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## **ANCIENT IRON PRODUCTION IN KARELIA**

### *Abstract*

In this paper some information about 61 sites with iron slag is given, and the remains of 26 furnaces from 14 sites in Karelia are described and classified. They belonged to the cultures of hunters and fishers of the Iron Age - Early Middle Ages and are dated to between 500 BC and 1300 AD. The furnaces for making raw iron are grouped into 4 types: 1. Ground ones, perhaps, with a construction of wood, dating back to the Iron Age in SE Karelia; 2. Original furnaces in the shape of rectangular stone boxes in W and NW Karelia of the Iron Age - Early Middle Ages; 3. Two types of ground clay furnaces and pit furnaces built of stones, dated to the Iron Age - Early Middle Ages in Southern Karelia. Some issues are discussed; in particular, the disparity between relatively well developed raw iron production in Karelia and the total lack of blacksmith's implements and smithies in the archaeological record.

*Keywords:* iron production, iron slag, furnaces.

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### **INTRODUCTION**

This survey of the present state of knowledge about iron production in the territory of Russian Karelia, which is situated in eastern Fennoscandia, is limited to the local hunting-fishing cultures of the Iron Age - Early Middle Ages. For a long time these periods remained unstudied, and most of the data and classifications have formed during the past three decades. Four local cultures of the Iron Age have been discerned: The Late-Kargopol culture in SE Karelia, Luukonsaari in its SW, Late-White Sea culture in E-SE areas of the White Sea coastal region, and the culture with ceramics of the so-called "Arctic" type in NW Karelia i.e. the western part of the White Sea basin (Kosmenko 1993, 1996b; Manjuhin 1991, 1996). These cultures form the "Ananyino" layer of local pottery types in the chronological sequence of the main cultural types in Karelia (600-500 BC - 500-700 AD). They have some traditional features of the more eastern Ananyino culture gradually disappearing towards the west, as well as growing traits of adaptation to the local natural and cultural environments. The cultures of this type are classed as belonging to the ancient Saami (Kosmenko & Kochkurkina 1996).

In the Early Middle Ages (10-14 centuries AD) the appearance of the material culture and the pattern of cultural interactions changed radically. Most of Karelia was occupied by an aceramic culture which in Fennoscandia is usually identified as Saami, but in the southern part of the Lake Onega basin the culture which produced vessels closely resembling those from the simultaneous Ladoga burial mounds was found (Kochkurkina & Spiridonov 1988; Kosmenko 1980, 1992, 1996c). The latter have been identified in the SE Ladoga area for toponymic reasons as belonging to the ancient Vepsians. In this period the culture of the ancient Karelians formed in the NW part of the Lake Ladoga basin (Kochkurkina 1996). Iron production in the Ladoga basin is beyond the scope of this work, because no settlements of the Ladoga mound culture have actually been studied. Also, the culture of the ancient Karelians belonged to a different type of economy characterized by agriculture, cattle-breeding and fortified settlements. Some data on iron making taken mostly from medieval tax records (see: Kochkurkina 1982:76) are rather incomparable with ours.

The settlements of hunters and fishermen of the periods in issue have several similar traits in Karelia:

their topographic location at the mouths of the rivers either on the boards of the low lake and river terraces, or on other kinds of glacial period relief features such as eskers, cams and drumlins which had often been settled since the Stone Age. Furthermore, there are no traces of the pit- or log-houses, nor direct or indirect evidence of agriculture and a settled lifestyle. The level of metallurgy and crafts was not high and entailed the relative rarity of metal artifacts. Under these conditions, sandy cultural layers are usually thin and yield aggregate excavation units consisting of relatively poor diachronic assemblages of finds with combinations varying in different sites. As a consequence, there emerges the problem of differentiating these assemblages. It is partly solved by various methods (Kosmenko 1992), however, and some categories of finds including the remains of iron production have no obvious distinguishing features, so that it is often difficult to link them reliably to other categories or assemblages. To describe the aceramic assemblages in such contexts was sometimes an especially formidable task if there was lack of dated artifacts in areas of limited excavation. The most typical error was arbitrary or inexact division of such excavation units reflecting general views concerning iron production in Karelia

Iron slag and furnaces were found at individual sites as far back as the late 1920s. A. J. Brjusov (1940) attempted to interpret the paradoxical fact of the iron slag, bronze smelting and early textile pottery combination at the Tomitsa site near Petrozavodsk. He suggested an outwardly original decision of that paradox and identified iron slag as the by-product of bronze smelting, with reference to some German authorities. Nevertheless, special analysis revealed no traces of copper and tin in the samples of slag from Tomitsa (Schmidt & Iessen 1935). Later A. Äyräpää (1951:85) attributed this site to the Early Iron Age. Taking into account the Orovgu-ba site, the combination of a furnace with iron slag and asbestos-tempered pottery of the "classic", type as defined by herself (mostly resembling ceramics of the Pöljä group in Finland) N. N. Gurina (1951:133) did not doubt their simultaneity. She put forward the conception of the "Early Metal" period (Gurina 1961) which in general reflected the uncertain state of knowledge about the sequence and character of bronze and iron use in northwestern Russia. At the same time she suggested that the Bronze Age began in Karelia no later than in the end of the second millennium BC and the Iron Age around 500 BC (Gurina 1961:111).

The general views of Karelian archaeologists in the 1960s and '70s followed the course of Gurina's con-

cept as mentioned above, although they found some new sites with traces of iron making. Furnaces and iron artifacts from the Kudoma X "workshop" were dated approximately to the end of the first millennium BC, but were not linked with certainty to other finds (Anpilogov 1966). A similar state was described on a series of sites in the SW White Sea area (Savvateev 1977). An original opinion was suggested by G.A. Pankrush-ev (1988), who suggested the idea of the very long existence of asbestos-tempered pottery of the Eneolithic "classic" type, until the third century AD. This idea, however, was rejected, and the final dates of this pottery type were determined to lie between 1500 and 1000 BC (Vitenkova 1996:173).

The way out of this indeterminate situation was not the multiplication of new concepts but the accumulation of more data by means of wider and more intense excavations of the multistrata sites and a thorough analysis of their contexts and assemblages of finds. The excavations of 30 such sites in southern Karelia permitted the above-mentioned better-founded conceptions of the origin, cultural and chronological division and special features of the Bronze Age - early medieval material culture in Karelia (Kosmenko 1992) and to summarize all the data and conclusions (Kosmenko 1993, 1996a, 1996b, 1996c; Manjuhin 1996). Some traces of iron making were revealed also by other Karelian archaeologists while excavating several sites with predominant assemblages of the Stone-Eneolithic Ages. On the whole, the set of problems has been shifting towards a more precise determination of the character and scale of iron production in the Iron Age - Early Middle Ages, a chronology of the furnace types and so on. These questions are open to discussion because there remain several possibilities for inadequate determinations. It is from this angle that the available data on iron making in Karelia during the periods and cultures in question should be analysed.

## GEOGRAPHIC DISTRIBUTION OF THE SITES AND IRON ORE DEPOSITS

At present (1999) 61 sites with iron slag are known in Karelia including 14 sites with the remains of 26 primitive furnaces. In addition, 21 of them contain iron, bronze and other datable artifacts of the Iron Age - Early Middle Ages; altogether there are 38 such sites in Karelia (Fig. 1). As a rule, they are multistrata sites, and therefore the combinations of different artifact categories and their geographic distribution should be analysed.

