Acta Archaeologica vol. 78:2, 2007, pp 143-162
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ACTA ARCHAEOLOGICA
ISSN 0065-001X

THE MESOLITHIC SETTLEMENT IN NE SAVO, FINLAND

AND THE EARLIEST SETTLEMENT IN THE EASTERN BALTIC SEA

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1. INTRODUCTION

Archaeologists in Finland have been searching for Early Mesolithic sites with the help of shore displacement chronologies since the end of the 1990s. Surveys for sites have focussed on the shores of the Ancylus Lake Stage of the Baltic Sea basin (9000–7200 cal BC; calibrated dates based on Eronen 1990, 16; Miettinen 2002, 14) after Heikki Matiskainen showed their existence in Finland in 1996 and after Hans-Peter Schulz (1996) noted that several previously known sites in the Lake District of Southern Finland could be dated to the Early Mesolithic on the basis of their find material and shore displacement age. Already before this, Torsten Edgren (1992, 30-31) had observed that the Lahti Ristola site in Southern Finland (fig. 1:1) could be dated to the Early Mesolithic Stone Age. Several new sites discovered in the Lake District of Southern Finland by surveys carried out in the 1990s were found to date to the Ancylus Lake Stage (Jussila 2000b, 13).

The intensive search for shore-related Early Mesolithic Stone Age dwelling sites requires accurate shore displacement chronologies that cover the area under investigation. Such chronologies have been constructed for the great lakes of southern Finland (Saarnisto 1970, 1971; Miettinen 1996; Jussila 1999; Tikkanen & Seppä 2001). From these, it is possible to calculate and project hypothetical shore displacement chronologies based on crust tilting caused by uneven land uplift to smaller lakes and areas outside the areas of the original chronologies (Jussila 2000b). For this purpose a computer program has been written to simulate shoreline displacement. With this program it is possible to formulate hypothetical shore displacement chronologies for watersheds and lakes for which chronologies made by quaternary geological methods are not available (Jussila 2004). The plotting of the Ancylus Lake shores in survey areas has become a routine task to the writers of this article. In the beginning of the 21st century, more general attention has been paid to shore levels of the Ancylus Lake during surveys, and new sites dating to the Early Mesolithic have been discovered yearly in Finland.

The first systematic archaeological survey of the shorelines of the ancient Ancylus Lake was carried out in 1999 in the boroughs of Imatra and Joutseno in southeastern Finland, near the Russian border. According to the shore displacement chronology constructed for the Karelian Isthmus (projected onto the survey area by Timo Jussila on the basis of Saarnisto & Grönlund 1996), this area has been at the head of a long and narrow bay of the Ancylus Lake. 16 dwelling sites formerly located on the shores of the Ancylus Lake were discovered during the survey. Small-scale excavations were carried out at three of these in the summer of 2000 by the writers of this article. The Saarenoja dwelling site in Joutseno (fig. 1:2) was considered to be one of the oldest in the area, and this was confirmed by a 14C-date on burnt bone found in the excavation and analysed in 2003. The median value of the calibrated date was 8600 cal BC[1] (Hela-728: 9310 ± 75 BP – Jussila 2000a; Jussila & Matiskai-

1 Here and below the calibration of ^{14}C-dates is based on atmospheric data from Reimer et al (2004); OxCal v3.10 Bronk Ramsey (2005); cub r:5 sd:12 prob usp[chron].

