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Technical and Morphological Model of Chalcolithic Chopping Tools of the Russian-Karelian Type from Karelia and the Upper Volga Region*

This article addresses chopping tools (axes and adzes) from the Chalcolithic peatbog sites at Sakhtysh, Karelia, associated with the Volosovo culture. This group was first separated on the basis of technological and typological criteria, and their connection with the Volosovo component of these culturally and temporally heterogeneous sites was later verified with a detailed spatial analysis. The main traits of the Volosovo tools match those of the Russian-Karelian type, found in Russian Karelia at Chalcolithic sites with asbestos and porous ware. The analysis of the blanks suggests that their production followed a certain technological and typological model. The basic type of tool had a trapezoid or triangular cross-section, which was formed at the knapping stage and could then have been transformed into a semi-oval. Knapping was done with the punch technique, also evidenced by axes with a tetrahedral cross-section, widespread in the Neolithic of Northern, Central, and Eastern Europe. The Volosovo chopping tools at the sites with asbestos ware in the Upper Volga region and Karelia follow the same single technological tradition. Its distribution area cannot be delimited as of yet, but it could have extended beyond that of the axes with a tetrahedral cross-section.

Keywords: *Chopping tools, axes, adzes, Volosovo culture, asbestos ware, Upper Volga, Karelia, Sakhtysh sites, Russian-Karelian type.*

Introduction

This study presents the results of the technical and typological analysis of chopping tools from the widely known settlements of the Sakhtysh archaeological microregion in Teykovsky District of the Ivanovo Region (Fig. 1). The analyzed objects belong to the Chalcolithic (Volosovo) component of these sites, which has been established on the basis of technical and typological criteria and the analysis of their stratigraphic and planigraphic position in the cultural layer. These objects were made following a specific technological tradition, previously known only from materials originating from the settlements with asbestos and porous ware on the territory of present-day Karelia, generally synchronous with the Volosovo sites. In Russian archaeological literature, the objects of this tradition are designated as tools of the Russian-Karelian type.

This article introduces the concept of the technical and morphological model of stone chopping tools. One such model is the Russian-Karelian; this designation was proposed in accordance with the name of the type of the tools, which has become established in the literature. The

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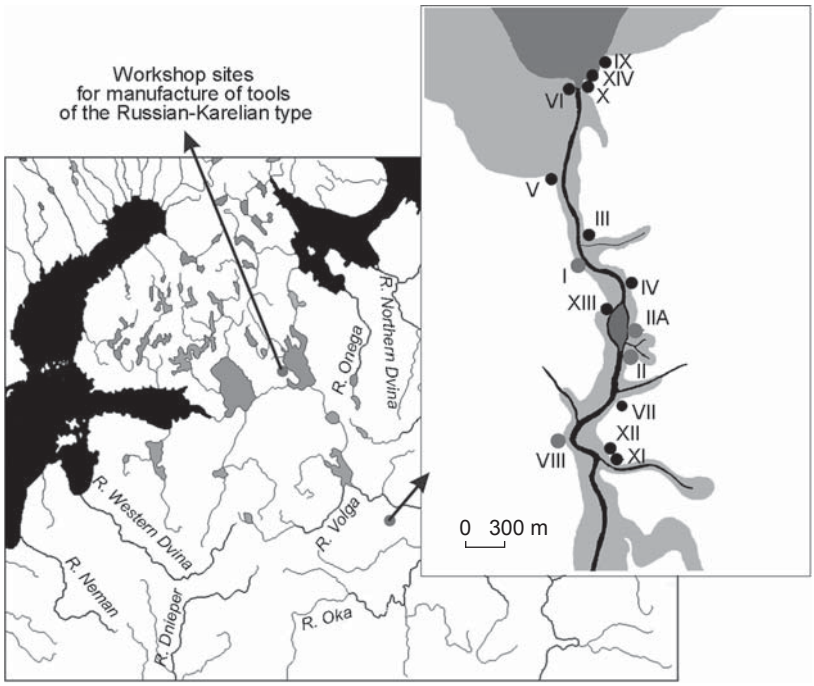

Fig. 1. Location of the Sakhtysh sites and lithic workshop sites of the Chalcolithic on the western shore of Lake Onega (Kostyleva, Utkin, 2010) (Roman numerals denote the sites of Sakhtysh I–XIV).

presence of this model on the territory of Karelia, as well as in the Upper and Middle Volga region, makes it possible to argue that its distribution and role in the set of tools of several cultures in the forest zone of Russia are comparable to the role of the model of tetrahedral axes in the Neolithic of Northern and Central Europe.

