig. 3. Settlements of the Tripolye culture of the Middle–Initial Late Periods (BII–CI, CI) where the models of dwellings have been found.

1 – Vladimirovka; *2* – Voroshilovka; *3* – Geleeshti; *4* – Grebeni; *5* – Dobrovody; *6* – Kolomiyshchina II; *6a* – Kolomiyshchina I; *7* – Konovka; *8* – Kosteshty IV; *9* – Kocherzhintsy; *10* – Maidanetskoye; *11* – Nemirov; *12* – Popudnya; *13* – Pishchana; *14* – Rakovets; *15* – Rassokhovatka; *16* – Sushkovka; *17* – Talyanki; *18* – Trostyanchik; *19* – Cherkasov Sad II; *20* – Chichirkozovka.

a–d – open models: *a* – with interior details and characters; *b* – with interior details; *c* – with characters; *d* – without interior details; *e* – closed models; *f* – fragments of objects whose type cannot be established.

Models of the open type with interior details, where human figurines of the same scale were placed, similar to the Popudnya model, should be singled out as a special type of objects. The closest parallel is the model from the settlement of Sushkovka (Umansky District, Cherkasy Region, Ukraine). This model contains all the same elements of the interior except for a human figurine near the stove (Kozlovska, 1926: 52–53, fig. 1, 2; Passek, 1949: 125). This figurine might have been placed separately into the interior space: a whole series of seated figurines, some of which might well have been used in the models of dwellings, go back to the period of Tripolye CI–Cucuteni B (see (Monah, 1997: Fig. 176–183)). This type of object also includes a fragment of the model from Chichirkozovka (Zvenigorodsky District of Cherkasy Region, Ukraine), which preserved a spot near the stove where a human figurine sitting next to the stove used to be attached (Passek, 1941: 219, fig. 11; 1949: 125, fig. 69, *3*). These three examples reflect a stable association of dwellings with characters placed inside.

*According to the observation of S. Nanoglou, in different periods of the Neolithic in Greece, statuary representations of dwellings emphasized either their exterior space (“closed” model) or interior space (“open” model). Nanoglou suggested that this might have been caused by changes in the social structure of the communities. The growth of the communities might have been accompanied by a shift from the family clan to a small family (Nanoglou, 2001: 308–310). Tripolye-Cucuteni, apparently, does not show such a pattern. In parallel with the “open” models (with or without interior details), there occurred “closed” models, which have been found at the sites of Tripolye BII–CI in Rassokhovatka, Voroshilovka, and Kolomiyshchina II (Gusev, 1996: Fig. 4).

The practice of exhibiting figurines in the interiors of dwelling models—a sort of "doll house"—was sufficiently widespread in the cultures of the Balkan-Carpathian circle (Palaguta, 2012: 91–94, 98). Models of dwellings with figurines placed inside have been found at the settlement of Ghelăieşti in Romania, which dates back to the end of the Cucuteni A-B–early Cucuteni B period. One model contained four figurines; another model contained two. Figurines were both male and female (Cucoş, 1993). Four figurines along with interior details were placed inside the model of a dwelling from the complex of Ovcharovo in Bulgaria (Todorova, 1983). Eight figurines of various gender and sizes were placed into a model, which reproduced the proportions and interior of the house where the model was found under the floor in Platia Magoula Zarkou in Greece. The author of the excavations interpreted the figurines as representations of three generations of the same family (Gallis, 1985). "Altars" on legs, resembling the models of dwellings, might have been specifically designed as a container for exhibiting figurines. Such an "altar" in the form of a bowl with a diameter of 42–43 cm on legs was found, for example, at the pre-Cucuteni–early Tripolye settlement in Isaia next to a vessel containing a set of figurines (Ursulescu, Tencariu, 2006: 123; Palaguta, 2013: 148, fig. 1, *2*; 8, *2*). Such sets allowed for free placement of figurines in the process of forming the composition, and manipulating with them. In most cases, the scale of the figurines was larger than the scale of the model of dwelling, as it is often the case with modern children's toys (Palaguta, 2012: 93–94).

The semantic field of this group of early agricultural portable art, constituted by a stable association of the characters and the dwelling, intersects with the cult of the household gods of Antiquity (Lares and Penates), which, in turn, were associated with the cult of the ancestors according to the written sources and the pictorial tradition (Palaguta, Mitina, 2014). The assumptions about the direct relationship of these examples of portable art with the cult of the ancestors are based either on the parallels between the models of dwellings from the Neolithic and the Chalcolithic and funerary urns in the form of "houses of the dead" of the Bronze and Early Iron Age (Gladilin, 2009), or on folklore parallels (Dyachenko, Chernovol, 2007).

However, it seems that the models from Popudnya, Sushkovka, and Chichirkozovka reflect a certain independent phenomenon. The figurines there were not only executed in the scale of the interior space of a typical Tripolye dwelling, which enhanced the realism of the scene, but also were represented in the process of performing a certain action: one person (the female) is grinding grain on a milling stone, and another person (probably a male) is sitting by the stove and watching her (the gender roles are reflected clearly and vividly). This scene is most fully represented in the model from Popudnya, but we may assume that the same "everyday" subject was the basis of sculptural compositions in the interior of the models from Sushkovka and Chichirkozovka. They differ from other similar objects with figurines in the correlation of the scale of figurines and the house, as well as in the attachment of the figurines: they were not supposed to be moved or removed from the model, which points to the intended representation of a specific scene. The repetition of this scene on several objects indicates that the image acts as illustration of a specific text, possibly, a folklore or heroic subject, which for several generations was regularly cited in the comments on this sculptural composition within a specific group of the Tripolye-Cucuteni population.

The settlements where the models of the Popudnya type were discovered are geographically and chronologically close to each other. All of them belong to the Tomashovka-Sushkovka group of sites left by the population that moved to the forest-steppe belt of the Dnieper-Bug interfluve from the Dniester area in the Tripolye BII–CI period (Kruts, Ryzhov, 1985: 53–54). The carriers of this tradition created giant settlements, whose area reached 300–400 ha and the number of dwellings reached 2000. According to various estimates, from 4000–5000 to 10,000 people lived in each of these settlements. The three-dimensional "narrative" representations are combined there with a concentration of discoveries not only of dwelling models, but also of sleigh models (Balabina, 2004). The emphasis on a subject associated with movement of goods was triggered both by the need to supply the sprawling settlements and by the established practice of "nomadic agriculture", which caused periodic moving of settlements to a new location after 50–60 years.

In addition, most of the "realistic" anthropomorphic figurines were discovered within the Tomashovka-Sushkovka group of sites (Burdo, 2010: Map 1; 2013). The term "realistic figurines", which was introduced by Movsha (1975), is not quite acceptable from the viewpoint of current art history where "realism" primarily means a creative method aimed at reflecting the surrounding reality in artwork and is mostly applied to the content of the artwork (Shekhter, 2011: 11–14)*. The notion of "naturalism" is more suitable for the Tripolye-Cucuteni art, since naturalism was necessary to create a similarity aimed at recognition (Ibid.: 14).

The emergence of a sufficiently representative series of naturalistic representations in the Tripolye BII–CI period could have been caused by the need to give a specific expression to the characters depicted against the

*Thus, even the "socialist realism", of the former Communist societies, in fact, was not realism, but the production of "simulacra"—the imaginary simulated reality.

background of changes in the social reality—the formation of collectives of considerable sizes, which comprised the population of giant settlements (Palaguta, 2012: 242–246). Communities amounting to a thousand people and consisting of a number of clans and families had the need to render individual traits of the characters represented. In this way they became more easily recognizable not only within the families living in individual households or within the groups of buildings, but also by their more distant neighbors.

Conclusions: on the interpretation of the models of dwellings

All of the above makes it possible to address the problem of the function of the models of dwellings. Obviously, it cannot be solved following the tendency that dominated until recently, to correlate the portable art of European early agricultural cultures exclusively with fertility cults. This approach, embodied in the fundamental studies of M. Gimbutas (1996), seems to be one-sided and speculative, lacking a clear substantiation in specific materials. It is also clear that the models of dwellings were represented both in the Tripolye culture and in other cultures not as "temples"*, but as "typical" dwellings.

The tradition of making models of dwellings was widespread in the cultures of the Balkan-Carpathian circle. Such finds are relatively common, and they should be viewed not as a special phenomenon, but as a part of the entire portable art complex. These objects have a polysemantic value that may vary within specific cultural traditions and may change in the process of development.

Most certainly, the model from Popudnya represents not a simple everyday scene as Majewski once thought (1913a: 227, 235). This cannot be the case since the same scene is reproduced on similar objects from Sushkovka and Chichirkozovka belonging to the same Tomashovka-Sushkovka group of sites. The sculptural composition could be associated with a specific folklore or mythological subject widespread among the carriers of the Tripolye-Cucuteni traditions, which had to be rendered using naturalistic forms of representation. It is also possible that these models were intended to visually express an auspicious formula associated with the foundation of the household or settlement, or with the cult of the ancestors—the founders of the family clan.

*This term without specific justification was used for example by N.B. Burdo (2004). We have not considered the models from the "Platar" private collection not only because of their origin from illegal excavations (see (Hershkowitz, 2005)), but also because the authenticity of these objects causes serious doubts.

Acknowledgements

We express our deep gratitude to Dr. B. Brzeziński, the Director of the National Archaeological Museum in Warsaw, S. Sałaciński, the Head of the Neolithic Department, and M. Krajewska, the employee of the Department of Scientific Documentation, for the opportunity to explore and publish the model of the dwelling from the Tripolye settlement in Popudnya using archival photographs. We are also very grateful to Dr. hab. A. Zakościelna from the Institute of Archaeology at the Maria Curie-Skłodowska University in Lublin for his assistance in the work with archival documents.

References

Balabina V.I. 2004
Glinyanye modeli sanei kultury Kukuten-Tripolye i tema puti. In *Pamyatniki arkheologii i drevnego iskusstva Evrazii: Pamyati Vitaliya Vasilievicha Volkova*. Moscow: IA RAN, pp. 180–213.

Burdo N.B. 2004
Sakralniy svit tripilskoї tsivilizatsiї. In *Entsiklopediya tripilskoї tsivilizatsiї: v 2 t.*, vol. 1. Kiev: Ukrpoligrafmedia, pp. 344–420.

Burdo N.B. 2010
Realisticheskaya plastika Tripolya-Kukuten: Sistematizatsiya, tipologiya, interpretatsiya. In *Stratum plus*, No. 2. Kishinev: pp. 123–167.

Burdo N.B. 2013
Realisticheskaya plastika kulturnogo kompleksa Tripolye-Kukuten: Sistematizatsiya, tipologiya, interpretatsiya. Saarbrücken: Lambert Academic Publishing.

Buttler W., Haberey W. 1936
Die bandkeramische Ansiedlung bei Köln-Lindenthal. Bd. 2: Tafeln. Berlin, Leipzig: De Gruyter. (Römisch-Germanische Forschungen; No. 11).

Cehak H. 1933
Plastyka eneolitycznej kultury ceramiki malowanej w Polsce. In *Światowit*, vol. 14. Warsaw: pp. 164–252.

Chernovol D.K. 2008
Interyer tripolskogo zhilishcha po materialam poseleniya Talyanki. In *Tripolskaya kultura v Ukraine: Poseleniye-gigant Talyanki*. Kiev: IA NANU, pp. 168–176.

Chernovol D.K. 2013
Postroiki petrenskoi lokalnoi gruppy. *Revista Arheologică. Academia de Ştiinţe a Moldovei. Serie nouă*, vol. IX (1): 72–88.

Chernysh E.K., Masson V.M. 1982
Eneolit Pravoberezhnoi Ukrainy i Moldavii. In *Eneolit SSSR*. Moscow: Nauka, pp. 165–320. (Arkheologiya SSSR).

Cucoş S. 1993
Complexe rituale cucuteniene de le Ghelăeşti, jud. Neamţ. In *Studii şi cercetări de istorie veche şi arheologie*, vol. 44 (1). Bucharest: pp. 59–80.

Dumitroaia Gh., Munteanu R., Preoteasa C., Garvăn D. 2009
Poduri – Dealul Ghindaru: cercetările arheologice din Caseta C. 2005–2009. Piatra-Neamţ: Editura Constantin Matasă.

Dyachenko O.V., Chernovol D.K. 2007
Modeli zhitel tripilskoï kulturi yak vidobrazhennya kultu predkiv. In *Materiali ta doslidzhennya z arkheologiï Skhidnoï Ukraïni: Vid neolitu do kimeriitsiv: zbirnik naukovikh prats*, No. 7. Lugansk: Skhidnoukr. Nat. Univ., pp. 39–44.

Gallis K.J. 1985
A Late Neolithic foundation offering from Thessaly. *Antiquity*, vol. LIX: 20–24.

Gimbutas M. 1996
Tsivilizatsiya Velikoi Bogini: Mir Drevnei Evropy. Moscow: ROSSPEN.

Gladilin V.N. 2009
O glinyanoi modelke s tripolskogo poseleniya Rossokhovatka na Cherkasshchine. In *S.N. Bibikov i pervobytnaya arkheologiya*. St. Petersburg: IIMK RAN, p. 344.

Gusev S.O. 1996
Modeli zhitel tripilskoï kulturi. *Arkheologiya*, No. 1: 15–29.

Hershkowitz Y.P. 2005
Khraniteli nelegalnikh starozhitnostei v Ukraïni. *Arkheologiya*, No. 3: 91–97.

Himner M. 1933
Étude sur la civilisation prémycénienne dans le bassin de la mer Noire d'après des fouilles personelles. In *Swiatowit*, vol. 14. Warsaw: pp. 26–163.

Issledovaniye poseleniy-gigantov tripolskoi kultury v 2002–2004 gg. 2005
V.A. Kruts, A.G. Korvin-Piotrovsky, S.N. Ryzhov, G.N. Buzyan, E.V. Ovchinnikov, D.K. Chernovol, V.V. Chabanyuk. Kiev: Korvin-Press.

Kozlovska V.E. 1926
Tochki tripilskoï kulturi bilya Sushkivki na Gumanshchini (rozkopi roku 1916). In *Tripilska kultura na Ukraïni*, iss. 1. Kiev: Ukraïnska akademiya nauk, pp. 43–66.

Krajewska M. 2009
Miniatura "chaty" z neolitu. *Spotkania z Zabytkami*, No. 6: 39–40.

Kruts V.A. 1990
Planirovka poseleniya u s. Talyanki i nekotorye voprosy tripolskogo domostroitelstva. In *Rannezemledelcheskiye poseleniya-giganty tripolskoi kultury na Ukraine: Tezisy dokl. I polevogo seminara. Talyanki, 1990*. Kiev: pp. 43–47.

Kruts V.A. 2008
Poseleniye-gigant Talyanki. In *Tripolskaya kultura v Ukraine: Poseleniye-gigant Talyanki*. Kiev: IA NANU, pp. 49–56.

Kruts V.A., Korvin-Piotrovsky A.G., Ryzhov S.N. 2001
Tripolskoye poseleniye-gigant Talyanki: Issledovaniya 2001 g. Kiev: IA NANU.

Kruts V.O., Ryzhov S.M. 1985
Fazi rozvitku pam'yatok tomashivsko-sushkivskoï grupi. *Arkheologiya*, iss. 51: 45–56.

Majewski E. 1913a
Habitation humaine (enclos) sur pilotis de la fin du néolithique. *Bulletins et Mémoires de la Société d'anthropologie de Paris*. Ser. VI, vol. 4 (2): 226–235.

Majewski E. 1913b
Miniatura neolityczna siedziby przedhistorycznej z Popudni. In *Światowit*, vol. 11. Warsaw: 77–79.

Majewski E. 1913c
Najstarsza zagroda na palach – z końca neolitu, w plastycznej miniaturowej reprodukcyi przedhistorycznej. In *Sprawozdania z Posiedzeń Towarzystwa Naukowego Warszawskiego*, vol. VI (1). Warsaw: pp. 1–18.

Markevich V.I. 1981
Pozdnetripolskiye plemena Severnoi Moldavii. Kishinev: Shtiintsa.

Monah D. 1997
Plastica antropomorfă a culturii Cucuteni-Tripolie. Piatra-Neamţ: Museul de Istorie Piatra-Neamţ.

Movsha T.G. 1964
O nekotorykh modelyakh zhilishch tripolskoi kultury. In *Kratkiye soobshcheniya o polevykh arkheologicheskikh issledovaniyakh Odesskogo gosudarstvennogo arkheologicheskogo muzeya 1962 goda*. Odessa: Mayak, pp. 95–102.

Movsha T.G. 1975
Antropomorfnaya plastika Tripolya (realisticheskiy stil). Cand. Sc. (History) Dissertation. Kiev.

Movsha T.G. 1984
Dobrovody – krupnoye poseleniye tripolsko-kukutenskoi obshchnosti na Bugo-Dneprovskom mezhdurechye. In *Arkheologiya i paleografiya mezolita i neolita Russkoi ravniny*. Moscow: Nauka, pp. 13–25.

Nanoglou S. 2001
Social and monumental space in Neolithic Thessaly, Greece. *European Journal of Archaeolology*, vol. 4 (3): 303–322.

Ovchinnikov E.V. 1997
Modeli tripolskoi kultury: Popytka sistematizatsii. In *Razvitiye kultury v kamennom veke*. St. Petersburg: MAE RAN, pp. 148–150.

Palaguta I.V. 2012
Mir iskusstva drevnikh zemledeltsev Evropy: Kultury balkano-karpatskogo kruga v VII–III tys. do n.e. St. Petersburg: Aleteiya.

Palaguta I.V. 2013
Nabory statuetok Prekukuteni – rannego Tripoliya: Opyt sotsiokulturnoi interpretatsii rannetripolskoi plastiki. In *Rossiyskiy arkheologicheskiy ezhegodnik*, iss. 3. St. Petersburg: Universitet. izdat. konsortsium, pp. 141–179, 208–211.

Palaguta I.V., Mitina M.N. 2014
Nekotorye zamechaniya k smyslovoi interpretatsii predmetov rannezemledelcheskoi plastiki: *Lares et Penates* epokhi neolita? *Vestnik SPbGU*. Ser. 15: Iskusstvovedeniye, iss. 4: 80–95.

Passek T.S. 1938
Tripolskiye modeli zhilishcha. *Vestnik drevnei istorii*, No. 4/5: 235–247.

Passek T.S. 1941
Tripolskoye poseleniye u Vladimirovki (raskopki 1940 g.). *Vestnik drevnei istorii*, No. 1 (14): 212–220.

Passek T.S. 1949
Periodizatsiya tripolskikh poseleniy. Moscow, Leningrad: Izd. AN SSSR. (MIA; No. 10).

Polishchuk L.Y. 1989
Pamyatniki razvitogo Tripoliya. In *Pamyatniki tripolskoi kultury v Severo-Zapadnom Prichernomoriye*, E.F. Patokova, V.G. Petrenko, N.B. Burdo, L.Y. Polishchuk; L.V. Subbotin (ed.). Kiev: Nauk. dumka, pp. 30–49.

Shatilo L.O. 2005
Glinyani modeli budivel kulturi Kukuteni-Tripillya. In *Issledovaniye poseleniy-gigantov tripolskoi kultury v 2002–2004 gg.*, V.A. Kruts, A.G. Korvin-Piotrovsky, S.N. Ryzhov, G.N. Buzyan, E.V. Ovchinnikov, D.K. Chernovol, V.V. Chabanyuk. Kiev: Korvin-Press, pp. 119–139.

Shekhter T.E. 2011
Realizm v izmerenii "giper". St. Petersburg: Asterion.
Shmagly N.M., Videiko M.Y. 2003
Maidanetskoye – tripolskiy protogorod. In *Stratum plus (2001–2002)*, No. 2. Kishinev: pp. 44–140.
Todorova K. 1983
Arkheologichesko prouchvane na praistoricheski obekti v raiona na s. Ovcharovo, Trgovishchko, prez 1971–1974. In *Ovcharovo*. Sofiya: Nats. arkheol. inst. s muzei, pp. 7–104. (Razkopki i prouchvaniya; vol. IX).
Tripolskoye poseleniye-gigant Talyanki: Issledovaniya 2012 g. 2013
V.A. Kruts, A.G. Korvin-Piotrovsky, V.V. Chabanyuk, L.A. Shatilo. Kiev: IA NANU.
Ursulescu N., Tencariu F.A. 2006
Religie şi magie la est de Carpaţi acum 7000 de ani. Tezaurul cu obiecte de cult de la Isaia. Iaşi: Demiurg.
Videiko M.Y. 2004
Popudnya. In *Entsiklopediya tripilskoï tsivilizatsiï: v 2 t.*, vol. 2. Kiev: Ukrpoligrafmedia, pp. 430–431.
Yakubenko O.O. 1999
Modeli zhitel z Tripilskikh kolektsiy muzeyu. In *Natsionalniy muzei istoriï Ukraïni: Iogo fundatori ta kolektsiï: tematichnyi zbirnik naukovykh prats*. Kiev: LTD, pp. 86–111.

Received December 12, 2014.
Received in revised form February 27, 2015.

DOI: 10.17746/1563-0110.2017.45.1.093-103

G.V. Kubarev
Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia
E-mail: gvkubarev@gmail.com

Old Turkic Statues from Apshiyakta, Central Altai: On Female Representations in Turkic Monumental Art*

Ancient Turkic statues discovered by the author near Apshiyakta on the Lower Chuya River, Central Altai, have no parallels either in the Altai or in adjacent regions. They show two vertically arranged faces on the same facet of the statue—that of a man, and that of a woman below. The woman wears a three-horned headdress. The statues are described with regard to several other Old Turkic female sculptures from Central Asia. Previous attempts at interpretation were unsuccessful because several Kimek and Kipchak specimens had been erroneously included in the database. Probably, most Old Turkic sculptures with beardless faces found in Southern Siberia, Eastern and Western Central Asia depict women. The Apshiyakta specimens are similar to female sculptures with three-horned headdresses from Semirechye (Zhetysu), and represent a variety of the so-called face sculptures. On the basis of parallels, and the semantic analysis of this headdress, it is concluded that these female portraits do not depict the goddess Umay or a shamaness; rather, they refer to noble Ancient Turkic women. The Apshiyakta sculptures, then, manifest the same idea that is embodied in the genre scenes in yurts—coupled images of the husband (warrior, or batyr) and his wife (katun). According to a radiocarbon estimate, these statues, like the Kudyrge-type funerary structures, date to the late 500s to early 600s. The canonical scene of the male and female rulers (the latter wearing a three-horned headdress) sitting in a yurt, is shown in numerous sculptures, petroglyphs, grave goods, and coins. It may refer to the marital union between two aristocratic Old Turkic families (Ashina and Ashide).

Keywords: *Central Altai, Ancient Turkic female statues, three-horned headdress, Ashina, Ashide, radiocarbon dating.*

Introduction

The range of graphic and statuary monuments of the Ancient Turkic period in Central Asia includes a category of original images and compositions where one of the main characters represents a female wearing a three-horned headdress. These images mostly show one and the same scene, depict the same ethnographic realities, and possibly have a common meaning. The famous Kudyrge boulder with an engraved genre scene is one of the most well-known monuments of this kind. Similar compositions have been reported from Bichiktu-Bom petroglyphs in the Russian Altai, engraved images on the horn comb from Suttuu-Bulak burial ground in Kyrgyzstan, an Ancient Turkic statue and rock-image from the Kogaly locality in Kazakhstan, and a figurine from the Khar-Yamaatyn-gol River valley in the Mongolian Altai. The present author was lucky to discover two statues in the Russian Altai, bearing similar images. One of these statues is

*Supported by the Russian Science Foundation (Project No. 14-50-00036).

unusually well-preserved and most informative, and shows two vertically arranged faces: that of a man, and that of a woman below. This article represents an attempt to determine the possible semantics of such images on the statue, and to establish their possible correlations with other mentioned compositions; and also proposes a hypothesis on the family character of many funerary structures of Old Turks, with an attempt to identify a special group of female statues.

Description of finds

In the 2011 field season, the Chuysky team of the IAE SB RAS Altai Expedition carried out an archaeological exploration of the Chuya River valley on the territory of the Ongudaysky District of the Altai Republic. Among others, a funerary complex of Apshiyakta I was investigated, located on a high fluvial terrace on the left bank of the dried Apshiyakta stream's mouth. The site is situated on the left bank of the Chuya River, opposite the well-known petroglyphic site of Kolbak-Tash I (Fig. 1). The funerary complex comprises 61 items. Two adjoining Ancient Turkic enclosures (No. 54 and 55) are situated separately (Fig. 2).

Enclosure 54 is 2.0 × 2.5 m in size and 0.2 m high. Its eastern wall is preserved better than the others, which are almost invisible. The structure is heavily sodded, and the stone filling can hardly be seen.

Fig. 1. Map showing location of Apshiyakta.

Close to the eastern wall of the enclosure, a statue is installed*, made from greyish light-blue chert. The size of this object is 135 × 18 × 19 cm. Upon cleaning of the frontal stone surface from moss, the facial image was noted in the upper part of the stone (Fig. 3; 4, *1*). The image is rather schematic. The lower face-outline is shown with an engraved line forming an obtuse angle; and nose and cheekbones with curved lines, whose lower ends adjoin the mouth-outline. The eyebrows are outlined, and the eyes are not shown; yet they are implied. The unworked subtriangular upper part of the stone might have symbolized a high headdress.

Below the first face, on the same facet, another one was discovered, which was partially sodded. This image is highly schematic, too. Cheekbones and nose are depicted with two separate engraved lines, the mouth is triangular. The image shows a three-horned headdress typical of women's attire (see Fig. 3; 4, *1*). Over the cheekbones, on the forehead (?) or on the headdress, two dots are observed.

Enclosure 55 adjoins enclosure 54 at the north, and possibly shares a wall with it. In its characteristics, enclosure 55 is close to the funerary structure described above. The enclosure is 2.8 × 2.8 m in size, and 0.2 m high. Its eastern wall is preserved better than other walls. The structure is heavily sodded; stone filling is represented only by few large boulders.

Close to the eastern wall of the enclosure, an anthropomorphic statue is installed, made of light grey chert. The size of the object is 75 × 33 × 14 cm. The upper part and the frontal surface of the stone have been broken off, probably in antiquity. However, the remaining engraved lines suggest that originally there were also two faces here (see Fig. 4, *2*). This is evidenced by the lines of the lower part of the face, mouth, and eyebrow (?) of the upper face-image, and also by the general outline of the lower one.

Ancient Turkic and Kimek-Kipchak female statues: history of study

As is known, Turkic statues in Eastern and Western Central Asia were dedicated mostly to male warriors. Female statues produced by Ancient Turks and Kimek-Kipchaks have been discovered primarily in Semirechye and Eastern Kazakhstan (Sher, 1966: 22; Charikov, 1980; Ermolenko, 2004: Fig. 12, *2*; 15, *1*; 63, *1*, *3;* and others). They represent two separate groups of images, greatly distinguished by their style

*A preliminary report on Apshiyakta statues has been published elsewhere (Kubarev, 2014).

Fig. 2. Ancient Turkic funerary enclosures in Apshiyakta. View from the east.

and by the depicted sex features, culture-specific items, etc. The Kimek-Kipchak female sculptures significantly outnumber those attributable to Ancient Turks.

The first small group of statues includes sculptural representations of women wearing three-horned headdresses. These were discovered in Semirechye and dated to the Ancient Turkic period, i.e., the 6th–10th century (Fig. 5, 6) (Akhinzhanov, 1978: 67; Ermolenko, 1995: 55; Tabaldiev, 1996: 82; and others). Apart from the headdress, such statues often showed images of other elements of clothing (triangular lapels of caftans, full sleeves, earrings). The depicted women hold a jar in their right hand, or both hands. They are distinguished from the male statues by their lack of representations of mustache, beard, or weapon. The stylistic features of their rendering of facial traits correspond to those of the Ancient Turkic statues: eyebrows and nose are shown with a T-shaped relief cordon, eyes are large, etc. Sculptures with representations of the three-horned headdress were placed close to Ancient Turkic funerary structures, often near the adjoining Kudyrge-type enclosures.

Y.A. Sher (1966: 26) determined approximately one third of the 145 sculptures discovered in Semirechye by the 1960s to be images of characters whose sex is unclear. They show no beard, mustache or weapon. V.P. Mokrynin (1975) was perhaps the first who classified the Semirechye statues with three-horned headdresses as a separate group, and proposed their interpretation as female images. S.M. Akhinzhanov (1978: 74) argued that the custom of representing headdresses of this type was imported by

Fig. 3. Statue representing male and female images, placed at enclosure 54.

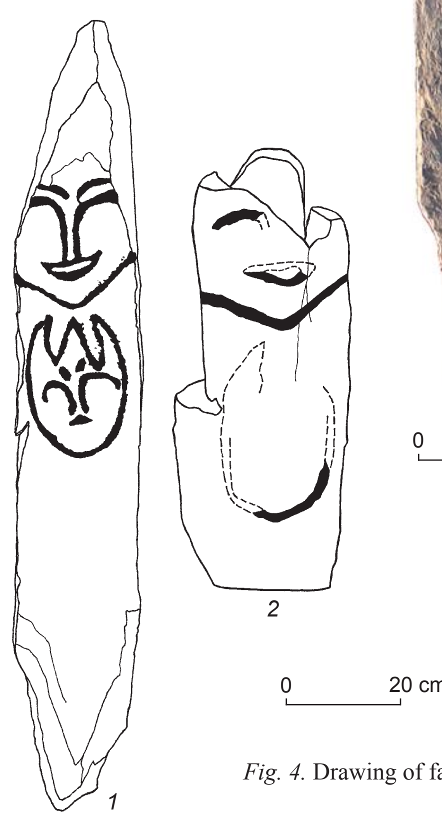

Fig. 4. Drawing of facial statues.

Fig. 5. Images of women wearing three-horned headdresses from Semirechye.
1–4 – Burana, Kyrgyzstan (after: (Tabaldiev, 1996)); *5*, *6* – Kyrgyzstan (after: (Sher, 1966)); *7*, *9*, *10* – Kochkor and Kara-Kuzhur valleys, Kyrgyzstan (after: (Tabaldiev, 1996)); *8* – Lake Balkhash, Kazakhstan (after: (Ermolenko, 2004)).

Fig. 6. Female statues with representations of three-horned headdresses.
1 – Chuya valley, Lake Issyk-Kul, Kyrgyzstan (after: (Tabaldiev, 1996)); *2* –Karatau, Kazakhstan (after: (Dosymbaeva, 2006)).

Turkic tribes who migrated here from Altai. The earliest of such images, like that on the Kudyrge boulder, he dated to the 7th–8th century; while generally, he considered these images typical of the 9th–10th century, and attributed them to the Kimek-Kipchak tradition (Ibid.).

The second, more numerous, group is represented by Kimek-Kipchak female statues. They differ considerably from the Old Turkic images in the stylistic features of the facial representation (small eyes and mouth shown as depressions, various styles of rendering nose and eyebrows, etc.) and by other depicted elements or attributes (Fig. 7, *1–5*). Elements of clothing are usually not shown on such statues. Female breasts are depicted. These statues often represent a woman holding a jar with both hands at her stomach (Fig. 7, *5*). As compared to the Ancient Turkic sculptures with mostly individual and personified facial features and clothing details, the Kimek-Kipchak images are schematic. Probably the Kimek-Kipchaks depicted a generalized image of an ancestor or a progenitrix, while the Turks represented real, formerly living women.

In those cases where the original placement of the Kimek-Kipchak statues is known, this place is usually close to (or in the center of) the so-called sanctuaries (rectangular stone enclosures-piles, mounds, etc.) (Ermolenko, 2004: 34–37). Y.A. Sher (1966: 46, 61, fig. 15) and A.A. Charikov (1986: 87–88, 101) dated these statues to the 9th–early 13th centuries, and correlated them with the Cuman stone stelae ("babas"). Attribution of such stelae to the Kimek-Kipchak tradition, and their dating to the mid-9th–13th centuries, were supported by other researchers (Ermolenko, 2004: 12–13). Kipchak-type statues are spread over the territory from Eastern Kazakhstan in the east to the Southern Urals in the west.

Female sculptures made by the Ancient Turks of Central Asia are also known, but they are quite few as yet. Unlike the Semirechye statues, they were not installed separately at the enclosure, but almost always accompanied male sculptures. Examples of these are the female statue with a shawl; that of Kyul-Tegin's wife at his funerary site (Zholdasbekov, Sartkozhauly, 2006: Fig. 119, 120, 124, 125); and the female statue at Shiveet-Ulan site (Ibid.: Fig. 39).

The tradition of accompanying male sculptures by female ones (representing wives of the warriors and nobility) has been recognized in the (currently) few examples in the Altai region. For instance, at the funerary complex of an Ancient Turkic noble on the Khar-Yamaatyn-gol River in the Mongolian Altai, near a male statue, the broken base of another sculpture was found. Judging by a number of features, this was a sculpture of a woman, the wife of this noble (Kubarev, 2015). Another coupled male and female statue has been noted in the Makazhan steppe in Kosh-Agachsky District of the Altai Republic. Here, two sculptures were placed at the eastern wall of a simple enclosure. One of them, depicted with a belt and weapon, is a man; while another, highly schematic facial one, might be a woman. These two examples represent the only such finds in the Altai. Furthermore, the possibility cannot be excluded that a considerable number of the facial images without moustaches, beards, and weapons in Central Asia represent females.

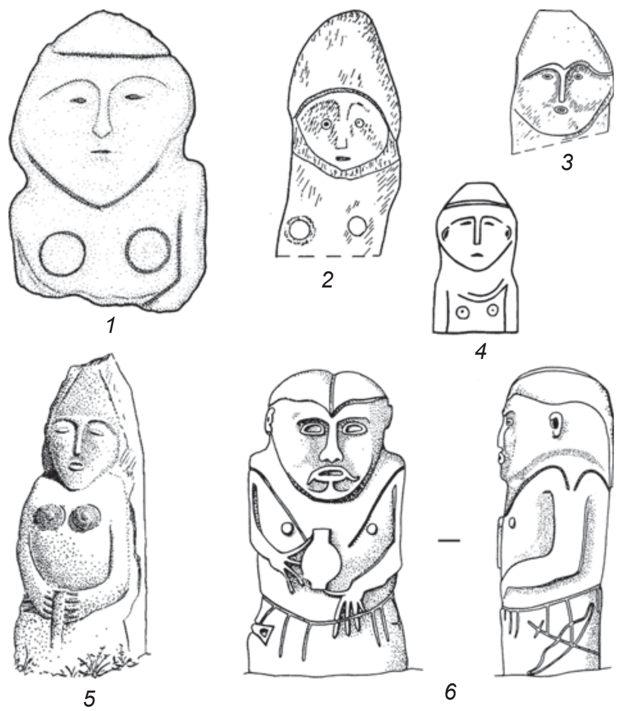

Fig. 7. Female statues of Kimek-Kipchak tradition with representations of breasts (*1–5*), and an Uyghur male statue (*6*). *1* – Ailyan, Altai (after: (Hudiakov, Belinskaya, 2012)); *2*, *3* – Aktogaisky District, Karaganda Region, Central Kazakhstan (after: (Ermolenko, 2004)); *4* – Merke, Kazakhstan (after: (Dosymbaeva, 2006)); *5* – Kazakhstan (after: (Margulan, 2003)); *6* – Ergi-Barlyk, Tuva (after: (Kyzlasov L.R., 1949)).

Peculiarities of the Ancient Turkic and Kimek-Kipchak female statues are evident, and their distinction among the main bulk of statuary monuments is well-grounded. The majority of scholars support attribution of these statues to the category of female, and their different chronological and ethno-cultural affiliations; yet some researchers put forward another assumption. The most controversial and vulnerable point of view belongs to Y.S. Hudiakov and K.Y. Belinskaya (2012). They attribute the female statue from Ailyan (Fig. 7, *1*) in Shebalinsky District, the Altai Republic, to the Kurai stage of the Ancient Turkic culture (Ibid.: 128). These authors proposed to identify a separate group of Ancient Turkic female statues, depicting breasts, from Altai, Tuva, and the Upper Ob, and formed corresponding cultural-historical and ideological conclusions that do not stand up to scrutiny (Kubarev, 2012). The Ailyan sculpture represents one of the few Kimek-Kipchak statues discovered in the Gorny Altai, and should be dated to the mid-9th–13th century.

Parallels and semantics of the three-horned headdress

The most specific feature of the Apshiyakta female faces, and also of those from Semirechye, is the headgear with three cogs (see Fig. 5, 6). In the literature, it is most often referred to as a three-horned headdress (Gavrilova, 1965: 66; Sher, 1966: 100; Akhinzhanov, 1978; Tabaldiev, 1996: 69, and others), more rarely, as a three-horned tiara (Kyzlasov L.R., 1949: 50; Dluzhnevskaya, 1978: 231) or a crown (Motov, 2001: 68). Almost all researchers agree that this headdress highlighted the special status of its owner. This detail is important, because its interpretation was regarded as the main argument in favor of iconographic attribution of the character wearing a three-horned headdress to the goddess Umay (Kyzlasov L.R., 1949; Dluzhnevskaya, 1978; Motov, 2001; and others) or to a shaman (shamaness) (Akhinzhanov, 1978: 70, 71; Dosymbaeva, 2006: 45; and others)*.

Detailed representations of the three-horned headdress on some Semirechye statues, on a horn object from Suttuu-Bulak (Fig. 5, *7*; 8, *2*), and on coins of Western Turkic Khaganate (Fig. 9, *1–3*) suggest that this headdress was neither a tiara nor a crown, because the central "cog" was shown in projection behind the two rather curved lateral cogs (Kubarev, 2003: 244). Thus, the three-horned headdress had a high cone-shaped protrusion on top and two, often curved, blades at the temples. The headdress was most likely made from some organic material, such as felt. On the detailed images, blades have edging. Possibly, the blades could have been edged with stripes of printed silk, in the same way as the elements of caftan (cuffs, collar, and lower hem).

It is generally recognized that in various chronological periods, the most meaningful piece of attire of the nomads in Eastern and Western Central Asia was the women's headdresses. Examples include high and complex headdresses of the Pazyryk women, Mongol female headgear bokka, etc. It is likely that they represented some complicated ideological symbols. G.V. Kubarev (Ibid.) and Y.S. Hudiakov (2010: 99–100) have come to the conclusion that the three-horned headdress cannot be regarded as a crown or a tiara, but rather, it represents quite functional women's headgear.