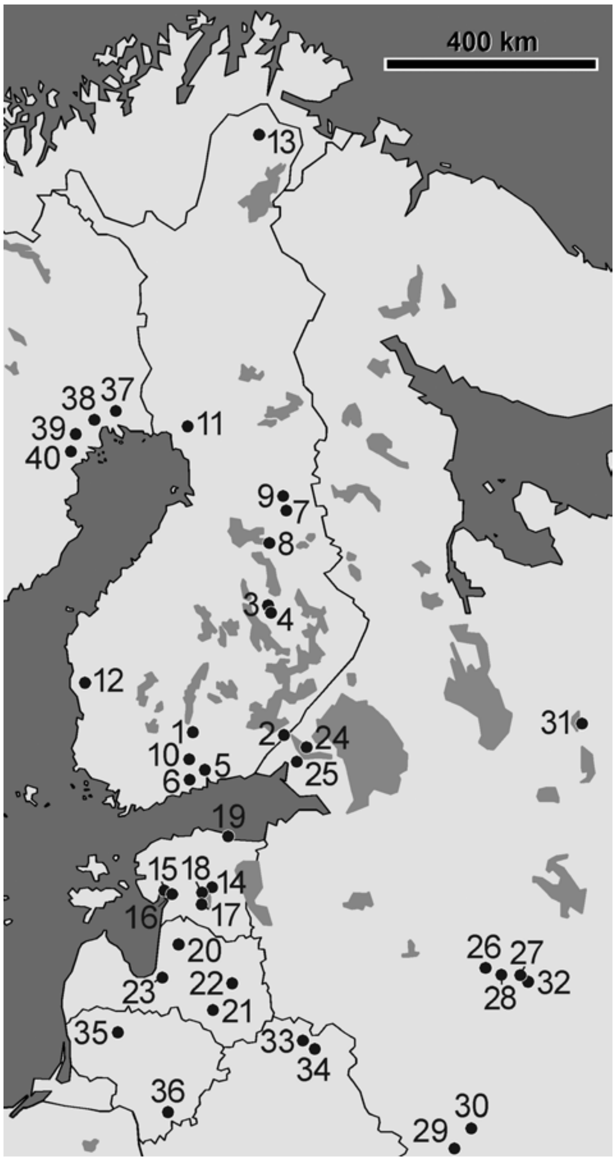

Fig. 1. Stone Age sites mentioned in text. Finland: 1. Ristola in Lahti, 2. Saarenoja in Joutseno, 3. Helvetinhaudanpuro in Juankoski, 4. Likolampi in Tuusniemi, 5. Hopeapelto in Askola, 6. Pisinmäki in Kerava, 7.Koppeloniemi in Hyrynsalmi, 8. Äkäläniemi in Kajaani, 9. Salonsaari in Suomussalmi, 10. Pukinkallio in Mäntsälä, 11. Kauvonkangas in Tervola, 12. Råvåsen in Kristiinakaupunki. 13. Sujala in Utsjoki. Estonia: 14. Kivisaare, 15. Lemmetsa I and II, 16. Pulli, 17. Sõõrikunurme, 18. Oiu I, 19. Kunda Lammasmägi. Latvia: 20. Zvejnieki II, 21. Jersika, 22. Sūlagaļs, 23. Laukskola in Salaspils. Russia: 24. Korpilahti in Antrea, and Ozero Borovskoe (Suuri Kelpojärvi in Antrea), 25. Veshevo 2 (Tarhojenranta in Heinjoki), 26. Butovo, 27. Prislon, 28. Ozerski 5, 29. Krasnoi 3 and 8, 30. Resseta 2, 31. Veretye 1, 32. Okaemovo 4. Belorussia: 33. Krumpliovo and Zamoshye, 34. Plusy. Lithuania: 35. Dreniai and Biržulis, 36 Margionys. Sweden: 37. Lillberget, 38. Alträsket, 39. Bjurselet, 40. Lundfors A-G.

nen 2003; Takala 2004, 150). During a small-scale survey on the Karelian Isthmus in 2000 and 2001, the writers of this article found ten new sites dating to the Early Mesolithic on the basis of shore displacement chronology. This survey concentrated on the shorelines of the Ancylus Lake near the site Korpilahti in Antrea (fig. 1:24), where an ancient net dated to the Early Mesolithic had been discovered in the beginning of the 20th century (Pälsi 1920, 14; Luho 1967, 31; Carpelan 1999, table IX). The Ozero Borovskoe site (Suuri Kelpojärvi, Antrea in Finnish sources, fig. 1:24), discovered by the authors in 2000, produced a 14C-date of 8500cal BC (Hela-931: 9275 ± 120BP) on burnt bone. More sites probably dating to the Early Mesolithic were subsequently discovered in the same area in connection with research projects carried out by the Historical Museum of the City of Lahti (Takala 2004, 152, 154).

By the end of the year 2000, 18 dwelling sites in the Great Lakes District of southern Finland were presumed to predate 8000 cal BC and 23 sites were thought to be older than 7200 cal BC, assuming that these sites were originally located on the shores of the Ancylus Lake (Jussila 2000b). Sites are dated according to different shore displacement chronologies. In 2003 Jussila found a dwelling site atop an ancient Ancylus Lake cliff in Juankoski, East Central Finland. The following year, the writers of this article decided to shift the focus of their investigations concerning the Early Mesolithic from southern Karelia in SE-Finland to the northern part of Savo, Central Eastern Finland. Fieldwork began in the summer of 2004, when excavations were carried out at two Stone Age dwelling sites: Helvetinhaudanpuro in the village of Akonpohja, Juankoski and Likolampi in the village of Tuusjärvi, Tuusniemi (fig. 1:3 and 4). The first aim of these excavations was to find pieces of burnt bone that could be 14C-dated. In the summers of 2005 and 2006 investigations were continued on a larger scale at the Helvetinhaudanpuro site.