It is obvious that the clusters of sites with slag and furnaces concentrate in the areas where there are many assemblages of Iron Age – early medieval pottery or aceramic ones. They are located at the mouths of the rivers Shuja, Suna, and Muromka flowing into Lake Onega, the Vyg (White Sea), as well as similar places at Syamozero and Vodlozero. Iron slag and furnaces are common in the largest sites of these clusters: Kudoma X, XI (Syamozero), Ileksa IV, V (Vodlozero), Suna VI, Pichevo, Muromskoe VII (lake Onego), and some sites at the mouth of the Vyg (White Sea). The sites become more sparse and poor with metal artifacts and ceramics at the lakes and rivers in the inland areas, distanced from large bodies of water. Nonetheless, several individual furnaces are known from Orovguba (Lake Onega), Kurmoila I, Shapnavolok (Syamozero), Peldožskoe I (the river Shuya basin), Vyatchelskoe II (middle Suna), and Tunguda XII (Lake Tunguda, SW part of the White Sea basin). There are either different combinations of iron production and types of pottery on these sites, or a total lack of pottery and only some quartz artifacts as at Kjuperiainen (Lake Upper Kuito). The same geographic distribution is observed for iron slag often combined either with ceramics of the Neolithic - Eneolithic periods especially in NW Karelia, or with quartz artifacts only as at Kimasozero V, VI.

These very casual combinations led astray the archaeologists who took for granted the simultaneity of all finds from the poor sites. Of course, it should be taken into account that different areas and sites have been studied to different extent. However, we have to lay emphasis on the same general distribution of such poor combinations around all clusters of the Iron Age – early medieval sites in the whole territory of Karelia. After all, the slag and furnaces cannot be linked to the pottery of the Neolithic - Bronze Ages and are not necessarily associated with Iron Age pottery. It should be acknowledged that so far we could not determine in every case the precise age of iron production at many sites. In any case, we should never have to leave out of account the probability that there could have been a medieval aceramic assemblage, if we had iron slag without the pottery of the above-mentioned late periods in an excavation unit. At last, there could be the short-term workshops of the Iron Age without any remains of pottery, situated at locations with ease of access to deposits of lake ore.

One of the ways to establish the relative chronology of iron production, except for radiocarbon dating, is the development of a reliable historical typology of furnaces. But first of all, we have to give some infor-

mation on the local ore deposits. Karelia is considered to be the region richest in bog and lake iron ore within NW Russia. Inasmuch as sites with traces of iron production are usually located near the shoreline, especially of shallow, sometimes marshy bays of lakes, the prevalent usage of lake ore was most probable. This kind of ore has been found on the bottom of almost all lakes in Karelia. It contains 5-47% iron. The total quantity of prospected lake ore deposits in Karelia is about 7-8 million tons. The largest deposits were discovered at lakes Syamozero, Vodlozero, Segozero, Vygozero and some other lakes. Lake ore usually forms fields of varying area on the bottom of the lakes located mostly in 0.1-0.3 km-wide strips along the shoreline, at a depth of about 1-3 m and consisting of a 0.015-0.7 m-thick crust or of small roundish concretions (Geology of the USSR, v. 37,2:86-89). For example, at Lake Syamozero it forms more than 80 fields with an average thickness of crust of about 0.35 m. The total amount of ore has formerly been estimated at 5 million tonnes (Karnauhov 1922: 286-291), but later corrected to 780 thousand tonnes (Mironov 1935:87-101). This ore contains 47% iron. The lake ores of Karelia are considered to be easily fusible raw materials.

#### TRACES OF WOODEN FURNACES OF SINGLE USE

The traces of 4 very primitive furnaces of this kind were discovered in southeastern Karelia at the Ileksa V and Muromskoe VII sites of the Late Kargopol culture and the Pichevo site of the Luukonsaari culture of the Iron Age (Kosmenko 1992).

The remains of a bloomery at Ileksa V were preserved quite well (Fig. 2). It was a roundish feature of red, highly burnt sand (0.23 x 0.2 x 0.04 m) found a little above the level of clear sand. The feature was surrounded by a narrow band of black sooty soil and small flat stones. A large round slag piece of plano-convex cross-section lay in the centre of the red feature. On the flat upper surface of the slag were several short grooves made with a pointed tool. This was not a bloom of raw iron. A modern reconstruction of ancient iron making technique in a clay furnace showed that such "bottom" slag was formed on the bed of the furnace by easily fusible components, which trickled down during the process. A bloom of iron had formed in the middle part of the furnace and was taken out at the end of the process (Kolchin & Krug 1965:196-215). The spot adjoined a shallow oval pit (1.5 x 1.4 x 0.37 m) filled with dark-

grey charcoal-mixed sand and containing some sherds of Late Kargopol vessels, 2 flakes of flint and several small stones.

The traces of two similar objects were revealed in Pichevo. The first one appeared at the level of the untouched sandy layer as a round feature of red burnt sand (diameter 0.4 m, thickness 0.05 m), surrounded by charcoal-mixed sand and some small flat stones. A round "bottom" slag lay in its centre in situ. Also this feature adjoined a shallow oval pit (1.5 x 1.35 x 0.2 m) filled with charcoal-mixed sand, in which some potsherds of sand-tempered Luukonsaari ware and a piece slag were found. Near this object there had been a second one represented only by a round spot of black sooty sand (diameter 0.4 m); there was a piece of slag in its centre and several small stones surrounded the feature.

In Muromskoe VII a fireplace was excavated (diameter 1.0, thickness of the sooty lens 0.2 m). It was dated to 1420±60 BP (TA-1013). On its bottom some small stones, 3 fragments of clay crucibles for bronze smelting and a bottom slag with high percent of iron were

found. The fireplace adjoined a pit (2.5 x 2.0 x 0.45 m) with some sherds of Late Kargopol vessels and stone artifacts.

Features at the Olsky mys site at Lake Lacha in the Kargopol district (the upper course of the River Onega) bear much resemblance to the aforesaid furnaces (Ovsiannikov & Grigorjeva 1964:22). The remains of a furnace were revealed as a shallow round pit (diameter 0.35, depth 0.2 m) which had vitrified walls covered with a thin slag layer. Many pieces of slag were dispersed around the pit, and there was also an iron knife. Near this pit two similar pits with vitrified walls and slag were found.

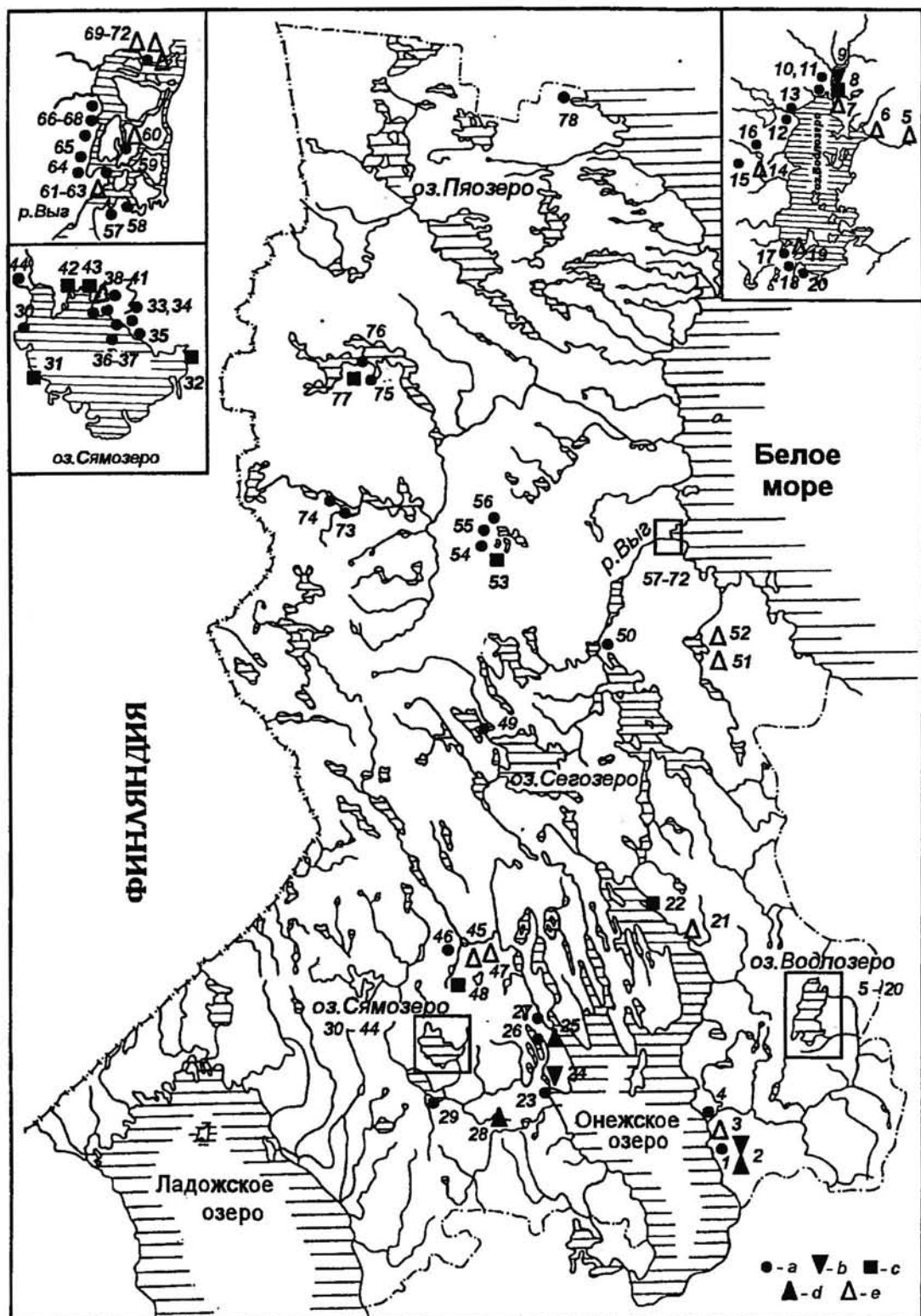
All the described objects can be identified as the remains of furnaces used only once where iron blooms were produced, if we take into consideration the bottom slag in situ in their centre and a relatively small number of slag piece around them. Their shape cannot be reconstructed precisely, but it is clear they were not built of clay or stones. In principle, we can not exclude that a "clamp" was used for their construction, in which