While the majority of scholars correlate a woman wearing a three-horned headdress with the goddess Umay or a shamaness (shaman), L.P. Potapov proposed a quite different interpretation of the composition depicted on the Kudyrge boulder. According to him (Potapov, 1953: 92), this drawing illustrated written sources narrating the story of the Turkic khagan subduing other tribes as tributaries— "head bowing and kneeling". The dismounted horsemen kneeled in front of a sitting woman, wearing a three-horned headdress and rich clothing, and an infant (Fig. 8, *3*). This political and social interpretation of the scene was supported by A.A. Gavrilova (1965: 18–21) and G.V. Kubarev (2003).

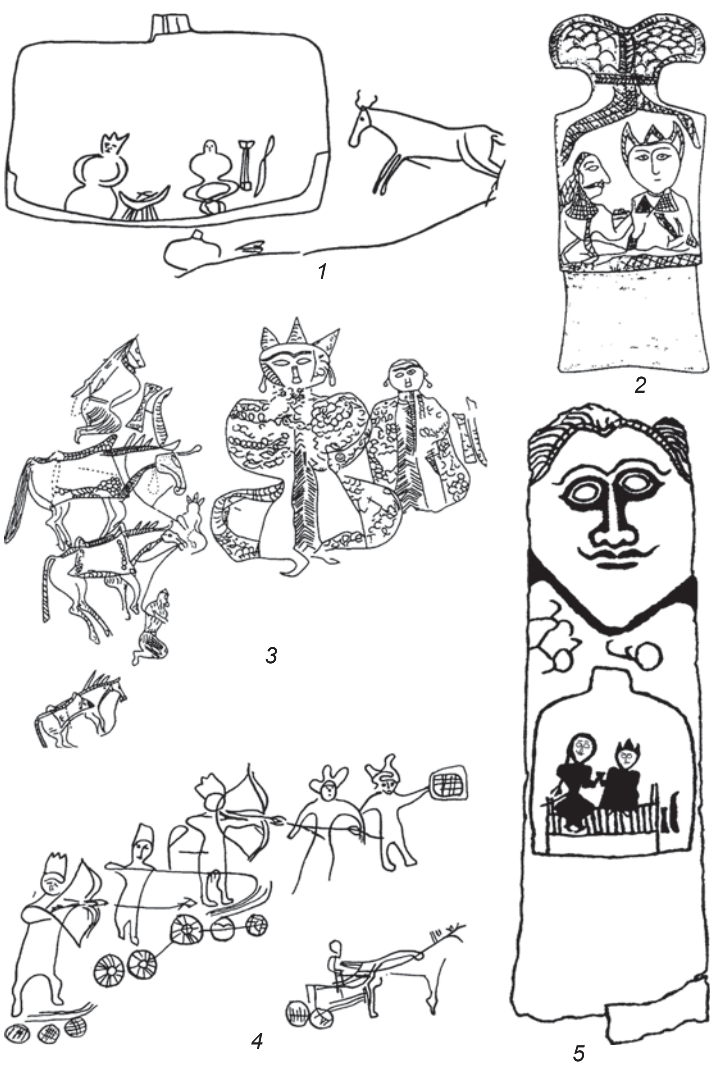

Fig. 8. Genre scenes with female characters in three-horned headdresses. *1*, *4* – rock graffiti from Bichiktu-Bom, Altai (*1* – after: (Kubarev, 2003); *4* – after: (Martynov, 1995)); *2* – scene on a horn object from mound 54 at Suttuu-Bulak burial ground, Kyrgyzstan (after: (Tabaldiev, 1996)); *3* – scene on the Kudyrge boulder, Altai (after: (Gavrilova, 1965)); *5* – statue from Kogaly, Kazakhstan (after: (Rogozhinsky, 2010)).

*The history of study of the Umay image iconography among the Ancient Turks on the basis of pictorial materials requires special research. The present article does not contain either comprehensive information on this topic nor criticism of the attempts of identification of the possible iconography of this image.

Fig. 9. Western Turkic Khaganate coins from Chach, bearing images of a ruler, and his wife in a three-horned headdress. Photograph by G. Babayarov.

The most fantastic interpretation of the Kudyrge boulder composition was proposed by P.P. Azbelev. He believed that the main character was the Mother of God, while the composition rendered the scene of Adoration of the Magi (Azbelev, 2010: 48–49). This work by Azbelev, who named it a "treatise", might be not taken seriously, were it not for the publication activity of the author and questionable quality of many of his inferences. Azbelev is not perplexed by the fact that the "baby" from the Kudyrge composition (Fig. 8, *3*) is rather grown up, judging by the proportions of the body, and most likely a girl (like the main character, she also has an earring in each ear), and also that there were other representation of women in three-horned headdresses with children (Fig. 8, *4*) that were not accompanied by the kneeled "Magi". It does not seem necessary to comment on the speculative and unreliable ideas of the "treatise's" author (Ibid.: 51) about Nestorian sermons in the Altai, about Christian women who became wives of Turks but reserved their Christian faith, and about captive or hired Christian artists.

In sum, available points of view on the characters wearing three-horned headdresses, represented in graffiti and on monumental statues of the Ancient Turks, can be summarized in the four major interpretations.

1. Characters with a crown or a tiara represent the goddess Umay (Kyzlasov L.R., 1949; Dluzhnevskaya, 1978; Kyzlasov I.L., 1998; Motov, 2001; and others) or even the Mother of God (Azbelev, 2010). Researchers came to this conclusion on the basis of analysis of Ancient Turkic graffiti, and primarily of the composition on the Kudyrge boulder.

2. Characters in three-horned headdresses represent either shamanesses, personifying the cult of ancestors through female lineage (Akhinzhanov, 1978), or shamans (Dosymbaeva, 2006: 45).

3. Social and political interpretation of Ancient Turkic scenes with representations of women in three-horned headdresses implies the acknowledgement of the high social status of their owners and a possible reflection of political history (subordination of one tribe to another, etc.) (Potapov, 1953: 92; Gavrilova, 1965: 18–21; Kubarev, 2003).

4. A three-horned headdress was broadly used by the Ancient Turks and other Turkic-speaking nomads, and did not imply any high social status of its owner (Hudiakov, 2010: 99–100).

Interpretations 1 and 2 are based mostly on the presence of the three-horned headdress representing either a crown or a tiara, and its possible semantics, and also on representation of the "kneeling" scene on the Kudyrge boulder graffiti. Neither the one thing nor the other can be regarded as a reliable argument in favor of interpretation of the images as those of goddess Umay or a shamaness (Kubarev, 2003). In contrast, all the mentioned arguments (interpretation of three-horned headdress as a functional piece of attire, representation of women wearing such headdress on stone statues, family character of many funerary structures with such statues, etc.) testify to the contrary.

There is another representative series of images of women wearing three-horned headdresses, to which practically no attention was paid. But inclusion of these images in the discussion seems to be important with respect to the topic. It concerns the numerous coupled images of a ruler and his wife on the coins of the Western Turkic Khaganate in Sogdia of the 6th–8th centuries (Rtveladze, 2006: 88–89; Shagalov, Kuznetsov, 2006: 75–76, 79–85; and others). The co-ruling woman is shown there in the three-horned headdress.

One variant of such an image represents the so-called chest-high portrait of a ruler and his wife (see Fig. 9, *1–4*)*. In the foreground (left), the image of a man is shown. He has a broad face with high cheekbones, and long hair falling down his back. The woman is depicted to the right and behind the man. Her face is broad, and she wears a three-horned headdress, whose central "cog" is curved, cone-shaped, and considerably higher than the other two. The reverse shows a *tamga* surrounded by a Sogdian legend.

Another variant is the representation of a man and a woman sitting in a cross-legged position and facing each another (see Fig. 9, *5–8*). The ruler's face is shown in side view; his wife's face is in front view. The man's hair is long and falls down to the shoulders; earrings are shown in the ears. He wears a long slim-cut caftan with a broad right-side lapel, which was typical of Ancient Turks; in his left hand, he holds some object (vessel?). The woman wears a high three-horned headdress and a caftan. She holds something in her hands, possibly a vessel. On some coins in this series, the co-ruling woman is shown to be pregnant (Fig. 9, *6–8*).

Apparently, both coin-types represent one and the same scene: a Turkic ruler with his wife. Despite various interpretations of the Sogdian legends from the coins proposed by researchers, they imply either a representative-governor of the Western Turkic khagan, or a khagan himself (Shagalov, Kuznetsov, 2006: 61, 76).

Notably, more-or-less canonical images of a husband and his wife were popular and widely spread among the Ancient Turks. These images have been reported from numerous petroglyphic sites, grave goods, and stone statues. Therefore, it can be asserted that this scene on coins was popular and clear to the Ancient Turks. Most representative are the images of sitting ruler and his wife (Fig. 9, *5–8*). These images are absolutely identical to the Ancient Turkic engravings from Altai and Tian Shan. Even the details are basically the same: both man and woman sit in a cross-legged position; she is almost always to the right of him; he sits half-face to her and holds an object resembling a vessel; the woman wears a three-horned headdress, etc.

Chinese written records hold that the Ancient Turkic Khaganate was characterized by a dual power structure: a confederation of several related tribes was headed by two aristocratic families—Ashina and Ashide. The Khagan was descended from the Ashina clan, whose symbol was the sun and whose clan *tamga* was the image of an *argali* (wild sheep). His wife (*katun*) was descended from the Ashide clan (Ashtak), which symbol was the moon and the clan *tamga* was the image of a snake or dragon (Zuev, 2002: 33–34, 85–88).

The most vivid illustration of the marital union between two aristocratic families of Ashina and Ashide is the representation of a ruler and his wife on the majority of coins of the Western Turkic Khaganate in Sogdia. This has already been mentioned by other researchers (Babayarov, 2010: 397). The territory of the Turkic khaganates was traditionally subdivided into two parts: eastern and western. The economic and political significance of the aristocratic clans that formed the dual marital union and their influence on khaganate affairs was buttressed by the fact that the eastern part was governed by the khagan's clan of Ashina, while the western part was under the authority of katun's clan Ashide (Zuev, 2002: 33–35, 85–88).

The canonicity of the scene and its frequent reproduction on coins, statues, rock surfaces, and household utensils is explained by the illustration of the marital union of two aristocratic clans, whose members might have been perceived as personifications of Tengri and Umay, rather than as simple portraits of a ruler and his wife. Supposedly, even if the three-horned headdress was not an exclusive element of a katun's (kagan's wife's) costume, it reflected the high social status of its owner. This may also be the reason for the scarcity of statues with images of a three-horned headdress.

A large number of facial stelae have been recorded in the Altai. However, the Apshiyakta stelae bearing images of male and female faces on a single facet are unique. No parallels to them have been known either in the Altai, or elsewhere in the territory of distribution of Ancient Turkic statuary monuments that includes Mongolia, Tuva, Semirechye, and Eastern Turkestan. By their extraordinary features, the Apshiyakta stelae can be listed among such single early Ancient Turkic monuments as the Kudyrge boulder (Gavrilova, 1965: Pl. VI) in the Russian Altai, the statue from Khar-Yamaatyn-gol (Kubarev, 2015: Fig. 1, 2) in the Mongolian Altai, and the Kogaly sculpture (see Fig. 8, *5*) in the Chu-Ili interfluve in Kazakhstan.

The Apshiyakta anthropomorphic stelae and the above-mentioned monuments belong to a single cultural-chronological range of artifacts showing several genre scenes, in which a woman in a three-horned headdress is one of the main characters. Such scenes have been recorded in the Bichiktu-Bom graffiti (Fig. 8, *1*, *4*), the Kudyrge boulder (Fig. 8, *3*) in the Altai, in the horn

*The author thanks Dr. G. Babayarov, a scientific expert of the International Turkic Academy in Astana, Kazakhstan, for his generous permission to use photos of coins of the Western Turkic Khaganate from Chach, and also for his helpful consultations concerning the interpretation and dating of the coins.

object from Suttuu-Bulak (Fig. 8, *2*) in Kyrgyzstan, and in petroglyphs of the Kogaly locality in Kazakhstan (Rogozhinsky, Solodeynikov, 2012: Fig. 8). Interestingly, the majority of genre scenes have been found in the Altai, while statues with female facial images and three-horned headdresses have been discovered here for the first time, unlike the Semirechye, where quite a number of such monuments has been known (Fig. 5).

It can be assumed that the Apshiyakta sculptures manifest the same idea that is embodied in the genre scenes in yurts—coupled images of the husband (warrior, or *batyr*) and his wife (*katun*). The same idea is implemented in the placement of a male and a female sculpture near one enclosure (Altai) or near individual adjoining enclosures (Tian Shan).

Dating the Apshiyakta statues

The Apshiyakta funerary structures represent a single complex, constructed during a single chronological period. This assertion is supported by the following: the enclosures are adjoining, have similar dimensions and construction features, and are accompanied by statues bearing male and female facial images executed in a single artistic manner—possibly by a single artisan. The complex likely belongs to the early Ancient Turkic Period, i.e. to the 6th–7th century. As is known, the adjoining enclosures are attributable to the earliest Ancient Turkic funerary structures. At that period, funerary sites, like the iconography of statues created by the Ancient Turks of the Altai, had not yet gained their final classical look. They might have been face stelae, realistic three-dimensional sculptures, or anthropomorphic stelae. The Apshiyakta statues should be interpreted in this context. They represent a variant of face-sculptures, with the difference that they bear two facial images. The schematic representation of the faces serves as an additional argument for the early dating of these monuments.

The radiocarbon analysis of a horse's tooth that was found close to the Apshiyakta stela provided the date of 1486 ± 52 BP. Calibration calendar intervals by 1σ have been estimated as 540–639 AD, by 2σ, 429–495 AD (18 %), 507–521 AD (2 %), and 526–652 AD (79 %). It may therefore be asserted that the funeral structures and statues were created 526–652 AD. This is well correlated with the date of the Kudyrge burial ground (late 6th–7th century), and possibly of the majority of genre scenes and sculptures bearing images of three-horned headdresses. This date also supports our assertion that facial stelae and adjoining enclosures of the Kudyrge type belong the early period in the history of the Old Turks. The abovementioned Sogdian coins (Shagalov, Kuznetsov, 2006: 75, 79) provide one more argument for the attribution of the images of women in three-horned headdresses, and the scenes portraying a ruler and his wife, to the period of the 6th–7th century.

Conclusions

In conclusion, the following inferences can be made.

1. Ancient Turkic female statues are to be found in Central Asia, though currently only few of them have been discovered. A rather large number of sculptures of women bearing three-horned headdresses have been recorded in Semirechye. It is likely that a significant proportion of the Ancient Turkic facial stelae that lack mustache, beard, and weapons, and are found in Southern Siberia, Eastern and Western Central Asia, depict women. The quantity of such stelae reaches one third of the total number of Ancient Turkic sculptures known so far.

2. Female statues of the Ancient Turkic tradition should not be conflated with the Kimek-Kipchak images, as some researchers do. These statues are distinct in their style, in depicted realities, in their placement (at the funeral enclosures versus inside the so-called sanctuaries), and also, probably, in their semantics and purpose. The Ancient Turkic female sculptures always show or imply clothing. Female breasts were never depicted in them, unlike the Kimek-Kipchak statues.

3. The Ancient Turkic sculptures with representations of three-horned headdresses, like the characters wearing such headgear engraved on stone, bone, etc., portray noble women, but not shamans/shamanesses; and even more emphatically, not the goddess Umay or Mother of God. This inference is supported by all the mentioned facts: placement of statues at the funerary enclosures, the family character of some of these monuments, representations of the Turkic ruler and his wife on the Sogdian coins, canonical representation of a man and a woman in a yurt, etc.

4. Statues representing women in three-horned headdresses have been recorded mostly in Semirechye, and only two of them were found in Apshiyakta, in Altai. However, the images of noble women of the Ancient Turkic period were distributed over a considerably larger area, from Khakassia to Sogdia, Central Asia. Nevertheless, the majority of such engraved images have been found in Altai and in Semirechye.

5. The Apshiyakta statues belong to the single cultural-chronological range of sculptures, rock engravings, and grave goods and coins, which have been mentioned as parallels. They are dated to the early Ancient Turkic period of the 6th–7th century.

6. Apparently, the canonical scene showing a ruler and his wife sitting in a yurt represents an illustration of the marital union of the two Ancient Turkic aristocratic families of Ashina and Ashide. This union was mentioned

in Chinese and autochthonous written records. The scene can be regarded as a type of encoded information on the structure of the Ancient Turkic state, and also as a symbolic representation of the divine couple of Tengri and Umay. This is the reason for the broad distribution of this scene, which was reproduced on rocks, statues, household utensils, and on coins of Western Turkic Khaganate. Its popularity suggests that it was very meaningful and symbolic for Ancient Turks.

This is probably the reason why statues representing women in three-horned headdresses were dispersed mostly in Semirechye, the western part of the Turkic khaganates headed by the Ashide aristocratic family. The images might have represented women from this family. Also, the ruling couple probably personified the male and female principles and the material incarnation of the two supreme deities, Tengri and Umay. This is evidenced by the epithets that were used to describe khagan and his wife (*katun/khatun*) in runic texts: *khagan* is "Sky/Tengri alike, raised by Heaven (or born by Heaven)"; "mother-katun, Umay alike". The female principle in this scene was stressed by the image of pregnant ruler on the coins of Western Turkic Khaganate from Sogdia and Tokharistan. The goddess Umay was known as a patroness of children and pregnant women. However, we cannot as yet speak about the established iconography of the Tengri and Umay deities among the Ancient Turks.

References

Akhinzhanov S.M. 1978
Ob etnicheskoi prinadlezhnosti kamennykh izvayaniy v "trekhrogikh" golovnykh uborakh iz Semirechya. In *Arkheologicheskiye pamyatniki Kazakhstana*. Alma-Ata: Nauka, pp. 65–79.

Azbelev P.P. 2010
Kudyrginskiy syuzhet. St. Petersburg: Lema.

Babayarov G. 2010
The tamgas of the co-ruling Ashina and Ashida dynasties as royal tamgas of the Turkic Khaganate. In *Traditional marking systems: A preliminary survey*. London: Dover-Dunkling Books, pp. 393–402.

Charikov A.A. 1980
Kamennye skulptury srednevekovykh kochevnikov Priirtyshya. In *Arkheologicheskiye issledovaniya drevnego i srednevekovogo Kazakhstana*. Alma-Ata: Nauka KazSSR, pp. 130–140.

Charikov A.A. 1986
Izobrazitelnye osobennosti kamennykh izvayaniy Kazakhstana. *Sovetskaya Arkheologiya*, No. 1: 87–102.

Dluzhnevskaya G.V. 1978
Eshche raz o "kudyrginskom valune": (K voprosu ob ikonografii Umai u drevnikh tyurkov). In *Tyurkologicheskiy sbornik – 1974*. Moscow: Nauka, pp. 230–237.

Dosymbaeva A.M. 2006
Zapadnyi Tyurkskiy kaganat: Kulturnoye naslediye kazakhskih stepei. Almaty: Tyurkskoye naslediye.

Ermolenko L.N. 1995
K probleme izvayaniy v "trekhrogikh" golovnykh uborakh. In *Naskalnoye iskusstvo Azii*, vol. 1. Kemerovo: Kuzbassvuzizdat, pp. 54–55.

Ermolenko L.N. 2004
Srednevekovye kamennye izvayania kazakhstanskikh stepei (tipologiya, semantika v aspekte voyennoi ideologii i traditsionnogo mirovozzreniya). Novosibirsk: Izd. IAE SO RAN.

Gavrilova A.A. 1965
Mogilnik Kudyrge kak istochnik po istorii altaiskikh plemen. Moscow, Leningrad: Nauka.

Hudiakov Y.S. 2010
Ob izobrazhenii bozhestv drevnetyurkskogo panteona na pamyatnikakh iskusstva nomadov Yuzhnoi Sibiri i Tsentralnoi Azii epokhi rannego srednevekovya. In *Drevnosti Sibiri i Tsentralnoi Azii*, No. 3 (15). Gorno-Altaisk: Gorno-Alt. Gos. Univ, pp. 92–102.

Hudiakov Y.S., Belinskaya K.Y. 2012
Stone statue of Ailyan, Gorny Altai. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 40 (1): 122–130.

Kubarev G.V. 2003
Zhanrovaya stsena iz Bichiktu-Boma. In *Stepi Evrazii v drevnosti i srednevekovye: Materialy Mezhdunar. nauch. konf., posvyashch. 100-letiyu so dnya rozhdeniya M.P. Gryaznova*, bk. II. St. Petersburg: Izd. Gos. Ermitazha, pp. 242–246.

Kubarev G.V. 2012
K voprosu o zhenskikh drevnetyurkskikh izvayaniyakh na Altae. In *Kultury stepnoi Evrazii i ikh vzaimodeistviye s drevnimi tsivilizatsiyami*, bk. 1. St. Petersburg: IIMK RAN, Periferiya, pp. 339–346.

Kubarev G.V. 2014
Parnye supruzheskiye izvayaniya u drevnikh tyurok Yuzhnoi Sibiri i Tsentralnoi Azii. In *Drevniye i srednevekovye izvayaniya Tsentralnoi Azii*. Barnaul: Izd. Alt. Gos. Univ., pp. 55–57.

Kubarev G.V. 2015
Memorialnyi kompleks drevnetyurkskogo aristokrata iz Khar-Yamaatyn-gola (Mongolskiy Altai). *Vestnik Novosib. Gos. Univ*. Ser.: Istoriya, filologiya, vol. 14. Iss. 7: Arkheologiya i etnografiya: 136–150.

Kyzlasov I.L. 1998
Izobrazheniye Tengri i Umai na sulekskoi pisanitse. *Etnograficheskoye obozreniye*, No. 4: 39–53.

Kyzlasov L.R. 1949
K istorii shamanskikh verovaniy na Altae. *KSIIMK*, iss. XXIX: 48–54.

Margulan A.K. 2003
Kamennye izvayaniya Ulytau. In *Idem. Sochineniya*, vol. 3/4. Almaty: Daik-Press, pp. 36–46.

Martynov A.I. 1995
Srednevekovye stseny okhoty na plitakh Bichiktu-Bom. In *Voyennoye delo i srednevekovaya arkheologiya Tsentralnoi Azii*. Kemerovo: Kuzbassvuzizdat, pp. 178–185.

Mokrynin V.P. 1975
O zhenskikh kamennykh izvayaniyakh Tyan-Shanya i ikh etnicheskoi prinadlezhnosti. In *Arkheologicheskiye pamyatniki Priissykkulya*. Frunze: Ilim, pp. 113–119.

Motov Y.A. 2001
K izucheniyu ideologii rannesrednevekovogo naseleniya Altaya (po materialam mogilnika Kudyrge). In *Istoriya i arkheologiya Semirechya*, iss. 2. Almaty: Fond "Rodnichok", pp. 63–86.

Potapov L.P. 1953
Ocherki po istorii altaitsev. Moscow, Leningrad: Nauka.
Rogozhinsky A.E. 2010
Novye nakhodki pamyatnikov drevnetyurkskoi epigrafiki i monumentalnogo iskusstva na yuge i vostoke Kazakhstana. In *Rol nomadov v formirovanii kulturnogo naslediya Kazakhstana*. Almaty: Print-S, pp. 329–344.
Rogozhinsky A.E., Solodeynikov A.K. 2012
O novykh nakhodkakh i metodakh dokumentirovaniya drevnetyurkskikh graffiti na yuge Kazakhstana. In *Istoriko-kulturnoye naslediye i sovremennaya kultura*. Almaty: Service Press, pp. 123–126.
Rtveladze E.V. 2006
Istoriya i numizmatika Chacha. Tashkent: Media Land.
Shagalov V.D., Kuznetsov A.V. 2006
Katalog monet Chacha III–VIII vv. Tashkent: Fan.
Sher Y.A. 1966
Kamennye izvayaniya Semirechya. Moscow, Leningrad: Nauka.
Tabaldiev K.S. 1996
Kurgany srednevekovykh kochevykh plemen Tyan-Shanya. Bishkek: Aibek.
Zholdasbekov M., Sartkozhauly K. 2006
Atlas Orkhonskikh pamyatnikov. Astana: Kyultegin.
Zuev Y.A. 2002
Ranniye tyurki: Ocherki istorii i ideologii. Almaty: Daik-press.

Received August 13, 2015.
Received in revised form December 14, 2015.

DOI: 10.17746/1563-0110.2017.45.1.104-111

Y.S. Hudiakov[1, 2] and Y.A. Filippovich[2]

[1]Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia
E-mail: khudjakov@mail.ru
[2]Novosibirsk State University,
Pirogova 2, Novosibirsk, 630090, Russia
E-mail: post-ost@yandex.ru

Early Medieval Armor from Southern Siberia*

This article describes iron armor plates, weapons, and a horse harness from a randomly discovered site at the village of Filimonovo in the Kan Valley, southern Siberia. The reconstructed lamellar armor consists of several horizontal rows of vertically arranged and joined narrow iron plates. Parallels suggest a date and cultural attribution. The group of finds includes three-bladed arrowheads, stirrups, bipartite bits, buckles, twisted loops, and bronze plaques. These items of horse harness are typical of the Old Turkic culture from the middle of the first millennium AD. The armor, the decorated stirrups, and horse harness from Filimonovo apparently date to the late 500s, when the Yenisei Kyrgyz were forced into vassalage to rulers of the First Turkic Khaganate. We suggest that the Filimonovo assemblage is a cache. The tradition of caching weapons and armor was practiced by various peoples of southern and western Siberia during the Xiongnu-Xianbei age and in the Early Middle Ages. Based on the analysis of various types of plates, a reconstruction of the late first millennium AD Old Turkic armor is proposed.

Keywords: *Southern Siberia, Early Middle Ages, weapon cache, protective armor, lamellar armor, Old Turks, Yenisei Kyrgyz.*

Introduction

Metal armor is relatively rarely found at the sites of ancient and medieval nomads in Southern Siberia and Central Asia, because it was highly valued. The Central Asian nomads could have adopted iron plate armor in the Xiongnu period (Davydova, 1985: 49, fig. IX, 19, 19a; Hudiakov, 1986: 48). Such finds occur among the materials from the sites of the Xiongnu-Xianbei period in the Altai-Sayan. Armor plates have been found in the Bulan-Koba burial grounds Chendek and Yaloman II in the Altai Mountains (Soenov, 1997; Gorbunov, 2003: Fig. 7, *11*). The materials of the Kokel culture include individual finds of this type (Hudiakov, 1986: 86). Armor, first reconstructed as breastplates (Umansky, 1974: 147–148, fig. 7), but after restoration interpreted as a whole armor consisting of a breastplate and backplate (Gorbunov, 2002: 72, 75, fig. 8, *1–3*), was found in the Upper Ob region at the site of Tatarskiye Mogilki. One armor plate is known from the materials of Blizhniye Elbany XIV (Gryaznov, 1956: 104, pl. XLI, 11). Such plates were found at the burial ground of Kok-Pash (Bobrov, Vasyutin A.S., Vasyutin S.A., 2003: 24–25); a fragment of armor was discovered at the early Turkic site of Berel (Radlov, 1989: 465), while fragments of armor plates were found at the site of Kyzyl-Tash (Gorbunov, 2003: Fig. 21, *1–6*).

*Supported by the Russian Science Foundation (Project No. 14-50-00036).

In the Early Middle Ages, scale and lamellar armor were used by the Old Turks, the Yenisei Kyrgyz, and other ethnic groups (Hudiakov, 1980: 119–123; 1986: 158–159, 175, 196–197; 1991: 19, 42, 65). Armor plates have been found in Turkic memorial enclosures in Kudyrge, Mendur-Sokkon, and Kishneg-Atudar in the Altai Mountains (Gavrilova, 1965: Pl. V, 1; Soenov, Ebel, 1997: Fig. III, 2). A fragment of armor consisting of "long, overlapping armor plates" was found at the burial ground of Uzuntal I (Savinov, 1982: 107, fig. 8). Armor was found at the site of Balyk-Sook I (Kubarev, 2002: 88, fig. 1, *11*). A cluster of iron plates of "oval and semi-oval shape with holes for fastening" was discovered in the Kyrgyz joint burial ground at the Ulug-Khorum mound (Grach, 1982: 158, 164).

Plate armor from Abaza belongs to the Advanced Middle Ages in the Altai-Sayan (Sunchugashev, 1979: 133–134). Armor plates were found in the rocky cache of Iyi-Kulak in Tuva (Mongush, Grach, 1977) and subsequently were studied by M.V. Gorelik (1983: 251). The Pokrovka hoard and the finds from the village of Kamenka may belong to the same kind of "cache"—intentionally hidden objects of protective armor.

The plates from the brigandine, found in the Minusinsk Depression belong to the Late Middle Ages (Hudiakov, 1991: 89, fig. 2, *1*, *2*; 3, *1*, *2*; 4). Similar plates have been found in graves of the 17th century on the Chulym River (Radlov, 1989: 460, 478–480). Elements of plate armor have been found in the shaman's burial of Ortyzy-Oba (Hudiakov, Skobelev, 1984: 110, 113, fig. 6, *1–11*).

Description of finds from the village of Filimonovo

An interesting find among the objects of medieval protective armor that have been found in southern Siberia is the assemblage of armor plates discovered in the village of Filimonovo in the Kansky District of Krasnoyarsk Territory. In 2012, Y.A. Filippovich received information about this discovery. According to this information, in the year 2010 local dwellers discovered a group of "ancient things" during earthworks at the outskirts of the village over an area of 5 × 5 m and at a depth of 30 to 40 cm. The finds included 422 fully and partially preserved iron armor plates of the same type with rounded upper edges, 42 fragments of larger plates of rectangular shape, two stirrups, one bit, 5 iron three-bladed tanged arrowheads, 5 iron buckles and one bronze buckle, 3 twisted iron chains, 47 bronze hemispherical sewn plaques with a rim, and a bronze "bell".

Iron arrowheads. According to the form of their attachment to the shaft, these arrowheads are tanged. Two groups can be distinguished according to the cross-section of the body. The first group contains three-bladed arrowheads, represented by three types according to the shape of the body.

Type 1. Elongated hexagonal arrowheads (2 spec.). The length of the body is 6 cm; the width is 2.8 cm; the length of the tang is 3.5 cm. These arrowheads have sharply angular tips, a massive elongated hexagonal body, as well as gently sloping shoulders and lower part of the body. Rounded holes are located at the bottom of the blades (Fig. 1, *1*, *2*). Such arrowheads first appeared among the Xiongnu (Konovalov, 1976: Pl. I, 12–15; II, 17–28). In the Early Middle Ages, they were used by the Old Turks, the Yenisei Kyrgyz, and the Kimaks (Hudiakov, 1980: 79–80; 1986: 145, 185).

Type 2. Stepped arrowheads (1 spec.). The length of the body is 6 cm; the width is 2 cm; the length of the tang is 2 cm. The arrowhead has a sharply angular tip, distinct extended striking part, widened trapezoidal blades, as well as gently sloping shoulders and lower part of the body. Oval holes are located on the shoulders (Fig. 1, *3*). Stepped arrowheads were used by Xiongnu shooters (Hudiakov, 1986: 31), by the carriers of the Kokel, the Tashtyk, the Kok-Pash, and the Upper Ob cultures, as well as by nomads who left sites of the Airydash and Berel types (Ibid.: 70–71, 92, 111–112).

Type 3. Elongated rhombic type (1 spec.). The length of the body is 5.3 cm; the width is 1.2 cm; the length of the tang is 4.2 cm. The arrowhead has a sharply angular tip, oblong-rhombic body, as well as gently sloping shoulders and lower part of the body (Fig. 1, *4*). Similar arrowheads were used by the Xiongnu (Konovalov, 1976: Pl. I, 1; Hudiakov, 1986: 32–33). They have been found at the sites of the Tes stage, as well as the Kokel and the Upper Ob cultures (Hudiakov, 1986: 54, 70, 92, 111). In the Early Middle Ages, such arrowheads were used by the Old Turks, the Yenisei Kyrgyz, the Kimaks, the Bayirqu, and the Shiwei (Hudiakov, 1980: Pl. XXIV, 6;

Fig. 1. Iron arrowheads.

XXV, 4, 5; Hudiakov, 1986: 143, 183; 1991: 30, 52). In the Advanced Middle Ages, they were used by the Yenisei Kyrgyz, the Kyshtyms, and the Uyghurs (Hudiakov, 1997: 9, 32, 80–81).

The second group includes a single arrowhead with a flat body. The arrowhead has a sharply angular tip, elongated pentagonal body, barbs, and concave shoulders. The length of the body is 4.3 cm; the width is 2 cm; the length of the tang is 4.9 cm (Fig. 1, *5*). A similar arrowhead was found in an early Turkic burial at the burial ground of Berel (Gavrilova, 1965: 55, fig. 5, 7).

Despite the small numbers, the set of iron arrowheads from this collection is unique. Its composition includes both common types, which were widespread for a long time, and rare forms whose presence makes it possible to give a more precise dating and cultural attribution of the site. The presence of the stepped elongated arrowhead with large oval holes gives grounds to date the finds from the village of Filimonovo to the period from the second quarter to the middle of the first millennium AD. The flat, elongated, pentagonal arrowhead made it possible to attribute this assemblage to the sites of the Berel type (Ibid.: 54–55).

Iron armor plates. Most of the armor plates belong to the first type and can be called "figurate": their rounded upper part is inclined in one direction and forms a kind of "ridge", the middle part is widened and the bottom part is somewhat narrowed to a straight end. The plates have four pairs of rounded holes: one pair is along the bottom edge; two pairs are on the sides of the widened part, and one pair is on the central axis closer to the upper rounded edge. One more hole is located on the lower third of the plate (Fig. 2).

The height of the plates is 5.9–6.3 cm; the width of the "ridge" is 1.6–1.9 cm; the width of the middle (widened) part is 2 cm; the width of the lower part is 1.3–1.4 cm; the thickness of the plates taking into account corrosion of the metal is 0.07–0.09 cm; the diameter of the holes is 0.26–0.30 cm. The total weight of all plates of this shape is 1.796 kg. We also weighed individual fully preserved plates, and the weight of each such plate was about 5 g.

Such plates are known from the territory of East Turkestan, Central Asia, and Eastern Europe (Kubarev 2007: Fig. 10–12). According to Gorelik (1993: 170), they belong to the 5th–6th century AD.

Judging by the shape and location of the holes, the plates were located vertically in the protective plate armor with their rounded "ridge" on top. They were joined in horizontal rows with the help of leather straps. Each lower row was partially overlapped by the upper row.

On the basis of the remaining 42 fragments we were able to distinguish three types of plates. Although all these plates are similar to each other, they vary in length and curvature. The second type includes plates of rectangular

Fig. 2. Iron armor plates.

shape with a slightly rounded upper edge; all of them have survived in fragments. We have managed to glue together 23 fragments and obtain 15 parts of at least nine plates. The length of these plates is 31 cm; their width is 3.1 cm. These plates are slightly bent along the long axis. In the lower third they are curved in one direction, and in the upper part they are curved in the opposite direction. Six pairs of rounded holes are located along the long sides of the plate; one pair is at the upper edge perpendicular to the edge, and four holes are along the bottom edge.

The third type includes a single find. The length of the surviving part of the plate is 12.2 cm; the width is 3.1 cm. The plate has a broken upper and a straight lower edge. Three pairs of rounded holes run along each of the long sides; some of the holes are broken off. One rounded hole has survived at the upper edge. Originally there must have been two holes, and they were arranged vertically. Three holes are located along the bottom edge (Fig. 3, *2*).

Fig. 3. Iron armor plates.

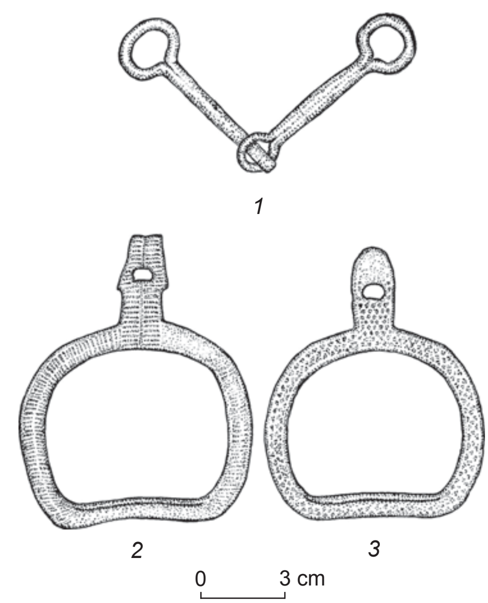

Fig. 4. Iron bit (*1*) and stirrup (*2*, *3*).

The fourth type of plate is also represented by a single find that has survived in a fragmentary form. Its length is 16.2 cm; its width is 2.8 cm. The plate is slightly bent along the long axis. Its top and bottom edges are broken off. The length of the plate could have been about 20 cm. Originally, there were two pairs of rounded holes along each of the long sides. Three holes at the bottom are partly or completely broken off. Two holes are located at the top perpendicular to the upper edge; they are damaged. An additional hole is located on the line of fracture in the middle of the plate across from the pair of rounded holes (Fig. 3, *1*).

Long rectangular plates of the second-fourth types were probably a part of a lamellar armor.

Iron stirrups. Both stirrups are plate-like with a wide semicircular opening and narrow horizontal footrest at the bottom part of the opening, decorated by indentations over the entire surface on one side. They have plate-like loops of different shapes. The loop in one stirrup is topped by a trapezoid finial with an oval hole for the stirrup-leather; the loop in the other stirrup is of semi-oval shape with an oval hole. The stirrups are slightly different in size: the height of the first stirrup including the loop is 20 cm, and width of its opening is 16 cm; the height of the second stirrup including the loop is 19 cm, and the width of its opening is 15 cm (Fig. 4, *2*, *3*).