In this article we analyse the material of the Helvetinhaudanpuro and Likolampi sites from the 2004-2005 excavations, and compare it with other materials from Finland, the Karelian Isthmus, Northwestern Russia, and the Eastern Baltic area. Our aim is to interpret this material especially from the point of view of the Early Mesolithic settlements in the east-

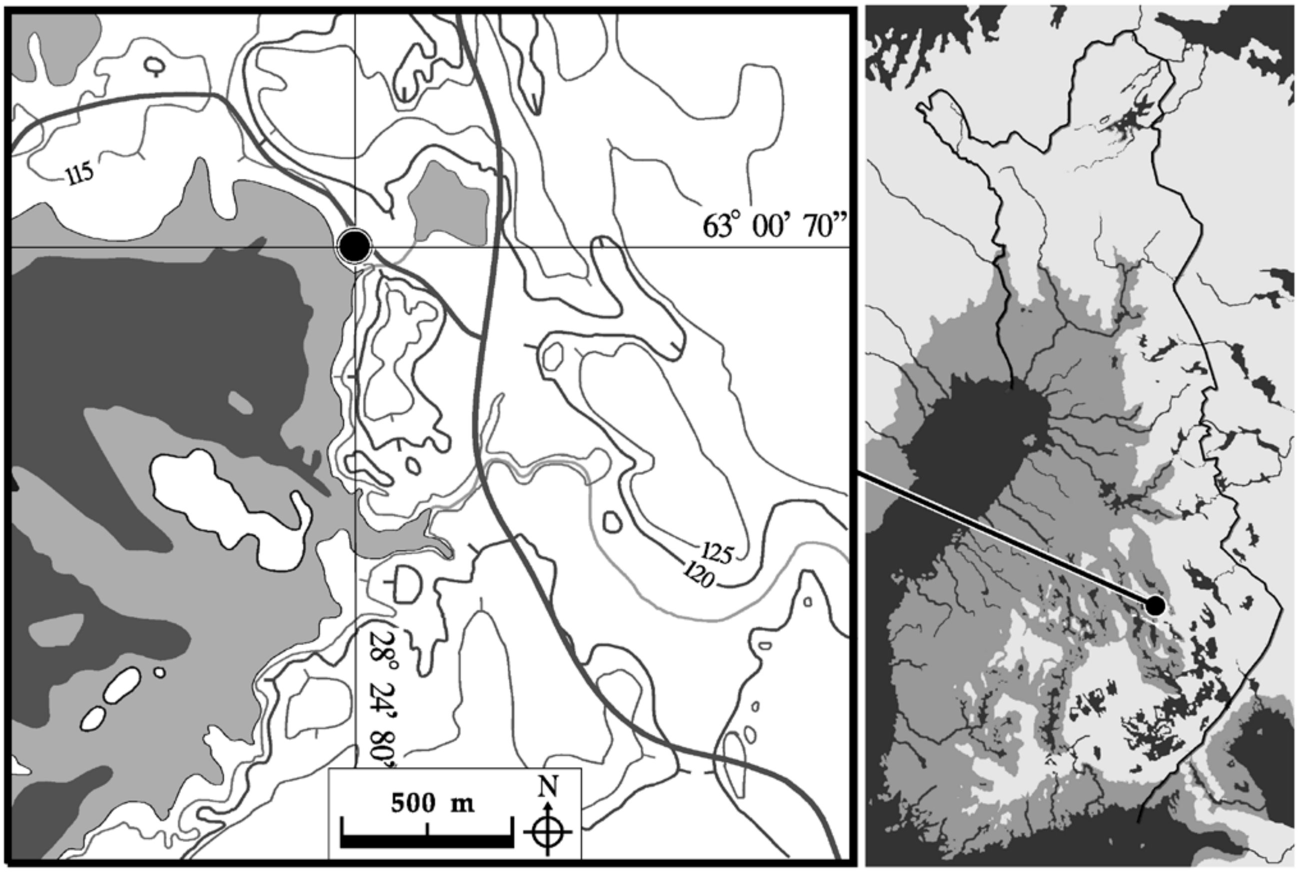

Fig. 2. Location of the site Helvetinhaudanpuro in Juankoski. Dark grey is the maximum water level of Lake Saimaa in 4800-4000 cal BC at ~99 m asl. Lighter grey is the water level of Ancylus Lake ca. 8400 cal BC at ~110 m asl.

ern Baltic Sea area. The dwelling sites in question are currently the only Mesolithic Stone Age sites in Eastern central Finland where archaeological excavations have been carried out.