*Fig.1. Karelian sites of the Iron Age – early medieval hunting-fishing cultures with finds of iron slag, furnaces and iron, bronze, and glass artifacts.*

*a - sites with iron slag without furnaces; b - sites with slag and furnaces of the Iron Age; c - sites with furnaces in shape of boxes built of stone slabs; d - sites with furnaces of clay and stones; e - sites with iron, bronze and glass artifacts without slag and furnaces.*

*1 - Muromskoe III-IV.ABCDHN; 2 - Muromskoe VII-VIII.ACDFGHKM; 3 - Ust-Vodla II.ABDH; 4 - Ust-Vodla V.ABDGN; 5 - Vodla V.ABCDGH; 6 - Suhaya Vodla I.ABCDH; 7 - Ileksa III.ACDEGH; 8 - Ileksa IV.ACDGHM; 9 - Ileksa V.ACDEGHK; 10 - Shettima I.ACEN; 11 - Shettima II.ACEN; 12 - Kelka I.ABCDGHN; 13 - Kelka III.ABCDHN; 14 - Ohtoma I.ABCDGH; 15 - Ohtoma II.ABCHN; 16 - Ohtoma III.ABCDGHN; 17 - Poga I.ABDGHN; 18 - Somboma I.ABCDEHN; 19 - Malaya Poga I.BCDH; 20 - Kevasalma.ABCN. 21 - Chelmushi.DGH; 22 - Orovguba.AL; 23 - Tomitsa.BCN; 24 - Pichevo.CGHK; 25 - Suna II.AC?N; 26 - Suna VI.ABDGHM; 27 - Suna IX.N; 28 - Peldožskoe I.AM; 29 - Kamen-Navolok II.AN; 30 - Sargilahta.AN; 31 - Kurmoila I.AL; 32 - Shapnavolok.ABL; 33 - Malaya Suna I.ABCHN; 34 - Malaya Suna IX.ABCGHN; 35 - Malaya Suna XII.AN; 36 - Chuinavolok site.N; 37 - Chuinavolok I.ABCN; 38 - Lahta X.AN; 39 - Lahta I.ABCEG; 40 - Lahta II.ABCDEGHN; 41 - Lahta site.N; 42 - Kudoma X.ABCGHL; 43 - Kudoma XI.ABCEFGHL; 44 - Oskarvi III.N; 45 - Cheranga I.ABGH; 46 - Cheranga III.ACHN; 47 - Cheranga VI.AH; 48 - Vyatchelskoe II.BCL; 49 - Maslozero III.ACEN; 50 - Nadvoitsy.AN; 51 - Sumozero I.H; 52 - Sumozero XV.ABG; 53 - Tunguda XII.ABL; 54 - Tunguda XV.ABN; 55 - Tunguda XL.AN; 56 - Bohta II.ABCFGN; 57 - Erpin Pudas I.ACDHN; 58 - Erpin Pudas III.AN; 59 - Zalavruga I.AN; 60 - Zalavruga IV.ACH; 61 - Besovy Sledki III.ACH; 62 - Zolotets I.ACEN; 63 - Zolotets III.ACEN; 64 - Zolotets V.AN; 65 - Zolotets VI.AN; 66 - Zolotets X.ACGN; 67 - Zolotets XI.AN; 68 - Zolotets XV.ABCN; 69 - Gorelyi Most IV.BCH; 70 - Gorelyi Most V.BCH; 71 - Gorelyi Most VI.BCDGH; 72 - Gorelyi Most VIII.BCGHN; 73 - Kimasozero V.N; 74 - Kimasozero VI.N; 75 - Enonsu site.N; 76 - Elmenkoski.BCN; 77 - Kjuperiainen.L; 78 - Nilmozero IV.AN.*

*A - pottery of the Neolithic and Eneolithic Ages; B - "net" (textile) pottery of the Bronze Age; C - pottery of the Iron Age cultures; D - hand-made pottery of the Early Middle Ages; E - dated bronze artifacts of the Iron Age; F - dated iron artifacts of the Iron Age; G - dated bronze artifacts and glass beads of the Early Middle Ages; H - iron artifacts of the Iron and Early Middle Ages; K - traces of Iron Age furnaces; L - furnaces in the shape of stone boxes; M - furnaces of clay and stones of the Iron Age - Early Middle Ages; N - iron slag.*



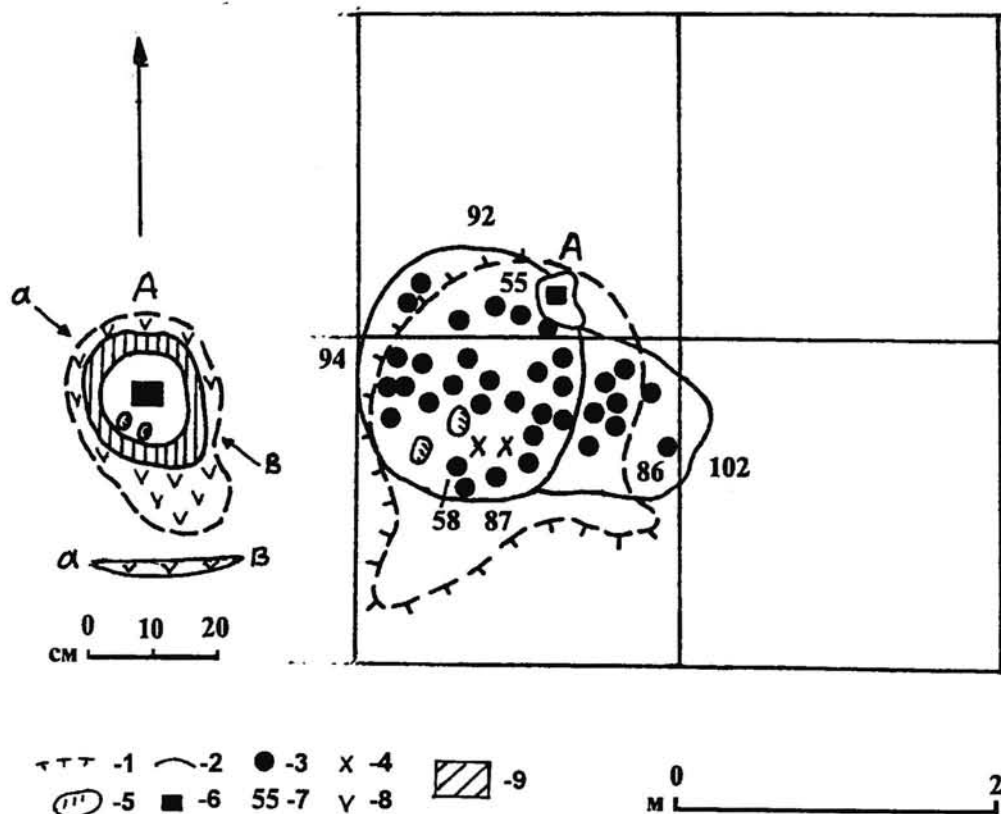


Fig. 2. Ileksa V, remains of the furnace.