In 1917, a similar stirrup from the Minusinsk Depression was published by A.M. Tallgren (1917: Des. 86). In 1965, using the materials from the burial ground of Kudyrge in the Altai Mountains, A.A. Gavrilova (1965: 34, pl. XIV, 7) designated as a special type a stirrup of unusual shape "with a rectangular earlet, without a neck, made of a wide plate that was battered in the upper part, for a footrest that is T-shaped in cross-section". Gavrilova attributed it to the Kudyrge type of sites of the 6th–7th centuries (Ibid.: 60, pl. XXXI). In 1973, such stirrups were called one of the most important inventions of the Early Middle Ages (Ambroz, 1973: 83). In 1982, similar finds from a joint burial ground with the horse in the Ulug-Khorum mound were studied by V.A. Grach (1982: 158, 160) who dated them to the late 5th–mid 6th century AD. In 1990, a similar stirrup from the Middle Volga region, dated to the same period, was published (Izmailov, 1990: 62–63). T.N. Troitskaya and A.V. Novikov (1998: 45, fig. 23, *13*, *14*) studied similar finds from the Upper Ob site of Krokhalevka-23. In 1999, Y.V. Grichan and Y.A. Plotnikov (1999) published a find consisting of a decorated stirrup of the same shape from the village of Karakol.

Most scholars believe that this type of iron stirrup was the earliest, and was typically used in the nomadic cultures of the Eurasian steppes in the late 5th–first half of the 6th century AD. The distribution of stirrups of the same type over such a vast territory from Trans-Baikal region to the Middle Volga region, including the Altai-Sayan and Western Siberia can be associated with the emergence of the First Turkic Khaganate, which united these lands and triggered an active borrowing of Old Turkic weaponry and horse equipment. The chronology of the spread of the stirrups in Eurasia was substantiated by S.I. Weinstein (1972: 129–130). Judging by the parallels, the stirrups found in the village of Filimonovo can be dated to the 5th–6th centuries AD.

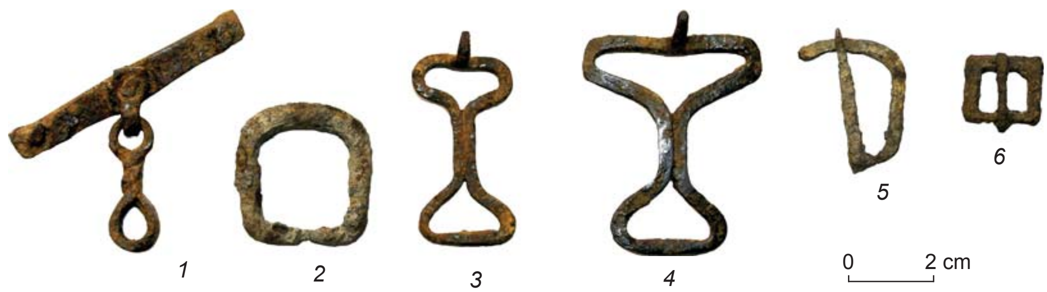

Fig. 5. Sheath fitting (*1*) and buckles (*2–6*).

Fig. 6. Bronze plaques (*1*, *2*), a buckle (*3*), and a "bell" (*4*).

Iron bit. It is bipartite with single-ringed endings of the parts (Fig. 4, *1*). Such bits have been found in the Kudyrge assemblages (Gavrilova, 1965: 58, 61).

Iron fittings of a sheath. One of the fittings is a plate with rivets; a link of a twisted chain is passed through the loop of the fitting. The length of the plate is 6 cm; the width is 4.5 cm. Another fitting has an elongated rectangular shape; a link of a chain with rounded endings and a twisted central part is passed through the loop attached to the fitting. The length of the fitting is 5.6 cm; the width is 0.6 cm; the length of the chain is 3 cm (Fig. 5, *1*). Fittings of similar shapes with twisted links of chains have been found at the burials of Blizhniye Elbany XII and XIV of the Upper Ob culture and at a joint burial ground in the Pazyryk locality (Gryaznov, 1956: 101, 103–104, pl. XXXII, 1, 22; XLI, 10; Gavrilova, 1965: 52, fig. 3, 5–7). Similar links have been found at the site of Kok-Pash in the Eastern Altai (Bobrov, Vasyutin A.S., Vasyutin S.A., 2003: Fig. 35, *7–9*). Similar chains for sheaths are known from the materials of the Upper Ob and Relka cultures (Troitskaya, Novikov, 1998: 44). Another find is a chain of interconnected twisted links of different sizes. Its length is 9 cm; its width reaches 0.8 cm.

Iron buckles. These include some specimens with a fixed prong on the frame. The sides of the frame are connected in such a way that they form two triangular openings with rounded corners for attaching a waist belt that was supposed to be passed through the opening and attached to the fixed prong. One buckle has identical openings. Its length with the prong is 5.8 cm; the width of the openings is 2.3 cm. In the second buckle, the opening with the prong is noticeably wider than the first opening to which the belt was attached. Its length is 5.5 cm; the width of the first opening is 4 cm; the width of the second opening is 2.7 cm (Fig. 5, *3*, *4*). Two iron buckles with a fixed prong have trapezoidal frames.

The collection also includes iron buckles with a movable prong. One buckle has a square frame. The end of the movable prong protrudes over the frame (Fig. 5, *6*). The length of the frame is 2.8 cm; the width is 2.7 cm. Two more buckles have not been completely preserved. One buckle is represented by a subrectangular frame to which the prong used to be attached. Its length is 3 cm; the width is 2.8 cm. Another buckle preserves three parts of a frame of subrectangular shape with rounded corners and a movable prong. The length of the frame is 3 cm; the width of the preserved part is 2.4 cm (Fig. 5, *2*, *5*).

Bronze buckle. It has an oval opening, movable prong, rectangular base and fixed semi-oval shield with a pointed end. Its length with the shield is 4.3 cm; the width of the frame is 2.6 cm (Fig. 6, *3*).

Bronze plaques. They have a hemispherical bulge in the center, a narrow rim, and a bar on the inside (Fig. 6, *1*, *2*). The diameter of the plaques is 1.5–1.7 cm; the height is 0.3–0.4 cm. Plaques of similar shapes are known from the materials of the Bolshaya Rechka and Sargat cultures, as well as of the Tes stage; plaques without the rim are known in the Kok-Pash and Kudyrge assemblages (Gavrilova, 1965: Pl. XV, *2*; Bobrov, Vasyutin A.S., Vasyutin S.A., 2003: Fig. 43, *12–15*, *18–21*, *29–33*).

Bronze objects from the village of Filimonovo include a cone-shaped object with a plate-like loop at the top, which looks like a bell. Its diameter is 2.4 cm; the height is 1.4 cm (Fig. 6, *4*).

Dating, cultural attribution, and functional purpose of the assemblage

The assemblage of weaponry, and military and horse equipment found in the village of Filimonovo includes a variety of things, some of which were used for a short period of time in the middle of the first millennium AD, while others were used throughout the entire Early Middle Ages. The three-bladed arrowhead with narrow elongated stepped body and the flat arrowhead with elongated pentagonal body and barbs (Gavrilova, 1965: Fig. 3, *2*; 5, *7*) can be dated to the period from the second quarter to the mid first millennium AD. Concerning the items of protective armor, the set of plates of different types, including the "figurate" armor plates, should be dated to the mid first millennium AD (Gorelik, 1993: 170). The sheath fittings with twisted chains (Gavrilova, 1965: Fig. 3, 5–7) and stirrups (Grach, 1982: 160; Grichan, Plotnikov, 1999: 77; Izmailov, 1990: 65) belong to the same period. On the basis of parallels, the Filimonovo assemblage can be dated to the late 5th–third quarter of the 6th century AD. Other objects from this collection were used throughout the entire Early Middle Ages. However, their presence among the finds from Filimonovo does not contradict the suggested dating.

The iron arrowheads, armor plates, bit and stirrups that belong to the mid first millennium AD have parallels in the Old Turkic Berel and Kudyrge assemblages (Gavrilova, 1965: Fig. 5, 7, pl. XIV, 7). The presence of the "figurate" armor plates may testify to contacts with the population of East Turkestan and Central Asia, where lamellar armor with similar plates was widely used in the middle of the first millennium AD. At the same time, the twisted iron chains and hemispherical bronze plaques have parallels in the material complexes of the Tashtyk, the Kok-Pash, and the Kokel cultures (Bobrov, Vasyutin A.S., Vasyutin S.A., 2003: Fig. 6, *15*; 12, *17*, *18*; 35, *7*). Some similarities can be observed between the iron buckles with the fixed prong from the village of Filimonovo and the buckles from the Tes stage and the Kokel culture. Judging by the set of iron arrowheads, armor plates, and the stirrups, most of the objects from the village of Filimonovo belong to the culture of the Old Turks at the Kudyrge stage of its development. Only a small amount of Tashtyk artifacts are present.

In our opinion, the collection found at the outskirts of the village of Filimonovo can be considered a "weapon cache". The tradition of hiding such "caches" goes back to the Metal Age when it was customary to preserve bronze objects intended for smelting in this manner. In the Tes time, in the Minusinsk Depression, people began to bury not only the objects of toreutics, but also weaponry. According to one hypothesis, these "weapon cashes" were the offerings of the ancient and medieval population to the higher powers. In the forest zone of Western Siberia, such sites were the sanctuaries of the Ugric and the Samoyed tribes (Plotnikov, 1987: 131). At the Yenisei, objects of protective armor were placed in caches throughout the entire Middle Ages (Gorelik, 1983: 251).

The find from the village of Filimonovo suggests that the tradition of including armor into "weapon caches" emerged in Southern Siberia at the turn of the Metal Age and the Middle Ages. This "cache" contains a unique set of weapons, military equipment, and horse harness, which distinguishes it from the Tes and Medieval caches in the Minusinsk Depression and Tuva. It could have belonged to a warrior from the local tribes of the Kyrgyz State on the Yenisei.

Reconstruction of the armor from Filimonovo

On the basis of the iron plates from the collection, Filippovich made a material reconstruction of the lamellar armor. It was supplemented by a protective covering of the neck and a helmet with an aventail (Fig. 7). Protection of the body includes a rectangular breastplate that consists

Fig. 7. Reconstruction of the armor based on the plates from the village of Filimonovo, made by Y.A. Filippovich.

of a horizontal row of vertically arranged plates of the third type found in Filimonovo, connected by straps. It is bordered on the bottom and on the sides by leather piping stitched with a strap. The breastplate is connected with the protective covering of the body, which partially overlaps the breastplate at its lower edge, consisting of a horizontal row of vertically placed plates of the second type. They are fastened with straps and are bordered with leather piping along the bottom edge and partially along the upper edge. The shoulder protection consists of horizontal rows (six in each row) of vertically arranged "figurate" plates of the first type placed with their rounded "ridge" up. They are interconnected with straps and are bordered with leather piping on the bottom and on the sides. Each row except the uppermost partially overlaps the rows located above with the "ridges" of the plates. The lower edge of the shoulder protection is decorated by silk fringe with ornamental décor. Both shoulder protection pieces are connected to each other with leather straps. The leg coverings consist of the same horizontal rows (nine on each side) of "figurate" plates. The lower edge is also bordered by decorated silk fringe. The armor was additionally tightened by a military belt with metal buckle, onlays, and plaques.

Conclusions

Items of weaponry, military equipment, and horse harness found in the village of Filimonovo indicate that at the turn of the Metal Age and the Middle Ages, the valley of the river Kan was involved in the events associated with the expansionist policy of the Old Turks during the First Turkic Khaganate. According to Chinese sources, in 554–555, the Turkic Muqan Qaghan "conquered Tsigu in the north and put fear in all the lands lying beyond the border" (Bichurin, 1998: 233). The Yenisei Kyrgyz fell into vassalage to the Turks. The Minusinsk Depression became the base for manufacturing weaponry for the Turkic qaghans. The "extremely sharp weapons", produced by the Kyrgyz, "were constantly exported to the Tūjué" (Ibid.: 360). However, already in 581, the Yenisei Kyrgyz freed themselves from the vassalage as a result of internal strife and weakening of the Khaganate. Subsequently, the Old Turks conquered them again in the early 8th century. Most likely, the Old Turkic lamellar armor and horse harness with early stirrups could have reached the valley of the river Kan in the period when the Yenisei Kyrgyz were the vassals of the rulers of the First Turkic Khaganate from 555 to 581 AD. After the Khaganate lost its military superiority over the Central Asian nomads and disintegrated, it became less likely that such objects could have reached the eastern outskirts of the Yenisei Kyrgyz State.

References

Ambroz A.K. 1973
Stremena i sedla rannego srednevekovya kak khronologicheskiy pokazatel (IV–VIII). *Sovetskaya arkheologiya*, No. 4: 81–99.

Bichurin N.Y. 1998
Sobraniye svedeniy o narodakh, obitavshikh v Srednei Azii v drevniye vremena, vol. I. Almaty: Zhalyn baspasy.

Bobrov V.V., Vasyutin A.S., Vasyutin S.A. 2003
Vostochnyi Altai v epokhu Velikogo pereseleniya narodov (III–VII veka). Novosibirsk: Izd. IAE SO RAN.

Davydova A.V. 1985
Ivolginskiy kompleks (gorodishche i mogilnik) – pamyatnik khunnu v Zabaikalye. Leningrad: Izd. Leningr. Gos. Univ.

Gavrilova A.A. 1965
Mogilnik Kudyrge kak istochnik po istorii altaiskikh plemen. Moscow, Leningrad: Nauka.

Gorbunov V.V. 2002
Pantsir iz Tatarskikh mogilok (restavratsiya i rekonstruktsiya). In *Materialy po voyennoi arkheologii Altaya i sopredelnykh territoriy*. Barnaul: Izd. Alt. Gos. Univ., pp. 62–78.

Gorbunov V.V. 2003
Voyennoye delo naseleniya Altaya v III–XIV vv. Barnaul: Izd. Alt. Gos. Univ. Pt. 1: Oboronitelnoye vooruzheniye (dospekh).

Gorelik M.V. 1983
Mongolo-tatarskoye oboronitelnoye vooruzheniye vtoroi poloviny XIV – nachala XV v. In *Kulikovskaya bitva v istorii i kulture nashei Rodiny*. Moscow: Izd. Mosk. Gos. Univ., pp. 244–269.

Gorelik M.V. 1993
Zashchitnoye vooruzheniye stepnoi zony Evrazii i primykayushchikh k nei territoriy v I tysyacheletii n.e. In *Voyennoye delo naseleniya yuga Sibiri i Dalnego Vostoka*. Novosibirsk: Nauka, pp. 149–179.

Grach V.A. 1982
Srednevekovye vpusknye pogrebeniya iz kurgana-khrama Ulug-Khorum v Yuzhnoi Tuve. In *Arkheologiya Severnoi Azii*. Novosibirsk: Nauka, pp. 156–168.

Grichan Y.V., Plotnikov Y.A. 1999
Arkhaichnoye stremya iz Gornogo Altaya. In *Evraziya: Kulturnoye naslediye drevnikh tsivilizatsiy*. Iss. 2: Gorizonty Evrazii. Novosibirsk: Novosib. Gos. Univ., pp. 76–77.

Gryaznov M.P. 1956
Istoriya drevnikh plemen Verkhnei Obi po raskopkam bliz s. Bolshaya Rechka. Moscow, Leningrad: Izd. AN SSSR. (MIA; No. 48).

Hudiakov Y.S. 1980
Vooruzheniye eniseiskikh kyrgyzov VI–XII vv. Novosibirsk: Nauka.

Hudiakov Y.S. 1986
Vooruzheniye srednevekovykh kochevnikov Yuzhnoi Sibiri i Tsentralnoi Azii. Novosibirsk: Nauka.

Hudiakov Y.S. 1991
Vooruzheniye tsentralnoaziatskikh kochevnikov v epokhu rannego i razvitogo srednevekovya. Novosibirsk: Nauka.

Hudiakov Y.S. 1997
Vooruzheniye kochevnikov Yuzhnoi Sibiri i Tsentralnoi Azii v epokhu razvitogo Srednevekovya. Novosibirsk: Izd. IAE SO RAN.

Hudiakov Y.S., Skobelev S.G. 1984
Pozdnesrednevekovoye shamanskoye pogrebeniye v mogilnike Ortyzy-Oba. In *Etnografiya narodov Sibiri*. Novosibirsk: Nauka, pp. 105–119.
Izmailov I.L. 1990
Poyavleniye i rannyaya istoriya stremyan v Srednem Povolzhye. In *Voyennoye delo drevnego i srednevekovogo naseleniya Severnoi i Tsentralnoi Azii*. Novosibirsk: IIFF SO AN SSSR, pp. 61–70.
Konovalov P.B. 1976
Khunnu v Zabaikalye (pogrebalnye pamyatniki). Ulan-Ude: Buryat. kn. izd.
Kubarev G.V. 2002
Dospekh drevnetyurkskogo znatnogo voina iz Balyk-Sooka. In *Materialy po voyennoi arkheologii Altaya i sopredelnykh territorii*. Barnaul: Izd. Alt. Gos. Univ., pp. 88–112.
Kubarev G.V. 2007
Zashchitnyi dospekh s figurnymi plastinami (proiskhozhdeniye, rasprostraneniye i konstruktivnye osobennosti). In *Altae-Sayanskaya gornaya strana i sosedniye territorii v drevnosti*. Novosibirsk: Izd. IAE SO RAN, pp. 103–120. (Istoriya i kultura Vostoka Azii).
Mongush V.T., Grach A.D. 1977
Obsledovaniye tainika v Biy-Khemskom raione Tuvy. In *Arkheologicheskiye otkrytiya 1976 g*. Moscow: Nauka, p. 227.
Plotnikov Y.A. 1987
"Klady" Priobya kak istoricheskiy istochnik. In *Voyennoye delo drevnego naseleniya Severnoi Azii*. Novosibirsk: Nauka, pp. 120–135.
Radlov V.V. 1989
Iz Sibiri: Stranitsy dnevnika. Moscow: Nauka.
Savinov D.G. 1982
Drevnetyurkskiye kurgany Uzuntala (k voprosu o vydelenii kuraiskoi kultury). In *Arkheologiya Severnoi Azii*. Novosibirsk: Nauka, pp. 102–122.
Soenov V.I. 1997
Nagrudnyi pantsir gunno-sarmatskoi epokhi s Gornogo Altaya. *Rossiyskaya arkheologiya*, No. 4: 181–185.
Soenov V.I., Ebel A.V. 1997
Ritualniye sooruzheniya mogilnika Mendur-Sokkon I. In *Izvestiya laboratorii arkheologii*, No. 2. Gorno-Altaysk: Gorno-Alt. Gos. Univ., pp. 103–115.
Sunchugashev Y.I. 1979
Drevnyaya metallurgiya Khakasii: Epokha zheleza. Novosibirsk: Nauka.
Tallgren A.M. 1917
Collection Tovostine des antiquités préhistoriques de Minoussinsk conservées chez le dr. Karl Hedman à Vasa: Chapitres d'archéologie sibérienne. Helsingfors: Société finlandaise d'archéologie.
Troitskaya T.N., Novikov A.V. 1998
Verkhneobskaya kultura v Novosibirskom Priobye. Novosibirsk: Izd. IAE SO RAN.
Umansky A.P. 1974
Mogilniki verkhneobskoi kultury na Verkhnem Chumyshe. In *Bronzovyi i zheleznyi vek Sibiri*. Novosibirsk: Nauka, pp. 136–149. (Drevnyaya Sibir; iss. 4).
Weinstein S.I. 1972
Istoricheskaya etnografiya tuvintsev. Moscow: Nauka.

Received August 7, 2015.
Received in revised form December 17, 2015.

DOI: 10.17746/1563-0110.2017.45.1.112-120

D.O. Osipov[1], S.F. Tataurov[2, 3], S.S. Tikhonov[2], and M.P. Chernaya[3]

[1]State Historical Museum,
Krasnaya pl. 1, Moscow, 109012, Russia
E-mail: dmitriyosipov@mail.ru
[2]Institute of Archaeology and Ethnography, Siberian Branch,
Russian Academy of Sciences,
Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia
E-mail: tatsf2008@rambler.ru; st-57@mail.ru
[3]National Research Tomsk State University,
Pr. Lenina 34, Tomsk, 634050, Russia
E-mail: mariakreml@mail.ru

Leather Artifacts from Tara, Western Siberia, Excavated in 2012–2014*

We describe 1083 leather items found during the excavation of Tara, one of the oldest Russian fortified towns in western Siberia. Their preservation is excellent, owing to the high humidity of the habitation deposits and the presence of natural preservatives in the soil. Most items are parts of footwear (64 %) and scraps of material (26 %); other leather items are mittens, scabbards, and belts. Unique finds include saddle holsters and a compass case. Most artifacts date to late 1600s–early 1700s. The most popular categories of footwear were soft multi-piece shoes and stiff high-boots worn by garrison members. Fashionable shoes were rigid. On the basis of this collection, we reconstruct certain aspects of the early Russian settlement of the Irtysh region at the time when it became part of the Russian Empire.

Keywords: *Western Siberia, early Russian colonization, Tara, leather footwear.*

Introduction

The study of the archaeological records pertaining to the period of the Russian colonization of Siberia had become an independent branch of Siberian studies by the beginning of the 2000s, and added considerably to the existing data base, and also promoted historical reconstructions of settlement in the region. Excavations of the towns that served as multipurpose centers of the colonized territories produced the greatest amounts of information (Chernaya, 2008, 2016). One of the oldest cities in western Siberia, which played an important role in the development of new lands, was Tara, founded by Prince Andrey Eletsky in 1594. The joint research works in Tara have been carried out since 2007 by the Omsk Division of the Institute of Archaeology and Ethnography SB RAS, Omsk State University, and National Research Tomsk State University. In the course of archaeological and archival studies, new information was obtained concerning the history of the foundation and development of Tara, as well as its role as a military, administrative, economic, and interethnic center of the region.

The high information potential of the urban archaeological sites is indicated by the high density of building, the concentration of various facilities, and the intensity of an urban way of living. The good state of preservation of the cultural remains and the low anthropogenic impact increase the significance of the

*Supported by the Russian Science Foundation (Project No. 14-50-00036).

culture-bearing layers. The archaeological site of Tara was well preserved, owing to beneficial conditions. Despite continuous development of the town above the old cultural layers, the original layout and building remains were preserved by the absence of major construction works.

It is important to note that abundant and diverse materials have been recovered from a particular archaeological context: mansions consisting of various structures arranged as single complexes. The information obtained in the course of the studies makes it possible to correlate the historical context of Tara center with the chronological and topographic development of the area, and supports the accuracy of our conclusions.

Available archival records provide insight into the development of handicrafts in the town and a general picture of its citizens in the 17th–18th centuries. In that period, the town was almost in a state of siege, and differed considerably from other similar settlements in its arrangement and way of living. The direct subordination of Tara to Moscow made Tara independent from the local authorities in Tobolsk, which fact raised the living standards of the citizens: they benefited from various gainful activities such as salt mining, trading with western Central Asia and China, and controlling the local fur market. The size of Tara's population was not particularly large at that time, yet Tara trade-fairs competed with those of Tobolsk and other Siberian towns.

The remoteness of Tara, and logistic difficulties in the delivery of military allowances, stimulated the development of handicrafts that met the requirements of the garrison and the adjacent Cossack settlements. However, for the aforementioned reasons, the attempts to dress the officials in the uniforms prescribed by the Peter I's reforms were unsuccessful. In 1706, a decree was issued permitting Siberian citizens, including the military, to wear clothing according to their taste. But by the middle of the 18th century, the militaries had gradually changed their clothing to the uniforms generally accepted in the Russian Army. In Tara, this led to an increase in the number of tailors (49), shoe-makers (50), and leather-crafters (39). The records also listed 24 smiths, 11 coppersmiths, 9 rawhide artisans, 14 carpenters, and 2 soap-makers (Tara…, 2014: 89, 122).

Shoe-makers represented the largest artisan group. Shoe-making was a widespread occupation. This inference is supported by the artifacts found in the cultural layer of a rich mansion of the pre-Peter I period. Near the building, which was designated as a servant's house, a concentration of several hundred leather scraps was found: the remains of shoe-cutting. Judging by the shape of the majority of leather scraps, this workshop focused on the repair of boots, which were the typical footwear of the service people in this fortified settlement (Bogomolov, Tataurov, 2010).

Historical-typological classification of the collection

A comprehensive approach was applied to the analysis of the collection of 1083 leather items. The proposed classification was based on the available archaeological finds, which were analyzed by the X-ray fluorescence technique* and spectroscopic analysis; and also on the available written records and ethnological data.

Separate parts of footwear constitute 64.2 % of the total, while scraps of the material make 26 %. The sample also includes various leather goods: mittens, scabbards, belts, and such rare items as saddle holsters and a compass case.

The artifacts were mostly associated with the deposits of the second half of the 17th–first quarter of the 18th century. A more exact date could have barely been established at the initial stage of excavations. Our experience of working at the sites with "wet" (highly moisturized) deposits has shown that "archaeological leather" imbedded in such deposits does not always belong to the same stratigraphic period, because of the durable existence of leather goods (excluding footwear) or their secondary use. This is also true for the artifact concentrations at the mansions' peripheries: the goods might have been repeatedly redeposited during earthworks (Sorokin, 1995: 28–31).

The discovered items were made of large and small cattle rawhide tanned with vegetative extracts, and also *rovduga* (oil-tanned deer or elk rawhide).

FOOTWEAR. Footwear represents mass-production, and shows the level of handicraft-development. Manufacturing complexity and wide-scale production of footwear require high technical and technological skills. Using a systematic approach, we have classified the footwear into high and low models. Decoration techniques are described separately (Osipov, Likhter, 2004: 9).

Soft footwear. ***Simple porshen (carbatina) shoes.*** The majority of *porshens* (58 items) represent simple one-piece shoes, cut of a single trapezoid or rectangular piece of leather 3–5 mm thick. The edges were cut into loops through which a lacing pulled the uppers together. The toe was formed via sewing together** the edges of the frontal part of the piece with the seam turned inside. Simple in manufacture and comfortable to wear, this *porshen* footwear was widespread in Russian towns since the 9th century.

The Tara collection represents two types of back-making: 1) the edge of a leather piece was simply bent up; 2) two short longwise cuts were made at the distal end

*X-ray fluorescence is one of the modern spectroscopic methods of the elementary analysis of substances.

**Sometimes, sewing with thread was replaced by strapping with leather band.

Fig. 1. Multi-piece *porshen*.

Fig. 2. Soft multi-piece shoe.

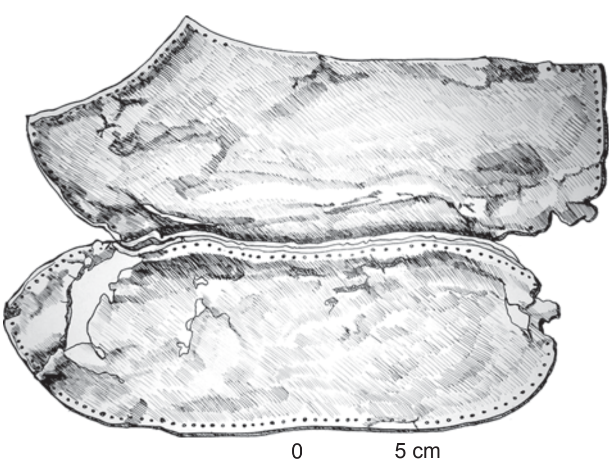

Fig. 3. Parts of a shoe with a two-piece upper.

of a leather piece, and then the three obtained parts were sewn together with a through stitch.

Multi-piece *porshens* (13 items) also had inserts of semi-oval or helmet-like shape, covering the toes (Fig. 1). The ethnic attribution of multi-piece *porshens* has not yet been clearly established. However, similar footwear has been recorded in the Finnish-speaking peoples (Vizgalov, Parkhimovich, Kurbatov, 2011: 41). *Porshens* were manufactured from cattle-hide, tanned and raw, and from *rovduga*. The quality of manufacture (shape of cutout-parts, straight seams, equal distances between the seam-holes) suggests that this footwear was made by professional shoe-makers. For insulation, the upper of a *porshen* was provided with an edging made from a double folded strap of linen or twill-weave woolen fabric, which was attached to the shoe with a zigzag seam. Judging by the length of the feet, *porshen* shoes were worn by all groups of the urban population: men, women, and children.

Soft multi-piece shoes. In the classification proposed by the Mangazeya researchers, this construction is referred to as "multi-piece footwear without heels" (Ibid.: 42). The construction consists of the upper; and a slightly profiled, symmetrical sole, which are sewn together with a blind inserted stitch (Fig. 2). To the uppers of shoes, cloth or suede edging was often attached (as in *porshens*), inside of which a woolen cord or narrow suede band could have run. The cord was passed through a loop in the counter, which was attached over the shoe's back. The upper was made of soft leather 1.2–1.8 mm thick, which was oil- or vegetable-tanned. The sole was cut of a more stiff and thick (4.5 mm) leather.

By the upper cutting pattern, soft shoes can be subdivided into one-piece and two-piece variants. A shoe with a two-piece upper included a soft counter, which was cut separately and attached to the vamp's wings with a plain stitch. The collections of Mangazeya, Staroturukhansk, Tara, and other Siberian towns are dominated by multi-piece footwear without heels (Ibid.). Tara yielded over 300 parts of soft multi-piece shoes. According to ethnographers, this type of footwear, designated as *obutki*, *chirki*, and *koty*, was common for the rural Siberian population till the 19th century (Etnografiya…, 1981: 160; Fursova, 1997: 115).

A.V. Kurbatov (2008: 165–167) called the soft shoes described above *uledi*. However, we believe that the best term for such footwear would be the neutral word *shoes*, since in various regions footwear of the same model could have been designated differently and, conversely, one and the same name could have been used for various footwear types.

A two-piece type of shoe, which was represented by a single item, consisted of two symmetrical parts attached to one another with an inserted stitch along axis of the toe and back (Fig. 3). High quarters allow us to refer to this footwear as a boot*. Close parallels to this shoe have been reported from Mangazeya, where researchers regard two-piece type of shoes as a part of the traditional garment of indigenous people (Vizgalov, Parkhimovich,

*In modern shoe-production, *boot* means a construction covering the whole foot and the shin above the ankle (Zybin, 1978: 12). In written records, this word first occurs at the end of the 15th century.

Kurbatov, 2011: 45). Footwear of similar construction was used by the Khanty, Mansi, and Nenets peoples (Bogordaeva, 2006: 170–171; Vasilevich, 1963; Povod, 1997: 234–245).

Rigid multi-piece shoes. A shoe of this type has a lining*, which is sewn as a pocket with a birch-bark insert, and a heel. A distinction between the high (high-boots) and low (shoes, boots) models is difficult, because of the similar construction of the low parts of high-boots and shoes. That is why this footwear is often distinguished by the absence or presence of heels (Vizgalov, Parkhimovich, Kurbatov, 2011: 41). However, we believe that the Tara footwear can be traditionally classified into high (high-boots) and low (shoes) models.

High-boots. Modern shoe-makers use this term for footwear with a boot-shaft tightly covering the foot and shin and with no front or lateral cuts (Zybin, 1978: 12–13). The Tara collection includes a considerable number (22 items) of fragments of two-piece boot-shafts. Boot-shafts are rare in archaeological materials than other construction elements (vamps, soles, etc.), because these large and durable parts were often reused. The boot-shafts found in Tara are lower than knee high. Their upper edges are obliquely cut from the knee towards the calf. The leather's thickness does not exceed 2 mm. The boot-shafts were cut of two parts connected at the sides with a plain stitch.

The lower part of the boot-shaft was sewn to the vamp having a two-piece lining. The vamp's toe could have been rounded, or slightly pointed. The upper edge was either bent inwards; or had a pointed tongue, which was sewn in a corresponding cut in the front part of a boot-shaft. The closest parallel to the Tara high-boots with tongues at the insteps has been recorded in late 17th century materials from the excavations of the Tomsk kremlin (Osipov, Chernaya, 2016).

The elongated lateral parts (wings) of the vamp were sewn to the rigid counter with a pointed upper part. The back of a high-boot was set on an "interior" or stacked heel, which was resoled from below with iron nails or a metal heelplate. The sole and heel were resoled with iron nails. The X-ray fluorescence analysis of the metal of the heads of nails decorating the vertical strip of the counter has shown its tin content, which was possibly connected with their tin-plating.

High-boots with interior heels had the straight soles, while the models with stacked heels had the soles distinctively curved at the frontal side of the heels**; the heel's height did not exceed 3 cm. Several fragments of the small-profile soles show a markedly narrow waist area, which suggests their attribution to women's footwear that was fashionable at that time. Available archaeological materials contain only few high-boots of this model, typical of the European part of Russia, whence they were apparently imported to Tara.

The high-boot vamp with an incurved toe-edge and an impression on the instep was unique. High-boots of this model were quite popular in Muscovy, but they disappeared by the beginning of the 17th century.

Shoes. Modern shoe-technologists define shoes as footwear with a split vamp, covering the foot no higher than the ankle (Zybin, 1978: 12). In terms of construction, rigid shoes are close to high-boots. They share a two-piece upper, a lining, a rigid counter with a birch-bark insert, and a sole with either a stacked or an interior heel resoled with nails or heelplate. The upper edge, in the absence of a boot-shaft, is folded inside and stitched to the lining. This type of footwear was more expensive and fashionable, and thus was affordable only by prosperous urban citizens. Judging by the size of the upper parts*, shoes were worn by people of both sexes. Exactly such shoes were provided with wooden heels typical of the footwear of the early 18th century.

Decoration. In the late medieval period, to which the discussed collection belongs, patterns of footwear-decoration changed. Multicolored thread embroidery, which prevailed in the Old Russian time, was replaced by decoration with metal parts: nails and wire.

Decorative metal nails, unlike plain footwear iron nails that protected the back of the sole from attrition, were attached to the exterior part of the counter. Models with soles turned up had nails decorating their up-turned toes. Some parts of counters showed only small holes from the decorative nails, which may have been taken out for reuse.

Wire. The counter could have been decorated with twisted metal wire, 0.6–0.8 mm in diameter, which was attached to the back welt. We have examined the wire made from brass—an alloy of copper and zinc. It can be compared with the brass wire on the footwear from Migalka cemetery in the Tomsk Region (Chindina, 2001). Such wire was made of various alloys; for instance, high-boots recovered from the deposits of the turn of the 16th–17th century in Ivangorod Fortress were decorated with wire of a lead-tin alloy (Kurbatov, 1995: 199).

Impression. Two Tara rigid shoes from the deposits of the early 18th century show the uppers totally covered with impressed lines, forming an oblique net. Pieces of the impressed leather were reused to cut several heel-lifts. According to Kurbatov (2010), this technique of leather finishing, well known from archaeological

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*Lining is an interior part that has a shape and size corresponding to the exterior vamp layer, and which reinforces the shoe shape's stability and ensures its durability.

**In the modern shoe-making industry, parts of this shape are termed flap sole.

*Soles of the high- and low-heeled footwear are practically identical.

materials from the late medieval sites of Siberia, originated in the Volga region.

Decorative seams. The upper part of a single fragment of the back portion of a two-piece boot-shaft recovered from the layer of the late 17th century shows the line of a decorative non-through seam forming an acute angle at the rear part of the boot-shaft. The seam runs at some distance from the upper edge of the boot-shaft, and underlines the oblique upper edge from the knee to the calf.

In the late 17th century, stitching of seam-joints with colored threads was a typical decoration technique. The collection studied contains two such parts, possibly belonging to a single pair of high-boots.

Stamps. The Tara collection includes four soles bearing stamps of two types. Type 1 consists of three parallel lines applied under the arch of the foot with a pointed hot tool (Fig. 4). Stamps of this type were widely used all over the Moscow State, and are well known in the archaeological materials from Moscow (Osipov, 2003: 26), Tver (Kurbatov, 2002: Fig. 9, *1*; 10, *4*), Smolensk (Osipov, Sobol, 2012), Mangazeya (Vizgalov, Parkhimovich, Kurbatov, 2011: 51), Tomsk (Osipov, Chernaya, 2016: 136–150), and other towns. Type 2 shows three longitudinal and five transverse lines located close to the heel. Such stamps were recorded on soles uncovered from deposits in the Moscow Kremlin (Osipov, 2014: 47–48).

Fig. 4. Sole of a boot, with a stamp.

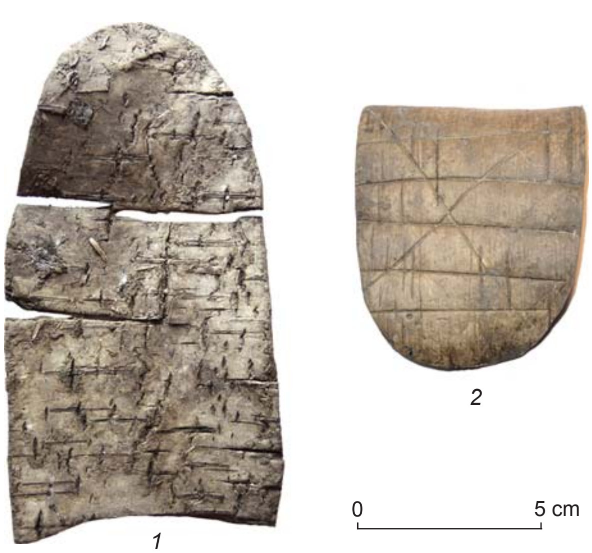


Fig. 5. Birch-bark templates used in cutting soles (*1*) and heel-lifts (*2*).

In Russia, as well as in Western European countries, stamps began to be used in the middle of the 17th century. This was connected with the process of specialization of labor, and the intention of the artisan to label his products with his individual mark (Swann, 2001: 120–121).

Tools. The Tara collection contains shoe-making tools including such interesting artifacts as four birch-bark templates that were used for cutting soles (Fig. 5, *1*) and heel-lifts (Fig. 5, *2*).

Birch-bark templates for cutting have long been considered to be footwear-parts. However, they were used not only for shoe-making but also for cutting mittens. Such templates are well known in materials of excavations from Moscow, Pskov, Veliky Novgorod, and Mangazeya (Veksler, Osipov, 1999a; Labutina, 1970; Kolchin, 1985: 270, pl. 110, *11*, *12*; Vizgalov, Parkhimovich, Kurbatov, 2011: 68, fig. 84, *2*). They were also mentioned in written sources (Buslaev, 1861: Col. 389).

Birch-bark templates have been found rarely, because of their perishable material and poor state of preservation, which hampers their correct identification; and because they were often reused (for example, as kindling material).

Footwear made from vegetable fibers. Bast shoes have traditionally been attributed to rural footwear, yet they are often found during excavations of urban mansions (Osipov, 2006: 68–70). The Tara collection comprises eight fragments of bast shoes of diagonal plaiting made of birch-bark stripes 1.7–2.0 cm wide.