2. RESEARCH HISTORY AND SITE DESCRIPTION OF THE DWELLING SITES

2.1. HELVETINHAUDANPURO IN JUANKOSKI

The Helvetinhaudanpuro site is located on top of a high and rather gently sloping fossilized 7-10 m wide ancient shore escarpment (see fig. 2). According to the shore displacement chronology of Lake Saimaa, the water level was near the top edge of the escarpment (112 m asl.) about 8500 cal BC and at the foot of the escarpment (108 m asl.) about 8400 cal BC, during the Ancylus Lake Phase of the Baltic Sea basin. At this location, the highest shoreline of ancient Lake Saimaa lies some 160 m further down the gentle slope at an elevation of 99 m asl., where the water level stood c. 4800-4000 cal BC. Today, the nearest body of water is Lake Akonjärvi, a part of the present Saimaa Lake system located 1,5 km west of the site at an elevation of 82 m asl. The water has previously been at the present level in the beginning of the ancient Lake Saimaa transgression phase soon after the isolation of the Saimaa lake complex from the early Litorina Sea c. 7000 cal BC (Saarnisto 1970; 14C- dates calibrated by Jussila 1999).

The site opened towards the Ancylus Lake in the southwest and was located on the northwestern side

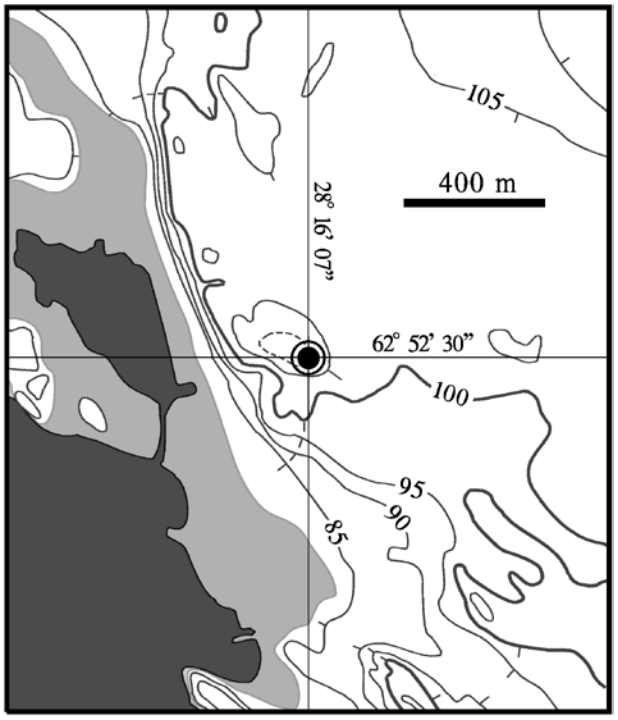

Fig. 3. Detail Map of the Early Mesolithic site of Helvetinhaudanpuro in Juankoski.

of a small river mouth at the bottom of a 600-1000 m wide bay sheltered by an archipelago. The site lies on a c. 25 m wide terrace between the ancient shore escarpment and a gently rising slope (see fig. 3). The terrain rises in all directions except southwest and west as seen from the site. When the site was occupied, the water directly in front of it was moderately deep, but on the northwestern side the shore became shallow.

The site lies on the edge of a glacifluvial esker where the deposited sand of the esker turns into till. The soil at the site is quite loose equigranular sand; at the root of the escarpment it turns into fine sand and further downhill to silty till. Vegetation at the site is spruce-dominated mixed forest changing just above the site to pine-dominated barren moorland. To the north of the site the esker expands into a glacifluvial delta with kettleholes. 200 meters northeast of the site is a kettlehole c. 200 m in diameter with a maximum depth of some five to six meters. In this depression there has been a pond that is now almost completely paludified. From this pond, an ancient riverbed with steep banks runs directly to the southeastern edge of the site where a small but fairly deep river discharged into the Ancylus Lake. On the opposite side of the ancient riverbed the terrain becomes somewhat more uneven and on the upper slopes there are also outcrops of bedrock. Farther towards the southeast the soil is sandy till with a stony topsoil that has so far yielded no traces of prehistoric activities. Northwest of the site the topsoil becomes stonier while the site area and its immediate surroundings are totally stone free. The fossilized erosion escarpment gradually disappears towards the northwest as the floor of the ancient lakebed in front of it gradually rises and blends into the gentle slope.