1 - dark-grey sand; 2 - contours of pits; 3 - sherds of the Iron Age pottery; 4 - stone chips; 5 - stones; 6 - "bottom" slag; 7 - height above the level of the river; 8 - charcoal; 9 - red burnt sand.

the necessary components were put in a pit and covered with pieces of turf (A.P. Smirnov 1953:105). There was, however, no bottom slag in the pits and no clearly expressed features of such furnaces revealed in the above-mentioned sites. In our opinion (Kosmenko 1993:130-131), if we take into account the round shape and dimensions of the bottom parts of these objects, the bodies of the furnaces can be hypothetically reconstructed as the more or less short hollow parts of tree trunks up to 0.5 m in diameter. They were prepared in a way fit for the preservation of wooden walls during the process of iron bloom forming. A new wooden body was prepared for every process. Such furnaces could be used quite successfully, because the process took a relatively short time; and the minimum required temperature was low enough, 900-1050°C (Baikov 1948:370-371). In front of the furnaces working places were arranged where charcoal and ore were stored, and, probably, a bellows functioned to provide an artificial draught with-

in the furnace. We can also assume that such furnaces were used on some other sites of the Iron Age where some sparse pieces of bottom slag were scattered without any restricted areas of concentration. The remains of such furnaces could easily be demolished in the course of intense everyday activities or by subsequent groups of inhabitants.

We have no reliable information on such furnaces in other regions of the forest zone between the Urals and the Baltic Sea.

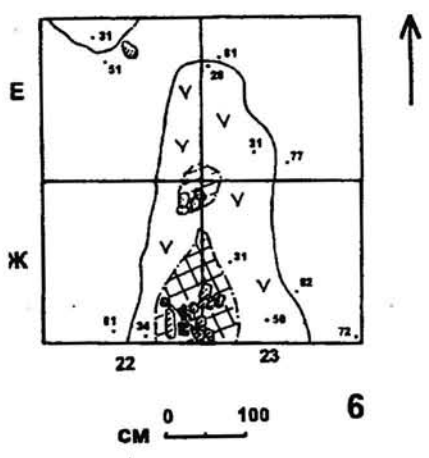
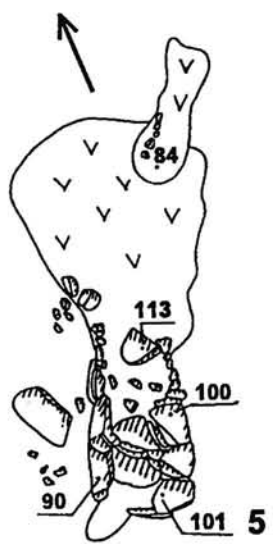
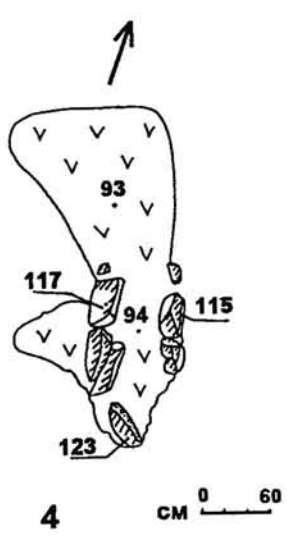
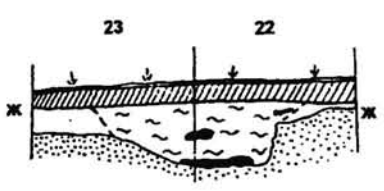
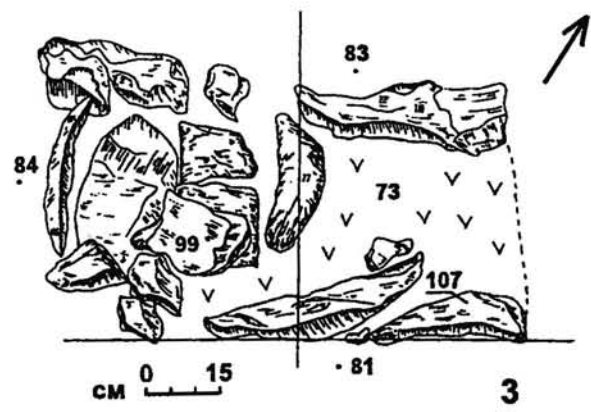
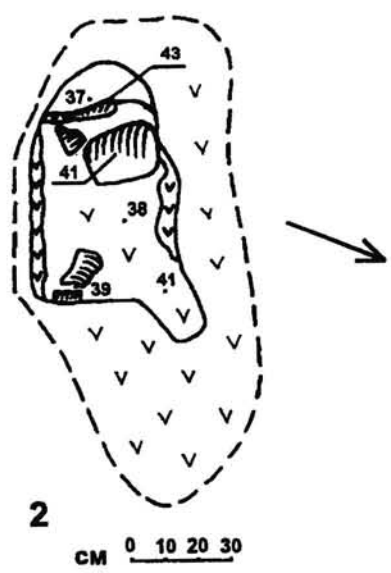
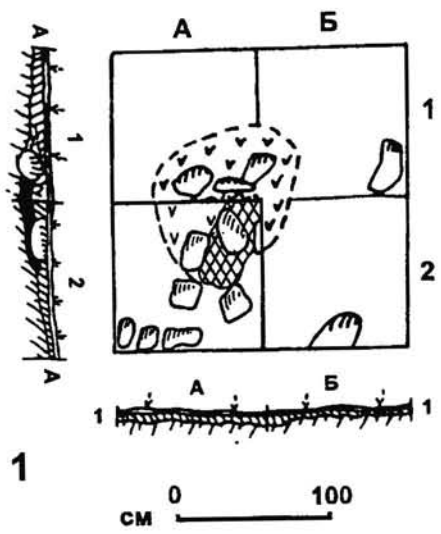
The most ancient evidence of iron making in ordinary textile ceramic vessels were acquired in the Umilnie site in the upper Volga region (Foss 1949:39) as well as from fortified settlements between the Rivers Volga and Oka (Folomeev 1975:168). They are dated to between 1000 - 500 BC. This technology did not spread to the north from the upper Volga region.

It should be noted that remains traces of pit furnaces with wooden frames were excavated in the Kama



*Fig. 3. The remains of stone furnaces from SW Karelia in the excavation pits.*

*1, 2 - Kudoma XI, furnace 5, side and back views; 3,4 - furnace 3, side and front views; 5 - furnace 7, side view; 6,7 - Vyatchelskoe II, furnace 2, side and front views.*



	-1		-5	73-9
	-2		-6	-10
	-3		-7	-11
	-4		-8	-12



river region and dated close to the end of the first millennium BC; such pit or ground furnaces were used in this region at least until the 10th century AD (Gening 1970:99-101). Large furnaces, whose wooden walls were protected with clay, were used in Siberia until the beginning of the 20th century (Baikov 1948:358-359). The remains of iron production in a pit furnace built of stones were revealed in the Neitilä 4 site in northern Finland dated to the 6 century BC and pertaining to a pottery assemblage of the last centuries BC; some slag were found also on two sites near Suomussalmi (Kehusmaa 1972:80-88). Several sites with assemblages of Luukonsaari ceramics in eastern Finland contained iron slag (Purhonen 1982:167). The beginning of local iron production in eastern Sweden is dated to 1000-800 BC; in the first millennium BC there were furnaces of stone and clay in smaller pits (Hjärthner-Holdar 1993:194-197).