Visual inspection suggests that at least some types of plaited shoes originally did not have any sides and counter; they represented either a sole with a front vamp part; or only a sole, which was adjusted to the foot with ropes or leather straps and served as exterior or protective footwear. According to ethnological data, the Old Believers from Baraba used to wear snow-shoes as exterior footwear over their felt boots (Fursova, 2009). By plaited footwear without sides could have been meant the *stupni* mentioned in written records, which were widespread in the Russian North and Siberia (Pamyatniki…, 1851: 379).

OTHER LEATHER GOODS. A small collection of 28 leather items may be classified into several categories: containers for storing and carrying various goods, play items (ball), pieces of handicraft equipment (mittens), and horse-trappings.

Scabbards. This item represents the most widespread type of leather container—an attribute of medieval garments, especially those of the taiga population. The

Tara collection comprises seven knife-covers in various state of preservation. These are made of a two-fold blank stitched at the side of the cutting edge. T.S. Varfolomeyeva (1993: 165) attributes these scabbards to cut type 1 (the most widespread). They are well correlated with scabbards that were classified by Kurbatov also as type 1, but are stitched over the entire back edge (Vizgalov, Parkhimovich, Kurbatov, 2011: 60).

All scabbards were made from oil- or vegetable-tanned leather not more than 1.5 mm thick. Their edges were stitched with simple and shoe seams. The shoe-stitch was executed with two needles: one needle was stuck in the inner side, another needle in the face side, after which the threads were tightened to ensure a firm joint.

Judging by their length, which did not exceed 22 cm, scabbards were intended for all-purpose household knives. Two scabbards each preserved a small domed tongue, with holes in its base for hanging scabbards on the belt. One of the covers, made of oil-tanned leather, was decorated with four narrow transverse straps in its upper third, which were made from leather tanned with vegetable-extracts.

Mittens. Nine mittens, represented by fragments, were found. Two mittens were each made of one two-fold piece of leather, in the center of which a cut-out for adjusting the thumb had been made. Seven mittens were each made of two trapezium-shaped parts with rounded ends, which were stitched together with an inserted stitch.

Play items. These were represented only by a single fragment of a leather ball, an all-purpose toy widespread in Russian towns, including Moscow and Veliky Novgorod (Veksler, Osipov, 2000: 155; Morozova, 1990: 70). Leather balls were used in competitive outdoor games by adults and adolescents; the idea of the games was to drive a ball into a hole (Rybina, 2006: 18).

The part of the ball was segment-shaped (5.0 × × 8.5 cm), and was cut from leather 1.5 mm thick. Such balls were stitched together turned inside out, with a plain stitch. One of the seams on a small area remained unfinished, after which the blank was turned face-up. The balls were filled with wool, horse hair, and moss; then the opening was sewn from outside with a through stitch. The balls, 5–7 cm in diameter, usually consisted of four segments.

Compass case. This item represents the leather cover of a wooden case for a ship's compass, and belongs to the rarest finds. Only five such items have been recorded in Russia: rectangular boxes decorated on their face sides with vegetable-impressions. They all were found in Mangazeya, and have a Western European origin (Belov, Ovsyannikov, Starkov, 1980: 60, 126; Vizgalov, Parkhimovich, Kurbatov, 2011: 71, 72, fig. 88, 89).

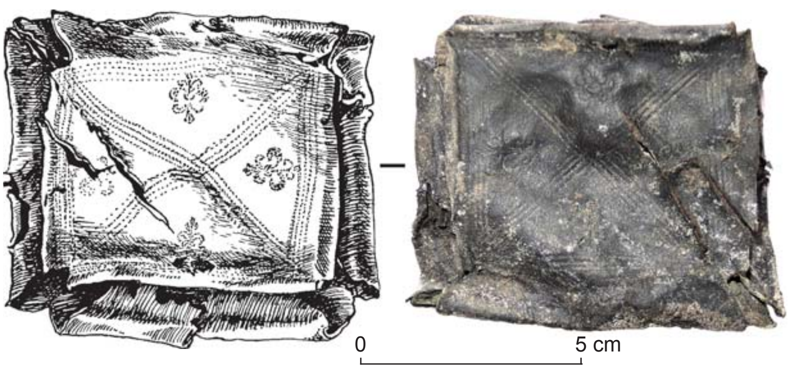


Fig. 6. Compass case.

The case from Tara, recovered from the 17th century deposits, was made of one piece of leather with a flap and edges turned in (Fig. 6). Its outer face shows a stamped ornament representing a trilinear frame divided by a sidelong cross into four parts; inside each part, a *fleur de lys* image is imprinted. This symbol was initially regarded as the coat of arms of the Kings of France; but later it became an emblem of many Western European cities (Entsiklopediya simvolov, 1996: 283–284).

Saddle holster. Saddle holsters for carrying pistols and carbines became popular upon the introduction of portable firearms in the troops of the Moscow State. Prior to excavations at Tara, three such items had been

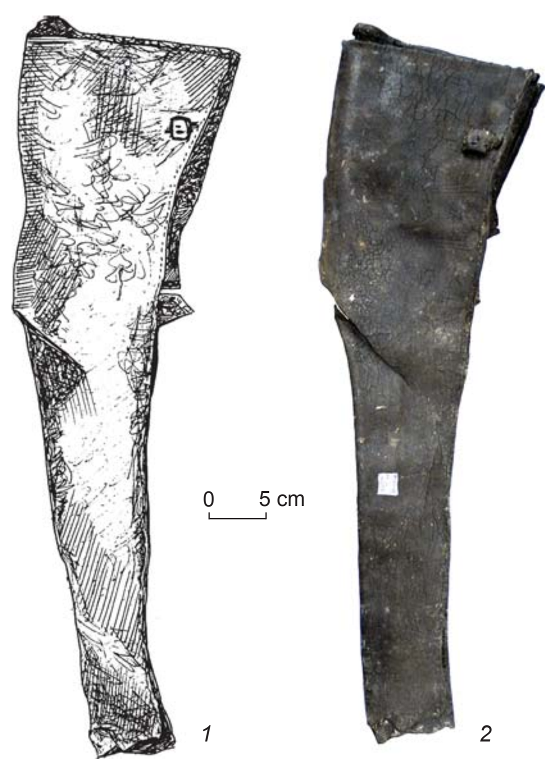


Fig. 7. Saddle holster.

known in archaeological collections: two holsters were found during excavations at Streletskaya Sloboda in the area of the modern Manezhnaya Square in Moscow (Veksler, Osipov, 1999b: 215, fig. 1, *9*), and one holster at Ivangorod Fortress in the sediments of the turn of the 16th–17th century (Kurbatov, 2014).

At Tara, two saddle holsters for cavalry firearms were found. The better-preserved holster was cut from a single two-fold piece of thick leather stitched with a through seam along the side opposite to the fold. When assembled, this represents a leather cover 56 cm long with a widening at its upper third, where slots for leather straps were made for hanging the holster on the saddle* (Fig. 7). The second holster was preserved only partially: its lower portion had been cut off so as to reuse the leather.

Horse cavalry was an elite branch of arms, and was formed of nobility; therefore, its equipment was often richly decorated. Holsters were often embroidered with colored silk or silver threads, and had velvet lapels. The 1657 inventory of goods belonging to Nicholas Romanov stated the price of a holster: "carbine holster, price—6 altyns, 4 dengas" (Rospis vsyakim veshcham…, 1887: 50).

*Holsters were usually located on both sides of the saddle's pommel.

Conclusions

The representative collection of leather goods from Tara provides information on the character of shoe-making as one of the most popular handicraft occupations in the town, and also on the urban lifestyle, elements of costume and equipment. Available archaeological materials made it possible to reconstruct the main shoe-types used by the Tara population in the 17th–18th century, and the main patterns of their cutting and assembly. The chemical composition of the metal of shoe nails and decorative wire was determined. The overwhelming part of the Tara footwear has parallels to the models from other Russian sites, primarily from Tomsk, which proves the high level of standardization of shoe-making.

Analysis of 2012–2014 excavation materials supports the earlier conclusions on the existence of a shoe-manufacturing shop in Tara, which produced footwear of vegetable-tanned rawhide of large and small cattle, as well as oil-tanned deer or elk rawhide. *Rovduga* was used in the manufacture of primitive and cheap products. It was most likely provided by the local population, and allowed a shortage of higher-quality materials to be supplemented.

The existence of a full-fledged leather-making industry in Tara, which would have enabled processing of leather tanned with vegetable extracts, seems unlikely. This long and water-consuming process hardly fits with the tough life of a military fortress. Apparently, local artisans made shoes of imported materials, which corresponded well with the character of Tara as a trading center. The list of items sold by the St. Trinity Selenginsky monastery in 1720–1730 includes a variety of leathers: *yuft* (Russian) leather, dyed and tanned skins of calf, elk, horse, and goat; parts of footwear: vamps, soles, boot-shafts, and patches; and ready-made footwear: *charyki*, high-boots, boots, and high fur-boots; as well as various mittens and horse collars (Mashanova, 1974: 150–165, tab. 8).

The Tara shop also specialized in shoe-repair, as evidenced by heavily worn soles, and a small number of heel-shoe models with heelplates. Shoe-repair workshops have often been traced during excavations in Russian towns (Chernaya, 2015: 157).

Excavations of the 2015 field season established the absence of any direct correlation between the shoe-making shop and the concentrations of poorly degradable and burnable waste, which were accumulated in ravines, on wastelands, or in basements of abandoned houses. In the periphery of the town, where cellars for roots were located, some pits were discovered that were especially excavated for the dumping of old worn footwear, so not to clutter up the residential areas.

Most popular Tara footwear consisted of soft multi-piece shoes and stiff high-boots (typical of the military fortress garrison). Fashionable rigid shoes served as festive footwear. In Tomsk, shoes with high heels were quite popular; however, in Tara, where much more footwear-parts were found in the "wet" deposits, no abundance of high heels is observed.

Sole shapes (apart from their size) suggest the onset of division of the construction of footwear into men's and women's*; where women's footwear was characterized by the width of the waist area, which was narrowed in the small soles.

Among the models plaited from vegetable fibers, noteworthy are *stupni* (mentioned in written sources), which, unlike the common bast shoes, do not have sides and counters. These finds suggest that the so-called exterior (protective) footwear, widespread in Western Europe, was also used in Russia.

The Tara archaeological collection includes birch-bark templates intended for cutting leather items. Such templates were described in the written sources as early as the 11th century, and were termed "shoe-making measure" (Sreznevsky, 1912: 1268). The great number of discovered templates contradicts Kurbatov's idea that they represented some auxiliary items, and were used only as teaching aids (2003: 169).

Saddle holsters and a leather compass case illustrate the daily life of the service people, who were engaged in

*In the medieval period, there was no division into men's and women's footwear.

the development of new lands. Such finds as mittens, ball, and scabbards testify to the wide use of leather. The small number of leather covers and scabbards may be explained by the possibility that they were made of birch-bark, which was easier and cheaper. The collection includes a well preserved birch-bark case for the axe*.

The collection of leather goods from Tara provides an illustration of the early history of the town, and a perspective of its role in the process of occupation and economic development of the region by the Russian people.

References

Belov M.I., Ovsyannikov O.V., Starkov V.F. 1980
Mangazeya. Part 1: Mangazeyskiy morskoi khod. Leningrad: Gidrometeoizdat.

Bogomolov V.B., Tataurov S.F. 2010
Kollektsiya obuvi iz raskopok goroda Tary v 2009 godu. In *Integratsiya arkheologicheskikh i etnograficheskikh issledovaniy*. Omsk: Nauka, pp. 91–96.

Bogordaeva A.A. 2006
Traditsionnyi kostyum obskikh ugrov. Novosibirsk: Nauka.

Buslaev F.I. 1861
Istoricheskaya khrestomatiya tserkovnoslavyanskogo i drevnerusskogo yazykov. Moscow.

Chernaya M.P. 2008
Russkaya arkheologiya kak novoye napravleniye v sibirevedenii. In *Moskovskaya Rus. Problemy arkheologii i istorii arkhitektury*. Moscow: IA RAN, pp. 482–515.

Chernaya M.P. 2015
Voevodskaya usadba v Tomske. 1660–1760 gg.: Istoriko-arkheologicheskaya rekonstruktsika. Tomsk: D'Print.

Chernaya M.P. 2016
Sibirskiy opyt osvoeniya prostranstv v istoriko-arkheologicheskom kontekste. In *Ot Smuty k Imperii. Novye otkrytiya v oblasti arkheologii i istorii Rossii XVI–XVIII vv.: Materialy nauch. konf.* Moscow, Vologda: pp. 14–23.

Chindina L.A. 2001
Gruntovyi mogilnik Migalka. In *Narody i kultury Tomsko-Narymskogo Priobya: Materialy k entsiklopedii Tomskoi oblasti*. Tomsk: Izd. Tomsk. Gos. Univ., pp. 97–98.

Entsiklopediya simvolov. 1996
I.S. Sventsitskaya (ed., transl., pref.). Moscow: Respublika.

Etnografiya russkogo krestyanstva Sibiri. XVII – seredina XIX v. 1981
V.A. Aleksandrov (ed.). Moscow: Nauka.

Fursova E.F. 1997
Traditsionnaya odezhda russkikh krestyan-starozhilov Verkhnego Priobya (konets XIX – nachalo XX v). Novosibirsk: IAE SO RAN.

Fursova E.F. 2009
Tradtsionnaya kultura staroobryadtsev Vasyuganya kak rezultat mezhetnicheskikh vzaimodeistviy. *Etnograficheskoye obozreniye*, No. 1: 119–139.

*It cannot be excluded that this case was only a frame sewn round with fabric.

Kolchin B.A. 1985
Remeslo. In *Drevnyaya Rus. Gorod. Zamok. Selo*. Moscow: Nauka, pp. 243–297. (Arkheologiya SSSR; vol. 15).

Kurbatov A.V. 1995
Kozhanye izdeliya shvedskogo perioda iz raskopok Ivangorodskoi kreposti. *Russkaya arkheologiya*, No. 2: 198–208.

Kurbatov A.V. 2002
Pogrebalnaya obuv srednevekovoi Rusi. *Arkheologicheskiye vesti*, No 9: 155–172.

Kurbatov A.V. 2003
"Mery sapozhnye" i problema remeslennogo uchenichestva. *Arkheologicheskiye vesti*, No. 10: 169–182.

Kurbatov A.V. 2008
Zaklyucheniye po nakhodkam predmetov, svyazannykh s kozhevenno-obuvnym remeslom (Prilozheniye k otchetu o nauchno-issledovatelskikh rabotakh). In *Vizgalov G.P. Kompleksnye arkheologicheskiye issledovaniya Staroturu-khanskogo gorodishcha v Turukhanskom rayone Krasnoyar-skogo kraya v 2008 godu.* Nefteyugansk. Arkhiv nauchno-proizvodstvennogo obyedineniya "Severnaya arkheologiya" (Tsentr kulturnogo naslediya. Nefteyugansk. r-n, Khanty-Mans. avt. okr.) R-I. D. 213.

Kurbatov A.V. 2010
O gorode Bolgar i sorte kozhi "Bulgari". In *Dialog kultur i narodov srednevekovoi Evropy: K 60-let. so dnya rozhd. E.N. Nosova*. St. Petersburg: Dmitry Bulanin, pp. 447–452.

Kurbatov A.V. 2014
Olstra po pismennym i arkheologicheskim dannym. *Stratum plus*, No. 6: 99–102.

Labutina I.K. 1970
Raskopki v Pskove u zdaniya Pedagogicheskogo instituta. *Arkheologicheskiye otkrytiya 1969 goda*. Moscow: Nauka, pp. 25–26.

Mashanova L.V. 1974
Khozyaistvennoye osvoyeniye Zabaikaliya v kontse XVII – nachale XVIII veka. Cand. Sc. (History) Dissertation. Irkutsk.

Morozova N.A. 1990
Igrushki drevnego Novgoroda. In *Novgorod i Novgorodskaya zemlya. Istoriya i arkheologiya: Tezisy nauch. konf.*, iss. 3. Novgorod: pp. 69–71.

Osipov D.O. 2003
Informatsionnye vozmozhnosti kollektsii kozhanoi obuvi (po materialam raskopok v Moskve). *Rossiyskaya arkheologiya*, No. 2: 17–30.

Osipov D.O. 2006
Obuv moskovskoi zemli XII–XVIII vv. Moscow: IA RAN. (*Materialy okhrannykh arkheol. issledovaniy*; vol. 7).

Osipov D.O. 2014
Srednevekovaya obuv i drugiye izdeliya iz kozhi (po materialam raskopok v Moskovskom Kremle). Moscow: Akteon.

Osipov D.O., Chernaya M.P. 2016
Kollektsiya izdeliy iz kozhi po materialam raskopok Tomskogo Kremlya. *Rossiyskaya arkheologiya*, No. 4: 138–150.

Osipov D.O., Likhter Y.A. 2004
Sistemnoye opisaniye i klassifikatsiya kozhanoi obuvi: Metod. rekomendatsii. Moscow: IA RAN.

Osipov D.O., Sobol V.E. 2013
Kollektsiya kozhanoi obuvi iz Smolenska. In *Materialy Zachodniopomorskie. Nova seria 2012.*, vol. IX, z. 1:

Archeologia, Rocznik naukowy museum nadopoweco w Szczecinie. Szczecin: pp. 375–405.

Pamyatniki diplomaticheskikh snosheniy s Rimskoi imperiyeyu. 1851
Vol. II. St. Petersburg.

Povod N.A. 1997
Nauchnoye opisaniye obuvi severnykh narodov (iz fondov TOKM). In *Ezhegodnik Tyumenskogo obl. krayeved. muzeya*. 1993. Novosibirsk: pp. 234–249.

Rospis vsyakim veshcham, dengam i zapasam, chto ostalis po smerti boyarina Nikity I vanovicha Romanova i dachi po nem na pomin dushi. 1887
Chteniya v Obshchestve istorii i drevnostei rossiyskikh pri Mosk. Univ., bk. III, pt. I. Moscow: pp. 1–128.

Rybina E.A. 2006
Mir veshchei srednevekovogo Novgoroda (po arkheologicheskim nakhodkam). *Vestnik Novgorod. Gos. Univ.*, No. 38: 14–19.

Sorokin A.N. 1995
Blagoustroystvo Drevnego Novgoroda. Moscow: Ob-vo istorikov arkhitektury.

Sreznevsky I.I. 1912
Materialy dlya slovarya drevnerusskogo yazyka, vol. III. St. Petersburg: Tip. Imp. Akad. nauk.

Swann J. 2001
History of Footwear in Norway, Sweden and Finland. Stockholm: Coronet Books Inc.

Tara v XVI–XIX vekakh – rossiyskaya krepost na beregu Irtysha. 2014
Omsk: Amfora.

Varfolomeyeva T.S. 1993
Kozhanye nozhny iz raskopok v Novgorode. In *Novgorod i Novgorodskaya zemlya. Istoriya i arkheologiya: Materialy nauch. konf., Novgorod, 26–28 yanv. 1993 g.*, iss. 7. Novgorod: pp. 162–169.

Vasilevich G.M. 1963
Tipy obuvi narodov Sibiri. Moscow, Leningrad: Izd. AN SSSR, pp. 3–61. (*Sbornik MAE*; vol. XXI).

Veksler A.G., Osipov D.O. 1999a
Masterskaya sapozhnika na ul. Prechistenka v Moskve. *Rossiyskaya arkheologiya*, No. 2: 142–151.

Veksler A.G., Osipov D.O. 1999b
Kozhanaya obuv iz raskopok na Manezhnoi ploshchadi v Moskve (1995 g.). In *Tver, Tverskaya zemlya i sopredelnye territorii v epokhu srednevekovya*. Tver: Tver. nauch.-issled. istoriko-arkheol. i restavrats. tsentr, pp. 214–221.

Veksler A.G., Osipov D.O. 2000
Kozhanye sapogi iz raskopok v Moskve. In *Trudy Muzeya istorii goroda Moskvy*, iss. 10. Moscow: pp. 160–165.

Vizgalov G.P., Parkhimovich S.G., Kurbatov A.V. 2011
Mangazeya. Kozhanye izdeliya (materialy raskopok 2001–2007 gg.). Yekaterinburg: AMB.

Zybin Y.P. 1978
Istoriya razvitiya konstruktsii obuvi. Moscow: Izd. Mosk. Tekhnol. Inst. legk. prom.

Received December 23, 2015.
Received in revised form May 18, 2016.

DOI: 10.17746/1563-0110.2017.45.1.121-134

A.V. Zubova, T.A. Chikisheva, and M.V. Shunkov
Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia
E-mail: zubova_al@mail.ru; chikisheva@ngs.ru; shunkov@archaeology.nsc.ru

The Morphology of Permanent Molars from the Paleolithic Layers of Denisova Cave*

The article describes the morphology of two permanent molars from the Pleistocene layers of Denisova Cave, the Altai Mountains. Denisova 4 is an upper left third or second molar, and Denisova 8 is an upper left third molar. Both specimens were examined using the extended trait battery. The results indicate a high informative potential for dental traits in the analysis of group variation within the genus Homo. They support the view that Denisovans, or H. altaiensis, were a distinct group of hominins, differing from both H. sapiens and H. neanderthalensis not only genetically but morphologically as well. The distinctive dental features of the Denisovans include extremely large dimensions, and affinities with Homo erectus of Sangiran and the Middle Pleistocene hominins of China, such as Xujiayao. On the basis of the morphological analysis of Denisovan upper molars, it is proposed that the unidentified part of the Denisovan genome may stem from Homo erectus. Dentally, Homo altaiensis is a very conservative taxon.

Keywords: *Denisovans, Homo altaiensis, Homo erectus, Homo neanderthalensis, Middle Paleolithic, Upper Paleolithic, dental anthropology.*

Introduction

The archaeological site of Denisova Cave is located in the south of the West Siberian region, in the Altai Mountains, close to the Russian Federation's border with China, Mongolia, and Kazakhstan.

The remains of Pleistocene hominins from the Denisova Cave have been studied for more than 30 years. First dental remains were excavated here in 1984: a deciduous molar named Denisova 2 was found in the stratigraphic layer 21.1 (Shpakova, Derevianko, 2000). In the same year, one more tooth was found in layer 12. It was initially attributed as an upper permanent incisor (Turner, 1990; Shpakova, Derevianko, 2000); but later, a comparative study demonstrated that the tooth actually belonged to an animal from the *Bovidae* family (Viola et al., 2011: 209). In 2000, a well-preserved upper permanent molar was recovered from layer 11.1 (Denisova 4); and in 2010, fragments of the crown of an upper permanent molar (Denisova 8) were found in the bottom of stratigraphic layer 11.4, in the contact zone with layer 12.

According to geochronological data, the Denisova 4 and Denisova 8 permanent molars are dated to 50–40 ka BP; however the layer containing the Denisova 4 is younger than the layer where Denisova 8 was found (Sawyer et al., 2015).

Sequencing of mtDNA and the nuclear genome from the distal phalanx of the carpal minimus of a 6–7 year old girl (which was found in layer 11.2 (Denisova 3)) and the Denisova 4 molar has shown that both specimens represent a formerly unknown hominin species. The species was named "Denisovan" (Reich

*Supported by the Russian Science Foundation (Project No. 14-50-00036).

et al., 2010), or *Homo altaiensis* (Derevianko, 2011) by the authors of the study. It was the first case in the history of physical anthropology when a new taxon was described by the results of genetic analysis, rather than by a morphological study.

The analysis of the mtDNA has shown that the hominin lineages ancestral to Denisovans, Neanderthals, and *Homo sapiens* diverged about a million years ago (Krause et al., 2010). The study of the nuclear DNA revealed a much later date for the separation of the line leading to *H. sapiens* from the hominin population ancestral to *H. neanderthalensis* и *H. altaiensis*, about 800 ka BP (Meyer et al., 2012). The divergence between Denisovan and Neanderthal lineages was initially thought to have occurred 640 ka BP (Reich et al., 2010); but according to the results of recent studies, it happened only some 430 ka BP (Meyer et al., 2016).

Denisovans have occupied the Altai Mountains for a long period of time. Judging by the rate of accumulation of mutations in the mtDNA of present-day humans, it can be hypothesized that the Denisova 2 and Denisova 8 specimens are some 65 thousand years more ancient than the Denisova 3 and Denisova 4 samples (Slon et al., 2015). It was found that Denisovan genome contained alleles associated with a dark skin-color, chestnut hair, and brown eyes (Meyer et al., 2012). According to the results of analysis of the mtDNA of all individuals found at Denisova Cave, the level of the intragroup genetic diversity in the Denisovan population was much lower than in both Neanderthals and modern humans (Meyer et al., 2012; Slon et al., 2015).

The place of origin of the Denisovans, as well as their position in the hominin taxonomy, have been hotly debated. On the basis of archaeological data, A.P. Derevianko put forward a hypothesis that the Denisovans are a subspecies of polymorphic *H. sapiens,* contemporaneous with other subspecies, e.g. *H. sapiens neanderthalensis*, *H. sapiens africaniensis*, and *H. sapiens orientalensis* (Derevianko, 2011). According to this hypothesis, the subspecies originated from local Asian populations of *H. erectus* (Ibid.). However, recent paleogenetic data on the Pleistocene hominins from Sima de los Huesos in Spain suggest that the mitochondrial genomes of this population and those of Denisovans were similar (Meyer et al., 2016). This result questions an Asian origin for the most ancient components in the genome of *H. altaiensis*.

This study presents the results of an extended morphological analysis of the Denisova 4 and Denisova 8 permanent molars. The results describe peculiarities of *H. altaiensis* dentition, and infer relationships of the Denisovan population with other taxa: *H. erectus s.l.*, *H. heidelbergensis s.l.*, *H. neanderthalensis*, and *H. sapiens s.l.*

Study protocol

The dental samples from Denisova Cave were previously described using standard ASUDAS protocol and the protocol of Neanderthal apomorphies, during the paleogenetic study of the Denisovan hominins (Krause et al., 2010; Sawyer et al., 2015).

We carried out an examination of the Denisova 4 and Denisova 8 upper molars employing a substantially extended set of traits. The set was generally based on the ASUDAS protocol (Turner, Nichol, Scott, 1991; Scott, Turner, 1997) and the conventional set of traits used in Russian dental anthropology (Zubov protocol), which includes a comprehensive description of the pattern of crown grooves (Zubov, 1968, 1974, 2006; Zubov, Khaldeyeva, 1989, 1993). The protocol of the Neanderthal complex markers (Bailey, 2002; Bailey, Skinner, Hublin, 2011) was also employed in our study, as well as a protocol previously developed for accounting of plesiomorphic traits in modern human populations (Zubova, 2013).

Each of the protocols has some advantages, and thus the combination of these protocols can help to extract as much information as possible from the dental samples. The ASUDAS protocol employs the most diversified scales for fixing dental traits that are particularly precise in terms of describing the dental patterns found in modern populations. The main advantage of the traits put forward by S. Bailey is their increased sensitivity to the presence of Neanderthal genes in a population. The Zubov protocol permits not only study of the details of the macrorelief of the crown, but also the pattern of its grooves, which represent an independent and hierarchically organized set of traits: odontogliphics.

In total, 60 dental traits were scored. In the molars studied, the following traits were observed: reduction of the hypocone and metacone, rhomboid shape of the upper molars, metaconulus, mesiostylid, enamel extension, Carabelli cusp, distal and mesial accessory cusps of the upper molars, epicrista, plagiocrista (crista oblique), entocrista, posterior fovea, and odontoglyphic traits.

Hypocone reduction. The trait describes the dynamic of the hypocone's size relative to the protocone and metacone. The ASUDAS and Zubov protocol scales have some differences: the former includes 6 grades (0 – absence of the cusp, 5 – maximal development of the cusp) (Turner, Nichol, Scott, 1991: 18), while the latter has only 4 grades (4, 4–, 3+, 3), where grade 4 stands for the maximal development of the cusp, and grade 3 for the absence of the cusp (Zubov, 1968: 152).

Metacone reduction. This trait describes the dynamic of size of the metacone relative to the paracone. In ASUDAS, the trait is scored in the same way as the hypocone reduction (Turner, Nichol, Scott, 1991: 18), while the Zubov protocol employs a 5-level scale (1 to 5), where grade 1 means the absence of reduction, and grade 5 its maximal development (Zubov, 1968: 160).

Rhomboid shape of the upper molars. This trait describes upper permanent molars showing a non-reduced hypocone, strongly developed in the disto-lingual direction, and a reduced metacone, which forms an oblique disto-vestibular corner of the crown (Bailey, 2004).

Metaconulus. A small cusp in the depth of the enamel of the axial ridge of the metacone, in its central part (Zubov, Khaldeyeva, 1993: 68).

Carabelli cusp. A styloid cusp in the mesio-lingual part of the crown. Grades 0 to 7 in ASUDAS: 0 – absence, 7 – maximal development (Turner, Nichol, Scott, 1991: 19). Zubov protocol employs 5 grades from 0 to 5 (1968: 157). The grades of the two protocols correspond as follows:

ASUDAS	Zubov
0	0
1,2	1
3,4	2
5	3
6	4
7	5

Distal accessory cusp of the upper molars. A styloid cusp at the distal marginal ridge, at the interface between the metacone and hypocone. A scale, in which grade 1 correspond to the absence of the cusp and grade 6 to maximal development, is employed in both protocols (Zubov, 2006: 56; Turner, Nichol, Scott, 1991: 19).

Mesial accessory cusp of the upper molars. A cusp at the mesial margin of the crown. It is delimited by an additional groove that falls into the fissure separating the paracone and protocone. Phylogenetically, it differs from the cusps formed by the distal segments of the paracone and protocone (Zubov, Khaldeyeva, 1993: 67; Scott, Turner, 1997: 45). A scale for evaluating the degree of development of this trait is absent.

Epicrista. A ridge connecting protocone and metacone. The trait is present when the fissure dividing the cusps is fully covered.

Plagiocrista. A ridge connecting the metacone and protocone. This study employs a 4-level scale for this trait (Zubova, 2013: 114).

Entocrista. A marginal ridge connecting the protocone and hypocone (Zubov, Khaldeyeva, 1989: 62). It is almost never found in modern humans.

Posterior fovea. An elongated depression in the distal part of the upper and lower molars, which can vary in length. In modern humans, it is typically located at the occlusal surface of the metacone. Mesially, it is delimited by the distal segment of the metacone, and distally by the distal marginal ridge (Zubov, 2006: 61). In ancient specimens, it can reach the surface of the hypocone as well. In such cases, it is delimited by the same elements as in the metacone. Scales for evaluating the degree of development of this trait are absent.

Odontoglyphic elements. Like other dental traits, these elements are not equal in terms of taxonomic value. Combinations of the elements reflect the evolutionary status of the population (Zubov, 1974). The nomenclature of the odontoglyphic elements has been repeatedly changing during its development. As a result, different researchers employ rather different nomenclatures for these elements (Zubov, 1974, 2006; Zubov, Khaldeyeva, 1989; Hillson, 1996). In our study, we follow the methodology described in the last publications of A.A. Zubov (Zubov, Khaldeyeva, 1989; Zubov, 2006). In the next section, the classification and description of the odontoglyphic traits are outlined.

We employ three types of the grooves of the occlusal surface of the crown. The first and most ancient type comprises the intertubercular fissures of the first order. They separate major cusps of the crown, and are designated as I–IV for the upper molars, and I–VI for the lower molars. Fissure I separates the metacone and the paracone; fissure II separates the paracone and the protocone; fissure III separates the metacone and the protocone; and fissure IV separates the hypocone from both the metacone and the protocone.

Tubercular grooves of the second order delimit the axial ridges of each cusp, dividing a cusp into three segments. In some studies, these segments are designated as mesial, central, and distal (Carlsen, 1987; Bailey, Skinner, Hublin, 2011). Intersegmental grooves are tagged as 1 and 2 plus the two (or three for the lower) first characters of the name of the cusp (e.g. "pa" stands for the paracone, "prd" for the protoconid) (Zubov, 1974).

In the metacone and paracone, these grooves separate the axial segment from mesial one (groove 1), and the axial segment from the distal one (groove 2). The grooves are designated as 1me, 2me, 1pa, and 2pa, respectively. In the protocone and hypocone, groove 1 separates the axial and distal segments (1pr, 1hy), groove 2 the axial and mesial segments (2pr, 2hy).

Grooves of the third order are divided into two categories. The first includes accessory grooves dividing the mesial and distal segments of each cusp into two parts in the sagittal direction, and lying parallel to grooves 1 and 2. These are designated as 1' and 2', respectively. The second category includes accessory grooves of the axial ridges of the major cusps, designated as 3 and 4 (Zubov, Khaldeyeva, 1989; Zubov, 2006).

In the metacone, 1'me falls into fissure I, and divides the mesial segment in the vestibular direction, while 2'me falls into fissure III parallel to the posterior fovea and divides the distal segment in vestibular direction. In the paracone, 1'pa falls into fissure I and divides the distal segment in vestibular direction, 2'pa falls into fissure II and divides the mesial segment in vestibular direction, 3pa falls into fissure II and divides the axial segment in vestibular direction, and 4pa divides the axial segment in medio-distal direction. In the protocone, 1'pr falls into fissure IV and divides the distal segment in lingual direction, 2'pr falls into fissure II and divides the mesial segment in lingual direction, 2''pr duplicates 2'pr in the mesial segment and falls into fissure II or 2'pr, 3pr falls into fissure II and the central fovea and divides the axial segment in lingual direction, 4pr bisects the axial segment in transverse direction. In the hypocone, 1'hy falls into fissure IV or the posterior fovea and divides the distal segment in lingual direction, 2'hy falls into fissure IV or the basin of the talon and divides the mesial segment in lingual direction.

The total number of tubercular grooves and their directions differ in various species of the genus *Homo*. The grooves of the third order are the most variable. Many of them are reduced, and very rare in modern humans. An increased irregularity of enamel is typical of early *Homo*, and teeth of these hominins can exhibit additional grooves of the third order, which are absent in later species of *Homo*. The positions of the points of contact between tubercular grooves and the inter-cusp fissures can also vary. Furthermore, the tendency to ridge formation is more prominent in extinct representatives of the genus *Homo* than in modern humans.

The traits studied can be divided into three groups. The first group includes evolutionary stable and taxonomically neutral variables related to the basal teeth morphology in the hominin lineage and its evolutionary continuity (e.g. four-cusped upper molars, five-cusped lower molars or the number of intertubercular grooves of the crown). Traits of this group are present in all *Homo* species.

The second group is composed of so-called generalized archaic markers. These are plesiomorphic traits displaying a negative temporal dynamic. In other words, they are found with the highest frequency in early *Homo,* and become increasingly rare in later *Homo* species. The second group includes such traits as derivatives of the cingulum; ridge-forming structures of molars; M1<M3<M2 and M1<M2<M3 patterns; phylogenetic diastems; and the sub-squared shape of the crown of the upper and lower molars lacking prominent angles, etc. (Khaldeyeva, Kharlamova, Zubov, 2010; Zubova, 2013; Gomez-Robles et al., 2007).

The third group includes traits that are evolutionarily progressive among members of the genus *Homo*, and is composed of two blocks of traits. One of the blocks includes traits describing reduction of the dentition: hypocone and metacone reduction, decrease in the size of distal teeth in a row, small size or absence of the styloid cusps in the distal part of the lower molars, axial position of the hypoconulid, simplified odontoglyphic pattern, etc. The frequency of these traits steadily increases with time in the hominin lineage. Another block includes apomorphic patterns of various taxa.

When describing the upper molars from Denisova Cave, most attention was paid to the traits of the second and third groups, namely plesiomorphic traits and the markers of Neanderthal and modern dental patterns. The frequency traits were then compared with the patterns typical of *H. erectus s.l.*, *H. heidelbergensis s.l.*, *H. neanderthalensis*, and *H. sapiens s.l.*

Previously published raw data, as well as high-definition images and morphological descriptions of finds, were used as reference data (see Table).

Material

Our sample comprises two permanent molars. The Denisova 4 molar from the lithological layer 11.1 was previously described by B. Viola as an upper left third molar (Viola et al., 2011). But the pattern of attritional facets provides some evidence that the tooth might also be a second molar, if the individual lacked the third molar. In the study cited, the patterns of enamel macrorelief and dental metrics were published. The authors pointed out a similarity in dental metrics between the Denisovan specimen and early *Homo* (and even australopithecine) samples, but not Neanderthal dentition.

The Denisova 8 molar also belongs to the left side of the upper jaw. A.P. Buzhilova (2014) determined it to be an upper second or third permanent molar, while Viola pointed that this was most probably the third upper left molar (Sawyer et al., 2015). This tooth is worse preserved than the Denisova 4 molar: the roots were completely lost, the crown was reconstructed from fragments, and the mesial part of the crown at the interface between the paracone and protocone was destroyed. The macrorelief of the cusps of the trigon was almost completely worn off, as well as most intertubercular fissures. But there is almost no attrition at the hypocone and the distal part of the metacone; just one small contact-facet can be seen on the top of the main ridge of the hypocone, in its mesial part. On the interproximal surface of the distal part there is no contact-facet.

Morphological description

Left upper permanent second or third molar ($M^{2/3}$) from the layer 11.1, Denisova 4 (Fig. 1). This belonged to a young adult male (Slon et al., 2015).