Jussila discovered the fossilized Ancylus escarpment mentioned above in 2000 and visited the location several times during years 2000-2002, digging a number of random test pits at the edge of the escarpment without noticing any traces of prehistoric activity. In the autumn of 2003, the topsoil at the location was partly exposed as a result of logging operations, and when visiting the site again Jussila observed several quartz flakes and tools indicating the presence of a Stone Age site. The site was not at the edge of the escarpment, as is usual, but about 15-20 metres away from it. Later, during excavations, a number of quartz flakes were found in a test pit on the opposite side of the riverbed. The northwestern part of the site has been partially destroyed by two 19th century charcoal-pits (see figure 3).

In the summer of 2004 a small excavation area of 15 sq. m. was opened up on the spot where the highest concentrations of quartz were observed in patches of revealed mineral soil. In the summer of 2005 the excavation area was expanded to 48 sq. m., of which 33 sq. m. was excavated that year. A small test area of 6 sq. m. was excavated at the edge of the escarpment. The finds from this second area were few and consisted of small quartz flakes. A third area of 7 sq. m. was opened up 10 meters northwest of the main area, where a small chunk of flint was found in a scarification patch. This area was excavated only to a depth of 5 cm into the mineral soil, forming a "seed" for forthcoming excavations. Fieldwork continued in 2006, revealing among other things some traces of a semi-subterranean rectangular house. The material recovered from the site in 2006 is undergoing analysis at the moment and is therefore not discussed in this

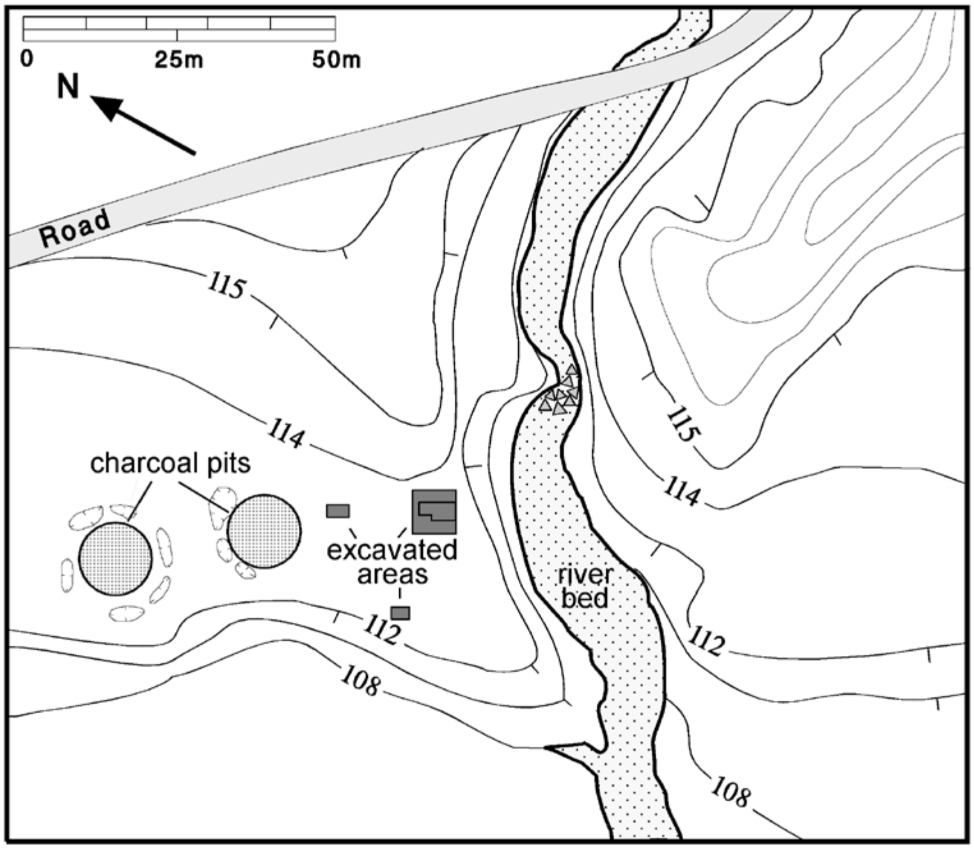

Fig. 4. Location of the site Likolampi in Tuusniemi. Dark grey is present lake. Light grey is the water level of Lake Saimaa in ca 6300 cal BC at ~84 m asl.

article. The overall size of the site is assumed to be roughly 80×25 m.