In the process of this study, we reviewed the materials from the sites of Sakhtysh I, II, IIa, and VIII, which have been studied by a number of scholars especially D.A. Krainov, E.L. Kostyleva, and M.G. Zhilin (see (Kostyleva, Utkin, 2010)). The objects from the collections of the Ivanovo State University were analyzed in detail. The materials from the Ivanovo Museum of Local History were also considered but we did not have an opportunity to describe them in the same detail. Some objects have been identified from the descriptions and field journals, but they were not taken into account in the quantitative analysis of features of the objects in question.

Russian-Karelian type of tools in Karelia and beyond: Historiography

Tools of the Russian-Karelian (or Eastern Karelian according to the Finnish tradition) type drew the attention of Finnish scholars in the second half of the 19th century. The Finnish experts located their production center as being on the western shore of Lake Onega and established that some objects were transported from there to very remote regions (Äyräpää, 1944; Heikkurinen, 1980: 5–7; Nordquist, Seitsonen, 2008; Tarasov, Kriiska, Kirs, 2010). Russian archaeologists were aware of the research of their Finnish colleagues, but the interpretation of the Finnish scholars did not become universally accepted in Russia (Bryusov, 1940: 227; 1947; 1952: 104–106; Voss, 1952: 196; Clark, 1952; Filatova, 1971; Gurina, 1974).

In the 1980–1990s, A.M. Zhulnikov investigated a number of Chalcolithic sites with asbestos and porous ware (1999). It was established that the tools of the Russian-Karelian type were typically found at the sites with such pottery and were absent from the archaeological sites with unmixed assemblages of other cultures (Tarasov, 2008). The mapping of such finds was first done by A. Äyräpää in the middle of the 20th century (1944). This work was resumed in 2008, when archaeological collections from Estonia (Tarasov, Kriiska, Kirs, 2010) were analyzed, and continued in 2009 in Latvia (Kriiska, Tarasov, 2011). Collections from a number of museums in Northwestern and Central Russia have also been studied. By now, 3466 objects have been considered, including tools, their fragments, and blanks. The majority of the blanks came from the lower reaches of the Shuya River. Some of the objects were found within the basin of Lake Onega, but not further.

The material of the tools of the Russian-Karelian type was identified in the second decade of the 20th century by the Finnish geologist E. Mäkinen, who established that the tools were made of weakly metamorphosed tuff (metatuff) from the northwestern coast of Lake Onega (see (Äyräpää, 1944)). This material was not quite correctly designated in the archaeological literature as "green Olonets slate" (Tallgren, 1922: 67; Äyräpää, 1944; Heikkurinen, 1980: 5). The petrographic studies were resumed in 2009. An analysis of a series of finds from Estonia has shown that most of them were made of metatuff, absent in this territory and similar to the material of the samples from the western shore of Lake Onega (Tarasov, Kriiska, Kirs, 2010).

There are no studies with a detailed technical and typological analysis of the chopping tools of the Volosovo culture; only a brief description can be found in general studies or publications of the materials from individual sites. There are some references to chisels and adzes

with a high, convex, or "humped" dorsal surface and semi-oval cross section, which have been sometimes referred to as chisels of the "Volosovo" type, as well as fluted chisels with "wide" or "narrow" grooves, chisels with or without grooves with triangular, sub-oval, or trapezoid cross-sections, "chisels with a humped dorsal surface", lenticular or trapezoid adzes in cross-section, etc. (Tsvetkova, 1948: 10; 1953: 28; 1970: 136; Bryusov, 1952: 76; Nikitin, 1991: 31; 1996: 136–137, 142; Zhilin et al., 2002: 55–56; Korolev, Stavitsky, 2006: 65–66, 69; and others). Some studies, specifically focusing on the Volosovo culture, contain only several remarks about the stone tools for woodworking (Krainov, 1987: 18; Tretyakov, 1990: 36, 50).