The above-mentioned ground furnaces in Karelia have closer resemblance to the pit wooden furnaces of the Kama region than those of Scandinavia made of clay and stones. Perhaps they are of eastern origin in the long run. Nonetheless, they represent the simplest type of such furnaces, which was most suitable for the local populations and their mobile way of life, in contrast to permanent furnaces built by settled inhabitants on the fortified settlements in the Kama region. Certainly, this type of furnace pertained to the Iron Age cultures of eastern origin. The Late Kargopol pottery assemblages of the Ilekka V and Muromskoe VII sites belong to the late stage of this culture (0-700 AD); simultaneously there formed the Luukonsaari assemblage in Pichevo (Kosmenko 1993:133-134, 171; Manjuhin 1996:236-237). In general, this type of furnace can be dated to the period between 500 BC - 500 AD.

#### FURNACES IN THE SHAPE OF RECTANGULAR STONE BOXES OF PERMANENT USE

Ground furnaces made of flat stones as rectangular boxes represent another type. Their area is limited to western Karelia (Fig.1) and eastern Finland. Most of them in Karelia, 13 of 18, are concentrated on the multistrata sites around Syamozero. Seven furnaces of this

kind were excavated in Kudoma XI (Kosmenko 1980; 1992:85-89), four objects revealed in the neighbouring site Kudoma X (Anpilogov 1966; G.A. Pankrushev's excavations, 1968). These sites are located at the shoreline of a shallow marshy bay in the NE part of Lake Syamozero.

There was no visible order in the arrangement of furnaces in Kudoma XI within an area of about 1500 square metres. Moreover, two or three of them pertained to the Luukonsaari assemblage, and the others were connected with an early medieval potteryless assemblage.

Furnace 2 was mostly destroyed shortly after it was last used. It showed itself a little deeper than the level of clear soil as a rectangular spot of rusty sand mixed with charcoal and slag (0.6 x 0.4 m). Many pieces of slag also concentrated in the cultural layer within a charcoal-mixed location, surrounding the bloomery (1.5 x 0.7 m). There was a partly destroyed back wall made of stone plates which stuck out of the sandy soil and distinct traces of the side walls visible as narrow stripes of charcoal (Fig. 4:2). The bed of this furnace consisted of a flat stone with slag stuck to its upper surface. Under the bed some alternated layers (0.2 m) of flat slag and charcoal were revealed. These objects are evidence of repeated iron smelting. A sample of charcoal from the bottom layer was dated to 1590±60 BP (TA-1014). The exit of a rectangular workshop building (3.6 x 2.4 x 0.2 m) on the floor of which some Luukonsaari potsherds were dispersed adjoined the working place in front of the furnace. The completely destroyed furnace 2 was seen as a rectangular spot of black sand with slag (0.6 x 0.4 m), driven down to 0.1 m in the clear soil; on its bottom was a large flat piece of slag. Its front part also adjoined the remains of a workshop building (2.4 x 2.8 x 0.15 m) whose walls were rather heavily destroyed. Nevertheless, some sherds of Luukonsaari were found in its centre. Furnace 4, which was destroyed almost completely except for some part of a side wall near the front side, was possibly associated with the Luukonsaari assemblage. The precise dimension of its bottom could not be measured: only a spot of sooty black sand between the stones taken out of their pits was outlined (1.1 x 0.6 x 0.1 m). There were many pieces of slag in it. The front part of

Fig. 4. Contours of some furnaces from Karelia.

1 - Kjuperiainen; 2-5 - Kudoma XI, furnaces 1,7,3,5; 6 - Muromskoe VII.

1 - grey podzol sand; 2 - black sooty soil; 3 - dark-grey sand; 4 - sand of variegated colours; 5 - yellow sand; 6 - clayey sand with gravel; 7 - stones; 8 - charcoal; 9 - high above the level of lakes; 10 - contours of pits; 11 - spots of dark-grey sand; 12 - lenses of charcoal.

this location adjoined a long narrow pit filled with black sand, some pieces of slag and 2 sherds of Luukonsaari ware.

Other furnaces possibly pertained to the aceramic medieval assemblage. They had the same construction but no traces of any buildings in front of them, except for small working areas. Furnace 3 was in the shape of a rectangular box and consisted of 8 flat stones which formed its back and side walls (Fig. 3:3,4; 4:4). The front wall was destroyed. The side walls leaned on each other forming an incomplete arch. The inner chamber (0.5 x 0.25 x 0.2 m) was filled with sooty sand, slag and pieces of baked clay. In front of the furnace was an amorphous feature measuring c. 0.7 x 0.6 x 0.1 m and consisting of rusty soil mixed with charcoal and slag. The well preserved furnace 5 also had no front wall and looked like a rectangular box 0.7 x 0.45 m on the outside and 0.5 x 0.3 x 0.2 m in its inner chamber, which was filled with charcoal and slag (Fig. 3:1,2; 4:5). Two flat stone plates served as its bed. The inner surface of the stones in the chamber was covered with a thin layer of slag. The side walls also formed an incomplete arch: the gap between the tops of the stones was filled with baked clay and small stone fragments. A large number of slag pieces were dispersed around this furnace within an area 8-10 m in diameter; they mostly concentrated in the small working area in front of the furnace (1.1 x 0.8 m). A charcoal sample taken from the bottom of the furnace was dated 800±80 BP (TA-965). The partly destroyed furnace 6 at first showed itself as a shapeless heap of flat burnt stones surrounded with mixed charcoal and rusty sand. A rectangular feature of charcoal and slag (1.2 x 0.5 m) was identified under the stones as the general shape of this furnace and its working place (0.45 x 0.4 m). The rectangular chamber was placed 0.1 m deep in clean soil and measured 0.75 x 0.5 m. It was partly restricted, with several stones of the back and one of the side walls. The level of its bed after the last smelting has not been determined precisely. Furnace 7 (Fig. 3:5; 4:3) measured 1.0 x 0.5-0.6 m on the outside and was enclosed by an area of slag concentration about 10 m in diameter. It looked like a rectangular stone box with vertical walls of several flat stones, in contrast to the bent side walls of furnaces 3 and 5. The front wall and top had been removed. The chamber (0.55 x 0.4 x 0.25 m) had a bed of two flat stones and was filled with charcoal, slag and baked clay in its upper part. The inner surface of stones in the chamber was covered with a slag layer; a large flat piece of slag stuck to the stone of the bed near the back wall. In front of this furnace was a working place with coal

and slag (1.1 x 0.8 m). A coal sample from the bed was dated 1165±60 BP (TA-1259). Besides, an oval fireplace (0.9 x 0.5 m), made of stones, should be mentioned: it is dated 880±100 BP (TA-964).

The furnaces at Kudoma X were also distributed without any order within an area of about 600 square metres. Furnace 1 had been built in the middle of a pit dwelling of the Eneolithic period. It consisted of 3 flat stones which formed the back and two side walls bent over the chamber; the front stone had been removed. Its chamber (0.5 x 0.3 x 0.3 m) was filled with mixed charcoal, baked clay and slag, which were also dispersed around the furnace. Furnace 2 was placed outside the pit house and built of 3 flat stones: the side walls leaned against each other over the chamber (0.6 x 0.3 x 0.3 m). The final smelting does not appear to have been finished, according to A. V. Anpilogov (1966), for the chamber was filled with a great deal of charcoal and vitrified iron ore. Furnace 3, like the ones described above had the back and two side walls, which consisted of 4 flat stones: their tops were visible on the turf surface. The side walls leaned to each other over the chamber (0.35 x 0.3 x 0.2 m), which was filled with mixed charcoal, baked clay and vitrified pieces of ore. According to field record of G. A. Pankrushev, furnace had been built in a rectangular pit (1.1 x 0.9 x 0.3 m). It had vertical back and side walls placed on the flat stone bed. The chamber contained so much charcoal mixed with vitrified ore that G. A. Pankrushev believed the final smelting had not been completed just as in other furnaces at Kudoma X. All these furnaces most likely pertained to the aceramic medieval assemblage represented by some iron artifacts. There were relatively few potsherds of the Luukonsaari type and no traces of workshop buildings.