The main excavation area was characterized by a fairly thin podsol soil profile typical of the coniferous forest zone. Distinct coloured cultural layers were not discernable. Ten thousand years of podsolization processes in the loose and sandy soil had eradicated most of the visible traces of original anthropogenic dirt and sooty soil from the surface layers of the topsoil. A weakly outlined but deep pocket of dirty soil in the northeastern corner of the main excavation area also contained a concentration of small quartz flakes. The find layer was generally 30-35 cm thick and was located directly below the organic surface layer. In a limited area towards the middle of the main excavation the find layer reached a depth of 40-45 cm, and in the previously mentioned spot in the northeastern corner a depth of 70 cm.

The median date of the dated burnt fragment of elk bone from Helvetinhaudanpuro is 8400 cal BC (Hela-918: 9200±75 BP), which corresponds extremely well to the age determination given by shore displacement chronology.

2.2. LIKOLAMPI IN TUUSNIEMI

The Likolampi site is located on the southeastern rim of the level top of a gently sloping hill (fig. 4). The level area on top of the hill is about 60×40 m in size, with an elevation of 107,5 m asl. According to the shore displacement chronology of Lake Saimaa (Saarnisto 1970; 14C-dates calibrated by Jussila 1999) the water level was near the top of the hill at an elevation of 106 m at c. 8400 cal BC, when the hilltop was a small island in the inner archipelago of the Ancylus Lake, one kilometre from the mainland coast. Today, the nearest lakes, Lake Vianvesi and small Lake Likolampi (both

Fig. 5. Mesolithic site Likolampi in Tuusniemi.

parts of the Saimaa lake system), lie 300 meters from the site at an elevation of 82 m. The waters were previously at the present level about 7000 cal BC, just before the isolation of the Saimaa Lake complex from the early Litorina Sea, and again during the transgression phase of early Lake Saimaa about 6600 cal BC. The highest shoreline of the ancient Lake Saimaa in this area was 140 m from the site at an elevation of 97-98 m asl. at about 4800-4000 cal BC. The soil at the site is loose sand deposited by shore processes. Further down the hill, the soil changes to silty till.

Jouko Aroalho of the Kuopio Museum of Cultural History discovered the site in 1999 when he observed some quartz flakes in scarification patches and in a test pit. In the summer of 2004, an excavation area of 12 m2 was opened up on the southeastern side of the hilltop (fig. 5). The surface of the excavated area produced a normal thin podsol soil profile. Distinct coloured cultural layers were not observed, but some concentrations of bits of charcoal were noticed, as were also some faint spots of anthropogenic dirty soil in the deeper layers. The find layer extended to a depth of 40-45 cm as measured from the bottom of the organic surface layer. On the basis of the test pits and surface observations, the site is assumed to be about 10×10 m in extent.

A 14C-date on a burnt elk bone from the Likolampi site did not quite fulfill expectations as it dated site to the Late Mesolithic (Hela-919: 7425±95 BP, the calibrated median being 6300 cal BC). When this site was inhabited, it was 300 meters inland from the nearest shore. The water level of ancient Lake Saimaa was about two meters higher than at present.

3. ARTEFACTS

3.1 METHODS AND TERMS

In primary lithic reduction, two different striking techniques can be distinguished in northeastern Central Finland: the platform technique and the bipolar technique. In the platform technique the core is held in one hand and supported on, e.g., the thigh when removing flakes or blades from it with a hammer. In this technique the impact point lies towards the edge of the striking platform and a platform remnant can be detected on the flake. Other characteristics of flakes or blades can be bulbs, points of percussions, or various sharp edges (e.g. Crabtree 1972, 11; Knutsson 1988a, 37).

When using the platform technique an anvil can be of good assistance. In this technique a piece of raw material or a core is placed on an anvil and flakes or blades are detached from it with blows to the platform. This technique is quite clearly platform striking, and features mentioned above can be identified in the artefacts. Especially when working with quartz, the other end of the core, flake, or blade is often crushed on the anvil. This working technique is easily identified if an artefact is crushed on the other end and yet a platform can be distinguished. Basically stones can be worked with direct or indirect blows. Direct blows are executed with a hammer. Indirect blows can be executed using a connecting piece (punch) made of, e.g., wood, antler, or bone between the core and the hammerstone. We have not observed any evidence of indirect percussion in this material.