The tooth is very massive, with a long neck. The roots are strongly divergent in the mesial and distal norms, the crown exhibits rounded corners. The bucco-lingual

Materials used for comparison

Region	Taxonomic status of the find*	Site	Specimen No.	Source
1	2	3	4	5
Africa	*Anatomically modern Homo sapiens*	Fish Hoek	–	Schwartz, Tattersall, 2003
	Homo helmei	Florisbad	–	Ibid.
	Homo habilis	Hadar	A.L. 666	"
	Homo heidelbergensis	Kabwe	–	"
	Homo erectus	Koobi Fora	KNM-ER 1813, KNM-ER 3733	"
	Homo ergaster	Nariokotome	KNM-WT 15000	Khaldeyeva, Zubov, Kharlamova, 2012
	Homo habilis	Olduvai Gorge	OH 6, OH 13, OH 16, OH 24	Schwartz, Tattersall, 2003, vol. II
	Homo erectus? *Athlanthropus mauritanicus* (?)	Thomas Quarry (Rabat)	–	Ibid.
	Homo erectus	Konso	KGA 4-14, KGA 11-350	Suwa et al., 2007
	Early Homo sapiens	Dar es-Soltan	DS II – H9, DS II – NN, DS II – H5, DS II – H10	Hublin et al., 2012
	"	Smugglers' Cave	Ctb H7, Ctb Ib 19, Ctb T4, Ctb T3b	Ibid.
West Asia	*Early Homo sapiens*	Jebel Qafzeh	Qafzeh 4, Qafzeh 5, Qafzeh 6, Qafzeh 9, Qafzeh 11	Schwartz, Tattersall, 2003, vol. II
	Homo neanderthalensis	Skhul	Skhul IV, Skhul V	Ibid.
	"	Tabun	Tabun I, Tabun T I, Tabun T II	"
	"	Kebara	KNM 24, KNM 21	Tillier et al., 2003
	Early Homo sapiens	Qesem	–	Hershkovitz et al., 2011
East and Central Asia	*Archaic Homo sapiens*	Jinniushan	–	Schwartz, Tattersall, 2003, vol. II
	Homo sapiens	Liujiang	–	Ibid.
	Homo erectus	Sangiran	Sangiran 4, 7, 17, 27, NG 91- G10 No1, NG 0802.1, NG 0802.3, NG 92.3, Njg 2005.05, Bpg 2001.04, PDS0712, NG0802	Ibid.; Zanolli, 2013; Kaifu et al., 2007; Zaim et al., 2011
	Homo sapiens	Wadjak	Wajak 1, Wajak 2	Schwartz, Tattersall, 2003, vol. II
	Homo erectus	Zhoukoudian, Lower Cave	ZKD 169.25, ZKD PA 327, ZKD skull XI	Ibid.
	Homo sapiens	Zhoukoudian, Upper Cave	PA 101, PA 102, PA 103	Ibid.; Turner, Manabe, Hawkey, 2000
	Early Homo	Xujiayao	PA 1480, PA 1481, PA 1500	Xing et al., 2015
	Homo sapiens	Daoxian	DX 1, 4, 5, 6, 8, 12, 14, 16, 17, 20, 21, 24, 28, 31,33, 35, 36, 39, 41, 47	Liu et al., 2015
	Homo erectus	Liang Bua	LB1	Kaifu et al., 2015
North Asia	*Homo sapiens*	Malta	1, 2	Zubov, Gokhman, 2003; Zubova, Chikisheva, 2015
	Homo neanderthalensis	Chagyrskaya	10, 51.1, 57	Unpublished data of A.V. Zubova
Western Central Asia	*Homo neanderthalensis*	Obi-Rakhmat	–	Glantz et al., 2008; unpublished data of A.V. Zubova
	"	Teshik-Tash	–	Unpublished data of A.V. Zubova

Table (end)

1	2	3	4	5
Europe	*Homo sapiens*	Abri Pataud	Pataud 1	Schwartz, Tattersall, 2003, vol. II
	Homo heidelbergensis	Arago	Arago 21, 14, 31	Ibid.
	Homo antecessor	Atapuerca: Gran Dolina	ATD 6-69	"
	Homo heidelbergensis / antecessor	Atapuerca: Sima de los Huesos	AT-16, AT, 3177, AT-138, AT-406, AT-139, AT-26, AT-959, AT-20, AT-2076, AT-812, AT-944, AT-196, AT-2071, AT-4317, AT-3424, AT-587, AT-46, AT-4326, AT-960, AT-824, AT-2179, AT-407, AT-4319, AT-4336, AT-12, AT-2175, AT-815, AT-821, AT-15, AT-170, AT-602, AT-816, AT-274, AT-3181, AT-171, AT-826, AT-601, AT-945, AT-1471, AT-2393, AT-3183, AT-194, AT-5082, AT-2150, AT-140	Martinón-Torres et al., 2012
	Homo erectus	Dmanisi	D 2882, D 2700	Schwartz, Tattersall, 2003; Martinón-Torres et al., 2008
	Homo sapiens	Engis	Engis 2	Schwartz, Tattersall, 2003, vol. II
	"	Grimaldi	Barma grande 2	Ibid.
	"	Isturitz	Ist 71	"
	Homo neanderthalensis	Krapina	45, 46, 47, 48, D 119, D 120, D 170, D 180, D 136, D 164, D 178, D 188	Radovčić et al., 1988
	"	La Quina	H 5, H 18	Schwartz, Tattersall, 2003, vol. II
	"	Le Moustier	–	Ibid.
	Homo sapiens	Mladeč	1, 2	"
	Homo neanderthalensis	Pech-de-l'Azé	–	"
	"	Saccopastore	2	"
	"	Sakajia	–	"
	"	Scladina	–	"
	"	Spy	1, 2	"
	"	Subalyuk	2	"
	Homo sapiens	Akhshtyrskaya	–	Unpublished data of A.V. Zubova
	"	Rozhok-1	–	Same
	"	Caldeirao	1	Trinkaus, Bailey, Zilhao, 2001
	"	Sungir	2, 3	Zubov, 2000
	"	Kostenki	14, 15, 17, 18	Khaldeyeva, 2006; unpublished data of A.V. Zubova
	"	Visogliano	6	Abbazzi et al., 2000
	"	Galeria da Cisterna	–	Trinkaus et al., 2011
	Early Homo	Peştera cu Oase	2	Trinkaus, 2010

*Since the taxonomic status of some finds is debatable, information in this column is given according to the opinion of the authors referenced in this article.

diameter of the metacone is small relative to the paracone, while the mesio-buccal corner demonstrates only moderate obliquity. As a result, the crown is narrowed in its distal portion. But since the hypocone is not biased lingually, the crown does not display the rhomboid shape typical of the Neanderthal upper molars (Fig. 2). The apexes of the major cusps are inclined towards the center of the crown. The intertubercular fissures are very deep. Fissures I and III are visible only on the occlusal surface, while fissures II and IV expand to the vertical surfaces of the tooth: fissure IV, which divides the hypocone and protocone, reaches the lingual surface, and fissure II, which separates the protocone and paracone, is present on the mesial surface (Fig. 3).

The paracone is divided into three segments by deep grooves, which dissect the margin of the crown and continue in the upper portion of the buccal surface. The mesial ridge of the paracone is wider than its distal ridge, which disappears in the middle of the axial ridge. The groove delimiting the mesial ridge joins the intertubercular fissure, which separates the metacone and paracone. The paracone exhibits deep grooves 1pa and 2pa, the first of which falls into fissure I, and the second into the central fovea. The terminal segments of the grooves lie on the border of the occlusal plane, and change their direction towards the apex of the axial ridge (Fig. 3). So the above-mentioned grooves delimit elements of the marginal ridge of the vestibular surface (eocrista). The latter are found in the central branch of the ridge, and are not present in modern humans. At the interface between the paracone and metacone, the ridge is intercepted by fissure I and a short parallel groove 1'pa.

The metacone is not reduced. Its mesio-distal diameter is not less than that of the paracone. On the surface of the metacone, an axial, a mesial, and a distal segment can be distinguished. The axial segment is very massive, and its distal portion is divided into separate fragments by accessory transversal grooves. The distal and mesial segments of the metacone are clearly visible only at the vestibular margin of the crown.

The plagiocrista is almost completely interrupted by the central groove; only a thin enamel bridge in the distal portion, lying parallel to fissure IV, is left.

The terminal segments of the first and second grooves of the metacone continue on the vestibular surface. They form separate apexes of the mesial and distal portions of the cusp. Groove 1me falls into fissure I just below 1pa, and 2me merges with the basin of the talon. Two accessory enamel ridges branch out of the axial ridge of the metacone in the distal direction. These are oriented towards the accessory cusps of the distal margin of the crown, but do not reach it, being intercepted by the basin of the talon. The ridges are separated by an accessory groove of the third order. The groove delimits elements of the metaconulus in the axial ridge, and does not match precisely with conventional elements of the odontogliphic pattern of the molars of modern humans (Zubov, 2006; Zubov, Khaldeyeva, 1989). Following the nomenclature of other cusps, it is referred to as 4me. In the vicinity of the central fovea, the axial segment of the metacone is divided in the axial plane by one more accessory groove of the third order (3me), which originates approximately in the middle third of the ridge and falls into fissure III.

The hypocone is large, sub-oval in shape, and elongated in the vestibular-lingual direction. A massive central ridge is prominent on its surface. The mesial segment of the cusp is very thin, and the groove that delimits it is almost merged with fissure IV. The distal segment is somewhat better pronounced. On the occlusal surface, the hypocone is separated from the metacone and protocone by a wide and elongated basin of the talon, which merges with the elements of the posterior fovea at the metacone. In its distal portion, the hypocone is separated from the metacone by a rounded accessory cusp in the marginal ridge (C5 grade 1 ASUDAS). Both major grooves of the hypocone (1hy and 2hy) fall into the basin of the talon. These are not particularly long, but rather deep. They are duplicated in the mesial and distal segments by parallel grooves of the third order, which are very rarely found in modern humans. Similarly to corresponding grooves of other cusps, they can be referred to as 1'hy and 2'hy. An element of the marginal ridge is prominent in the apex of the cusp, as is the case in the metacone and paracone.

The protocone is massive: it is the largest cusp of the crown. Such a large size is related to an increase in size of its basal portion owing to the Carabelli cusp, which contacts with the mesio-lingual groove separating the hypocone and protocone. The Carabelli cusp occupies the whole base of the protocone in its cervical portion (Fig. 1). In the middle third of the height of this cusp, there are four apexes formed by cingular ridges (Fig. 2). Thus, the genetic potential of the upper molar growth is more fully realized in this specimen than in modern human teeth. Multiple apexes in such cases are a manifestation of rudimentary derivatives of the cingulum, which are referred to by P. Hershkovitz (1971) as entostyles.

Finding a correspondence between the morphological pattern described above on the one hand, and the grades of standard dental protocols on the other, is a complicated task, since none of the protocols has grades to describe a cusp with multiple apexes. In ASUDAS, the pattern, in which the Carabelli cusp contacts with the intertubercular groove, is referred to as grade 5; in Zubov protocol it is grade 4.

The protocone, like other major cusps, is segmented into three portions. The central segment is the largest, followed by the mesial, and the distal segment is the smallest. The second groove of the protocone (2pr)

Fig. 1. Denisova 4: disto-vestibular view.

Fig. 2. Denisova 4: occlusal view.

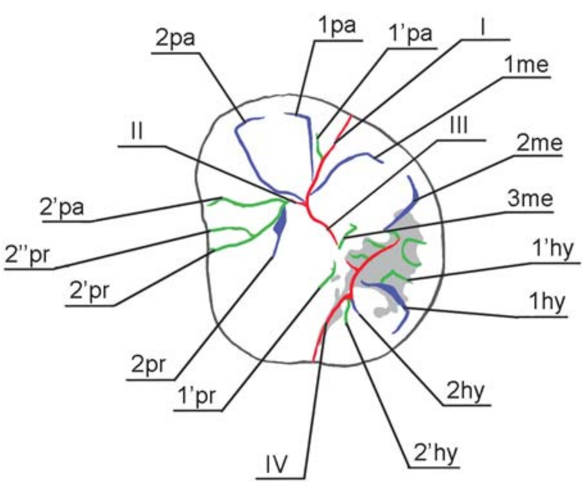


Fig. 3. Denisova 4: odontoglyphic pattern.

Fig. 4. Denisova 4: root system.

merges with 2'pr and forms an isolated triradius. One more groove of the third order, 2''pr, falls into 2'pr in its terminal segment. The 1pr groove is reduced, and its distal segment is outlined by 1'pr. The latter appears as a fovea isolated from fissures III and IV by a narrow enamel bridge. The bridge connects the distal segment of the protocone with the distal portion of the axial ridge of the metacone, thus forming a continuous element of the plagiocrista (Fig. 3).

The protocone and paracone are separated by an accessory mesial cusp, which is formed by accessory grooves 2'pa and 2'pr both falling into fissure II. In modern humans, this cusp is usually round in shape, and is formed by the terminal triradius of fissure II strictly at the mesial marginal ridge. In our case, the cusp appears as a segment lying parallel to fissure II and almost reaching the central fovea. The triradius is biased towards the central third of the intertubercular fissure, which is thereby substantially shortened. "Sprigs" of the triradius are similar to the major tubercular grooves. The epicrista is interrupted. The anterior fovea is absent, as is the enamel extension on the vestibular side of the tooth.

Initially, the tooth had three roots: lingual, mesio-buccal, and disto-buccal (Fig. 4). The lingual root, the longest and the most massive, was destroyed during the paleogenetic investigation. It is oval in section, flattened in the bucco-lingual direction, and branches off the buccal roots at a very large angle. The lingual root separates from the distal root at a level of 3.6 mm from the cementoenamel junction, and from the mesial root at the level of 4.1 mm.

The roots of the buccal side separate only in its lower third, 8.2 mm from the cementoenamel junction. Above this level they are connected by a cemental lamina. The mesial root is curved in the middle third. It is flattened in the mesio-distal direction, and its vestibular portion is more massive than the lingual one. The distal root is the least massive and almost flat in section.

Left upper permanent third molar (M^3) from the base of the layer 11.4 at the interface with the layer 12, Denisova 8 (Fig. 5). This is an upper left molar of an adult male (Slon et al., 2015), who was slightly older than the Denisova 4 individual. After restoration of the crown, it became possible to assess its contours. It is of oval shape, without an obliquity in the mesio-vestibular portion, but with an expansion in the vestibular portion as compared to the lingual portion (Fig. 6).

The protocone looks fairly massive despite postmortem destruction. The axial ridge of the cusp is very wide, and, together with the axial ridge of the mesial portion of the metacone, it forms a wide ridge, plagiocrista. It was impossible to determine reliably if the plagiocrista was continuous or discrete. Groove 1pr is worn off, while groove 2pr was probably deeper than 1pr. This conclusion is based on the traceability of 2pr despite substantial attrition of the mesial portion of the crown. It segmented the marginal ridge of the protocone and extended to the vestibular surface of the crown (Fig. 7).

The metacone is very massive, and divided into two parts; it is much larger than the paracone and hypocone. One part is composed of the axial portion of the cusp with a reduced mesial segment, the second part comprises the distal segment and distal marginal ridge. Groove 1me is worn off, while 2me, which separates the two portions of the cusp, is of substantial length and depth and is similar to the intertubercular fissures. In the disto-vestibular

Fig. 5. Denisova 8 molar before the restoration.

Fig. 6. Denisova 8 molar after the restoration.

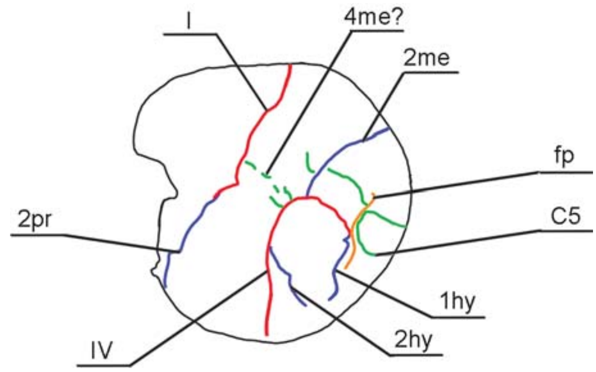


Fig. 7. Denisova 8: odontoglyphic pattern.

portion of the crown, 2me divides the marginal ridge, and extends well into the external surface of the tooth wall, reaching its lower third. In the central portion, 2me falls into fissure III. The axial ridge of the metacone is as massive in Denisova 8 as in Denisova 4. From the distal side, it is divided by accessory grooves 4me and 4'me, which delineate elements of the metaconulus in its structure (Fig. 7).

A massive ridge is prominent in the cusp that is formed by the distal part of the metacone. This ridge contacts the axial ridge of the hypocone, and forms a structure that is parallel to the plagiogrista but is interrupted by the sagittal groove dividing the metacone and hypocone. The ridge is divided into two parts by an accessory groove falling into 2me on one side, and into the posterior fovea on the other side. The fovea delimits the ridge distally, and separates it from the distal marginal ridge. On the vestibular surface of the metacone, at the interface with the paracone, there is a well-defined mesiostyle. The enamel extension is absent on the vestibular side of the tooth.

The paracone is substantially smaller than the metacone. The mesio-distal diameter of the former visually corresponds to the mesial portion of the latter. Owing to strong attrition and postmortem destruction, it is difficult to describe the paracone. We can only hypothesize the presence of an accessory groove 4pa, which dissected the axial ridge parallel to fissure II.

The hypocone is substantially reduced, and it does not form the disto-lingual corner of the crown. The cusp is smaller than the metacone and protocone and not as prominent as in Denisova 4. According to A. Dahlberg's scale, which is used in the Zubov protocol, the hypocone can be assigned to grade 4, and according to ASUDAS, to grade 5 (Turner, Nichol, Scott, 1991). The cusp is segmental in shape, with the apex lying at the intersection between fissures III and IV, and it is strongly morphologically differentiated. Three ridges can be observed on its surface: mesial, central, and distal marginal. The distal segment of the major portion of the cusp is reduced. The mesial ridge is very narrow and short, and appears as a thin enamel crest branching out of the margin of the lingual surface in the vestibular direction. It is separated from the axial ridge by the 2hy groove, which merges with intertubercular fissure IV near the lingual margin of the crown (Fig. 7). The axial ridge of the hypocone is outstandingly massive. It lies in the vestibular-lingual direction, parallel to the crista oblique (plagiocrista). It is delimited in distal portion by 1hy, which is almost merged with the posterior fovea separating the axial ridge of the hypocone from its distal marginal ridge. The fovea is very narrow, and appears as a deep groove interrupted by an accessory distal cusp (grades 3–4 ASUDAS). The fissure separating the hypocone and protocone terminates on the surface of the marginal ridge, instead of extending to the lingual surface as is usually found. A thin continuous bridge between the hypocone and protocone remains at the intersection between the occlusal and lingual surfaces of the tooth. It can be interpreted as a rudiment of the archaic ridge called "entocrista", which is found in primate dentition, but in modern humans is only observed in the deciduous second molar buds (Zubov, Khaldeyeva, 1989).

The root system of the tooth is destroyed; but the morphology of the remaining fragments points towards the presence of three roots: lingual, distal, and mesial.

On the taxonomic status of the dental pattern of the Denisovan upper molars

The permanent molars from Denisova Cave have a number of common traits, which suggests that both specimens belong to the same taxon. The most specific features of their dental pattern are: large size and rounded corners of the crowns; absence of notable reduction of the distal teeth in the row of molars; exceptionally strong development of the grooves of the first and second orders, which usually extend to the walls of the crown or form accessory cusps; and presence of accessory grooves of the third order, which are not found in modern humans. In both teeth, there are cingular structures represented by numerous entostyles in the Carabelli complex, accessory marginal cusps, and mesiostyle of the upper molars. This series of features also includes a pronounced trend towards formation of ridges on the occlusal surfaces of major cusps. This trend is evidenced in the formation of a wide and complex plagiocrista; a segmentation of the metacone accompanied by the emergence of a ridge parallel to the plagiocrista; a segmentation of major cusps; and in the persistence of the entocrista and elements of eocrista.

According to the results of the comparative analysis, the combination of traits observed in Denisovan molars does not match the dental patterns of any European hominin taxa. Most traits typical of Denisovan pattern are highly archaic markers. Despite this, the Denisovan dental complex lacks Neanderthal features (Khaldeyeva, Kharlamova, Zubov, 2010; Bailey, 2002) that might suggest an affinity of the population studied to *H. heidelbergensis.* The latter taxon is characterized by the increased frequency of archaic markers, accompanied by the presence of Neanderthal traits (Martinón-Torres et al., 2012). Markers of *H. sapiens* lineage, such as strong reduction of the hypocone of the second upper molar and reduction of the grooves of the third order, are not present in the Denisovan dental pattern. A substantial reduction of the hypocone of the upper third molar is the only relatively advanced evolutionary feature observed in Denisovan teeth. At the moment, there are not enough data to discuss apomorphic features of this species.

The morphological features of the molars from Denisova Cave are generally consistent with the pattern typical of the Archantropus evolutionary stage. They are mostly similar to the dental complexes found in *H. erectus* of Southeast Asia; in particular, in Sangiran specimens. Sangiran complexes are extremely variable, but there are megadontic specimens among them, comparable in size to Denisovan teeth (Lovejoy, 1970: Tab. 2; Orban-Segebarth, Procureur, 1983: Tab. 2; Tyler, 2001). Almost the full set of archaic markers typical of Denisovans is observed in the Sangiran specimens. First, the frequency of cingular derivatives (ectostyle and ectostylid extensions on the vestibular and lingual surfaces of the upper and lower molars and accessory cusps) is increased in the Sangiran specimens: NG 8503 (Kaifu, Aziz, Baba, 2005), Sangiran 5, 6, 7, 9 (Schwartz, Tattersall, 2003: Vol. II), Sangiran 8 (Kaifu, Aziz, Baba, 2005), Sangiran 22, 27, 33 (Ibid.), and Bpg 2001.4 (Zaim et al., 2011). The trend towards the formation of ridges is in many cases as pronounced in Sangiran hominins as it is in Denisovans. However, it is unclear from published data if the entocrista and eocrista persisted in the specimens from Java, and if they displayed some archaic odontoglyphic variants. For instance, a posterior fovea appearing as a T-shaped fissure was observed in specimen Bpg 2001.4 (Ibid.). Trapezoid contours with rounded corners, similar to those of Denisovans, were described in the upper molars of Sangiran 4, 27, and Bpg 2001.04 specimens (Schwartz, Tattersall, 2003: Vol. II; Zaim et al., 2011).

Another location of dental specimens morphologically similar to the Denisovan teeth is Xujiayao, a final Middle–early Upper Pleistocene site in northern China (Xing et al., 2015). The upper permanent molars from Xujiayao display the following set of features: very large size, sub-square shape of the crown, accessory mesial and distal marginal cusps, complex shape of the Carabelli cusp, differentiated odontoglyphic pattern with extremely pronounced major tubercular grooves, and a tendency towards fragmentation of the metacone and hypocone (Ibid.: Fig. 2). An extremely strong divergence between vestibular and lingual roots, similar to Denisova 4, was observed in the PA 1481 and PA 1500 upper molars (Ibid.: Fig. 3). The dental specimens from Xujiayao display a mosaic morphology, which is substantially different from the samples of early modern humans from China, but retain an archaic component that makes them similar to the dentition of Middle Pleistocene hominins from East Asia: Sangiran, Zhoukoudian, Longtandong, and Chaoxian. From Neanderthal complex markers, only non-specific traits, broadly found in the samples of the Middle Pleistocene hominins, were observed in the Xujiayao teeth (Ibid.: 237–238).

The taxonomic status of the Xujiayao samples relative to *H. sapiens* and *H. neanderthalensis* has not yet been determined. But the strong similarity in morphology of the upper molars from Xujiayao and Denisova Cave might suggest that the two populations could have belonged to the same taxon, exhibiting a long persistence of erectoid traits. If future research confirms this similarity, this will become a strong argument to support the hypothesis that Denisovans were widespread in East Asia (Reich et al., 2010; Derevianko, 2011). It is of note, though, that the complex of archaic features common to *H. erectus* from Sangiran and Denisovans is substantially reduced, or absent, in other Chinese finds (Turner, Manabe, Hawkey, 2000; Wu, Poirier, 1995; Schwartz, Tattersall, 2003: Vol. II; Xing, Zhou, Liu, 2009; Liu et al., 2010).

The skeletal remains of *H. floresiensis* (Brown et al., 2004), a species that emerged as a result of long island isolation, confirm the possibility of long-term conservation of erectoid morphology. The dental pattern typical of Denisovans and Xujiayao hominins suggests the presence of one more locus of evolutionary conservation in East Asia.

The similarity between dental complexes of the Upper Paleolithic population from Altai, the Middle Pleistocene hominins from China, and the Lower Paleolithic population from Southeast Asia does not contradict the results of paleogenetic studies. The estimated time of divergence between the ancestors of Denisovans and the common ancestor of *H. sapiens* and *H. neanderthalensis* coincides with the latest dates obtained for *H. erectus* finds from Java (Pope, Cronin, 1984). In Altai, the Karama site has a similar age (Bolikhovskaya, Derevianko, Shunkov, 2006). Thus, a migration becomes a feasible explanation for the similarity between the dental patterns of Denisovans and those of *H. erectus* from Java. Importantly, the complex of archaic morphological features is more pronounced in later Javanese *H. erectus* than in earlier specimens (Kaifu et al., 2005).

The greatest genetic impact of Denisovans is found in modern populations from Southeast Asia and Melanesia (Reich et al., 2010), Papua-New Guinea, Polynesia, and Fiji (Reich et al., 2011). The results of these studies have shown that admixture of Denisovan and basal modern human genomes could have occurred in neither the northwest nor the west of the Asian continent. The admixture between these two species most probably took place in Southeast Asia (Ibid.: 523). The paleogenetic data also suggest that Denisovan genes were widespread in this region before the advent of modern humans.

Our results have brought us to the following major conclusions. First, the conservation of archaic components without any replacement by more progressive features was the main evolutionary trend in the emergence of *H. altaiensis*. The most prominent feature of dental morphology of this species is the set of erectoid traits found in both molars studied. The set is fully present in both Denisovan individuals, despite the high level of genetic divergence between them. Genetic diversity was generally very low in the Denisovan population (Meyer et al., 2012; Slon et al., 2015), which sharply contrasts it to the maximally broad adaptive radiation and genetic diversity typical of modern humans. In this respect, Denisovans were more similar to Neanderthals who, as compared to modern humans, were a more specialized species with a lower level of genetic diversity (Reich et al., 2010: 1055).

Second, the peculiar morphology similar to the Denisovan molars is found only in Asian hominins, but not in any European specimens. Thus, the origin of *H. altaiensis* is most probably related to Asian *H. erectus*, which is supported by archaeological data (Derevianko, 2011).

Judging by the prevalence of erectoid features in the morphology of the Denisovan molars, we can hypothesize that the part of Denisovan genome related to an unknown hominin species (Krause et al., 2010) might have belonged to *H. erectus*. This is just a very tentative suggestion, since most of the archaic traits in the Sangiran hominins dentition are not apomorphic, but rather inherited from more ancient species of the genus, *H. habilis* and *H. rudolfensis*. However, from the point of view of dental morphology data, the presence of some genetic heritage of Asian *H. erectus* in Denisovans appears fairly well-based.

Conclusions

The results of the present study confirm the high importance of dental traits in detecting interspecific differences in the genus *Homo*. The results have also confirmed the presence in Altai of a specific hominin population referred to as *H. altaiensis,* and different from *H. sapiens* and *H. neanderthalensis* not only genetically but morphologically as well. Peculiar features of dental morphology of this population are megadontia; and a long-term conservation of the dental markers typical of the Middle Pleistocene hominins of Northern China, and of *H. erectus* from Sangiran.

Thus, *H. altaiensis* exhibits a very conservative mode of morphological evolution.

The analysis of the Denisovan upper molar morphology has confirmed the equal validity of genetic and morphological criteria for differentiating hominin species, which has been a matter of hot debate in paleoanthropology. Moreover, this morphological analysis has enabled us to put forward a well-based hypothesis according to which the unidentified portion of the Denisovan genome belongs to *H. erectus s.l.* Thus, our results emphasize the fact that classical dental studies still retain an independent value not lessened by the advent of molecular genetics methods.

References

Abbazzi L., Fanfani F., Ferretti M.P., Rook L., Cattani L., Masini F., Mallegni F., Negrino F., Tozzi C. 2000
New human remains of Archaic Homo sapiens and Low Paleolithic industries from Visogliano (Duino Aurisina, Trieste, Italy). *Journal of Archaeological Science*, No. 27 (12): 1173–1186.

Bailey S.E. 2002
Neandertal Dental Morphology: Implications for Modern Human Origins: Dissertation PhD. Tempe: Arizona State Univ.

Bailey S.E. 2004
A morphometric analysis of maxillary molar crowns of Middle-Late Pleistocene hominins. *Journal of Human Evolution*, vol. 47: 183–198.

Bailey S.E. 2006
Beyond shovel-shaped incisors: Neandertal dental morphology in a comparative context. *Periodicum Biologorum*, vol. 108 (3): 253–267.

Bailey S.E., Skinner M.M., Hublin J.-J. 2011
What Lies beneath? An evaluation of lover molar trigonid crest patterns based on both dentine and enamel expression.

American Journal of Physical Anthropology, vol. 145: 505–518.

Bolikhovskaya N.S., Derevianko A.P., Shunkov M.V. 2006
The fossil palynoflora, geological age, and dimatostratigraphy of the earliest deposits of the Karama site (Early Paleolithic, Altai Mountains). *Paleontological Journal*, vol. 40: 558–566.

Brown P., Sutikna T., Morwood M.J., Soejono R.P., Jatmiko, Saptomo E. Wayhu, Rokus Awe Due. 2004
A new small-bodied hominin from the Late Pleistocene of Flores, Indonesia. *Nature*, vol. 431: 1055–1061.

Buzhilova A.P. 2014
Dental crown dimensions of molars from Denisova cave in the context of paleogenetic data. In *Cultural developments in the Eurasian Paleolithic and the origin of anatomically modern humans*. Novosibirsk: IAE SO RAN, pp. 5–12.

Carlsen O. 1987
Dental Morphology. Copenhagen: Munksgaard.

Derevianko A.P. 2011
Verkhniy paleolit v Afrike i Evrazii i formirovaniye cheloveka sovremennogo anatomicheskogo tipa. Novosibirsk: Izd. IAE SO RAN.

Glantz M., Viola B., Wrinn P., Chikisheva T., Derevianko A., Krivoshapkin A., Islamov U., Suleimanov R., Ritzman T. 2008
New hominin remains from Uzbekistan. *Journal of Human Evolution*, No. 55: 223–237.

Gomez-Robles A., Martinón-Torres M., Bermúdez de Castro J.M., Margvelashvili A., Bastir M., Arsuaga J.L., Pérez-Pérez A., Estebaranz F., Martínez L.M. 2007
A geometric morphometric analysis of hominin upper first molar shape. *Journal of Human Evolution*, No. 53: 272–285.

Hershkovitz I., Smith P., Sarig R., Quam R., Rodríguez L., Garcia R., Arsuaga J.R., Barkai R., Gopher A. 2011
Middle Pleistocene dental remains from Qesem cave (Israel). *American Journal of Physical Anthropology*, vol. 144 (4): 575–592.

Hershkovitz P. 1971
Basic crown patterns and cusp homologies of mammalian teeth. In *Dental Morphology and Evolution*. Chicago: Univ. of Chicago Press, pp. 95–150.

Hillson S. 1996
Dental Anthropology. Cambridge: Cambridge Univ. Press.

Hublin J.-J., Verna C., Bailey S., Smith T., Olejniczak A., Sbihi-Alaoui F.Z., Zouak M. 2012
Dental evidence from the Aterian human populations of Morocco. In *Modern Origins: A North African Perspective*, J.-J. Hublin, P. McPherron (eds.). [s.l.]: Springer Netherlands, pp. 189–204.

Kaifu Y., Arif J., Yokoyama K., Baba H., Suparka E., Gunawan H. 2007
A new Homo erectus molar from Sangiran. *Journal of Human Evolution*, vol. 52: 222–226.

Kaifu Y., Aziz F., Baba H. 2005
Hominid mandibular remains from Sangiran: 1952–1986 collection. *American Journal of Physical Anthropology*, vol. 128 (3): 497–519.

Kaifu Y., Baba H., Aziz F., Indratti E., Schrenk F., Jakob T. 2005
Taxonomic affinities and evolutionary history of the Early Pleistocene hominids of Java: Denognatic evidence. *American Journal of Physical Anthropology*, vol. 128 (4): 709–726.

Kaifu Y., Kono R., Sutikna T., Saptomo E.W., Jatmiko, Due Awe R. 2015
Unique dental morphology of *Homo floresiensis* and its evolutionary implications. *PLoS ONE*. URL: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0141614

Khaldeyeva N.I. 2006
Rezultaty odontologicheskogo izucheniya cherepa Kostenki 18. In Doistoricheskiy chelovek. Biologicheskiye i sotsialnye aspekty. Moscow: Izd. IEA RAN, pp. 171–186.

Khaldeyeva N.I., Kharlamova N.V., Zubov A.A. 2010
Sravnitelnoye odontologicheskoye issledovaniye "klassicheskikh" zapadnoevropeiskikh neandertaltsev. *Vestnik antropologii*, iss. 18: 60–87.

Khaldeyeva N.I., Zubov A.A., Kharlamova N.V. 2012
Zuby Nariokotome III. In *Doistoricheskiy chelovek. Morfologiya i taksonomiya Nariokotome III*. Moscow: IEA RAN, pp. 88–106. (Shkola antropologicheskikh znaniy V.V. Bunaka; pt. 3).

Krause J., Fu Q., Good J.M., Viola B., Shunkov M.V., Derevianko A.P., Pääbo S. 2010
The complete mitochondrial DNA genome of an unknown hominin from southern Siberia. *Nature*, vol. 464: 894–897.

Liu W., Jin Ch.-Zh., Zhang Y.-Q., Cai Y.-J., Xing S., Wu X.-J., Cheng H., Edwards R.L., Pan W.-Sh., Qin D.-G., An Zh.-Sh., Trinkaus E., Wu X.-Zh. 2010
Human remains from Zhirendong, South China, and modern human emergence in East Asia. *Proceedings of the National Academy of Sciences of the United States of America*, vol. 107 (45): 19201–19206.

Liu W., Martinón-Torres M., Cai Y-J., Xing S., Tong H.-W., Pei S.-W., Sier M.J., Wu X.-H., Edwards R.L., Cheng H., Li Y.-Y., Yang X.-X., Bermúdez de Castro J.M., Wu X.-J. 2015
The earliest unequivocally modern humans in southern China. *Nature*, vol. 526 (7575): 696–699.

Lovejoy C.O. 1970
The taxonomic status of the "Meganthropus" mandibular fragments from the Jetis beds of Java. *Man*, No. 5: 228–236.

Martinón-Torres M., Bermúdez de Castro J.M., Gómez-Robles A., Margelashvili A., Prado L., Lordkipanidze D., Vekua A. 2008
Dental remains from Dmanisi (Republic of Georgia): Morphological analysis and comparative study. *Journal of Human Evolution*, vol. 55 (2): 249–273.

Martinón-Torres M., Bermúdez de Castro J.M., Gómez-Robles A., Prado-Simon L., Arsuaga J.L. 2012
Morphological description and comparison of the dental remains from Atapuerca – Sima de los Huesos site (Spain). *Journal of Human Evolution*, vol. 62 (1): 7–58.

Meyer M., Arsuaga J.-L., de Filippo C., Nagel S., Aximu-Petri A., Nickel B., Martinez I., Gracia A., Bermúdez de Castro J.-M., Carbonell E., Viola B., Kelso J., Prüfer K., Pääbo S. 2016
Nuclear DNA sequences from the Middle Pleistocene Sima de Los Huesos hominins. *Nature*, vol. 531: 504–507.

Meyer M., Kircher M., Gansauge M.-T., Li H., Racimo F., Mallick S., Schraiber J.G., Jay F., Prüfer K., de Filippo C., Sudmant P.H., Alkan C., Fu Q., Do R., Rohland N., Tandon A., Siebauer M., Green R.E., Bryc K., Briggs A.W., Stenzel U., Dabney J., Shendure J., Kitzman J., Hammer M.F., Shunkov M.V., Derevianko A.P., Patterson N., Andrés A.M., Eichler E.E., Slatkin M., Reich D., Kelso J., Pääbo S. 2012
A high coverage genome sequence from an archaic Denisovan individual. *Science*, vol. 338 (6104): 222–226.

Orban-Segebarth R., Procureur F. 1983
Tooth size of Meganthropus palaeojavanicus: An analysis of distances between some fossil hominids and a modern human population. *Journal of Human Evolution*, vol. 12 (8): 711–720.

Pope G.G., Cronin J.E. 1984
The Asian Hominidae. *Journal of Human Evolution*, vol. 13 (5): 377–396.

Radovčić J., Smith F., Trinkaus E., Wolpoff M. 1988
The Krapina hominids: An illustrated catalogue of skeletal collection. Zagreb: Mladost.

Reich D., Green R.E., Kircher M., Krause J., Patterson N., Durand E.Y., Viola B., Briggs A.W., Stenzel U., Johnson P.L.F., Maricic T., Good J.M., Marques-Bonet T., Alkan C., Fu Q., Mallick S., Li H., Meyer M., Eichler E.E., Stoneking M., Richards M., Talamo S., Shunkov M.V., Derevianko A.P., Hublin J.-J., Kelso J., Slatkin M., Pääbo S. 2010
Genetic history of an archaic hominin group from Denisova Cave in Siberia. *Nature*, vol. 468: 1053–1060.

Reich D., Patterson N., Kircher M., Delfin F., Nandineni M.R., Pugach I., Min-Shan Ko A., Ko Y.-Ch., Jinam T.A., Phipps M.E., Saitou N., Wollstein A., Kayser M., Pääbo S., Stoneking M. 2011
Denisova admixture and the first modern human dispersals into Southeast Asia and Oceania. *American Journal of Human Genetics*, vol. 89 (4): 516–528.

Sawyer S., Renaud G., Viola B., Hublin J.-J., Gansauge M.-T., Shunkov M.V., Derevianko A.P., Prüfer K., Kelso J., Pääbo S. 2015
Nuclear and mitochondrial DNA sequences from two Denisovan individuals. *Proceedings of the National Academy of Sciences of the United States of America*, vol. 112 (51): 15696–15700.

Schwartz J.H., Tattersall I. 2003
Human Fossil Records. Craniodental Morphology of Genus Homo. Vol. 1: Europe. Vol. 2: Africa and Asia. New York: Wiley-Liss Inc.

Scott J.R., Turner C.G. II. 1997
The Anthropology of Modern Human Teeth. Dental Morphology and Its Variation in Recent Human Populations. Cambridge: Cambridge Univ. Press.

Shpakova E.G., Derevianko A.P. 2000
The interpretation of odontological features of Pleistocene human remains from the Altai. *Archaeology, Ethnology and Anthropology of Eurasia*, No. 1: 125–138.

Slon V., Sawyer S., Renaud G., Viola B., Hublin J.-J., Gansauge M.-T., Shunkov M.V., Derevianko A.P., Meyer M., Prüfer K., Kelso J., Pääbo S. 2015
Genetic analysis of three Denisovan individuals from Altai Mountains (Siberia). In *5-th Annual Meeting of the European Society for the study of Human Evolution (ESHE)*. London: p. 207.