Tools of the Russian-Karelian type that have been found outside Karelia were mainly interpreted as the evidence of exchange (Ailio, 1922: 24; Clark, 1952; Filatova, 1971; Gurina, 1974: 15; Tarasov, 2008). In agreement with the Finnish scholars of the early 20th century, the authors noted that such tools were produced not only of metatuff in other territories. These facts were regarded as evidence for imitation of Karelian imported objects, leading to the conclusion that the emergence of this type could have been associated with a much larger territory (Ailio, 1922: 24; Tallgren, 1922: 124; Äyräpää, 1944: 66–68; Heikkurinen, 1980: 64–67). Thus, the presence of such tools, which were not made of metatuff, was observed in the collection of merchant V.I. Zausailov from the Middle Volga region, bought by A.M. Talgren for the Finnish National Board of Antiquities (Tallgren, 1916; Heikkurinen, 1980: 28–29).

A.Y. Bryusov, who introduced the term "Russian-Karelian type" of lithic objects and described the "chisels of the Volosovo type", surprisingly did not pay attention to the considerable similarity between them (1952). Other scholars who studied the Volosovo artifacts, but did not work with the Karelian materials, also treated the Volosovo tools without any connection to the chopping tools of the Russian-Karelian type (Tsvetkova, 1948, 1953, 1970; Krainov, 1987; Tretyakov, 1990: 36, 50).

In the Russian literature, the possible association of the Russian-Karelian type not only with objects from Karelian "slate", was proposed by V.F. Filatova (1971), who noted the presence of flint tools with typical morphology of the Russian-Karelian type in Central Russia. Filatova associated this type of tools with the sites of pit-comb pottery, and considered the population who left them to be migrant, coming to the conclusion that this type of stone tools was brought to the territory of Karelia in a fully formed state by migrants from the Volga-Oka interfluve. This conclusion seemed quite reasonable at the time, when unmixed assemblages with asbestos ware had not yet been investigated. Currently, the cultural and chronological attribution of this type of antiquities needs to be revised.

Technical and morphological models for producing chopping tools by knapping

The main feature of the chopping tools of the Russian-Karelian type is their cross-section in the form of a trapezoid or semi-oval. In the course of study of them, it seems that this morphological feature originated from the use of a certain technique, and the type as a static morphological phenomenon is based on a very specific technological tradition.

In the Neolithic and Early Metal Age, stone axes and adzes usually underwent abrasive processing (Semenov, 1968: 75–80). However, an attempt to create an object from a more or less large piece of stone only with the help of grinding would entail enormous efforts and time in the Stone Age. Knapping was much more effective, and thus abrasive treatment was applied at the final stage of production. Two main technological approaches that made it possible to ensure a specific shape even at the stage of knapping can be identified among the variety of methods used for producing stone axes. Their use directly affects the morphology of the finished products, especially the shape of their cross-section. These technological models can be designated as technological and morphological, which emphasizes the relationship between processing techniques and resulting shapes of the objects. The model makes it possible to make a blank of a tool with chopping functions. This blank may have different forms of the working edge and result in a variety of finished products such as axes, adzes, including fluted varieties, and chisels. At the same time, it also preserves a variability of proportions, as well as specific features of butt form and frontal shape of the tool.

The first of these models is based on the bifacial technology. Bifaces have two knapping surfaces, which form a sharp acute rib at the junction (Inizian et al., 1999: 44–49; Andrefsky, 1998: 172), and a cross-section of lenticular form. During their processing, flakes were alternately removed from both knapping surfaces in the direction from the edges towards the center. Negative scars of spalls removed from the opposite edges occur along the central axis of the object. This model was very common. It seems that bifacial techniques for producing chopping tools emerged independently in different parts of the world, since this is the most natural and simple way of creating the form of stone axes and adzes.