An anvil is also used in the bipolar technique. In bipolar reduction, a chunk of raw material or core is struck directly while being rested on an anvil. As a result, tension points in the stone give way and splitting takes place through fault planes in the material. Shattered pieces that are formed with this technique often resemble segments of an orange (Crabtree 1972, 10).

As a result of bipolar striking, flakes or blades are detached from both ends of the raw material chunk. A basic mark of this technique is often that both ends of the artefact are crushed. Unlike in flakes made by the platform technique, bipolar flakes usually do not have remnants of a platform or clear bulbs of percussion. Scars of percussion do appear, and flakes made with the bipolar technique can sometimes be even thinner and narrower than those made with the platform technique (Crabtree 1972, 10-11; see also Callahan 1987, 61).

The analysed material was divided into flakes, blades, cores, and tools. The definition of flakes is slightly different from the traditional one in our classification since we include both the results of primary reduction and debris. Quartz material fragments more easily than flint, but with certain restrictions correlations with flint can be applied (see e.g. Hertell & Manninen 2002, 85, with references).

If a flake is more than two times longer than it is wide, is it classified as a blade (see, e.g., Tixier 1974, 5). Microblades are not classified as a separate group in our research, even though this has been done in some analyses. Blades are distinguished from other materials in both the bipolar and platform techniques. If a blade is complete, both distal and proximal ends can be detected. If at least one of them is missing, the artefact is classified as a blade fragment.

If at least one flake or blade has been detached from a piece of raw material, it has been classified as a core. Cores are furthermore classified as protocores or cores, depending on how much they have been prepared or worked. If more than half of the raw material cortex is left, the artefact is called a protocore. The amount and type of cortex in the material was also observed, since it can reveal something about the way raw material was obtained. Raw material could be acquired either from quartz veins in cliffs and blocks or from individual pebbles picked up in moraines or on stony shores. In vein quartz, the amount of cortex is obviously quite small when compared to other quartz materials. In separate pebbles picked up in moraines or stony shores, on the other hand, the amount of cortex seems to be much higher (see e.g. Hertell & Manninen 2002, 89; Seitsonen 2005, 25).

The basis of our tool classification is morphological: an artefact is classified as a tool only if a distinct edge made by secondary working can be observed. Definition in itself is quite subjective and is based on the expertise of the analyser in the details of quartz and flint reduction. The shape and striking technique of tools was defined with the bare eye, without a microscope. This method undoubtedly reduces the total amount of information extracted from material, but it certainly also has some advantages. Most of the research conducted around the Baltic Sea area on flint and quartz materials has been done the same way, so the comparison of different materials is easier by this method. Had we used a microscope, the proportion of tools would most certainly have increased since the use marks on quartzes would have been detected. In this research we did not do so, however. The number of tools identified in our analysis probably does not correspond to the actual number of tools used in the dwelling site, since unretouched edges could be used at least for shorter periods (see e.g. Yerkes 1990, 173; Callahan 1987, 62; Knutsson 1988b, 14, with references).

Without taking any position on the functional use of the tools we have, however, evaluated their suitability for different situations. Edges that are suitable for scraping and cutting we call scrapers, while tools called burins are better suited for gouging and grooving. On flint material we additionally distinguish one more class called microliths, with a subgroup called inserts.

Scrapers were divided into side and end scrapers based on the position of the cutting edge. When examined from above, the shape of the edge was defined as straight or convex, and when inspected from the side, the edge angle was defined as blunt or sharp. The edge was considered blunt if the angle is over 45 degrees and sharp if the angle of the edge is less than 45 degrees. Burins were observed only from above.

3.2 MATERIAL

3.2.1. Helvetinhaudanpuro in Juankoski

The dwelling site produced a total of 10 880 lithic artefacts in 2004-2005 (see table 1), 10 859 of which were made of quartz, 6 of flint, and 15 of other lithic materials. The find density of the artefacts was quite high, 203 pieces/sq. m. The largest group among the quartzes were flakes and blades/blade fragments,