Suwa G., Asfaw B., Haile-Selassie I., White T., Katoh Sh., WoldeGabriel G., Hart W.K., Nakaya H., Beyene Y. 2007
Early Pleistocene Homo erectus fossils from Konso, Southern Ethiopia. *Anthropological Science*, No. 115: 133–151.

Tillier A.M., Arensburg B., Vandermeersch B., Chech M. 2003
New human remains from Kebara Cave (Mount Carmel). The place of the Kebara hominids in the Levantine Mousterian fossil record. *Paleorient*, No. 29 (2): 35–62.

Trinkaus E. 2010
Denisova cave, Peştera cu Oase, and human divergence in the Late Pleistocene. *PaleoAnthropology*: 196–200. URL: http://www.paleoanthro.org/static/journal/content/PA20100196.pdf

Trinkaus E., Bailey S., Davis S.J.M., Zilhao J. 2011
The Magdalenian human remains from the Galeria da Cisterna (Almonda karstic System, Torres Novas, Portugal) and their archaeological context. In *O Arqueólogo Português*, ser. V, No. 1. Lisboa: pp. 395–413.

Trinkaus E., Bailey S., Zilhao J. 2001
Upper Paleolithic human remains from the Gruta de Caldeirao, Tomar, Portugal. *Revista Portuguesa de Arqueologia*, vol. 4 (2): 5–17.

Turner C.G. II. 1990
Paleolithic teeth of the Central Siberian Altai Mountains. In *Chronostratigraphy of Paleolithic in North, Central, East Asia and America*. Novosibirsk: Inst. of Hist., Phylol. and Phylos. SB RAS, pp. 239–243.

Turner C.G. II, Manabe Y., Hawkey D.E. 2000
The Zhoukoudian upper cave dentition. *Acta Anthropologica Sinica*, No. 19: 253–268.

Turner C.G. II, Nichol C.R., Scott G.R. 1991
Scoring procedures for key morphological traits of the permanent dentition: The Arizona State University Dental anthropology system. In *Advances in Dental Anthropology*. New York: Wiley-Liss Inc., pp. 13–31.

Tyler D.E. 2001
Two new "Meganthropus" mandibles from Java. *Journal of Human Evolution*, vol. 16 (3/4): 151–158.

Viola B., Markin S.V., Zenin A., Shunkov M.V., Derevianko A.P. 2011
Late Pleistocene hominins from the Altai Mountains, Russia. In *Characteristic features of the Middle to Upper Paleolithic transition in Eurasia*. Novosibirsk: Publ. Dep. of the Inst. of Archaeol. and Ethnogr. SB RAS, pp. 207–213.

Wu X., Poirier F.E. 1995
Human Evolution in China. New York, Oxford: Oxford Univ. Press.

Xing S., Martinón Torres M., Bermúdez de Castro J., Wu X., Liu W. 2015
Hominin teeth from the early late Pleistocene site of Xujiayao, Northern China. *American Journal of Physical Anthropology*, vol. 156 (2): 224–240.

Xing S., Zhou M., Liu W. 2009
Crown morphology and variation of the lower premolars of Zhoukoudian *Homo erectus*. *Chinese Science Bulletin*, No. 54: 3905–3915.

Zaim Y., Ciochon R., Polanski M., Grine F., Bettis E.A., Rizal Y., Franciscus R., Larick R., Heizler M., Aswan, Eaves K., Marsh H. 2011

New 1,5 million-year-old *Homo erectus* maxilla from Sangiran (Central Java, Indonesia). *Journal of Human Evolution*, vol. 61 (4): 363–376.

Zanolli C. 2013

Additional evidence for morpho-dimensional tooth crown variation in a New Indonesian *H. erectus* sample from the Sangiran Dome (Central Java). *PLoS ONE*. URL: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0067233

Zubov A.A. 1968

Odontologiya. Metodika antropologicheskikh issledovaniy. Moscow: Nauka.

Zubov A.A. 1974

Odontoglifika. In *Rasogeneticheskiye protsessy v etnicheskoi istorii*. Moscow: Nauka, pp. 11–42.

Zubov A.A. 2000

Morfologicheskoye issledovaniye zubov detei iz Sungirskogo pogrebeniya 2. In *HOMO SUNGIRENSIS. Verkhnepaleoliticheskiy chelovek: Ekologicheskiye i evolyutsionnye aspekty issledovaniya*. Moscow: Nauch. mir, pp. 256–268.

Zubov A.A. 2006

Metodicheskoye posobiye po antropologicheskomu analizu odontologicheskikh materialov. Moscow: Etno-Onlain.

Zubov A.A., Gokhman I.I. 2003

Nekotorye odontologicheskiye dannye po verkhnepaleoliticheskoi stoyanke Malta. *Vestnik antropologii*, iss. 10: 14–23.

Zubov A.A., Khaldeyeva N.I. 1989

Odontologiya v sovremennoi antropologii. Moscow: Nauka.

Zubov A.A., Khaldeyeva N.I. 1993

Odontologiya v antropofenetike. Moscow: Nauka.

Zubova A.V. 2013

Predvaritelnye rezultaty izucheniya arkhaichnoy sostavlyayushchei odontologicheskikh kompleksov naseleniya Evrazii. *Vestnik antropologii*, No. 26: 107–127.

Zubova A.V., Chikisheva T.A. 2015

The morphology of human teeth from Afontova Gora II, Southern Siberia, and their status relative to the dentition of other Upper Paleolithic Northern Eurasians. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 43 (4): 138–146.

Received January 21, 2016.

DOI: 10.17746/1563-0110.2017.45.1.135-145

A.N. Bagashev[1], D.I. Razhev[1], O.E. Poshekhonova[1], S.M. Slepchenko[1–3], and E.A. Alekseeva[1]

[1]Institute of Northern Development, Siberian Branch, Russian Academy of Sciences, Malygina 86, Tyumen, 625003, Russia
E-mail: bagashev@mail.ru; rajevd0@gmail.com; poshehonova.olg@gmail.com; s_slepchenko@list.ru; alekseeva.elena.ae@gmail.com
[2]Tyumen Scientific Center, Siberian Branch, Russian Academy of Sciences, Malygina 86, Tyumen, 625003, Russia
[3]Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia

An Anthropological Study of Mummified Remains from the Zeleny Yar Cemetery on the Lower Ob, Western Siberia*

Zeleny Yar is a cemetery situated 40 km east of Salekhard, Yamal-Nenets Autonomous Okrug (YNAO). Human remains of 43 individuals from 37 graves have been described so far. Mummified remains were discovered in eight graves dating to the 12th or 13th centuries. We outline the results of a computed-tomography analysis of the best-preserved mummy—that of a male from grave 27. On the basis of an examination of endocranial sutures, the individual's age was estimated at 45–55. Dental pathology includes caries with consecutive apical periodontitis, and osteoarthritis of the left temporomandibular joint. Also, the examination revealed injuries and degenerative-dystrophic postcranial lesions. To analyze the individual's physical type and reconstruct his face, a plastic cast of the cranium was modeled using 3D-modeling technique. The male had a Mongoloid appearance. Specifically, he can be attributed to the Yamal-Yenisei local variant of the West Siberian race. The modern representatives of this type are the Nenets of the Siberian tundra.

Keywords: *Western Siberia, mummified remains, computed tomography, paleopathology, craniology, physical anthropology.*

Introduction

Mummified human bodies are found in all parts of the World and represent various periods of history. In terms of physical anthropology, they are potentially a very rich source of information. But on the other hand, studying such a complex object, with its modified tissues, is a complicated task.

The research techniques widely used till recent times for studying mummies implied "dissection" or "unfolding", which has usually led to damage, or even complete destruction, of mummies. Unsurprisingly, researchers have not been satisfied with these techniques (Manchester Museum…, 1979). The development and progress of X-ray computed

*Supported by the Russian Foundation for Basic Research, Project No. 13-06-00158.

tomography (CT) has made it a very promising non-destructive way of studying mummies. While traditional X-ray technology did not provide all the necessary information about methods of embalming, or about cranial morphology, the advent of CT has made it possible to overcome the above-mentioned difficulties, and has brought the study of mummies to a new level. The 3D models created from the CT data can be used to describe pathological conditions in the skeleton, or for anthropometry, with the same success as macerated skeletal remains (Hughes, 2011). A virtual model of the skull can be used for collecting standard cranial measurements, as well as for facial reconstruction. Importantly, the CT dataset of a mummy can be studied many times by various researchers. The advantages of CT technology for mummy-studies were first demonstrated in 1977 by D. Harwood-Nash, Toronto (1979), who examined mummified remains of a boy and a young woman. In subsequent years, the number of mummies studied using CT has grown exponentially.

In Russian physical anthropology, computed tomography has been used rarely so far, and is applied mostly to examining macerated bone specimens of Neanderthals and other Pleistocene hominins (Iskopaemyi Homo…, 2008; Mednikova, 2011). CT (magnetic resonance imaging, MRI) was employed in Russia just once for studying a mummy: a female from Ak-Alakha-3 mound at the Ukok Plateau, Altai, was examined using both MRI and X-ray. The authors of this study concluded that there were no evident pathological changes in the joints and spine of the mummy (Fenomen…, 2000).

Skeletal remains from the Zeleny Yar cemetery are the only presently available source of data for reconstructing the physical appearance of the people of subarctic regions of Western Siberia at the beginning of the 2nd millennium AD. These remains will also provide invaluable knowledge about the history of anthropological types of the region. But taking into account the uniqueness and historical importance of the Zeleny Yar mummies, the anthropological analysis carried out in this study was only made possible with the use of non-destructive techniques such as CT imaging.

Material

The archaeological complex Zeleny Yar is located nearby the eponymous village in the Transurals district of the YNAO, at a floodplain island. The island is delineated by the river Polui on one side and a channel of the river Gorny Polui on the other side. The burial-sites of the complex include flat graves dating to the 8th–9th and 13th centuries AD. Large-scale excavations of the complex were carried out in 1999–2002 by a team led by N.V. Fedorova. The results of the excavations were presented in a joint monograph (Zeleny Yar…, 2005). Excavation of the site was resumed in 2013 (Gusev et al., 2014).

The results of the study of 37 graves, containing the remains of 43 individuals (three more skeletons were found outside graves), have been published so far. In eight late burials, mummified remains were found (Zeleny Yar…, 2005: 189–192; Gusev et al., 2014). Five of the burials contained differently preserved mummies: three belonged to infants in the first two years of life, one to a subadult 6–7 years old, and one to an adult male. Examination of the mummified bodies revealed no evidence of deliberate mummification. The analysis has shown the mummification process to have been largely determined by the following factors: desiccation of soft tissues during the cold period of the year; inhibition of bacterial activity by the copper compounds coming from the grave goods surrounding the body (in summer); and low temperatures (in winter) (Zeleny Yar…, 2005: 193–196).

Among all mummified objects identified in the Zeleny Yar cemetery, the remains of the adult male from grave 27 have been the most thoroughly studied. A full description of the remains, as well as the results of the research carried out in the beginning of 2000s, has been published as a monograph (Ibid.: 109–113). An enclosed deck-sarcophage, imitating the shape of the boat, was found in grave pit 27. After removal of the upper part of the deck, a package was found. The deceased was completely wrapped in a thin fur, which was fixed in place by a copper cone near his feet. Inside the cone, there was a small larch stake. The stake was later sent for dendrochronological analysis, which revealed the absolute date of the burial—1282 (Ibid.: 108). Beneath the upper layers of the fur, a copper plate covering the middle part of the grave, from the clavicles to the knees, was found. Further on, strongly folded deerskin clothes, covering the deceased from the neck to the feet, were fixed. On the head of the mummy, there was headwear of wolverine fur reminiscent of a hood; the face was covered by a triangular patch. Beneath the latter, a rectangular copper plate surrounding the face was found. After removal of the coverings, the remains of an adult man were exposed (Fig. 1). Soft tissues were fairly well-preserved in the head (face and the

Fig. 1. Mummified head of a male from grave 27 at the moment of excavation in 2001 (Zeleny Yar…, 2005).

Fig. 2. Embalming of the mummy at the VILAR Research and Study Center for Biomedical Technologies (Moscow) in 2006.

left part of the vault), and fragmentary in the chest, abdomen, and legs.

In order to prevent the decay of soft tissues, the body was transferred to the VILAR Research and Study Center for Biomedical Technologies (Moscow) for conservation. After the body had been cleaned of the remaining soil and fur, specialists at the Center started the long multistage process of embalming, during which they carried out manipulations aimed at assembling the parts of the body, and getting it arranged in the right anatomical order (Fig. 2). "Bones of the upper and lower limbs were restored using plastic pins, sticks, and epoxy resin, according to topographic anatomical position. In order to make the limbs more rigid and to correct their shape, in some cases the bones were tied by threads impregnated with a special solution. Missing fragments of bones in the feet and hands were replaced with pieces of fur, wood, moss, or plastic masses impregnated with rosin. Separate fragments of soft tissues and bones were fixed with epoxy resin, rosin varnish, or special mixtures with dyes. After assembly of the skeleton and soft tissues of the body was finished, the whole surface of the mummified remains was treated with alcoholic solution containing thymol" (Ibid.: 315).

The macroscopic examination of the mummy was carried out by G.V. Rykushina (Institute of Ethnology and Anthropology, RAS, Moscow) during embalming in the VILAR laboratory. The examination revealed that the individual was a mature male with relatively long arms (particularly forearms), and short shins. His stature was reconstructed using Lee-Pearson's formula, which gave 160 cm. This value is below the average for males. The descriptive features of the face of the mummy undoubtedly pointed towards a Mongoloid pattern, typical of northern Asians. A substantial difference in the length of the right and left radii (257 and 236 mm, respectively) was also detected. Such a shortening of the left radius was supposedly a result of a fracture (Rykushina, 2005).

Study methods

The study of the individual from grave 27 was conducted by means of multi-slice X-ray computed tomography (Brilliance-16 Philips CT scanner;

three cycles of scanning with between-slice interval of 1.5 and 2.0 mm) at the City Clinical Hospital of Salekhard. The main parameters of the scanner: X-ray tube MRC 8.0 MHU; heat capacity of the tube 8 MHU; generator 60 kW; configuration of slice thickness 16 × 0.75 mm, 16 × 1.5, 8 × 3, 4 × 4.5, 2 × 0.6 mm; resolution 24 pairs of lines/cm; rotation time 0.5 sec (0.4 sec optional); reconstruction speed 6 images/sec. The CT study allowed us to prepare a 3D model of the skull, thoroughly describe the skeleton and the remaining soft tissues, and obtain virtual measurements of some bones.

Some complications emerged while studying and describing the CT data, owing to the above-mentioned techniques of embalming that were applied to the mummy. For instance, insertion of the plastic kernel through the cerebrospinal aperture of the vertebrae so as to fix the head has led to partial destruction of the vertebrae.

A 3D model of the skull had been used for printing a volumetric plastic cast that was used for further craniometric study and craniofacial reconstruction. While rendering the model, a high density threshold was applied to remove (virtually) as much soft tissue as possible (Fig. 3, *1*). Owing to this, some areas of the temporal, sphenoid, occipital, maxillary, nasal, and some other bones became invisible, while in other areas soft tissues were still partially present (Fig. 3, *2*). Therefore, these soft tissue fragments were removed from the cast by a drilling machine, while the absent fragments of bone were reconstructed to conform to normal anatomy using plastic masses.

The cast was measured using the standard craniometric protocol (Alekseev, Debets, 1964). However, to verify some dimensions, these were measured on the virtual model as well. The measurements were used in an intergroup craniometric comparison of the Zeleny Yar paleopopulation with a number of neighboring populations, carried out using canonical analysis.

A sculptured facial reconstruction of the individual was made on the basis of the CT study and the craniometric analysis of the mummy.

Results and discussion

The CT study has shown that the individual from grave 27 of the Zeleny Yar cemetery died at between 45 and 55 years of age. The age of the deceased was determined from the stage of obliteration of the cranial vault sutures and the degree of dental attrition. The study of the individual's dentition revealed cases of caries (upper first molars) complicated by apical periodontitis, and osteoarthritis of the left temporomandibular joint. The dental attrition was substantial. These changes point towards an increased loading on the masticatory complex. Unfortunately, it

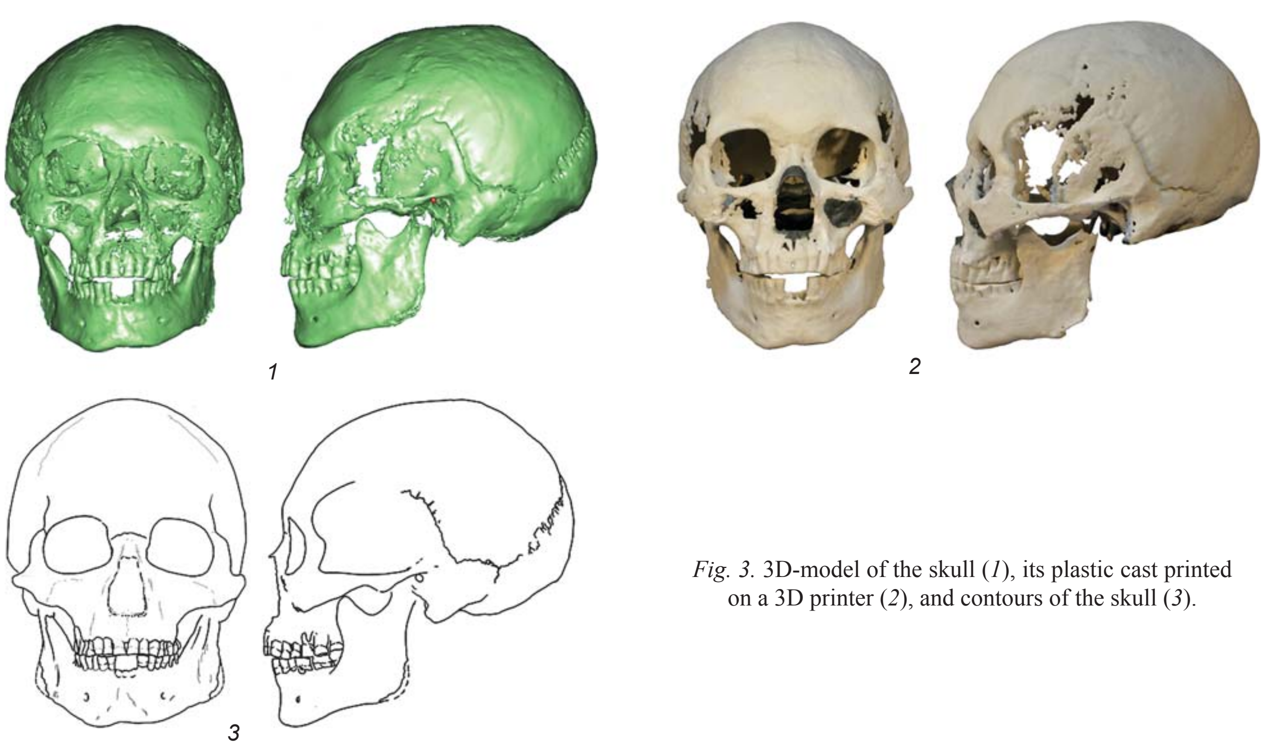
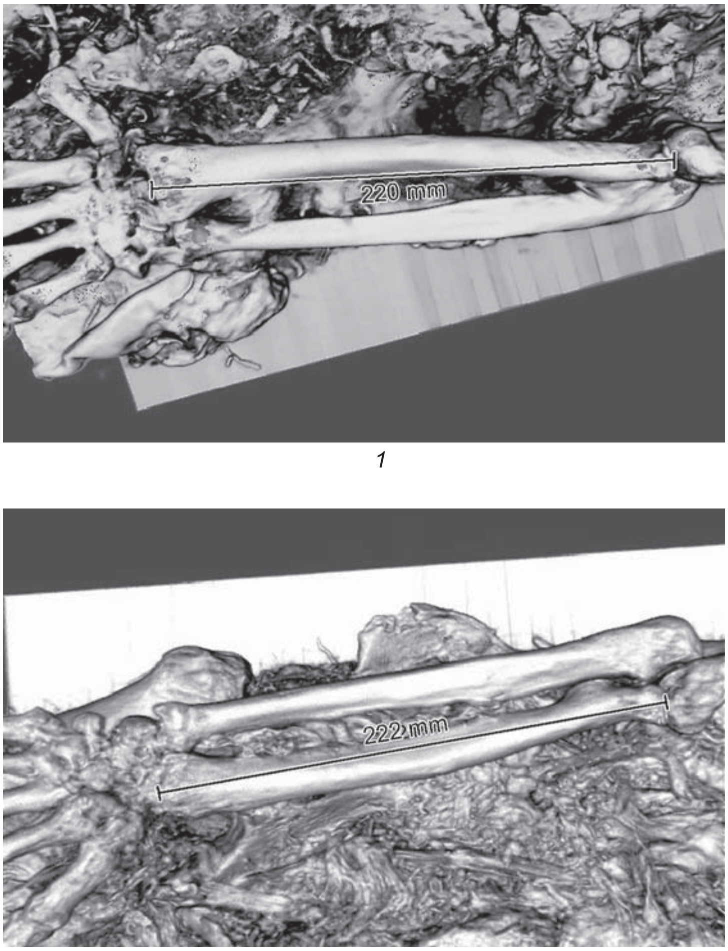


Fig. 3. 3D-model of the skull (*1*), its plastic cast printed on a 3D printer (*2*), and contours of the skull (*3*).



1

2

Fig. 4. Right (*1*) and left (*2*) radii.

cysts in the head of the left humerus points towards arthritis of the shoulder-joint. In the diaphysis and the distal end of the left humerus, no pathological manifestation was found. In all other bones of the upper limbs, weak manifestations of osteoarthritis were observed. The shortening of the left radius reported by Rykushina after a visual examination of the arms was not confirmed by our 3D study of the forearm bones. The length of the right radius was found to be 220 mm, the left radius 222 mm (Fig. 4). This finding confirms the higher resolution of computed tomography and 3D rendering, as compared to visual examination of mummified remains. The reconstructed body-length (Lee-Pearson's formula) was 158 cm, which concurs with the results of Rykushina.

There was marginal lipping 2–4 mm long found in the head of the left femur, which is indicative of severe osteoarthritis (coxarthrosis of the 1–2 degrees) (Fig. 5). The trochanteric regions of both femora exhibit marked enthesopathies. Numerous fractures of the pelvic bones were observed. These were most probably postmortem and emerged during the embalming procedures. No traces of healing were found.

The association of the cases of marked osteoarthritis with the left limbs (arthritis of

was not possible to determine if the carious lesion was of traumatic or primary etiology; but the fact that the individual had not lost any teeth during his long life makes it possible that the carious lesion emerged as a result of trauma and its complications.

The investigation of the spine revealed pathological changes in all parts of the column, but predominantly in the lumbar vertebrae, mostly in the form of subchondral sclerosis of the superior and inferior articular facets, as well as marginal lipping. Such lesions could have been caused by a substantial static loading to the spine, which has also regularly suffered microtraumas.

Examination of the long bones of the upper limbs found a displaced fracture of the right humerus at the *collum chirurgicum*. There was not enough evidence to decide if the trauma was pre- or postmortem, but no traces of healing were observed. The presence of subchondral sclerosis and, probably, subchondral

Fig. 5. Osteoarthritis of the left hip joint: arrows point to the marginal lipping of the head of the femur, and to enthesopathies of the greater trochanter.

the left shoulder joint, left-sided coxarthrosis of the 1–2 degrees, lesions around the trochanters) may indicate a trauma to those limbs.

An examination of the cranial cast revealed the features listed below. The forehead was broad, tall, gently sloping, metriometopic, with weakly pronounced frontal eminences. The *glabella* region was developed moderately (score 3). The parietal line had the shape of a convex arc, the parietal tubers were virtually absent. The mastoid processes were large, non-protrusive and facing forward. The external auditory meati were of medium size. The occiput was broad, not protrusive, and gently curved. The nuchal crest was considerably developed, while the external occipital protuberance was weakly pronounced (score 1). The transverse dimensions of the cranial vault were large or very large, and axial diameters small or very small. The skull was sub-brachicranial and low, according to the axial-sagittal and axial-transverse indices. The face was broad at all levels, of eurimorphic proportions, weakly protruding in the horizontal plane, mesognathic in the vertical plane, and prognathic by the index of protrusion. The canine fossa was of medium depth. The orbits were broad and moderately tall, of mesoconchic proportions. The nasal aperture was tall but of medium width, leptorrhine. The interorbital width at *dacryon* was intermediate between medium and large values, while the subtense was medium. The simotic chord and subtense were both of intermediate values. The nasal bridge was generally flat, and the nasal protrusion was average. The anterior nasal spine was horizontally oriented, and weakly developed (score 2). The mandible was very robust and broad, but only medium in length. The rami were vertical, the angles were deployed. The maxillary alveolar process was tall, protruding, and prognathic. The occlusion pattern was labidodontic. The mental eminence region was fairly developed. The shape of the lower mandibular border was angulate.

The 13th century Zeleny Yar cranial sample comprises only two skulls from graves 27 and 34 (see Table 1). In the latter, only a few measurements could be taken.

In order to determine what modern populations the individuals from the Zeleny Yar burials are morphologically similar to, their cranial metrics were compared with the most geographically and morphologically close ethnic groups. These included the Nenets (a composite sample of 38 skulls of the European, Ob, and Yenisei Nenets (Debets, 1951: 177–221), a sample from the Nyamboy-to and

Table 1. **Mean values and indices for male skulls form the Zeleny Yar cemetery. and reference samples**

Measurement	Zeleny Yar		Nenets										Northern Selkup, Kikki-Akki		Khanty						Northern Mansi	
			Aggregate		Yar-Sale		Taz River		Shchuchya River		Fort Nadym				Khalas-Pogor		Obdorsk		Muzhi			
	x̄	n	x̄	n	x̄	n	x̄	n	x̄	n	x̄	n	x̄	n	x̄	n	x̄	n	x̄	n	x̄	n
1. Cranial length, from *g*	183.0	2	179.0	38	177.8	10	183.3	6	179.2	6	176.9	3	183.0	3	181.1	111	177.2	12	187.3	22	183.9	28
8. Maximum cranial breadth	150.0	2	146.6	38	146.8	10	148.0	7	151.8	6	136.5	3	136.0	3	143.7	111	138.6	12	138.6	22	139.5	28
17. Cranial height (*ba–b*)	125.0	1	129.0	38	128.1	10	131.6	7	131.7	6	127.7	3	132.0	3	127.2	116	127.1	12	125.5	22	126.1	28
20. Cranial height (*po–b*)	110.0	1	112.3	37	–	–	114.0	8	–	–	–	–	112.3	3	110.3	115	–	–	–	–	108.6	28
8 : 1. Cranial index	81.9	2	81.9	38	82.7	10	80.1	6	84.7	6	77.2	3	73.6	3	79.5	111	78.2	12	74.0	22	76.1	28
17 : 1. Axial-sagittal index, from *ba*	66.3	1	72.0*	–	72.2	10	71.8	6	73.5	6	72.2	3	71.3	3	70.3	100	72.3	12	67.1	22	68.9	29
17 : 8. Axial-transverse index, from *ba*	81.0	1	88.0*	–	87.3	10	89.0	7	86.7	6	93.6	3	96.6	3	88.5	103	91.8	12	90.7	22	90.3	28
5. Cranial base length	100.0	1	98.7	38	99.0	10	102.9	7	–	–	94.9	3	99.0	3	101.3	115	99.3	11	100.7	22	100.1	28
9. Minimal frontal breadth	104.0	1	94.2	38	94.8	10	93.0	9	93.0	5	88.8	3	91.0	3	95.9	115	93.9	12	95.4	22	92.8	29

9 : 8. Fronto-transversal index	68.0	1	64.3*	–	64.6	10	64.3	6	60.8	5	65.1	3	66.3	3	66.8	103	67.8	12	68.9	22	66.0	29
32. Forehead profile angle, from *n*	72.0	1	81.8	38	–	–	76.2	6	–	–	85.0	2	76.7	3	79.4	113	79.6	10	–	–	79.3	26
40. Basion-prosthion length	110.0	1	101.1	35	–	–	101.7	6	–	–	95.5	3	91.7	3	103.0	114	98.4	9	–	–	98.9	26
40 : 5. Facial protrusion index	110.0	1	101.7	35	–	–	99.9	6	–	–	100.7	3	92.0	3	101.7	114	98.7	9	–	–	98.8	26
45. Bizygomatic breadth	152.0	1	139.1	38	137.9	9	142.2	6	143.0	–	138.8	2	134.0	3	139.4	114	136.0	10	133.3	22	135.3	25
45 : 8. Transversal facio-cerebral index	99.3	1	94.9*	–	94.3	9	96.9	6	92.4*	–	101.6*	–	98.3	3	97.0*	–	98.7	10	96.2	22	96.9*	–
9 : 45. Fronto-zygomatic index	68.4	1	67.7*	–	68.2	9	66.4	6	65.0*	–	–	–	67.7	3	68.8*	–	68.8	10	71.7	22	68.9*	–
48. Nasion-alveolar height	72.0	1	73.9	35	72*	–	74.7	6	72.8	5	68.2	3	70.0	3	73.9	113	70.8	12	68.0*	–	70.7	27
48 : 17. Vertical facio-cerebral index	58.9	1	57.4	35	–	–	56.8	6	–	–	53.4*	–	52.3	3	58.2	113	55.7	12	–	–	56.2	27
48 : 45. Upper facial index	48.0	1	53.1*	–	–	–	52.6	6	–	–	51.9	2	51.7	3	53.1	93	52.1	10	–	–	52.4	23
72. General facial angle	81.5	1	86.1	37	–	–	81.7	6	–	–	84.0	2	84.7	3	84.7	114	84.0	10	–	–	86.5	27
77. Nasomalar angle	152.0	1	146.4	36	–	–	145.9	7	–	–	149.0	3	145.7	3	143.9	112	142.8	12	–	–	142.1	26
∠zm'. Zygomaxillary angle	137.0	1	135.8	35	–	–	132.0	6	–	–	134.0	2	130.3	3	132.6	113	137.9	9	–	–	135.0	24
51. Orbital breadth, from *mf*	43.0	1	42.7	37	42.5	9	43.2	6	43.4	5	41.1	2	43.3	3	43.7	116	42.8	12	42.6	22	41.8	27
52. Orbital height	34.0	1	34.4	37	35.3	9	35.5	6	36.2	6	33.7	2	35.7	3	35.4	116	34.3	12	33.6	22	34.3	27
52 : 51. Orbital index, from *mf*	77.3	1	80.5	37	81.3	9	82.3	6	82.4	5	82.0*	–	81.7	3	81.2	116	80.4	12	79.0	22	82.2	27
55. Nasal height	54.0	1	53.0	37	51.3	9	54.5	6	55.2	6	49.7	3	53.0	3	53.8	114	52.7	12	51.0	21	52.5	28
54. Nasal breadth	25.0	1	25.0	37	25.1	8	25.7	6	25.8	6	24.6	3	24.3	3	25.9	114	24.7	12	25.9	21	26.3	28
54 : 55. Nasal index	46.3	1	47.2	37	48.9	8	47.3	6	46.7	6	49.5*	–	45.0	3	48.3	114	46.9	12	–	–	50.0	28
75 (1). Nasal protrusion angle	27.0	1	23.3	27	–	–	21.8	6	–	–	27.2	3	17.7	3	20.7	100	20.8	9	–	–	20.2	20
SC. Simotic chord	8.0	1	7.1	36	–	–	6.6	7	–	–	6.0	3	5.5	3	7.1	114	7.3	12	–	–	7.2	27
SS. Simotic subtense	3.0	1	2.3	36	–	–	2.9	7	–	–	3.4	3	2.1	3	2.8	114	2.4	11	–	–	2.8	27
SS : SC. Simotic index	37.5	1	37.3	36	–	–	44.5	7	–	–	65.9	3	40.3	3	36.8	114	33.7	11	–	–	40.2	27
DC. Dacrial chord	23.0	1	21.0	36	–	–	21.6	6	–	–	18.1	3	21.0	3	20.7	113	21.0	12	–	–	21.3	27
DS. Dacrial subtense	10.5	1	9.4	36	–	–	10.2	6	–	–	9.1	3	8.4	3	9.9	113	8.6	11	–	–	10.1	27
DS : DC. Dacrial index	45.6	1	45.6	36	–	–	48.0	6	–	–	50.5	3	39.7	3	47.3	113	41.0	11	–	–	47.9	27

*Counted using the mean values.

Vesakoyakha burial grounds in the Taz River basin (Bagashev, Slepchenko, 2015); two small samples from Yar-Sale and Shchuchya River (Dremov, 1984), and three female skulls from the Fort Nadym (Bagashev, Razhev, 2009), whose dimensions were converted to "conditionally male"); northern Khanty (116 skulls from the Khalas-Pogor cemetery (Debets, 1951: 177–221), 12 skulls from Obdorsk region, and 22 skulls from a cemetery near Muzhi village (Dremov, 1984)); Sosva (northern) Mansi (29 skulls from the Severnaya Sosva River basin (Debets, 1951: 177–221)); and northern Selkup (the only existing sample of northern Selkup comprises three male skulls from the Kikki-Akki burial ground in the upper Taz River (Poshekhonova, 2015)). At the moment, these samples represent a comprehensive list of published craniometric data on the modern population of the northern part of Western Siberia. The Khanty and Mansi of the Lower Ob region are considered representatives of the Ural group of populations (anthropological type) of West Siberian local race *per se*, while the Nenets belong to the Yamalo-Yenisei variant of this race (Bagashev, 1998, 2016). The northern Selkup are preliminarily classified as a southern, Ob-Irtysh variant of the same race (Poshekhonova, 2015). A brachicranial and tall cranial vault, a tall and wide face, a flattened face and nasal bridge, but a strongly protruding nose as compared to Ugric samples, are typical of the Nenets in general. In contrast, a low dolichocranial vault and a low and narrow face is characteristic of other groups of the West Siberian race.

Table 2. **Factor loadings**

Measurement	Canonical vector I	Canonical vector II
1. Cranial length	–0.2359	0.0223
8. Maximum cranial breadth	0.5659	0.3801
17. Cranial height	0.1946	0.0372
9. Minimal frontal breadth	0.0887	0.3227
45. Bizygomatic breadth	0.1499	0.1106
48. Nasion-alveolar height	0.2104	0.3747
51. Orbital breadth, from *mf*	–0.1097	0.4537
52. Orbital height	–0.2028	0.1113
54. Nasal breadth	–0.2464	0.0375
55. Nasal height	–0.4914	0.2252
77. Nasomalar angle	0.2013	0.1330
∠zm'. Zygomaxillary angle	0.0438	–0.4520
SS. Simotic subtense	0.0774	–0.0980
DC. Dacrial chord	0.0319	0.1115
DS. Dacrial subtense	0.0118	0.0952
75 (1). Nasal protrusion angle	0.3268	–0.2710
Eigenvalue	17.8183	11.3590
Dispersion, %	37.6	24.0

The inter-group analysis has shown that the individuals from Zeleny Yar are most similar in morphology to the modern tundra Nenets (Table 1). More specifically, they share with the Nenets such features as a brachicranial vault, a large and flat facial skeleton, and a moderately protruding nose.

Since three of the samples employed in the analysis were studied as far back as in the 19th century by Sommier (1887), Virchow (1877), and Flower (1878), and summarized by Dremov (1984), not all measurements were available for those samples. Specifically, such crucially important variables as the angle of the nasal and facial protrusion, and some dimensions of the nasal bridge, are absent. Therefore, those three samples were not subjected to the canonical variate analysis (CVA) of all samples; but an additional CVA employing only the cranial vault, facial, nasal and orbital measurements was carried out instead. But the results of the two analyses did not differ significantly.

The highest loadings on the first canonical vector (CV) describe samples comprising skulls with wide and short vaults, and low and more protruding noses, while highest loadings on CV2 are related to a wider forehead and orbit and a more protruding facial skeleton (Table 2). The samples analyzed appear to be quite evenly spaced in the morphospace defined by the CV1 and CV2 (Fig. 6). The mongoloid samples with tall brachicranial vaults and tall and more protruding noses, representing the anthropological type of the Nenets (the composite sample, the Taz River, and Fort Nadym samples), are found in the positive-negative and positive areas of the morphospace. The Zeleny Yar sample finds its place in the same area, and thus is apparently close to the Yamal-Yenisei anthropological type.

The Mongoloid traits are also typical of the populations from the opposite area of the scatterplot; but they also display a lower, more gracile and dolichocranial vault, and a smaller protrusion of the nasal bones, but a stronger protrusion of the face in general. It is not difficult to find similarities between this anthropological type and the low-faced Mongoloid variant that is wide-spread in the modern Ugric population of Western Siberia (Ocherki…, 1998: 136–140). Thus, the populations studied differ from each other in the expression of the Mongoloid traits, which are common to, and specific to, all West Siberian groups.

Summing up the results of the study of the human remains from the 13th century Zeleny Yar cemetery, it can be concluded that the deceased were representatives of an anthropological type widespread in the north of Western Siberia. Their facial skeletons display well pronounced Mongoloid features but are not tall. An increased flatness of the face at the level of the orbits, accompanied by a relatively stronger protrusion at the level of the anterior nasal spine, a moderately high nasal bridge, and a medium nasal angle, make the sample from Zeleny Yar most similar to the northern Samoyeds. Like the latter, the Zeleny Yar people can be attributed to the Yamal-Yenisei variant of the West Siberian anthropological formation. The morphological pattern described above distinguishes this variant both from Ural anthropological type *per se* (Ob Ugrians) and from Ob-Irtysh variant (southern Samoyeds) of the West Siberian local race. On the other hand, new craniometric data suggest that the northern Samoyeds and Kets can be considered a separate Yamal-Yenisei group of populations on the basis of their cranial morphology. However, this group of populations does not represent a subdivision of the North-Asian Mongoloid formation, but rather the third anthropological type of the West Siberian local race (Bagashev, 2016).

Owing to protection under the bronze plate surrounding the anterior part of the head of the male from grave 27, its soft tissues were fairly well preserved (Fig. 1). At the moment of excavation, the face of the male exhibited pronounced individual and racial features. However, over time, the face has been substantially changed under the influence of external factors. Though the embalming has stabilized the process of decay of soft tissues, it has not fully preserved the intravital appearance of the individual (Fig. 2). Therefore a facial reconstruction was performed, which resulted in two graphic portraits and a bust (Fig. 7).