The second model was typical for axes with tetrahedral cross-section, which originally appeared in the Funnel-beaker culture in Southern Scandinavia and Central Europe (Hansen, Madsen, 1983; Madsen, 1984; Stafford, 1999: 30, 49; Olausson, 2000: 125; Apel, 2001: 153; Sundström, Apel, 1998; Sundström, 2003: 143; see also more references in these studies). The carriers of the

Corded Ware culture and the Battle Axe culture, which later spread over significant territories of Central and Northern Europe, partially adopted the types of inventory that had been typical for these areas, and the corresponding traditions including the technique of producing flint axes (Malmer, 1962: 150–246, 339–528; Edenmo, 2008: 22). Together with the Fatyanovo culture, axes with tetrahedral cross-section also appeared on the territory of present-day Russia (Krainov, 1972: 62).

This technique is distinguished by removals made by striking with an intermediate tool (punch technique), and a specific processing method of using the lateral wall of the negative scar of the percussion bulb from the previous spall as a platform for removing a new flake from the adjacent knapping surface. Two adjacent surfaces could have been located strictly perpendicular or even at a blunt angle to each other, but the flaking angle of the resulting spalls turns out to be significantly smaller. This method makes it possible produce a right angle between the faces of the product, which results in an object rectangular in cross-section (Fig. 2, *1*). The platforms of flakes, often wide, acquire a number of markedly concave facets with slanting interfacial ribs, which separate them (Fig. 2, *2*, *3*). The most reliable indicator for the use of an intermediate tool is the concave platform located on the lateral surface of the wide facet that remained from the previous flake removal near the interfacial rib. Any other percussion instrument would have inevitably hit the rib instead of the platform (Pelegrin, 2004: 68).

The production technique of the tools of the Russian-Karelian type (Tarasov, 2003; Tarasov, Stafeev, 2014) can be defined as intermediate between bifacial and tetrahedral. As in the bifacial model, the edges of the blank are joined to each other at an acute angle. However, instead of two concave surfaces, they have three or four relatively flat facets. If there are three facets, the object is triangular in cross-section, and all adjacent facets join together at an acute angle, albeit less acute than in bifaces. More often, however, there are four facets, one of which (dorsal) is narrower than the opposite (ventral) facet, while the other two (lateral) facets, opposite to each other, have the same width. The lateral facets join with the ventral facet at an acute angle, and join with the dorsal facet at an obtuse angle, thus the form of the object's cross-section becomes trapezoid (Fig. 2, *4–6*). Blanks and flakes often show signs of using the punch technique (Fig. 2, *2–5*). The knapping sequence is reconstructed as a stage process (Tarasov, Stafeev, 2014).

Tools of the Russian-Karelian type were subjected to very high-quality abrasive processing, which was usually done on at least 2/3 of the entire surface of the product. Very often fine polishing (a smooth mirror-like surface) covers a wide area (Tarasov, 2008). Another feature is