A furnace in the usual shape of a rectangular stone box (0.55 x 0.3 m) was excavated in the Shapnavolok site at the SE shore of Syamozero (Gurina 1961:267). The chamber of the furnace was filled with red burnt sand. A number of pieces of slag and pieces of baked clay were dispersed around the furnace. This object cannot be dated any precisely, because there were no finds of any ceramics of the Iron Age, nor any artifacts of the potteryless medieval culture but the potsherds of the Neolithic and Bronze Ages. Most likely, there was a workshop of the medieval potteryless culture: its artifacts would quite rarely be discarded in the workshop area.

Traces of a similar but completely demolished feature were excavated by N. N. Gurina (1961:237-241, fig. 62) on the Kurmoila 1 multistrata site at the SW shore

of Lake Syamozero. A large pit of irregular oval shape (2.85 x 1.8 m) was filled with dark-coloured sand and deepened to 1.0 m under the turf layer. In its centre some burnt vitrified stones, slag and pieces of baked clay were concentrated. This layer partly overlapped the red layer of the Neolithic-Eneolithic periods. N.N. Gurina identified this object as a pit house, despite the fact that it had no well-expressed features of a house. In our opinion these could be the remains of a short-term workshop place with a stone furnace in its centre, if we take into account the dispersed stones, pieces of slag and baked clay. There were no pottery types of the periods later than the Eneolithic, so, in this case, we are perhaps dealing either with a short-term workshop of the Iron Age, or, most likely, with the traces of the medieval potteryless culture. The shape of the furnace cannot be reconstructed with any greater precision.

Northwards of Lake Syamozero the remains of two destroyed furnaces were excavated at Vyatchelskoe II (Kosmenko 1992:101). Furnace 1 was demolished almost completely except for a vertical flat stone of a side wall. The stone partly limited a rectangular feature of charcoal (0.8 x 0.5 m), found 0.1 m deep in clean sand and contained a series of pieces of flat slag: this was the bottom of the furnace. The partly destroyed furnace 2, situated near the previous one, consisted of one back and two side stones in the vertical position (Fig. 3:6,7). Two flat stone plates formed its bed at the level of undisturbed sand. Its chamber (0.5 x 0.3 m) was covered with a slag layer and contained several large pieces of slag which also concentrated in a large number around both furnaces. These furnaces have not been dated precisely. Perhaps, they pertained to the aceramic culture, judging by the total lack of pottery around the furnaces and their position almost on the surface of the ground. We can not exclude, however, their possible affiliation to the Luukonsaari assemblage found in the middle part of Vyatchelskoe II.

A partly destroyed stone furnace (0.3 m wide, 0.3 m high) was found on a high sandy terrace of Orovguba Bay on the N shore of Lake Onega (Gurina 1951:132-134). It was built of four vertically installed flat stones; the fifth one served as the bed placed at the depth of 0.1 m in clean sand. A large "bottom" piece of slag was found on the stone bed of its chamber, filled with sooty sand and baked clay. Pieces of slag, vitrified pieces of ore and baked clay were dispersed around the furnace; there were also some potsherds of the Eneolithic "classic" type. N.N. Gurina took for granted the simultaneity of the ceramics and the furnace. There were however no reasons for such a view except for

their similar position in the cultural layer. This may not be the decisive factor; we have spoken already about the modern dating of this pottery to the Eneolithic period. Near this furnace is the Orovnavolok XVI site is situated with pit houses and this type of pottery dated to the late third and the second millennium BC (Kosmenko 1992:69-74). It was, perhaps, a workshop most likely of the aceramic population of the Early Middle Ages, because there are no sites at all with pottery of the Iron Age at Orovguba Bay.

P.E. Pesonen excavated a well-preserved stone furnace at the Tunguda XII multistrata site in the SW of the White Sea basin. According to her field record, the furnace looked like a rectangular box of several flat stones in vertical position (outer dimension 0.8 x 0.6 m), at a depth of 0.15 m in clean sand. In front of the furnace was a flat stone which, perhaps, had been its lid. The chamber (0.3 x 0.4 x 0.3 m) was filled with alternating layers of slag, charcoal and baked clay, which were also dispersed around the furnace. A thin layer of large-grained lake sand served as its bed. A sample of coal from the chamber was dated back to 2200±70 BP (TA-2139). There was almost no pottery of the Neolithic-Bronze Ages at the edge of the site, where the furnace was located. The appurtenance of the furnace was not determined precisely. In view of radiocarbon dating, the site could perhaps have had a short-term workshop of the Iron Age.

So far M.G. Kosmenko excavated the northernmost stone furnace in Karelia in 1986-87 on the low shore of a strait between the lakes Upper and Middle Kuito near the Kjuperiainen rapids. It was demolished for the most part except for the back and one side wall limited by some vitrified stones (Fig. 4:1). The chamber (0.5 x 0.3 m) was filled with slag and charcoal. The bottom was depressed to a depth 0.15 m into clean soil and had no special attributes. The front of the furnace adjoined a spot of sooty sand with slag, small pieces of baked clay and 2 quartz flakes. Some pieces of were dispersed around the furnace. No pottery was found on the site. This was either a workshop site of the Iron Age, or that of the aceramic local population.

Summing up all the data on stone furnaces of this type in Karelia, we should stress their more or less permanent, at least repeated, use which can be estimated as progress in comparison with the above-mentioned wooden furnaces. Their chambers had the average capacity of no less than 0.03-0.05 cubic m. There were two kinds of furnaces of this type: 1. In the form of a rectangular box with a lid, 2. With side walls of the almost conical shape bent towards each other. Raw

materials were loaded into it and the product was taken out of the front by removing the wall. In front of the furnaces there were either small workshop buildings, or open working places where raw materials were stored and bellows functioned to keep draught in the furnaces.

The type in question is representative of western Karelia and eastern Finland, at least, to the latitude of the NE part of the Gulf of Bothnia and NW of the White Sea catchments in the north. Its area includes also the western part of the Lake Onega basin and some SE districts of Finland. In NE Finland a similar furnace was found at the Äkälänniemi site near Kajaani and dated by radiocarbon to the third century BC (Schulz 1986:169-173). Two furnaces of this kind, dated to the time around the birth of Christ, were found on the Sierijärvi Kotijänkä and Riitakangas sites near Rovaniemi (Saarnisto et al. 1996:104-111, 410). In SE Finland a stone furnace was excavated on the Ristiina Kitulasuo site near Mikkeli dated by radiocarbon to about the middle of the second millennium AD (Lavento 1996:64-72). Besides, some scarce and vague information exists about a heap of burnt stones on the Mys Semerka site in the Kola peninsula near which a slag was found; N.N. Gurina (1997:75,97) defined it literally as "a stone stove for iron smelting" which is problematic.

Thus, according to some radiocarbon dating those furnaces were used for a long period of time: at least, from the third century of the first millennium BC almost to 1500 AD. Their chronology, range and association are certainly to be corrected and determined more exactly. The origin of stone furnaces in eastern Fennoscandia is not quite clear, because their prototypes are not present in other regions of the vast area between the Ural mountains and the Baltic, Barents and Nordic Seas. It is unlikely that they were the kind of stone pit furnaces of the "rosette" form, which were in use the Roman Iron Age in middle Norway (Stenvik 1987:99-119). To all appearances, the ground furnaces of flat stones in eastern Fennoscandia were an innovation of local origin in the hybrid of western cultures with the Ananyino culture elements, as represented by ceramics of the Luukonsaari type and its northern branches. We can define this phenomenon as the result of environmental adaptation. The eastern origin of iron production in northern Finland has already been posited (Huurre 1987:32; Mäki vuoti 1987:61-62). The stone furnaces in the shape of rectangular boxes continued to be used also by the populations of the Early Middle Ages that made no pottery, at least, in SW Karelia and

SE Finland. To all appearances, they belonged to ancient southern Saami.