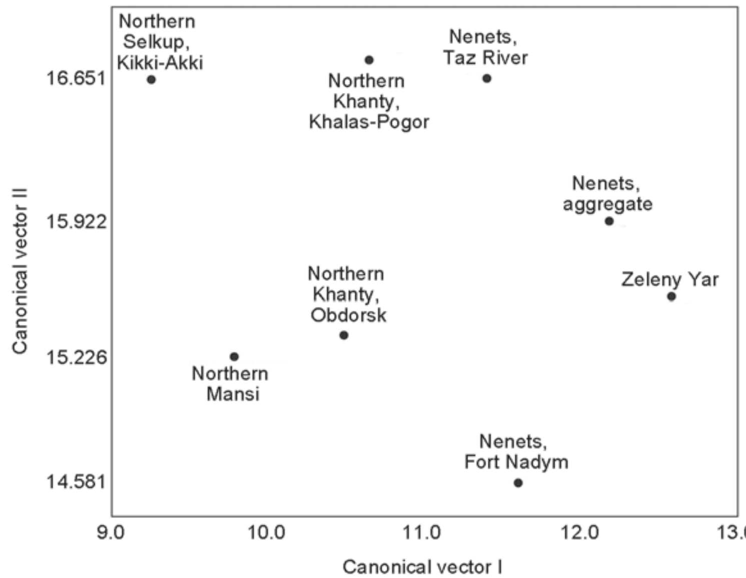


Fig. 6. Scatterplot of the samples studied, canonical vectors 1 and 2.

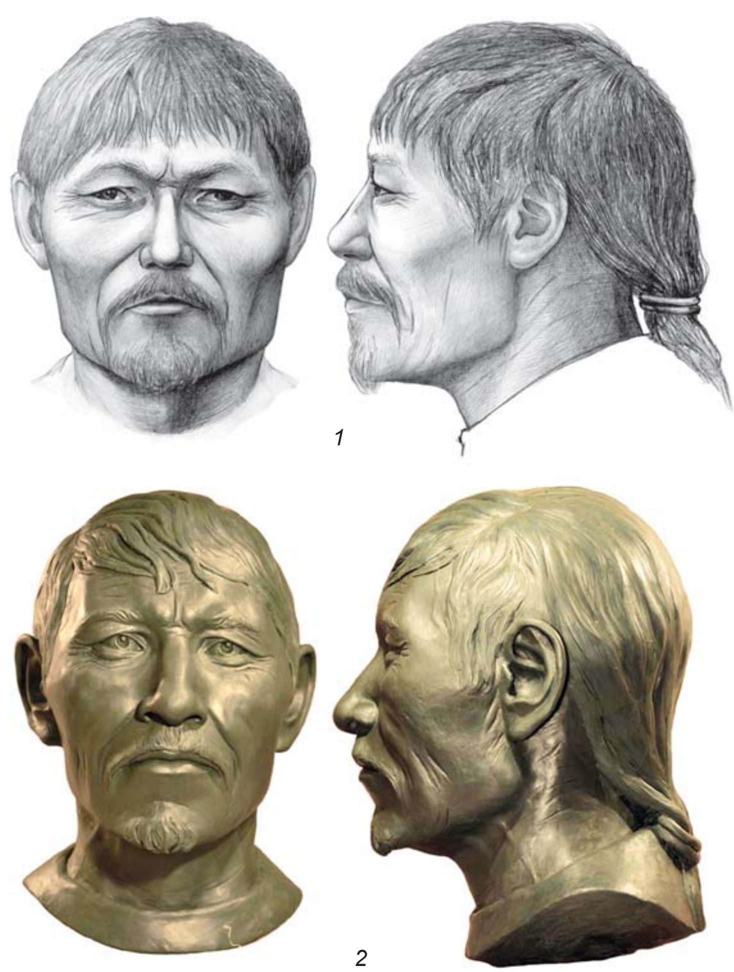


Fig. 7. Facial reconstruction of the male from grave 27.
1 – graphic portrait; *2* – bust.

Conclusions

Our CT-based study of the mummified human remains found in grave 27 of the Zeleny Yar cemetery has shown the informational significance and perspective of this approach. It is definitely "the method of choice" when studying unmacerated bone-remains. The use of CT imaging and 3D visualization software helped to specify the age at death of the individual (since the cranial vault sutures were visible not only externally but also at the endocranial surface); and to describe a dental pathology masked by soft tissues, and also a number of traumatic lesions and degenerative changes of the musculoskeletal system.

Using a 3D model of the skull, it was possible to carry out a comprehensive comparative craniometric analysis and perform a facial reconstruction. The results of the analysis revealed that the individuals buried in the 12th–13th centuries Zeleny Yar cemetery had a Mongoloid appearance. They can be assigned to the Yamal-Yenisei variant of the West Siberian local race. Among modern populations, the Nenets of the Siberian tundra are the most typical representatives of this variant, as is convincingly illustrated by our graphic and sculptural reconstructions of the individual's face.

Acknowledgements

The authors express their gratitude to Prof. Y.T. Ignatiev, Head of the Radiology Department of Omsk State Medical Academy, for assistance with studying the computed tomograms.

References

Alekseev V.P., Debets G.F. 1964
Kraniometriya. Moscow: Nauka.

Bagashev A.N. 1998
Antropologicheskiye obshchnosti, ikh sistematika i osobennosti rasoobrazovatelnykh protsessov. In *Ocherki kulturogeneza narodov Zapadnoi Sibiri*. Vol. 4: Rasogenez korennogo naseleniya. Tomsk: Izd. Tom. Gos. Univ., pp. 303–327.

Bagashev A.N. 2016
Mezhgruppovaya izmenchivost kraniologicheskikh osobennostei eniseiskikh populyatsiy severoaziatskoi mongoloidnoi formatsii. In *Vostok i Zapad: Problemy sinkhronizatsii etnokulturnykh vzaimodeistviy: Tezisy XVII Mezhdunar. Zap.-sib. arkheol.-etnogr. konf., posvyashch. 110-letiyu V.N. Chernetsova, 110-letiyu G.F. Debetsa, 115-letiyu A.P. Dulzona (20–22 apr. 2016 g., Tomsk, Rossiya)*. URL: http://zsaek.tsu.ru/sites/default/files/webform/%D0%A2%D0%B5%D0%B7%D0%B8%D1%81%D1%8B%20%D0%A2%D0%BE%D0%BC%D1%81%D0%BA%202016%20%D0%91%D0%B0%D0%B3%D0%B0%D1%88%D0%B5%D0%B2.pdf

Bagashev A.N., Razhev D.I. 2009
Nadymskiy gorodok: Paleoantropologicheskoye issledovaniye. *Vestnik arkheologii, antropologii i etnografii*, iss. 11: 111–124.

Bagashev A.N., Slepchenko S.M. 2015
Materialy po kraniologii tazovskikh nentsev. In Chelovek i Sever: Antropologiya, arkheologiya, ekologiya: Materialy Vseros. konf., iss. 3. Tyumen: Izd. IPOS SO RAN, pp. 6–10.

Debets G.F. 1951
Antropologicheskiye issledovaniya v Kamchatskoi oblasti. Moscow: Izd. AN SSSR. (TIE; vol. 17).

Dremov V.A. 1984
Rasovaya differentsiatsiya ugorskikh i samodiyskikh grupp Zapadnoi Sibiri po dannym kraniologii. In *Problemy antropologii drevnego i sovremennogo naseleniya severa Evrazii*. Leningrad: Nauka, pp. 106–132.

Fenomen altaiskikh mumiy. 2000
Novosibirsk: Izd. IAE SO RAN.

Flower W.N. 1878
The Native Races of the Pacific Ocean. London: Royal institution of Great Britain.

Gusev Al.V., Razhev D.I., Slepchenko S.M., Zaitseva O.V., Pushkarev A.A., Vodyasov E.V., Vavulin M.V. 2014
Arkheologicheskiy kompleks Zelenyi Yar: Novye tekhnologii polevykh issledovaniy. *Uralsky istorichesky vestnik*, No. 2 (43): 89–96.

Harwood-Nash D.F.C. 1979
Computed tomography of ancient Egyptian mummies. *Journal of Computer Assisted Tomography*, No. 3: 768–773.

Hughes S. 2011
Computed Tomography: Special Applications. Ch. 4: CT Scanning in Archaeology. URL: http://www.intechopen.com/books/computed-tomography-special-applications/ct-scanning-in-archaeology

Manchester Museum Mummy Project: Multidisciplinary Research on Ancient Egyptian Mummified Remains. 1979
A.R. David (ed.). Manchester: Manchester Univ. Press.

Iskopaemyi Homo iz Khvalynska. 2008
Moscow: Taus. (Antropologicheskaya kollektsiya).

Mednikova M.B. 2011
Postkranialnaya morfologiya i taksonomiya predstavitelei roda Homo iz peshchery Okladnikova na Altae. Novosibirsk: Izd. IAE SO RAN.

Ocherki kulturogeneza narodov Zapadnoi Sibiri. 1998
Vol. 4: Rasogenez korennogo naseleniya. Tomsk: Izd. Tom. Gos. Univ.

Poshekhonova O.E. 2015

Kraniologiya verkhnetazovskikh selkupov. In *Chelovek i Sever: Antropologiya, arkheologiya, ekologiya: Materialy Vseros. konf.*, iss. 3. Tyumen: Izd. IPOS SO RAN, pp. 46–52.

Rykushina G.V. 2005

Antropologicheskaya kharakteristika mumifitsirovannykh ostankov iz pogrebeniya No. 27. In *Zelenyi Yar: Arkheologicheskiy kompleks epokhi srednevekovya v Severnom Priobye*. Yekaterinburg, Salekhard: UrO RAN, pp. 318–379.

Sommier S. 1887

Sirieni, Ostiacchie e Samoedi dell'Ob. Prime Parte. *Archivio per l'Antropologia e la Etnologia*, vol. 17, fasc. 1/2: 20–70.

Virchow R. 1877

Westsibirischen Schadel (Samojeden, Ostjaken u.s.w.). *Zeitschrift für Ethnologie*, Bd. 9: 330–347.

Zeleny Yar: Arkheologicheskiy kompleks epokhi srednevekovya v Severnom Priobye. 2005

N.A. Aleksashenko, A.G. Brusnitsyna, M.N. Litvinenko, P.A. Kosintsev, E.V. Perevalova, D.I. Razhev, N.V. Fedorova. Yekaterinburg, Salekhard: UrO RAN.

Received May 16, 2015.
Received in revised form July 14, 2016.

DOI: 10.17746/1563-0110.2017.45.1.146-156

E.Z. Godina, I.A. Khomyakova, and L.V. Zadorozhnaya
Anuchin Research Institute and Museum of Anthropology, Lomonosov Moscow State University, Mokhovaya 11, Moscow, 125009, Russia
E-mail: egodina@rambler.ru; irina-khomyakova@yandex.ru; mumla@rambler.ru

Patterns of Growth and Development in Urban and Rural Children of the Northern Part of European Russia*

Two thousand children and adolescents of both sexes aged 7–17 were studied in 2009–2010 in Arkhangelsk and several villages of the Arkhangelsk Region. Results were compared with data, collected by the same authors in the same area in 1988–1989, on 1500 children of the same age. The program included some 50 metric and descriptive characteristics, estimates of biological age, and somatotyping. We collected data on parental education and occupation, number of children per family, etc. Lengths of body segments and extremities, body mass index (BMI), and certain other indexes were calculated. Statistical analysis included standardization of data and one-way ANOVA. Urban children were shown to be slightly taller than their rural peers but did not differ from them in weight, chest circumference, or BMI. Modern children, both urban and rural, showed greater stature, weight, and chest circumference as compared to those measured in 1988. Significant changes in body proportions were found in modern children: they had a longer torso, narrower shoulders, and a larger pelvic breadth. Also, a significant increase in limb circumferences and subcutaneous fat was found. Modern urban and rural children were closer to each other in most physical characteristics than were their peers of the previous generation. The results can be interpreted in terms of the ongoing secular trend in population of the Arkhangelsk Region.

Keywords: *Physical anthropology, growth and development, rural and urban children, Arkhangelsk Region, secular changes.*

Introduction

The study of growth and development processes in urban versus rural populations has a prolonged history. In the 18th and 19th centuries, in the majority of European countries and in the USA, rural children were taller than their urban peers (Rona, 1984; Bogin, 1988). A.T. Steegman (1985) gives the average height values for English military recruits according to the archives of the 18th century: 168.6 and 157.5 cm for rural and urban young men, respectively.

In the 20th century, this tendency has been reversed: urban children exceed rural ones in terms of height and weight, development of fat component, and other metric characteristics (Meredith, 1982). This trend is typical of the majority of economically developed and especially of developing countries (Godina, Miklashevskaya, 1989). Presumably, these differences have been caused by the better socioeconomic and hygienic living conditions and the nutritional status of urban children and adolescents (Eveleth, Tanner, 1990: 191–207; Rona, 1991).

Little seems to have changed in the 21st century. On the basis of analysis of the health indicators of children in 47 developing countries, it has been found that children's health is better in cities than in rural areas (Van de Poel,

*Supported by the Russian Science Foundation (Project No. 14-50-00029).

O'Donnell, van Doorslaer, 2007). In 2013, a large-scale study was conducted in urban and rural populations of 141 countries with low and middle income levels. On the basis of a meta-analysis of data on height and weight, the authors concluded that actually in all countries urban children were taller and heavier than their rural peers. The scale of differences can vary. The greatest difference is recorded in Latin America (Peru, Honduras, Bolivia, Guatemala), some African countries, in Vietnam, and China (Paciorek et al., 2013). Urban children are distinguished by higher growth rates, which account, in part, for the recorded differences in body dimensions (Wronska-Weclaw, 1984; Petrovic et al., 1984; Miklashevskaya, Solovieva, Godina, 1988: 53–59).

Differences in body proportions have been established: rural children are more heavily-built and brachymorphic (Wronska-Weclaw, 1984; Chigea, Miu, Tudoscie, 1987). Being inferior to their urban peers in height and weight, they keep abreast with them in chest circumference, thus demonstrating a higher strength of body compared to city dwellers (Polyakov, 1985). Hypodynamia is considered to be among the factors with negative influence on the physical development of modern city people; however, in recent years, studies pointing also to reduction in physical loads on rural dwellers have been published (Permyakova, 2012: 20–22; Liu et al., 2012).

Apart from differences in body dimensions, urban and rural schoolchildren are characterized by different ages of sexual maturation. A distinct correlation is observed between the settlement size and the age at menarche, indicating the latter's decrease with an increasing number of residents (Godina, Miklashevskaya, 1990). Also, quicker changes in the age of sexual development are recorded for representatives of different generations in cities (Popławska et al., 2013).

Secular changes of body dimensions in urban and rural children and adolescents are a subject of special research. The previously mentioned review (Paciorek et al., 2013) points to substantial differences in the rates of these changes and their trend. During the period from 1985 to 2011, the difference between rural and urban children in height has considerably decreased in the southern and tropical areas of Latin America and in South Asia; however, it has not changed substantially in the majority of other regions. Body weight differences have decreased in the same areas of Latin America, however, but they have considerably increased in the majority of regions, owing to the fact that body weight gain in urban children was substantially higher.

Differences between the urban and rural children were observed in Russia as well. On the basis of growth studies that were conducted to establish standards for assessment of physical development and were limited to measurements of total body dimensions (Materialy…, 1986; Fizicheskoye razvitiye…, 1988), the trend of accelerated growth in urban children was reported for many regions of Russia. Analysis of the results of physical examination of St. Petersburg children and their peers from the Leningrad Region, conducted in the 1990s by a group of U.S. and Russian scientists, revealed substantial differences in morphological characteristics, total caloric content of food, and consumption of vitamins and mineral nutrients, which proved to be significantly higher among the city dwellers (Spurgeon et al., 1994; Steele et al., 1994). In recent years, a number of researchers in various regions of Russia have studied specific features of physical development in urban and rural children (Kabanov, 2005; Medvedev et al., 2011; Osmanov R.O., Omarieva, Osmanov O.R., 2013; Egorova et al., 2014; Filatova, 2014; Tsybulskaya et al., 2014), including the Arkhangelsk Region (Degteva et al., 2013; Fedotov, Degteva, Godina, 2012; Fedotov, 2014). However, as with many other studies related to hygiene in children and adolescents, the program of this research was limited to a minimal set of characteristics.

The purpose of this paper is to characterize the processes of growth and development in the children and adolescents of Arkhangelsk and Arkhangelsk Region at the present stage (on the basis of an extensive set of characteristics, including biological age indicators), and to correlate the obtained results with archival data collected at the end of the 1980s.

Materials and methods

The material of this paper was collected in 2009–2010 as part of the project devoted to the tercentenary jubilee of M.V. Lomonosov, the founder of Moscow University. A comprehensive anthropological examination of the child population was conducted in the villages of Kholmogory (where M.V. Lomonosov was born), Matigory, and Emetsk, and in the city of Arkhangelsk. More than 2000 children and adolescents, aged from 7 to 17, were examined. The material was collected by the cross-sectional method with observance of the rules of bioethics and signing of informed-consent forms for each subject (in case of younger schoolchildren, forms were signed by their parents). The examination included only children whose parents, either both (96 %) or one (4 %), were ethnic Russians.

The comparison was based on materials collected by the authors in the same districts and villages as in 1988–1989 (Miklashevskaya et al., 1992). It can be said that two generations of urban and rural children and adolescents of the Arkhangelsk Region were studied. In each village, examination was conducted of all schoolchildren, the number of which has been considerably reduced as compared to the 1980s, owing to the fall of the birth rate, and also migration processes, in Russia. The rural population of the Arkhangelsk Region continually reduces (Tabakov, 2005): according to official statistics, in recent years, the total decline in population of the region proceeds at the rate of 10 thousand people annually (http://www.vdvsn.ru/novosti/region/tendentsiya_depopulyatsii/).

The material was divided into age groups according to the principle accepted in Russian anthropology: the average age of the children in a group is equated to an integral number of years. The anthropometric examination was performed following the standard procedure (Bunak, 1941: 58–86). The program included some 50 metric and descriptive characteristics; a questionnaire survey taking into account parental education and occupation, number of children per family, financial standing of family, type of nutrition, etc. (Zadorozhnaya, 1998: 13–16). The following calculations were performed: leg, arm, and torso lengths; the Quetelet index (body mass index (BMI)) from the formula $I = W/L^2$, where I is the index value, W is the body weight (kg), L is the height (m); absolute and relative amount of fat mass (kg, %) from the formulas provided by M. Slaughter with co-authors (Slaughter et al., 1988).

Data on the sexual development of adolescents have been collected. The following characteristics were taken into account: in girls, development of mammary glands (Ma), axillary (Ax) and pubic (P) hair, and age at menarche (Me); in boys, pubertal nipple swelling (S), axillary (Ax) and pubic (P) hair, age of voice change (VC), degree of protrusion of the Adam's apple (A), and growth of mustache (M), beard (B), and chest hair (C) (Solovieva, 1966: 51–56).

Statistical processing of the results was carried out using the standard statistical package *Statistica* (versions 6.0 & 8.0). The standardization procedure was applied to enable comparison of special features of intra-group differences irrespective of age and sex (Cole, 1997). The statistical significance of average values was evaluated by Student's *t*-test. Analysis of variance (one-way ANOVA) was conducted. Statistical significance was evaluated using Scheffé's test. The average age of appearance of secondary sexual characteristics was determined by the probit regression method.

Results and discussion

The dynamics of age-related changes in the average values of the main body dimensions in the girls and boys of Arkhangelsk and the Arkhangelsk Region are presented in Table 1*. During puberty, the girls of Arkhangelsk are ahead of their rural peers in height; however, the differences are only statistically significant at the ages of 11 and 12 (Table 1). At 17, this indicator reaches 161.97 cm in urban girls and 160.56 cm in girls from villages in the region. Both in the city and in rural areas, it is higher (reaching 163 cm) in the group of 16-year-olds than in the 17-year-olds. It is likely that the girls born in 1993 were affected by the economic crisis of the beginning of 1990s to a greater extent than members of subsequent age groups.

The boys of Arkhangelsk are actually ahead of their rural peers in height within the entire age interval. The differences are significant at the ages of 7, 11, and 15 (Table 1). At the age of 17, this indicator reaches 175.3 cm in urban young men and 173.4 cm in rural ones. The 17-year-old young men of Arkhangelsk are behind their Moscow peers in height (175.9 cm) (Godina, 2001: 143). The results of measurement of the height of the male population of the Arkhangelsky Uyezd conducted in 1870–1880s and, repeatedly, in 1925 (166.1 and 166.6 cm, respectively) were no different, on the whole, from the indicators for the Moskovsky Uyezd inhabitants (166.0 and 166.7 cm, respectively) (Bunak, 1932). A considerable secular gain of height in the Russians of Arkhangelsk of almost 10 cm over the 100-odd years is comparable in value to the mean European numbers (Malina, 2004).

The urban girls are ahead of their rural peers in body weight at younger ages; however, this trend is reversed at older ages (Table 1), which is in agreement with the earlier obtained data on more leptosomic body structure in urban girls (Godina, 2009). A statistically significant difference in favor of urban boys is only observed at the age of 11, while there are actually no significant differences in other age groups, though the trend towards greater body weight persists in city dwellers (Table 1).

The trend that we have already detected for body weight can also be noted for chest circumference: some excess of values in urban girls at younger ages and, in contrast, their reduction at older ones. Statistically significant differences are recorded for the age of 15, when the difference favoring rural girls reaches 3.5 cm ($p<0.01$). The urban boys are ahead of their rural peers in chest circumference at the age of 11 ($p<0.01$). No statistically significant differences have been revealed in other age groups. Having regard to the fact that city dwellers are taller, this points to a greater brachymorphia of the rural population, confirming conclusions made by other authors (Wronska-Weclaw, 1984; Chigea, Miu, Tudoscie, 1987).

The trends that we have already mentioned when analyzing the age-dependent dynamics of body weight are characteristic of BMI. This indicator is lower in urban girls at the age of 14–17, though statistically significant differences have been only recorded for the age of 15. The differences in boys reach statistically significant values in favor of city dwellers at the age of 11 (Table 1).

*For more detailed information about dimensional indicators see (Godina et al., 2011).

Table 1. **Main statistical parameters of morphological characteristics of children from the city of Arkhangelsk (CA) and the Arkhangelsk Region (AR)**

Age, years	*N*		Height, cm				Body weight, kg				BMI			
	CA, 2009/1988	AR, 2010/1989	CA		AR		CA		AR		CA		AR	
			2009	1988	2010	1989	2009	1988	2010	1989	2009	1988	2010	1989
Girls														
7	75/55	30/69	123.2 ± 6	121.6 ± 5	121.1 ± 7	120.4 ± 6	**25.4 ± 6**	23.5 ± 3	**22.6 ± 3**	23.2 ± 3	**16.6 ± 3**	15.9 ± 2	**15.4 ± 1**	15.9 ± 1
8	96/50	38/62	126.7 ± 6	126.1 ± 5	127.5 ± 6	124.9 ± 5	26.5 ± 6	24.9 ± 4	26.8 ± 5	24.7 ± 4	16.4 ± 3	15.6 ± 2	16.4 ± 2	15.8 ± 2
9	69/58	34/69	133.6 ± 6	**131.2 ± 6**	132.2 ± 6	**128.6 ± 5**	30.5 ± 6	**28.7 ± 4**	29.7 ± 6	**26.7 ± 5**	17.0 ± 3	16.6 ± 2	16.9 ± 3	16.1 ± 2
10	56/73	24/72	139.7 ± 8	**138.5 ± 6**	137.2 ± 8	**135.3 ± 7**	35.2 ± 10	31.8 ± 6	31.1 ± 7	31.0 ± 7	17.8 ± 4	16.5 ± 2	16.4 ± 2	16.8 ± 3
11	62/91	39/40	**148.0 ± 8**	**143.2 ± 7**	**142.9 ± 9**	**139.1 ± 8**	**40.7 ± 10**	35.8 ± 7	**35.7 ± 9**	33.8 ± 8	18.5 ± 3	17.3 ± 2	17.3 ± 3	17.2 ± 3
12	71/84	37/73	**151. 9 ± 8**	**151.2 ± 7**	**148.4 ± 8**	**146.1 ± 8**	43.5 ± 10	41.9 ± 8	40.6 ± 11	40.1 ± 9	18.7 ± 3	18.2 ± 2	18.2 ± 3	18.6 ± 3
13	62/80	39/55	157.4 ± 7	**156.1 ± 7**	154.9 ± 8	**152.1 ± 7**	48.4 ± 10	46.7 ± 8	48.3 ± 12	46.2 ± 12	19.4 ± 3	19.1 ± 3	19.9 ± 4	19.8 ± 4
14	84/78	32/55	160.7 ± 6	**159.0 ± 7**	158.6 ± 6	**156.0 ± 7**	52.0 ± 9	**52.5 ± 9**	50.1 ± 7	**49.1 ± 9**	20.1 ± 3	20.7 ± 4	19.9 ± 2	20.1 ± 3
15	66/75	43/53	161.0 ± 6	**162.2 ± 5**	161.6 ± 7	**159.7 ± 6**	**51.1 ± 8**	53.7 ± 8	**56.1 ± 9**	53.4 ± 9	**19.7 ± 3**	20.4 ± 3	**21.5 ± 3**	20.9 ± 3
16	87/79	41/56	163.1 ± 7	161.8 ± 6	163.2 ± 6	161.4 ± 7	55.7 ± 8	56.3 ± 9	57.8 ± 10	56.4 ± 7	20.9 ± 3	21.5 ± 3	21.7 ± 4	21.7 ± 3
17	62/0	44/43	162.0 ± 6	–	160.6 ± 7	161.2 ± 6	55.1 ± 8	–	55.7 ± 10	57.5 ± 8	21.0 ± 3	–	21.6 ± 3	22.1 ± 3
Boys														
7	68/50	24/54	**123.8 ± 5**	**123.8 ± 5**	**121.0 ± 6**	**118.9 ± 5**	25.8 ± 5	**24.6 ± 3**	24.4 ± 4	**22.8 ± 3**	16.8 ± 2	16.0 ± 1	16.5 ± 2	16.1 ± 1
8	73/56	40/74	128.8 ± 6	126.6 ± 5	126.4 ± 6	124.8 ± 6	28.4 ± 6	26.0 ± 3	26.6 ± 6	25.7 ± 4	17.0 ± 3	16.2 ± 1	16.5 ± 2	16.4 ± 1
9	69/67	28/55	132.9 ± 6	**133.2 ± 6**	133.1 ± 7	**129.9 ± 6**	30.7 ± 5	**29.9 ± 5**	29.8 ± 6	**27.9 ± 3**	17.3 ± 2	16.8 ± 2	16.7 ± 3	16.5 ± 1
10	67/71	26/70	139.5 ± 6	137.2 ± 6	138.2 ± 7	135.4 ± 6	33.5 ± 7	31.9 ± 5	33.6 ± 7	31.6 ± 5	17.2 ± 3	16.9 ± 2	17.4 ± 2	17.1 ± 2
11	53/72	33/58	**145.9 ± 7**	**141.7 ± 6**	**141.5 ± 8**	**139.3 ± 6**	**40.3 ± 10**	34.5 ± 5	**34.4 ± 6**	33.6 ± 5	**18.8 ± 4**	17.2 ± 2	**17.1 ± 2**	17.3 ± 2
12	58/78	42/67	151.0 ± 8	146.5 ± 7	149.8 ± 8	144.0 ± 8	41.7 ± 9	37.3 ± 6	41.2 ± 8	37.3 ± 7	18.2 ± 3	17.3 ± 2	18.2 ± 3	17.9 ± 2
13	57/62	48/59	157.3 ± 9	152.8 ± 8	156.9 ± 8	151.1 ± 9	47.1 ± 10	43.3 ± 8	48.4 ± 10	42.3 ± 7	18.9 ± 3	18.4 ± 2	19.6 ± 3	18.4 ± 2
14	56/65	33/58	163.7 ± 9	158.7 ± 9	160.1 ± 9	155.9 ± 7	55.2 ± 12	48.6 ± 8	51.7 ± 11	46.6 ± 8	20.5 ± 4	19.2 ± 2	20.0 ± 3	19.0 ± 2
15	81/58	43/56	**171.0 ± 7**	**170.6 ± 8**	**167.8 ± 8**	**164.2 ± 8**	60.5 ± 12	58.5 ± 10	57.1 ± 12	55.0 ± 10	20.6 ± 3	20.0 ± 2	20.2 ± 3	20.3 ± 3
16	71/73	57/51	174.0 ± 8	**172.3 ± 8**	171.8 ± 7	**168.8 ± 9**	62.0 ± 10	60.7 ± 8	61.9 ± 9	58.9 ± 11	20.3 ± 3	20.4 ± 2	20.9 ± 3	20.5 ± 2
17	53/44	44/30	175.3 ± 6	174.9 ± 6	173.4 ± 7	172.3 ± 7	65.3 ± 9	65.4 ± 9	63.4 ± 10	65.9 ± 9	21.2 ± 2	21.4 ± 2	21.0 ± 3	22.2 ± 3

Note: Characteristics, for which differences between the dwellers of Arkhangelsk and the Arkhangelsk Region (in the corresponding year of examination) reach the highest significance value ($p < 0.01$), are given in bold type.

The ANOVA results for combined age groups demonstrate highly significant differences in a number of characteristics. Substantial differences in relation between the lengths of torso and leg have been found ($p<0.000$ in boys, $p<0.05$ in girls). With similar values of torso length in urban and rural children, city dwellers have longer legs, which is well demonstrated by the results of ANOVA (Fig. 1). According to current opinion, differences in this indicator point primarily to the influence exercised by environmental conditions on growth processes at the prepubertal stage of ontogenesis. Relative shortening of legs and lengthening of trunk can be indicators of unfavorable growth conditions (Bogin, Varela-Silva, 2010).

A typical tendency towards a greater subcutaneous fat layer in modern city dwellers is observed (Fig. 2). It is more pronounced in boys: the scale of differences is greater, four skin-fat folds on the trunk and extremity are affected ($p<0.05$ to 0.01). The thickness of fat folds on the back and on the external surface of upper arm is a little larger in urban girls.

When comparing the dynamometric characteristics of urban and rural schoolchildren, it would be logical to assume that the latter show higher values owing to their engagement in seasonal agricultural works, active way of life, etc. (Gundegmaa, 2009: 17–19). In our case, the study has yielded some interesting results (Fig. 3). No differences have been actually revealed between the urban and rural boys (except for 16-year-olds, among which the rural boys have significantly higher indicators). In girls, they demonstrate the same already stated pattern: city dwellers are stronger before the onset of sexual maturity, while inhabitants of rural areas become stronger in postpuberty. The revealed differences constitute a trend. The obtained results can testify that life-style changes related to reduction in physical activity now affect not only the urban population, but the rural inhabitants as well. This is confirmed by the data provided by other authors (Permyakova, 2012: 20–22; Liu et al., 2012).

Urban girls are far ahead of rural ones with respect to the age of appearance of secondary sexual characteristics (Table 2). This difference is approximately 5 months in terms of the key indicator, the age at menarche. This age in the girls of Arkhangelsk falls at 12 years 9 months, which is considerably earlier than with

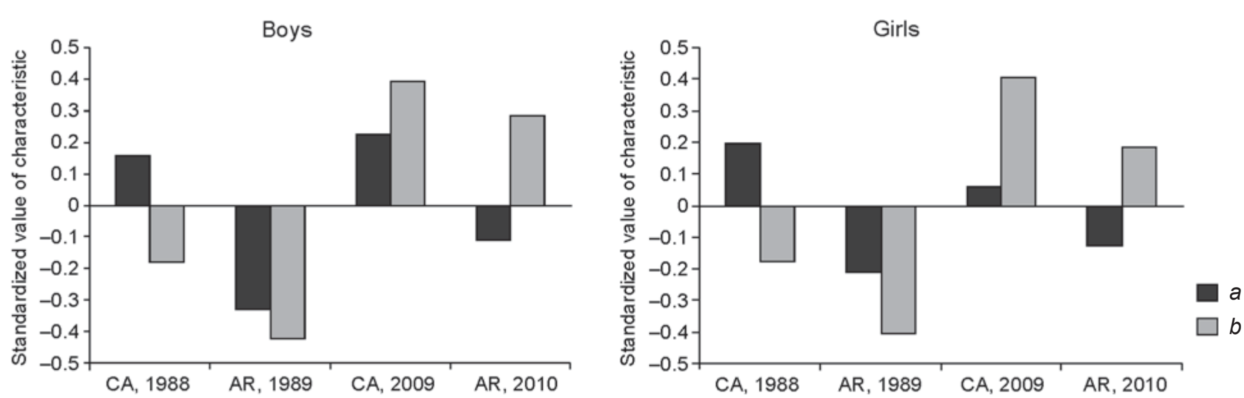


Fig. 1. The results of ANOVA of leg (*a*) and torso (*b*) lengths in children of urban (CA) and rural (AR) groups.

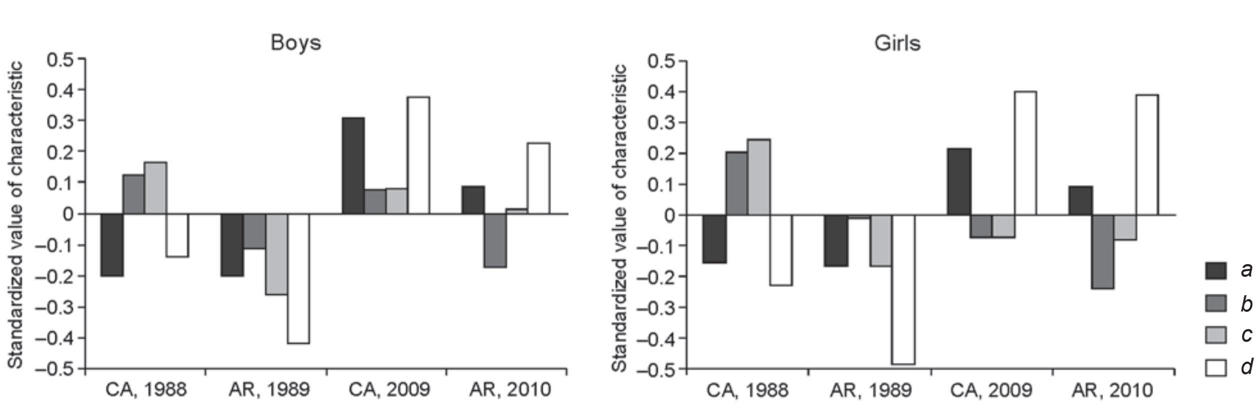


Fig. 2. The results of ANOVA of the skin-fat fold values in children of urban (CA) and rural (AR) groups.
a – on the back; *b* – on the outer surface of upper arm; *c* – on the internal surface of upper arm; *d* – on the abdomen.

Moscow girls, in whom this indicator was 13.0 years at the turn of the century (Godina, 2001: 133). Judging by these figures, active processes of a secular trend in modern women of the North can be described. The young men of the Arkhangelsk Region keep abreast of their urban peers in most indicators, and ahead of them in such characteristics as development of pubescence and pubertal nipple swelling (by 3 and 12 months, respectively). In general, these data confirm information in the literature about the type of differences in the ages of sexual maturation between urban and rural children (Godina, Miklashevskaya, 1990; Popławska et al., 2013).

The second important task of this research is to study secular shifts that have occurred in the last two decades. In the 21st century, two most probable scenarios have been identified: changes in body weight and subcutaneous fat along with stabilization of height, or changes in body shape towards more leptosomic type (Godina, 2009). What individual scenario of secular trend is characteristic of children and adolescents in the northern region of Russia?

One-way ANOVA analysis has revealed that modern Arkhangelsk girls are different in height from their peers who lived at the end of 1980s, slightly but significantly ($p<0.01$). Statistically significant differences by age groups are recorded for 8- and 9-year-old girls (which is, possibly, related to the earlier age of sexual development in modern urban girls). The boys, during the entire period of adolescence, demonstrate statistically significant differences in favor of the modern Arkhangelsk dwellers. By the age of 17, the indicators actually level off: modern young men reach a height of 175.27 cm, while their peers from the previous generation had a height of 174.88 cm (see Table 1). This confirms the conclusion drawn earlier by us (Miklashevskaya, Solovieva, Godina, 1988: 47–48; Godina, 2001: 142–157) and by a number of other researchers (Yampolskaya, 2000: 62–63; Roede, van Wieringen, 1985; Susanne, Bodzsár, 1998) that the processes of longitudinal growth in modern young people have stabilized in most countries of the world.

The average values of chest circumference in boys and girls of Arkhangelsk are indicative of secular shifts towards an increase (statistically significant differences are recorded for the majority of studied age groups). According to the results of analysis of variance

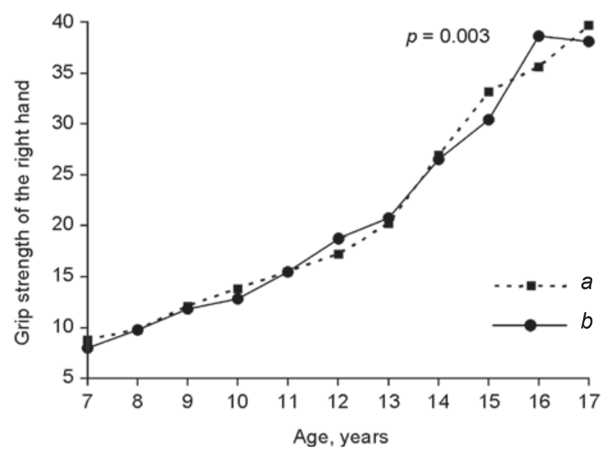


Fig. 3. Age-related changes in the grip strength of the right hand in urban (*a*) and rural (*b*) boys examined in 2009–2010.