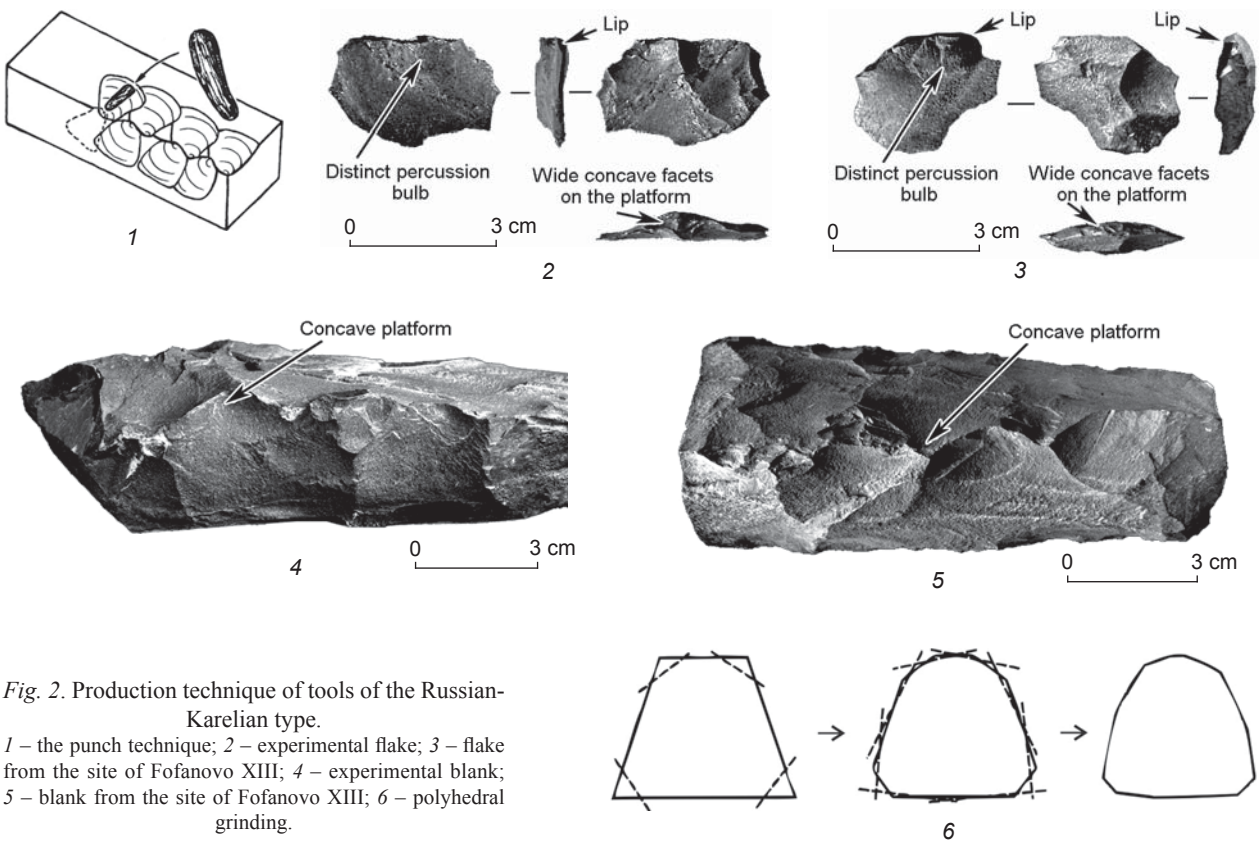

Fig. 2. Production technique of tools of the Russian-Karelian type.
1 – the punch technique; *2* – experimental flake; *3* – flake from the site of Fofanovo XIII; *4* – experimental blank; *5* – blank from the site of Fofanovo XIII; *6* – polyhedral grinding.

polyhedral grinding, when the main facets of the objects consist of a certain number of narrow longitudinal facets, usually extending along its entire length (Fig. 2, *6*).

Most often, the finished tools are trapezoid and in some cases triangular (in the butt part) in cross-section. Fluted adzes typically have a cross-section in the form of a semi-oval, which results from smoothening the ribs on the dorsal surface at the stage of polishing. In rare cases, the cross-section is in the form of a parallelogram. Along with tools made according to the Russian-Karelian technique, bifacial objects with one surface more convex than the other have been found in assemblages with the asbestos ware in Karelia. We have proposed to call such objects offset bifaces (Tarasov, 2003).

Tools from the Volosovo assemblages at the Sakhtysh sites

The Sakhtysh sites do not represent unmixed assemblages. In addition to the Volosovo materials, they contain Mesolithic materials (the Butovo culture), Early and Middle Neolithic materials (the Upper Volga and Lyalovo cultures), as well as Bronze Age and Early Iron Age materials. Different layers are detected lithologically, but are not separated by sterile interlayers. Moreover, they show damage related to economic and construction activities. A significant amount of materials are mixed, and it is difficult to make cultural attribution only from the context of each particular finding (Kostyleva, Utkin, 2010: 10–11).

When inspecting the collections, we selected objects with the signs of the Russian-Karelian model. First, these were the tools of the Russian-Karelian type proper, which traditionally included the objects made of gray-green rock. Secondly, we selected objects made of local materials from the territory of the Upper Volga region (flint and cherty limestone), produced in accordance with this model. After that, we checked their stratigraphic and planigraphic positions.

Karelian import. We determined 17 undeniable tools of the Russian-Karelian type, made of raw material that visually corresponds to metatuff from the territory of Karelia (Fig. 3, *6*, *8*, *9*). Six more objects were identified while viewing collection inventories on the basis of drawings and descriptions, and in this case there was the possibility of erroneous attribution. Seven objects resemble objects of the Russian-Karelian type, but have some significant deviations from its standard parameters. They include two blanks, as well as tools identified by inventory records. These tools show traces of wear, repair, and reshaping into tools with other functions, which indicates their use for production operations. Two objects can be interpreted as Russian-Karelian blanks of the first processing stage; they are made of boulders, the material of which visually resembles Karelian rocks. However, since the most typical signs of using this technology are missing (they manifest themselves at later stages of processing), there is no reason to claim that the objects really belong to the type under consideration. All data indicate that the series of tools described was imported from the territory of Karelia. The technological context of their use, but not production, appears at the Sakhtysh sites.