#### GROUND AND PIT FURNACES OF CLAY AND STONES IN SOUTHERN KARELIA

The remains of two different furnace types were excavated by M.G. Kosmenko in SE Karelia in the Suna VI and Muromskoe VII sites at Lake Onega, by V.F. Filatova in Ilekka IV at Vodlozero and by A.M. Spiridonov in Peldožskoe I in the River Shuya basin. The sites contained pottery assemblages, dated to the 10-11 centuries AD and resembling those of the Ladoga burial mounds, except Peldožskoe I that contained neither materials of the Iron Age, nor a medieval assemblage.

The Peldožskoe I site was found on a little island in the middle of Lake Peldožskoe at the watershed between the basins of lakes Onega and Ladoga. A destroyed pit furnace was revealed in a shallow pit of pear-like contours (1.15 x 0.35-0.6 m) deepened in clean soil to a depth of 0.1-0.35 m. in undisturbed soil. It was placed in the widest and deepest part of the pit, where an amorphous feature of scattered stones, large pieces of vitrified clay and slag was observed. The layer of charcoal and slag was on its bottom. This pit furnace was definitely made of stones and clay. The dimensions of its bed were no larger than 0.7 x 0.6 m. The shape of this object was not been reconstructed precisely. Nor can we exclude the possibility that there was a furnace in the shape of a stone box. Some pieces of slag were scattered around the pit. In front of the furnace was a small pile of stones like a fireplace. A charcoal sample from the furnace was dated to 1750±100 BP (TA-2272). In the excavation pits there were only three pottery types of the Neolithic-Enolithic periods. Most likely, a workshop of the Iron Age was on the island.

Remains of a destroyed furnace in Muromskoe VII (Kosmenko 1982:84-85; 1992:65,68) were revealed in an oblong pit (3.4 x 2.2 m). At its deepest, extending to 1.0 m, and widest part there was a shapeless pile of burnt stones (0.7 x 0.6 m) arranged without any order (Fig. 4:6). The heap was encircled by an area of black sooty soil (1.4 x 1.0 x 0.08 m) and it contained some potsherds of the Ladoga type. The dimensions and shape of the bottom of this furnace have not been identified but they were not larger than the heap of stones. The furnace functioned over a short period of time. Under the stones two large pieces of slag, a bronze decoration in the shape of a long spiral spring and a glass bead with eye-like red spots were found. They

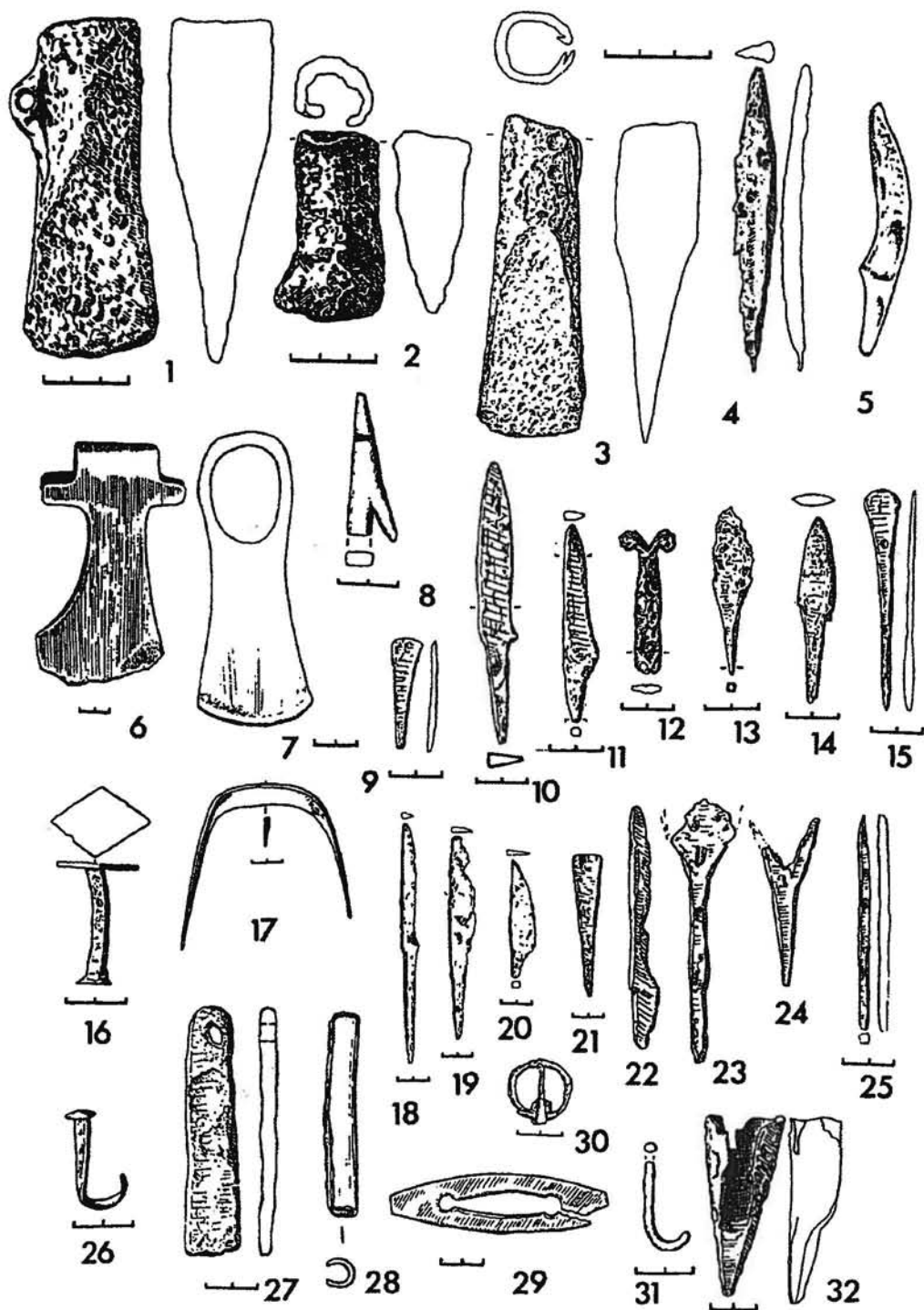


Fig. 5. Iron artifacts of the Iron Age - Early Middle Ages from Karelia.

1-5 - artifacts of the Iron Age. 1,2,5 - Kudoma XI; 3 - Bohta II; 4 - Muromskoe VII;

6-32 - artifacts of the Early Middle Ages. Potteryless assemblages: 6 - Sumozero I; 17 - Cheranga I; 18-20, 23,24,32 - Kudoma XI; 31 - Ohtoma II; 22 - Ileksa V; 29 - Pichevo; 30 - Kudoma X. Assemblages with the pottery of Ladoga type: 7,11 - Somboma I; 8,14 - Poga I; 9,15,16,25,26,31 - Muromskoe VII; 10,27 - Ohtoma III; 12,13,28 - Suna VI.

were dated the 10-11 centuries AD. Several pieces of slag were found near the pit. Traces of a demolished furnace in Ilekxa IV were found immediately under the turf in a pit (1.2 x 0.8 m). The pit was filled with sooty sand in which many pieces slag, baked clay, pieces of iron blooms and several pieces of sand stones were found. It was a pit furnace of clay and stones whose dimensions and shape could not be measured. In the pit about 10 pieces of iron blooms, more than 150 pieces of slag and 200 pieces of baked clay were found. This object belonged to the medieval pottery assemblage of the Ladoga type.

Remains of a furnace in Suna VI (Kosmenko 1978:150; 1992:76) presented themselves as a pile of slag, pieces of baked or vitrified clay, which concentrated in a spot of charcoal (0.9 x 0.4-0.5 x 0.07 m). The spot was revealed on the bottom of the medieval cultural layer and was encircled with a shapeless area of sooty soil, which grew thinner closer to its margin. Slag and baked clay were also dispersed around the furnace. The shape of the furnace bottom could not be outlined precisely, but it was nonetheless not larger than the dimensions of the above-mentioned feature. Undoubtedly, there was a ground furnace of clay built without the use of stones. Near the furnace, in the layer of sooty soil, large potsherds of the Ladoga type, an iron knife, a bronze tool with steel blade for striking fire and a bronze decorated plate were found. This assemblage has been dated to the 10th-11th centuries AD.