Table 2. **Average age of appearance of secondary sexual characteristics in adolescents of Arkhangelsk and the Arkhangelsk Region (years)**

Characteristic	Arkhangelsk, 1988	Arkhangelsk Region, 1989	Arkhangelsk, 2009	Arkhangelsk Region, 2010
Girls				
Mammary glands (Ma)	10.23 ± 1.96	10.36 ± 1.68	9.75 ± 1.66	10.25 ± 1.92
Pubic (P) hair	11.72 ± 1.68	11.78 ± 1.25	10.75 ± 1.66	11.25 ± 1.33
Axillary (Ax) hair	12.13 ± 1.96	11.92 ± 1.25	11.00 ± 1.83	12.75 ± 2.25
Menarche (Me)	12.82 ± 1.68	13.62 ± 1.68	12.75 ± 1.66	13.25 ± 1.66
Boys				
Pubertal nipple swelling (S)	13.54 ± 1.25	14.23 ± 1.96	12.75 ± 1.25	11.75 ± 2.25
Pubic (P) hair	13.27 ± 1.68	13.23 ± 1.96	12.50 ± 1.50	12.25 ± 1.92
Axillary (Ax) hair	14.22 ± 1.68	14.50 ± 1.16	12.50 ± 2.16	12.75 ± 1.66
Protrusion of the Adam's apple (A)	13.27 ± 1.68	14.00 ± 1.96	13.50 ± 1.25	13.75 ± 1.92
Voice change (VC)	13.40 ± 1.66	14.00 ± 1.33	13.66 ± 1.66	13.23 ± 1.66
Growth of mustache (M)	15.12 ± 1.39	15.23 ± 1.33	14.25 ± 1.92	14.00 ± 1.83
Growth of beard (B)	16.21 ± 1.11	16.23 ± 1.66	15.25 ± 1.92	14.25 ± 1.92

(Fig. 4), the differences reach the highest significance value ($p<0.000$). Similar shifts are somewhat less pronounced in rural children of the region ($p<0.05$). Thus, it is hardly possible to talk about changes of body shape towards leptosomization in this case, as was earlier shown by us for Moscow and other cities of Russia (Godina, 2009). However, certain changes in body shape still take place: these include a decrease of shoulder breadth and increase of pelvic breadth in urban children (Fig. 5). The absolute difference between individual ages is small; however the ANOVA results for combined age groups demonstrate highly significant differences ($p<0.001$). The changes are most pronounced in rural children.

Modern young dwellers of Arkhangelsk show rather substantial changes of body length segments against the background of slight changes in height per se. In contrast to the data on increasing leg length and decreasing trunk or torso length presented in classical studies on secular shifts in the body proportions (Tanner et al., 1982; Cole, 2003), the leg length in the Arkhangelsk population has significantly reduced in girls ($p<0.05$) and has remained unchanged in boys, while the torso length has increased in persons of both sexes ($p<0.001$). In rural areas of this region, the corresponding tendency is more pronounced in boys. These changes can be interpreted in terms of the deterioration of living conditions in Arkhangelsk during the last 20 years. Similar data on a larger contribution of trunk length in secular changes of growth are observed in some other countries as well (Leung et al., 1996).

Children of the Arkhangelsk Region show changes in limb circumferences, mainly an increase (Fig. 4), and similar changes (significant in boys) in total and relative amount of fat (Fig. 6). A greater increase of fat-mass is observed in urban children ($p<0.01$); however, rural children also undergo substantial changes in this regard ($p<0.05$). The tendency towards an increasing amount of fat in modern adult and child population is global. There is some evidence that it is more pronounced in rural children. Thus, according to materials of the 1999–2006 National Health and Nutrition Examination Survey, the present-day living conditions in the rural areas of the USA facilitate a greater development of fat deposition (Liu et al., 2012). The authors came to a conclusion about insufficient physical activity in rural children, which is in

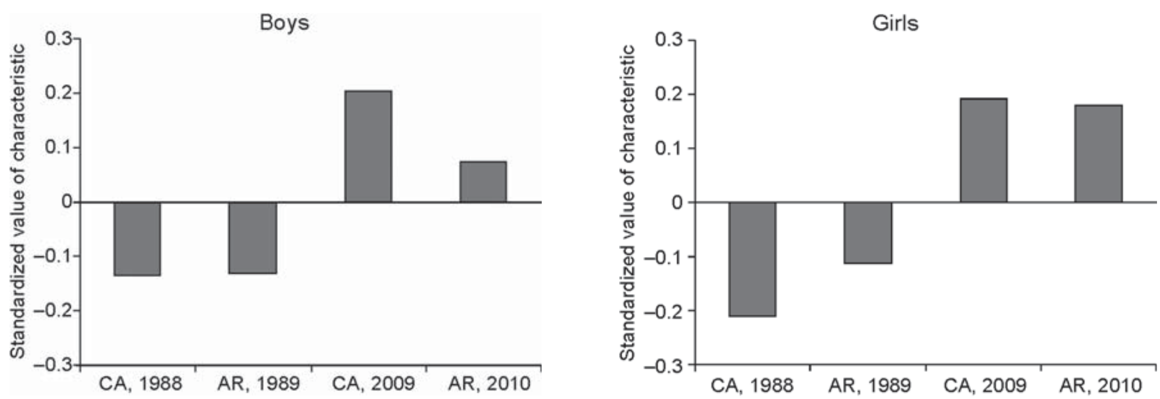


Fig. 4. The results of ANOVA of the chest circumference in children of urban (CA) and rural (AR) groups.

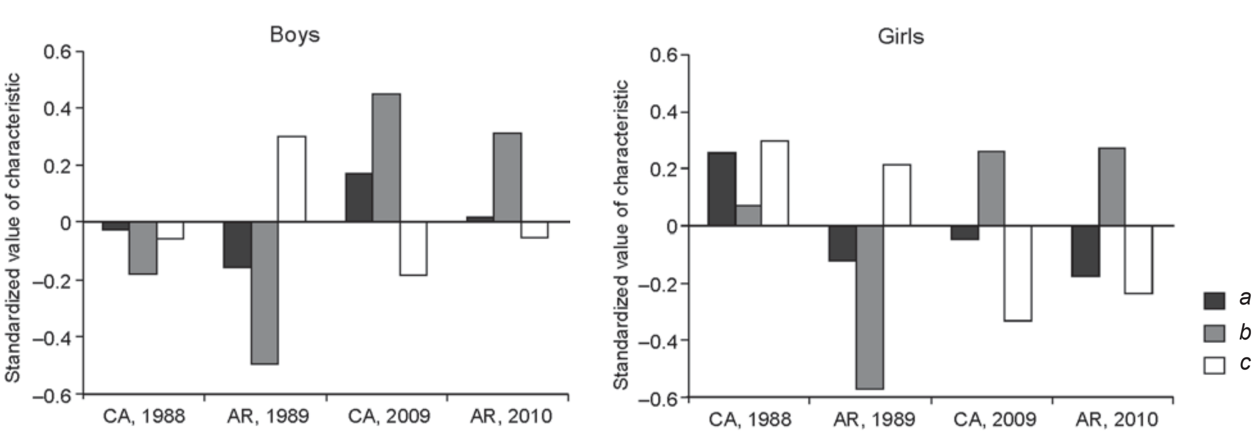


Fig. 5. The results of ANOVA of the shoulder breadth (*a*) and pelvic breadth (*b*), and relation between the shoulder breadth and height (*c*) in children of urban (CA) and rural (AR) groups.

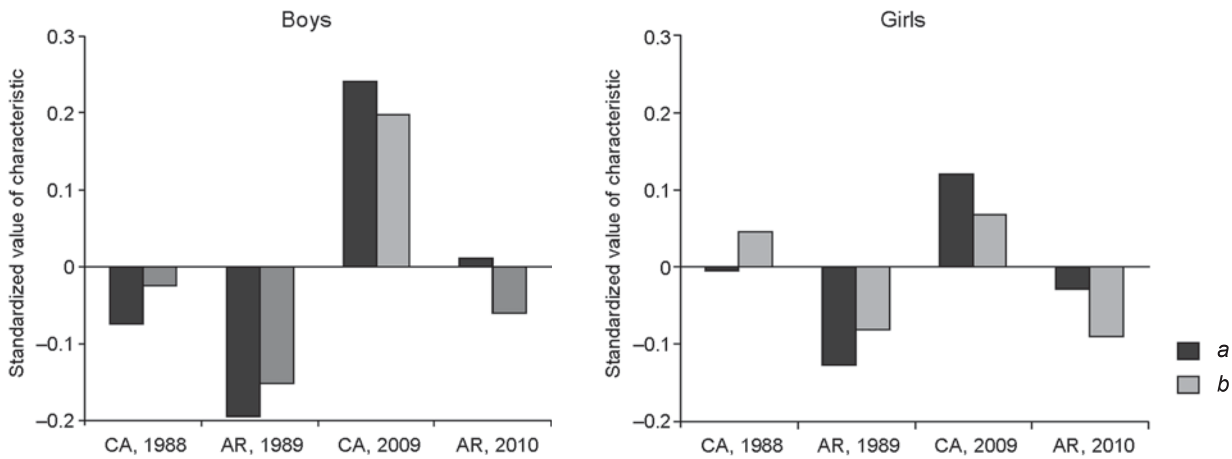


Fig. 6. The results of ANOVA of the total (*a*) and relative (*b*) amount of fat mass in children of urban (CA) and rural (AR) groups.

agreement with our data on equal indicators of muscle strength in urban and rural children and adolescents, and with the results of questionnaire survey of rural dwellers that show smaller physical loads as compared to city dwellers (Permyakova, 2012: 20–22).

Substantial changes have taken place in the character of subcutaneous fat-layer distribution. It has statistically significantly increased on the torso and decreased on extremities (Fig. 2) in urban and rural children and adolescents of the Arkhangelsk Region over 20 years. The fat fold on the abdomen has especially increased ($p<0.000$). Its thickness in some age groups has become larger by 4–5 mm, which is a quite substantial value. According to data obtained by a number of researchers, an increase in abdominal fat deposition is a predictor of a wide range of illnesses (cardiovascular diseases, diabetes, etc.) both in adult life and in childhood (Demerath et al., 2011). The mentioned tendencies may be indicative of unfavorable predictions regarding the health both of urban and of rural children living in the Arkhangelsk Region.

Substantial changes in the ages of sexual maturation towards its acceleration have taken place in urban and rural adolescents. Compared to archival data (Miklashevskaya et al., 1992), the average age of appearance of secondary sexual characteristics have considerably reduced both in boys and in girls (see Table 2). We already mentioned the inconspicuous but statistically valid increase of pelvic breadth in modern girls of Arkhangelsk. According to data from a number of authors (Ellison, 1982; Worthman, 1993), the age at menarche is best predicted exactly by this indicator. The average value of 24 cm determines the menstrual age in girls both in modern and in traditional populations. The “critical” value of pelvic breadth (to a greater extent than the “critical” weight (Frish, Revelle, 1971)) is one of the necessary conditions for successful establishment of the reproductive function. In 2010, the

Table 3. **Differences in socioeconomic and demographic characteristics of families of children examined in Arkhangelsk and the Arkhangelsk Region**

Groups compared (place, year of examination)	Average number of children per family		Average score of parental education		Average score of parental occupation	
	Boys	Girls	Boys	Girls	Boys	Girls
Arkhangelsk, 1988 and Arkhangelsk Region, 1989	–0.47*	–0.53	0.48 **	0.51	0.56	0.59
Arkhangelsk and Arkhangelsk Region, 2010	–0.26***	–0.36***	0.07	0.16***	0.26***	0.45
Arkhangelsk, 1988 and 2010	–0.04	0.16***	0.34***	0.11**	0.33**	0.18***
Arkhangelsk Region, 1989 and 2010	0.17***	0.33***	–0.07	–0.24***	0.03	0.04

*$p < 0.05$.
**$p < 0.01$.
***$p < 0.001$.

figures for the most important marker of adolescence, the age at menarche, were 12 years 9 months for the girls of Arkhangelsk and 13 years 3 months for rural girls, versus 12 years 10 months and 13 years 7 months in 1988, respectively. The shift towards acceleration is also observed in other characteristics in girls and young men, while the degree of urban-rural differences is reduced. Approximately equal rates of changes can be stated for rural and urban children and adolescents of the Arkhangelsk Region, though some other studies mention that biological age indicators in rural dwellers change more slowly (Popławska et al., 2013).

The degree of urban-rural differences has been substantially reduced for a number of indicators that characterize total body dimensions as well. To elucidate the nature of these changes, we have compared socioeconomic and demographic characteristics obtained on the basis of questionnaire surveys in two series of examinations. A significant reduction in the educational and professional level of adult population of Arkhangelsk is observed. At the same time, the average number of children, especially in rural families, is reduced, which means a larger income per family member (Zadorozhnaya, 1998: 13–16). A combination of the observed tendencies (Table 3) leads to equalization of socioeconomic conditions in the urban and rural areas, which can probably account for the increased resemblance between the two studied groups of child population.

Changes in socioeconomic and demographic characteristics may be caused by migration processes that have proceeded with maximum intensity in the Russian North during recent years (http://www.vdvsn.ru/novosti/region/tendentsiya_depopulyatsii/). In 2002, 83.9 % of migrants in Arkhangelsk (or 79.6 % according to the 2010 census statistics) shifted their permanent place of residence within the Arkhangelsk Region (Konstantinov, 2015), i.e. moved from smaller towns and villages. According to our data, the parents of 42.3 % of the children examined in Arkhangelsk in 2010 moved to the city from the countryside.

Conclusions

1. A comparison between modern rural and urban young men has shown that the dwellers of Arkhangelsk are slightly taller than their rural peers, but do not differ from them in chest circumference, body weight, or BMI. A tendency towards smaller chest circumference, body weight, and BMI has been found in urban girls at older ages, as compared to their peers from rural areas. City dwellers are ahead of rural inhabitants with regard to ages of sexual maturation.

2. It has been established that modern urban and rural schoolchildren have greater stature, body weight, and body mass index as compared to those measured in 1988, this being especially pronounced in boys during adolescence. Changes in body proportions towards longer torso are typical of modern children. Significant differences in limb circumference and subcutaneous fat have been found. Children and adolescents examined in 2010 are distinguished by greater chest and upper arm circumferences. They have thicker skin-fat folds. Changes in fat deposition topography towards a greater development of the fat layer, especially in the abdominal area, are typical of boys and girls. No substantial changes in height have been found in 17-year-old young men and girls, which suggests stabilization of the longitudinal growth processes in modern young people.

3. In a number of indicators, physical characteristics of urban and rural dwellers become closer. This can be attributed to equalization of socioeconomic and demographic characteristics of rural and urban environment caused by explosive social processes in the Russian North during the last two decades.

References

Bogin B.A. 1988
Rural-to-urban migration. In *Biological Aspects of Human Migration*, C.G.N. Mascie-Taylor (ed.). Cambridge: Cambridge Univ. Press, pp. 90–129.

Bogin B.A., Varela-Silva M.I. 2010
Leg length, body proportion, and health: A review with a note on beauty. *International Journal of Environmental Research and Public Health*, vol. 7 (3): 1047–1075.

Bunak V.V. 1932
Ob izmenenii rosta muzhskogo naseleniya SSSR za 50 let. *Antropologichesky zhurnal*, No. 1: 24–53.

Bunak V.V. 1941
Antropometriya. Moscow: Uchpedgiz.

Chigea S., Miu G., Tudoscie A. 1987
Variabiletatea ecologica a tipulue constitucional intervalul de virsta 17–20 de ani. *Studii si Cercetari de Antropologie*, vol. 24: 48–55.

Cole T.J. 1997
The use of Z-scores in growth reference standards. In *The Eighth International Congress of Auxology*. Philadelphia.

Cole T.J. 2003
The secular trend in human physical growth: A biological view. *Economics and Human Biology*, vol. 1 (2): 161–168.

Degteva G.N., Makarova V.I., Fedotov D.M., Godina E.Z., Zubov L.A., Kleshchinov M.N., Babikova I.V., Nepomilueva O.P., Korneyeva Y.A., Kononyuk N.N., Androsova L.N. 2013
Fizicheskoye razvitiye detei i podrostkov v vozraste 0–18 let, Arkhangelskaya oblast (Subyekt RF – Arkhangelskaya oblast). Etnicheskaya prinadlezhnost – russkiye. In *Fizicheskoye razvitiye detei i podrostkov Rossiyskoy Federatsii: Sbornik materialov*, A.A. Baranov, V.R. Kuchma (eds.), iss. VI. Moscow: Pediatr, pp. 88–94.

Demerath E.W., Rogers N.I., Reed D., Lee M., Choh A.C., Siervogel R.M., Chumlea W. C., Towne B., Czerwinski S.A. 2011
Significant associations of age, menopausal status and lifestyle factors with visceral adiposity in African-American and European-American women. *Annals of Human Biology*, vol. 38 (3): 247–256.

Egorova T.V., Savvina N.V., Savvina A.D., Lazareva A.A., Govorova M.D., Pavlova O.N. 2014
Sravnitelnyi analiz sostoyaniya zdorovya gorodskikh i selskikh shkolnikov Respubliki Sakha (Yakutiya) po rezultatam kompleksnogo obsledovaniya v Tsentre zdorovya za 2013 god. In *Ekologiya i zdorovye cheloveka na Severe: Sbornik nauch. tr. V Kongressa s mezhdunar. uchastiyem*, P.G. Petrova, N.V. Savvina (eds.). Kirov, pp. 231–237.

Ellison P.T. 1982
Skeletal growth, fatness and menarcheal age: A comparison of two hypothesis. *Human Biology*, vol. 54: 269–281.

Eveleth Ph.B., Tanner J.M. 1990
Worldwide Variation in Human Growth. 2nd Ed. Cambridge: Cambridge Univ. Press.

Fedotov D.M. 2014
Dinamika fizicheskogo razvitiya detei doshkolnogo vozrasta g. Arkhangelska za 20-letniy period. *Voprosy shkolnoi i universitetskoi meditsiny i zdorovya*, No. 3: 57–58.

Fedotov D.M., Degteva G.N., Godina E.Z. 2012
Dinamika antropometricheskikh pokazatelei u detei mladshego shkolnogo vozrasta Arkhangelskoi oblasti (1965–2010 gg.). In *Aktualnye problemy materinstva i detstva v realizatsii gosudarstvennoi programmy razvitiya zdravookhraneniya v Rossiyskoi Federatsii: Materialy nauch.-prakt. konf. (2–3 okt. 2012 g.)*. Naryan-Mar, pp. 314–318.

Filatova O.V. 2014
Raspredeleniye somatotipov i tempov polovogo razvitiya u yunoshei v usloviyakh gorodskoi i selskoi mestnosti Altaiskogo kraya. *Ekologiya cheloveka*, No. 2: 12–19.

Fizicheskoye razvitiye detei i podrostkov gorodskikh i selskikh mestnostei SSSR. 1988
Iss. IV, pt. 2. Moscow: [s.l.].

Frish R.E., Revelle R. 1971
Height and weight at menarche and a hypothesis of menarche. *Archives of Disease in Childhood*, No. 46: 695–701.

Godina E.Z. 2001
Dinamika protsessov rosta i razvitiya u cheloveka: prostranstvenno-vremennye aspekty. D.Sc. (Biology) Dissertation. Moscow.

Godina E.Z. 2009
Ot matreshki – k Barbi: Kak menyaiutsya fizicheskiye razmery nashikh detei. *Ekologiya i zhizn*, No. 5 (90): 76–81.

Godina E.Z., Khomyakova I.A., Zadorozhnaya L.V., Anisimova A.V., Ivanova E.V., Permyakova E.Y., Svistunova N.V., Stepanova A.V., Gilyarova O.A., Zubareva V.V. 2011
Auksologicheskiye issledovaniya na rodine M.V. Lomonosova. *Vestnik Mosk. Univ*. Ser. XXIII: Antropologiya, No. 3: 35–57.

Godina E.Z., Miklashevskaya N.N. 1989
Ekologiya i rost: vliyaniye faktorov okruzhayushchei sredy na protsessy rosta i polovogo sozrevaniya cheloveka. In *Rost i razvitiye detei i podrostkov*. Moscow: VINITI, pp. 77–134. (Itogi nauki i tekhniki. Ser.: Antropologiya; vol. 3.).

Godina E.Z., Miklashevskaya N.N. 1990
Vliyaniye urbanizatsii na rostovye protsessy u detei i podrostkov. In *Urboekologiya*, T.I. Alekseyeva, L.S. Belokon, E.Z. Godina (eds.). Moscow: Nauka, pp. 92–102.

Gundegmaa L. 2009
Morfofunktsionalnye osobennosti studencheskoi molodezhi Mongolii v zavisimosti ot geneticheskikh i sredovykh faktorov. Cand. Sc. (Biology) Dissertation. Moscow.

Kabanov Y.N. 2005
Morfofunktsionalnoye sostoyaniye detei s raznym urovnem dvigatelnoi aktivnosti, prozhivaiushchikh v ekologicheskikh usloviyakh goroda i sela. Cand. Sc. (Biology) Dissertation. Novosibirsk.

Konstantinov A.S. 2015
Migratsionnye protsessy kak faktor transformatsii territorialno-poselencheskoi struktury v Arkhangelskoi oblasti (1989–2010 gg.). *Arktika i Sever*, No. 18: 37–60.

Leung S.S., Lau J.T., Xu Y.Y., Tse L.Y., Huen K.F., Wong G.W., Law W.Y., Yeung V.T., Yeung W.K., Leung N.K. 1996
Secular changes in standing height, sitting height and sexual maturation of Chinese – the Hong Kong Growth Study, 1993. *Annals of Human Biology*, vol. 23 (4): 297–306.

Liu J.H., Jones S.J., Sun H., Probst J.C., Merchant A.T., Cavicchia P. 2012
Diet, physical activity, and sedentary behaviors as risk factors for childhood obesity: an urban and rural comparison. *Journal of Childhood Obesity*, vol. 8 (5): 440–448.

Malina R.M. 2004
Secular trends in growth, maturation and physical performance: A review. *Przegląd Antropologiczny-Anthropological Review*, vol. 67: 3–31.

Materialy po fizicheskomu razvitiyu detei i podrostkov gorodov i selskikh mestnostei SSSR. 1986
Iss. IV, pt. 1. Moscow: [s.l.].

Medvedev L.N., Kashkevich E.I., Demidova T.V., Chmil I.B. 2011
Fizicheskoye razvitiye detei 7–17 let Sibirskogo regiona. *Novye issledovaniya*, vol. 1 (26): 77–82.

Meredith H.V. 1982
Research between 1950 and 1980 on urban-rural differences in body size and growth rates of children and youths. In *Advances in Child Development and Behavior*, H.W. Reese (ed.), vol. 17. New York: Academic Press, pp. 83–138.

Miklashevskaya N.N., Godina E.Z., Danilkovich N.M., Zadorozhnaya L.V., Rusakova T.V., Khomyakova I.A. 1992
Rostovye protsessy u russkikh detei i podrostkov Severa Evropeiskoi chasti RF. *Voprosy antropologii*, iss. 86: 53–69.

Miklashevskaya N.N., Solovieva V.S., Godina E.Z. 1988
Rostovye protsessy u detei i podrostkov. Moscow: Izd. Mosk. Gos. Univ.

Osmanov R.O., Omarieva E.Y., Osmanov O.R. 2013
Vliyaniye okruzhayushchei sredy na zdorovye detei i podrostkov, prozhivayushchikh v raznykh raionakh i gorodakh Respubliki Dagestan. *Izvestiya Dagestanskogo Gos. Ped. Univ.: Estestvennye i tochnye nauki*, No. 4 (25): 78–81.

Paciorek C.J., Stevens G.A., Finucane M.M., Ezzati M. 2013
Children's height and weight in rural and urban populations in low-income and middle-income countries: A systematic analysis of population-representative data. *Lancet Global Health*, No. 1: 300–309.

Permyakova E.Y. 2012
Sovremennye tendentsii razvitiya zhirootlozheniya u gorodskikh i selskikh detei i podrostkov. Cand. Sc. (Biology) Dissertation. Moscow.

Petrovic J., Stojanovic V., Marinkovic G., Cvetanovic A., Popovic L. 1984
Vreddocti osnovnich antropometrijskih mera i skolske deti Nice. *Acta Medica Medianae*, vol. 23 (3): 11–19.

Polyakov I.P. 1985
Osobennosti fizicheskogo razvitiya podrostkov-yunoshei, prozhivayushchikh v gorodskoi i selskoi mestnosti. *Zdravookhraneniye RSFSR*, No. 2: 15–19.

Popławska H., Wilczewski A., Dmitruk A., Hołub W. 2013
The timing of sexual maturation among boys and girls in eastern Poland, 1980–2000: A rural-urban comparison. *Economics and Human Biology*, vol. 11 (2): 221–226.

Roede M.J., van Wieringen J.C. 1985
Growth diagrams, 1980. *Tijdschrift voor Sociale Gezondheidszorg*, vol. 63: 1–34.

Rona R.J. 1984
Ecological environment. In *Genetic and Environmental factors during Growth Period*, C. Susanne (ed.). New York, London: Plenum Press, pp. 199–207.

Rona R.J. 1991
Nutritional surveillance in developed countries using anthropometry. In *Anthropometric Assessment of Nutritional Status*, J.H. Himes (ed.), New York: Wiley-Liss, pp. 301–318.

Slaughter M.H., Lohman T.G., Boileau C.A., Horswil C.A., Stillman R.J., Van Loan M.D., Bemden D.A. 1988
Skinfold equations for estimations of body fatness in children and youth. *Human Biology*, vol. 60: 709–723.

Solovieva V.S. 1966
Morfologicheskiye osobennosti podrostkov v period polovogo sozrevaniya (v etnoterritorialnom razreze). Cand. Sc. (Biology) Dissertation. Moscow

Spurgeon J.H., French K.E., Giese W.K., Steele M.F., Utenko V.N., Bundzen P.V., Rogozkin V.A. 1994
Somatic comparisons of rural and urban Russian boys, ages 6, 9, and 15 years, living in St. Petersburg and surrounding areas. *American Journal of Human Biology*, vol. 6: 141–151.

Steegman A.T., Jr. 1985
18th century British military stature: Growth cessation, selective recruiting, secular trends, nutrition at birth, cold and occupation. *Human Biology*, vol. 57 (1): 775–795.

Steele M.F., Spurgeon J.H., French K.E., Giese W.K., Utenko V.N., Bundzen P.V., Rogozkin V.A. 1994
Dietary nutrient intake comparisons for rural and urban Russian boys, ages 6, 9, and 15 years, living in St. Petersburg and surrounding areas. *American Journal of Human Biology*, vol. 6: 153–159.

Susanne C., Bodszár E.B. 1998
Patterns of secular change of growth and development. In *Secular growth changes in Europe*. Budapest: Eötvös Univ. Press, pp. 5–26.

Tabakov A. 2005
Analiz sotsialno-ekonomicheskoi situatsii Arkhangelskogo regiona: Perspektivy i napravleniya razvitiya oblasti i Kenozerya. Kenozerskiye chteniya-2005. URL: http://kenozerjelive.ru/kr05-tabakov-sh.htm (accessed August 21, 2013).

Tanner J.M., Hayashi T., Preece M.A., Cameron N. 1982
Increase in length of leg relative to trunk in Japanese children and adults from 1957 to 1977: Comparison with British and with Japanese Americans. *Annals of Human Biology*, vol. 9 (5): 411–423.

Tsybulskaya I.S., Tsybulsky V.B., Leonov S.A., Nizamova E.R. 2014
Zdorovye detei goroda i sela v Rossiyskoi Federatsii. *Sotsialnye aspekty zdorovyya naseleniya*, vol. 36 (2): 9.

Van de Poel E., O'Donnell O., van Doorslaer E. 2007
Are urban children really healthier? Evidence from 47 developing countries. *Social Science & Medicine*, vol. 65 (10): 1986–2003.

Worthman C.M. 1993
Biocultural interactions in human development. In *Juvenile Primates: Life History, Development and Behavior*, M.E. Perieira, L.A. Fairbanks (eds.). New York: Oxford Univ. Press, pp. 339–357.

Wronska-Weclaw W. 1984
Dynamics of growth and maturation of countryside children in selected region of Poland. *Studies in Human Ecology*, vol. 5: 241–272.

Yampolskaya Y.A. 2000
Fizicheskoye razvitiye shkolnikov – zhitelei krupnogo megapolisa v posledniye desyatiletiya: Sostoyaniye, tendentsii, prognoz, metodika skrining-otsenki. D.Sc. (Biology) Dissertation. Moscow.

Zadorozhnaya L.V. 1998
Vliyaniye sotsialno-ekonomicheskikh faktorov na morfofunktsionalnye kharakteristiki detei i podrostkov. Cand. Sc. (Biology) Dissertation. Moscow.

Received May 23, 2015.

AKIN – Agency for Cultural and Historical Heritage of the Altai Republic (Gorno-Altaysk)

AN SSSR – USSR Academy of Sciences

ASF – Association of Physics Students and Young Scientists

GANIIIYAL – Gorno-Altaysk Research Institute of History, Language and Literature (Gorno-Altaysk)

GIM – State Historical Museum (Moscow)

IA NANU – Institute of Archaeology, National Academy of Sciences of Ukraine (Kiev)

IA RAN – Institute of Archaeology, Russian Academy of Sciences (Moscow)

IAE SO RAN – Institute of Archaeology and Ethnography, Siberian Branch of the Russian Academy of Sciences (Novosibirsk)

IEA RAN – Institute of Ethnography and Anthropology, Russian Academy of Sciences (Moscow)

IIFF SO AN SSSR – Institute of History, Philology and Philosophy, Siberian Branch of the USSR Academy of Sciences (Novosibirsk)

IIMK RAN – Institute for the History of Material Culture, Russian Academy of Sciences (St. Petersburg)

IPOS SO RAN – Institute of Northern Development, Siberian Branch, Russian Academy of Sciences (Tyumen)

KSIA – Brief Communications of the Institute of Archaeology, Russian Academy of Sciences

KSIIMK – Brief Communications of the Institute for the History of Material Culture

LOIA AN SSSR – Leningrad Branch of the Institute of Archaeology of the USSR Academy of Sciences

MAE RAN – Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), Russian Academy of Sciences (St. Petersburg)

MIA – Materials and Investigations on Archaeology in the USSR

OIFZ RAN – United Schmidt Institute of Physics of the Earth, Russian Academy of Sciences (Moscow)

OPI GIM – Department of Written Sources of the State Historical Museum (Moscow)

SAI – The collection of archaeological sources

SPbGU – Saint Petersburg State University

TIE – Transactions of the Institute of Ethnography

UrO RAN – Ural Branch of the Russian Academy of Sciences

VAOPI GIM – Archive of the Department of Written Sources of the State Historical Museum (Moscow)

VINITI – Russian Institute for Scientific and Technical Information (Moscow)

VSEGEI – A.P. Karpinsky Russian Geological Research Institute (St. Petersburg)

Agatova A.R., Senior Researcher, Institute of Geology and Mineralogy, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Koptyuga 3, Novosibirsk, 630090, Russia; Researcher, Ural Federal University, Mira 19, Yekaterinburg, 620002, Russia. E-mail: agatr@mail.ru; agat@igm.nsc.ru

Alekseeva E.A., Junior Researcher, Institute of Northern Development, Siberian Branch, Russian Academy of Sciences, Malygina 86, Tyumen, 625003, Russia. E-mail: alekseeva.elena.ae@gmail.com

Bagashev A.N., Director, Institute of Northern Development, Siberian Branch, Russian Academy of Sciences, Malygina 86, Tyumen, 625003, Russia. E-mail: bagashev@mail.ru

Bobrov V.V., Department Head, Institute of Human Ecology, Federal Research Center of Coal and Coal Chemistry, Siberian Branch, Russian Academy of Sciences, Pr. Sovetsky 18, Kemerovo, 650000, Russia; Professor, Kemerovo State University, Krasnaya 6, Kemerovo, 650043, Russia. E-mail: klae@kemsu.ru

Bulatović L., Research Consultant, Public Institution "Museums and Galleries", Mark Milanova 4, 32000, Podgorica, Montenegro. E-mail: hajhel@t-com.me

Chernaya M.P., Professor, Laboratory Head, National Research Tomsk State University, Pr. Lenina 36, Tomsk, 634050, Russia. E-mail: mariakreml@mail.ru

Chikisheva T.A., Department Head, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: chikisheva@ngs.ru

Derevianko A.P., Scientific Director, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: derev@archaeology.nsc.ru

Filippovich Y.A., Research Assistant, Novosibirsk State University, Pirogova 2, Novosibirsk, 630090, Russia. E-mail: post-ost@yandex.ru

Godina E.Z., Leading Researcher, Anuchin Research Institute and Museum of Anthropology, Lomonosov Moscow State University, Mokhovaya 11, Moscow, 125009, Russia. E-mail: egodina@rambler.ru

Grachev I.A., Junior Researcher, Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), Russian Academy of Sciences, Universitetskaya nab. 3, St. Petersburg, 199034, Russia. E-mail: lugavka@mail.ru

Hudiakov Y.S., Professor, Chief Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia; Professor, Novosibirsk State University, Pirogova 2, Novosibirsk, 630090, Russia. E-mail: khudjakov@mail.ru

Kandyba A.V., Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: arhkandyba@gmail.com

Kartoziya A.A., Engineer, Institute of Geology and Mineralogy, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Koptyuga 3, Novosibirsk, 630090, Russia; Graduate Student, Novosibirsk State University, Pirogova 2, Novosibirsk, 630090, Russia. E-mail: kartoziya-444@mail.ru

Kashina E.A., Researcher, State Historical Museum, Krasnaya pl. 1, Moscow, 109012, Russia. E-mail: eakashina@mail.ru

Khomyakova I.A., Leading Researcher, Anuchin Research Institute and Museum of Anthropology, Lomonosov Moscow State University, Mokhovaya 11, Moscow, 125009, Russia. E-mail: khomyakova@antropos.msu.ru

Kozintsev A.G., Chief Researcher, Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), Russian Academy of Sciences, Universitetskaya nab. 3, St. Petersburg, 199034, Russia; Professor, Saint Petersburg State University, Universitetskaya nab. 7–9, St. Petersburg, 199034, Russia. E-mail: agkozintsev@gmail.com

Kozlikin M.B., Junior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: kmb777@yandex.ru

Kubarev G.V., Senior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: gvkubarev@gmail.com

Lee Jaehoon, Adjunct Professor of Anthropology & Cross-Cultural Studies, University of Houston-Clear Lake, Campus Box 24, 2700 Bay Area Blvd., Houston, TX 77058, USA. E-mail: jaehoonfl@hotmail.com

Marochkin A.G., Senior Researcher, Institute of Human Ecology, Federal Research Center of Coal and Coal Chemistry, Siberian Branch, Russian Academy of Sciences, Pr. Sovetsky 18, Kemerovo, 650000, Russia. E-mail: comcon@yandex.ru

Nepop R.K., Senior Researcher, Institute of Geology and Mineralogy, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Koptyuga 3, Novosibirsk, 630090, Russia; Researcher, Ural Federal University, Mira 19, Yekaterinburg, 620002, Russia. E-mail: rnk@igm.nsc.ru

Osipov D.O., Researcher, State Historical Museum, Krasnaya pl. 1, Moscow, 109012, Russia. E-mail: dmitriyosipov@mail.ru

Palaguta I.V., Department Chair, Saint Petersburg Stieglitz State Academy of Art and Design, Solyanoy per. 13, St. Petersburg, 191028, Russia. E-mail: ipalaguta@yandex.ru

Pavlenok K.K., Head of the Scientific & Educational Department, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia; Researcher, Novosibirsk State University, Pirogova 2, Novosibirsk, 630090, Russia. E-mail: pavlenok-k@yandex.ru

Poshekhonova O.E., Researcher, Institute of Northern Development, Siberian Branch, Russian Academy of Sciences, Malygina 86, Tyumen, 625003, Russia. E-mail: poshehonova.olg@gmail.com

Razhev D.I., Leading Researcher, Institute of Northern Development, Siberian Branch, Russian Academy of Sciences, Malygina 86, Tyumen, 625026, Russia. E-mail: rajevd0@gmail.com

Shunkov M.V., Director, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: shunkov@archaeology.nsc.ru

Slavinsky V.S., Senior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: slavinski@yandex.ru

Slepchenko S.M., Researcher, Institute of Northern Development, Siberian Branch, Russian Academy of Sciences, Malygina 86, Tyumen, 625026, Russia; Researcher, Tyumen Scientific Center, Siberian Branch, Russian Academy of Sciences, Malygina 86, Tyumen, 625003, Russia; Junior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: s_slepchenko@list.ru

Slyusarenko I.Y., Senior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia; Senior Researcher, Novosibirsk State University, Pirogova 2, Novosibirsk, 630090, Russia. E-mail: slig1963@yandex.ru

Starkova E.G., Senior Researcher, The State Hermitage Museum, Dvortsovaya nab. 34, St. Petersburg, 190000, Russia. E-mail: astarkova2012@yandex.ru

Tataurov S.F., Department Head, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia; Senior Researcher, National Research Tomsk State University, Pr. Lenina 34, Tomsk, 634050, Russia. E-mail: tatsf2008@rambler.ru

Tikhonov S.S., Associate Professor, Senior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: st-57@mail.ru

Tsybankov A.A., Head of the Rescue Archaeology Department, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: tsybankov@yandex.ru

Ulyanov V.A., Researcher, Lomonosov Moscow State University, Leninskie Gory, Moscow, 119991, Russia. E-mail: vladul@front.ru

Vybornov A.V., Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia; Researcher, Novosibirsk State University, Pirogova 2, Novosibirsk, 630090, Russia. E-mail: vb.anton@gmail.com; vybornov@archaeology.nsc.ru

Yurakova A.Y., Junior Researcher, Institute of Human Ecology, Federal Research Center of Coal and Coal Chemistry, Siberian Branch, Russian Academy of Sciences, Pr. Sovetsky 18, Kemerovo, 650000, Russia; Doctoral Student, Kemerovo State University, Krasnaya 6, Kemerovo, 650043, Russia. E-mail: yurakova_al@mail.ru

Zadorozhnaya L.V., Leading Researcher, Anuchin Research Institute and Museum of Anthropology, Lomonosov Moscow State University, Mokhovaya 11, Moscow, 125009, Russia. E-mail: mumla@rambler.ru

Zolnikov I.D., Leading Researcher, Institute of Geology and Mineralogy, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Koptyuga 3, Novosibirsk, 630090, Russia; Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia; Professor, Novosibirsk State University, Pirogova 2, Novosibirsk, 630090, Russia. E-mail: zol@igm.nsc.ru

Zubova A.V., Senior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia; Researcher, Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), Russian Academy of Sciences, Universitetskaya nab. 3, St. Petersburg, 199034, Russia. E-mail: zubova_al@mail.ru