Tools and blanks made of local materials in accordance with the Russian-Karelian model. 154 objects have been identified. Most of them are finished tools (92 objects). There are significantly less blanks (40 objects), which can be expected for the assemblages from habitation settlements as opposed to workshop sites. There are some blanks (20 objects) made of broken tools and cases of secondary use with complete change in the original function (knife (?), core). Spalls from polished tools have also been found.

Tools. Detailed description of technical and morphological features was made for 87 tools, most of which are fragmented. Fluted adzes prevail (Fig. 3, *1*, *3*). There are many convex adzes with blades formed in the same manner as in fluted adzes by beveling from the broader ventral surface towards the narrower dorsal surface (and not vice versa, as is the case with adzes, chisels, and axes), but with an unpolished longitudinal groove (Fig. 3, *2*). There are rare occurrences of ordinary straight adzes and chisels. Owing to the predominance of fluted varieties, the most common cross-section is semi-oval.

Almost all objects that allow for estimating the size of the surface subjected to abrasive treatment (63 objects in total) have been completely polished. Most of them show very fine polishing (burnishing); the presence of polyhedral grinding has also been observed.

The comparison of metric features (Fig. 4) shows that the samples from the assemblages of the Sakhtysh sites and the finds of the Russian-Karelian type from Karelia are almost identical according to the ratio of width to thickness (about 1.5). This ratio is one of the stable signs of the Russian-Karelian type. Certain differences have been noted in the ratio of length to width (the Sakhtysh tools are narrower), which is probably related to the plastic properties of the Upper Volga raw materials.

Blanks (Fig. 3, *4*, *5*) have all been treated by knapping. The majority (32 objects) correspond to the Russian-Karelian model. One object was identified as an offset biface. Another object (a fragment of a butt) corresponds to the production technique of tetrahedral axes. Most likely, this was a random deviation from the general standard. Most of the blanks can be attributed to the later stages of processing. Their absolute predominance among the blanks from habitation