The distinction between the stone boxes in W and NW Karelia and the clay or pit furnaces in the SE districts is quite obvious. It is too difficult to compare the latter two types with other objects of the kind in the forest zone of European Russia and Fennoscandia, because our furnaces were mostly demolished. We have actually none of their specific and easily comparable features of resemblance or difference at our disposal.

It has been suggested with reference to a survey by B.A. Kolchin (1953) that except for their small size these types of medieval furnaces in Karelia bore some resemblance to certain features at several east-European sites of the Old-Russian period (Kochkurkina & Spiridonov 1988:131). Indeed, both kinds of medieval furnaces in question have been found at Old-Russian fortified settlements. Nevertheless, this resemblance is too general a character because of scarce data. The areas and chronology of our objects are therefore not clear therefore, and it is reasonable to consider them against the background of a broader cultural context.

Ground furnaces of clay that are not large appeared in fortified settlements in the Kama region at the beginning of the first millennium AD (Gening 1970:101).

They were possibly used also at similar settlements of the Dyakovskaya and Gorodetskaya cultures in the middle and upper Volga and Oka regions. Several features of slag concentration have been discovered, although with no contours of furnaces, for example, at the Bereznyaki (Tretyakov 1941:57), Scherbinskoe (K.A. Smirnov 1974:63), Paigusovskoe (Arhipov 1962:214) and other (A.P. Smirnov & Trubnikova 1965:18) fortified settlements. The remains of clay furnaces could have been easily demolished by intense everyday activities. In Finland, a location of slag and baked clay concentration has also been found at the Retulansaari site in Tyrv nt  (Hirviluoto 1977).

Pit furnaces built of stones and clay are not typical of the cultures in the forest zone to the north of the Volga. We can mention two large pit furnaces on the Sokolskoe II - multistrata site in the Kostroma region; one of them was excavated (Gurina 1963:182-187). In Gurina's opinion (ibid.195), the furnace dated from a later time than the latest assemblage of "net" (textile) pottery at this site. A number of clay nozzles used to blow air into the furnace and stone sledges, being most probably the attributes of a workshop, were found there. It can be dated, perhaps, to the medieval period, for such nozzles are typical of old-Russian settlements (Kolchin 1953:29). Stone pit furnaces are to a considerable extent representative of western and, partly, northern Fennoscandia in the first millennium BC - 1500 AD. They have been discovered on Karelian Isthmus (Lepp aho 1949:44-50), in northern Finland (M kivuoti 1987:64-68), in Sweden (Hj rthner-Holdar 1993:194-197) and in Norway (Martens 1982:29-44). Thus, the origin of clay furnaces in SE Karelia is very likely to be connected with the non-specialized cultures of more southern regions of the European Russia forest zone. Owing to the lack of specific data, the problem of the roots of local pit furnaces is open at present: we should take into consideration the possibility of their western, possibly Baltic, origin.

## CONCLUSION

To complete this survey, it is reasonable to examine an acute but vague problem of the proportion between local and imported iron artifacts on the sites of the periods in issue. This problem is also topical for other regions of the forest zone in European Russia. Despite the large number of sites with such artifacts in Karelia, including workshops, there were neither traces of smithies, nor many iron items or blacksmith's tools. Few iron

knives and celts have been dated to the Iron Age (Fig. 5:1-5), although we cannot rule out the belonging of some other knives or awls to this period at the multistrata sites. In the early medieval assemblages the total number and assortment of iron artifacts increased considerably: axes, adzes, arrowheads, tools for striking fire, scrapers, etc. (Fig. 5:6-32) but no implements of the blacksmith appeared.

The situation in the first millennium BC in the more eastern regions of the forest zone, particularly in the Komi Republic, was different. In this region quite a large number of iron artifacts, knives for the most part, datable to between the Ananyino period and the Early Middle Ages, have been found. However, no traces of local iron making have actually been revealed (Ashikhmina & Vaskul 1997:331; Vaskul 1997:383; Korolev et al. 1997:440). An opinion has formed that local inhabitants had too scarce a basis for ferrous metallurgy; they compensated the shortage of iron artifacts by importing them from the Kama and other regions (Korolev et al. 1997:440). In the southern part of the forest zone, in the fortified settlements of the early Ananyino and other cultures of the first millennium BC in the Kama, middle and upper Volga regions some pieces of slag but no furnaces have been found (Zbrueva 1952; Halikov 1977; K.A. Smirnov 1974). Early Ananyino cemeteries contained a large number of imported iron artifacts, mostly weapons, except also for blacksmith's tools (Halikov 1977:108-222). Local blacksmithing took its clearly expressed shape in the Volga-Kama regions approximately about 500 AD (A.P. Smirnov 1952:105; Gening 1970:177; K.A. Smirnov 1974:41).

In the coastal agriculture of SW Finland various iron artifacts have been found; a different situation formed in the aceramic culture of the Finnish inland and some regions of Scandinavia where, presumably, imported goods were prevalent (Carpelan 1979:146-148).

Against this background the main directions of trade and other relations of the hunting-fishing cultures in question in Karelia we can determine as follows. Local cultures of the Iron Age were predominantly linked to the cultures of the Ananyinski - Pyanoborski - Harinski periods in the Kama region approximately between 500 BC - 600-700 AD. Bronze decorations mostly were imported from this region. However, around the birth of Christ iron celts of eastern Baltic types appeared (Kosmenko 1993:139-140, 172-174). In the last centuries of the first millennium AD a considerable alteration of the main relations took place. Local populations reoriented their relations mainly toward

the western areas of the Baltic-Volga trade route (Kochkurkina & Spiridonov 1988:135; Kosmenko 1996c: 280, 285). These relations for the most part stipulated the composition of the preserved remains of their material culture. Individual hoards of Arabic and West European coins, dated to the 10-11 centuries AD, have been found in Karelia (Spiridonov 1995). No doubt, furs were the predominant type of local goods.

The early medieval inhabitants of Karelia imported many bronze decorations and pots, glass bead necklaces, perhaps, some kinds of iron artifacts: axes, adzes, steel knives, tools for striking fire, etc. As a rule weapons were not present. Nonetheless, several kinds of iron artifacts for hunting and everyday use were, to all appearances, made in Karelia: knives, awls, arrowheads, especially with transverse blades for hunting furry animals, and other small implements. They were standardized in form or size: this is indirect evidence of the relatively poor state of the craft, for the local population specialized in fur hunting.

Meanwhile, there is a disparity between the relatively well developed iron production and its processing and usage in Karelia. It could not be excepted that the blooms of raw iron were an item exported to other regions of the forest zone: mainly to the East in the Iron Age and to the South in the Early Middle Ages. Only indirect evidence for this hypothesis is so far available; the issue needs further in-depth study using special metal analyses. In any case, this problem needs to be investigated in future studies.

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#### ABBREVIATIONS

- IGAIMK - Izvestija Gosudarstvennoj akademii istorii material'noj kul'tury. Moskva - Leningrad.
- KSIA - Kratkije soobščeniya Instituta arheologii. Moskva - Leningrad.
- KSIIMK - Kratkije soobščeniya Instituta istorii material'noj kul'tury. Moskva - Leningrad.
- MIA - Materialy i issledovanija po arheologii SSSR. Moskva - Leningrad.
- NAR - Norwegian Archaeological Review. Oslo.
- SA - Sovetskaja arheologija. Moskva - Leningrad.
- SAI - Svod arheologičeskij istočnikov. Moskva - Leningrad.
- SM - Suomen Museo. Helsinki.
- SMYA - Suomen Muinaismuistoyhdistyksen Aikakauskirja. Helsinki.
- TGIM - Trudy Gosydartvennogo Istoričeskogo muzeja Moskva.
- TMAE - Trudy Marijskoj arheologičeskij ekspedicii. Joškar-Ola.
- VAU - Voprosy arheologii Urala. Iževsk - Perm'.