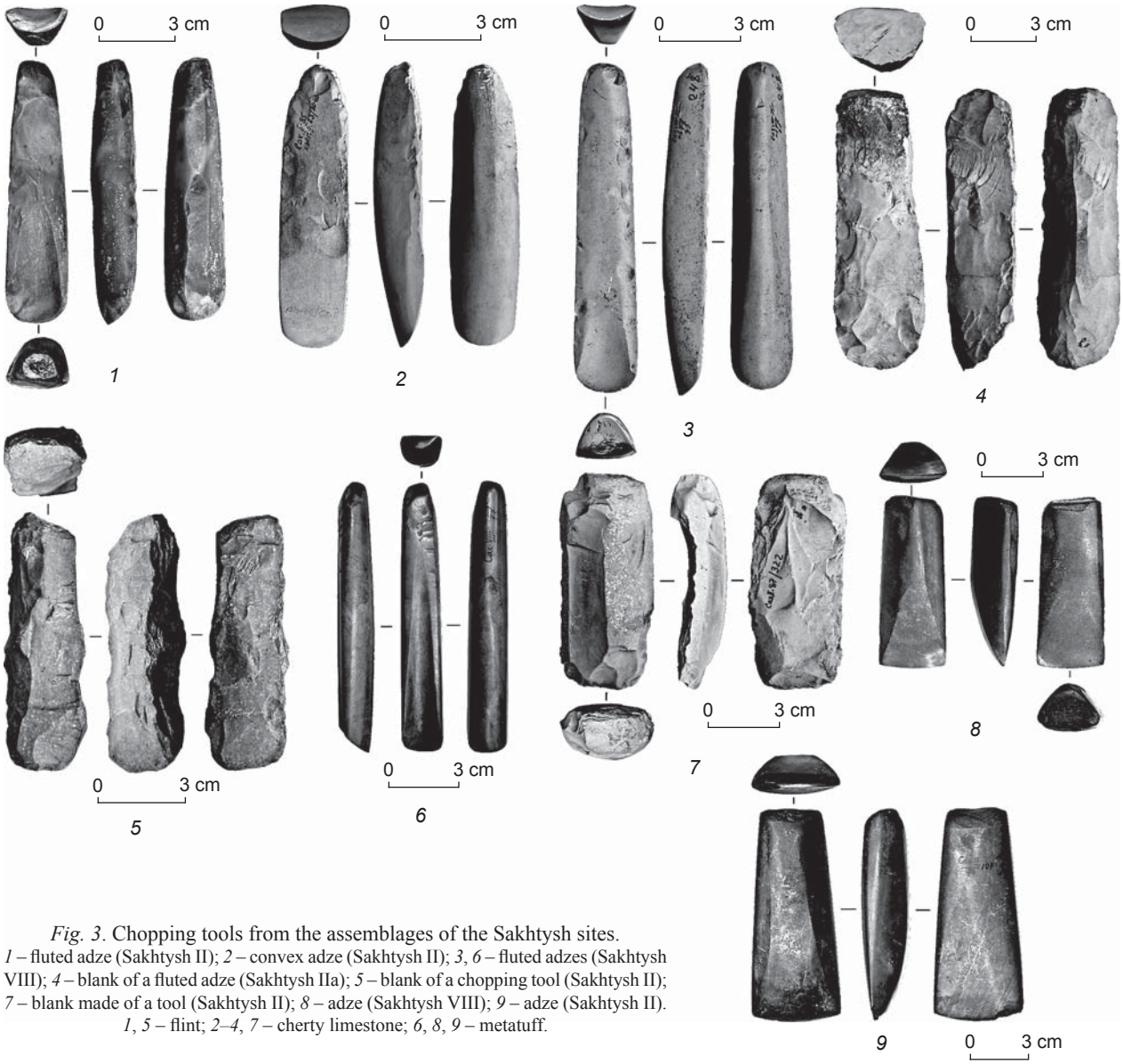

Fig. 3. Chopping tools from the assemblages of the Sakhtysh sites.
1 – fluted adze (Sakhtysh II); *2* – convex adze (Sakhtysh II); *3*, *6* – fluted adzes (Sakhtysh VIII); *4* – blank of a fluted adze (Sakhtysh IIa); *5* – blank of a chopping tool (Sakhtysh II); *7* – blank made of a tool (Sakhtysh II); *8* – adze (Sakhtysh VIII); *9* – adze (Sakhtysh II).
1, *5* – flint; *2*–*4*, *7* – cherty limestone; *6*, *8*, *9* – metatuff.

assemblages is also typical of the synchronous Karelian settlements (Tarasov, 2003, 2008).

Blanks made of tools. In addition to incomplete forms, these objects have areas that were polished before the fragment of the tool was reshaped (Fig. 3, *7*).

Stratigraphic and planigraphic analysis. The analysis made by E.L. Kostyleva has been described in detail (Tarasov, Kostyleva, 2015), thus it is sufficient to provide only a brief summary of the results. The objects with signs of the Russian-Karelian technical and morphological model at all four sites predominantly originate from the Volosovo horizon of the cultural layer, and their connection with the objects associated with this horizon (dwellings, sanctuaries, burial grounds) can be detected. This indicates that these objects must have belonged to the Volosovo culture.

Discussion

A significant part of the chopping tools and blanks from the Sakhtysh sites shows a great similarity to the tools of the Russian-Karelian type from the territory of Karelia both at the level of production technique and at the level of morphology of the finished objects. The analysis of the planigraphic and stratigraphic position makes it possible to associate them with the Volosovo assemblages, which are dated within ca 4800–3800 BP (ca 3550–2300 cal BC) at the Sakhtysh sites (for more details see (Kostyleva, Utkin, 2010: 248–250)). The artifacts made according to the Russian-Karelian model should be dated to the same chronological period. The imported tools made of metatuff are more likely associated with late Volosovo contexts (starting from ca 4100 BP or

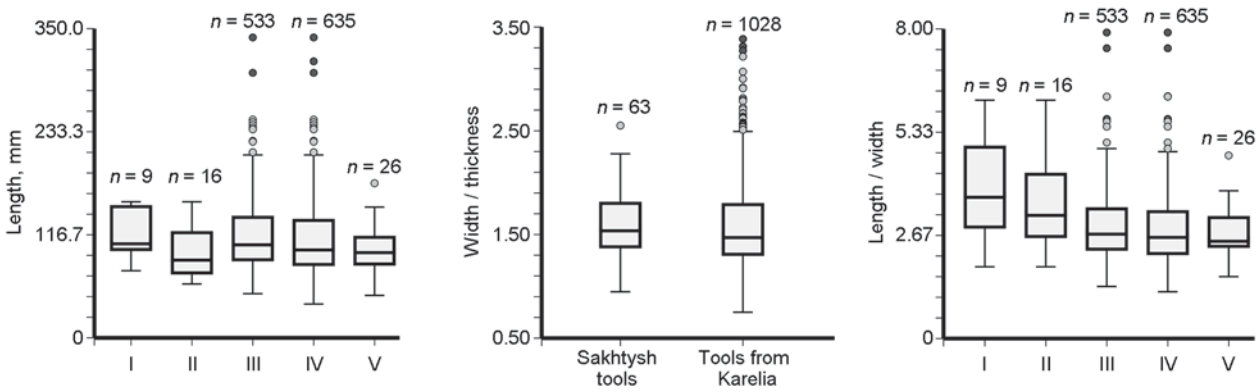

Fig. 4. Comparison of metric properties of the chopping tools, made according to the Russian-Karelian model, from the Sakhtysh sites, and the tools of the Russian-Karelian type from Karelia.

I – intact Sakhtysh tools with no traces of repair; II – intact Sakhtysh tools including those with traces of repair; III – intact tools, without traces of repair, from Karelia; IV – intact tools, including those with traces of repair, from Karelia; V – intact tools from the settlement assemblages of Karelia.

2800 cal BC) (Tarasov, Kostyleva, 2015). The earliest date for the assemblages containing the asbestos ware in Karelia is 4693 ± 35 BP (ca 3500 cal BC) (Zhulnikov, Tarasov, Kriiska, 2012); the latest date is 3150 ± 100 BP (ca 1400 cal BC) (Zhulnikov, 1999: 77). Accordingly, the industries of the tools of the Russian-Karelian type in Karelia and of the chopping tools in the Upper Volga region were synchronous for a long time. The level of their similarity makes it possible to consider them as varieties of a single tradition. This conclusion can likely be extended to the entire Volosovo industry of chopping tools. For a final conclusion, it is necessary to analyze the materials from other settlements. However, the use of the typologically significant features of the Russian-Karelian type for describing the Volosovo chopping tools from the sites that were left out of the scope of the present study (see the section on historiography) makes it possible to state that this tradition was typical of a significant part of the area of the Volosovo culture.

We may speak of a very large territory where not only exchange, but also production of such tools from different raw materials took place. Now it is impossible to determine the exact boundaries of the area where this tradition existed—they may turn out to be very broad. As in the case of tetrahedral axes, the industries based on the Russian-Karelian model could have appeared in different cultures, which were not necessarily genetically related, but maintained close information exchange.

The presence of a single production tradition at the settlements with asbestos ware in Karelia and the Volosovo sites in the Volga region by no means excludes the exchange of finished products. It is evidenced by the presence of imported tools from Karelia among the materials of the Sakhtysh sites, which were typologically identical to the objects of Sakhtysh production. It should be noted that only one object among all the finds in Karelia can be recognized as imported, most likely originating from the territory of the Volosovo culture. This fluted adze, semi-oval in cross section, is a stray find from the village of Nizhnyaya Salma, which became a part of L.V. Pääkkönen's collection of stray finds of 1899, kept in the Finnish National Board of Antiquities (No. KM 3824-6).

The present study did not intend to trace the origin of the technological tradition behind the production of chopping tools of the Russian-Karelian-Volosovo type or map the entire area of their distribution. The conclusions of this study are limited to the affirmation that this indeed was a single tradition despite the difference in raw materials and various names given to this phenomenon in historiography.

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