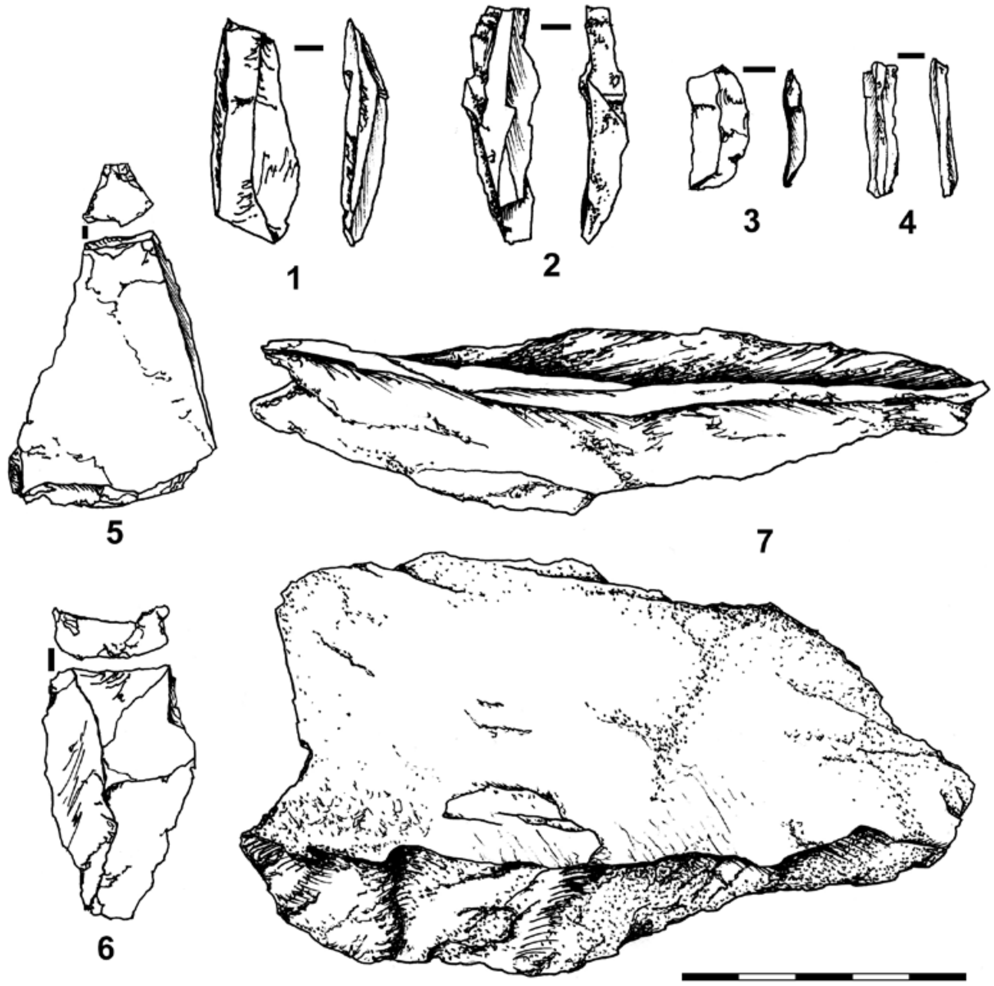

Fig. 6. Some quartz blades, blade fragments and flakes from the site of Helvetinhaudanpuro.1. Bipolar blade, 2. Platform blade modified on anvil, 3. Fragment of a bipolar blade, retouched on one side, 4. Blade made by pressure flaking, 5. Platform flake modified on anvil, 6. Platform flake, 7. Bipolar flake. (KM 35473: 180, 418, 1384, 98, 128, 64).

which amounted to 10 553 pieces (see table 2). Blades and blade fragments totalled 688 pieces (fig. 5), which is 6,5% of the total amount of quartzes. Cores and protocores numbered 173 pieces (fig. 6) or 1,6% of the total amount of quartzes.

Identified tools numbered 137, of which 133 were made of quartz (1,2% of all quartzes), 3 of flint, and one of other lithic material. 129 of the quartz tools are scrapers, 2 knives and 2 burins (fig. 8). On one scraper the other edge could also possibly have been used as a knife (KM 34661:87; KM = National Museum of Finland). Almost all quartz tools were manufactured from flakes; only one burin was made from a blade. On the basis of to the position of the edge, 51 tools were defined as end scrapers and 42 as side scrapers. Tools with edges on both the side and end also occur; they number 31 pieces. On 9 tools, the position of the edge was not documented. Almost all edges are convex, and on two cases out of three the angle of the edge is blunt, i.e., over 45 degrees. Of the burins, one is end edged and the other side edged. The edges of both burins were created by removing several burin spalls.

Six pieces of flint were found. Of these, three are tools, two are flakes, and one is a chunk. One flake is brownish black and translucent, originating from

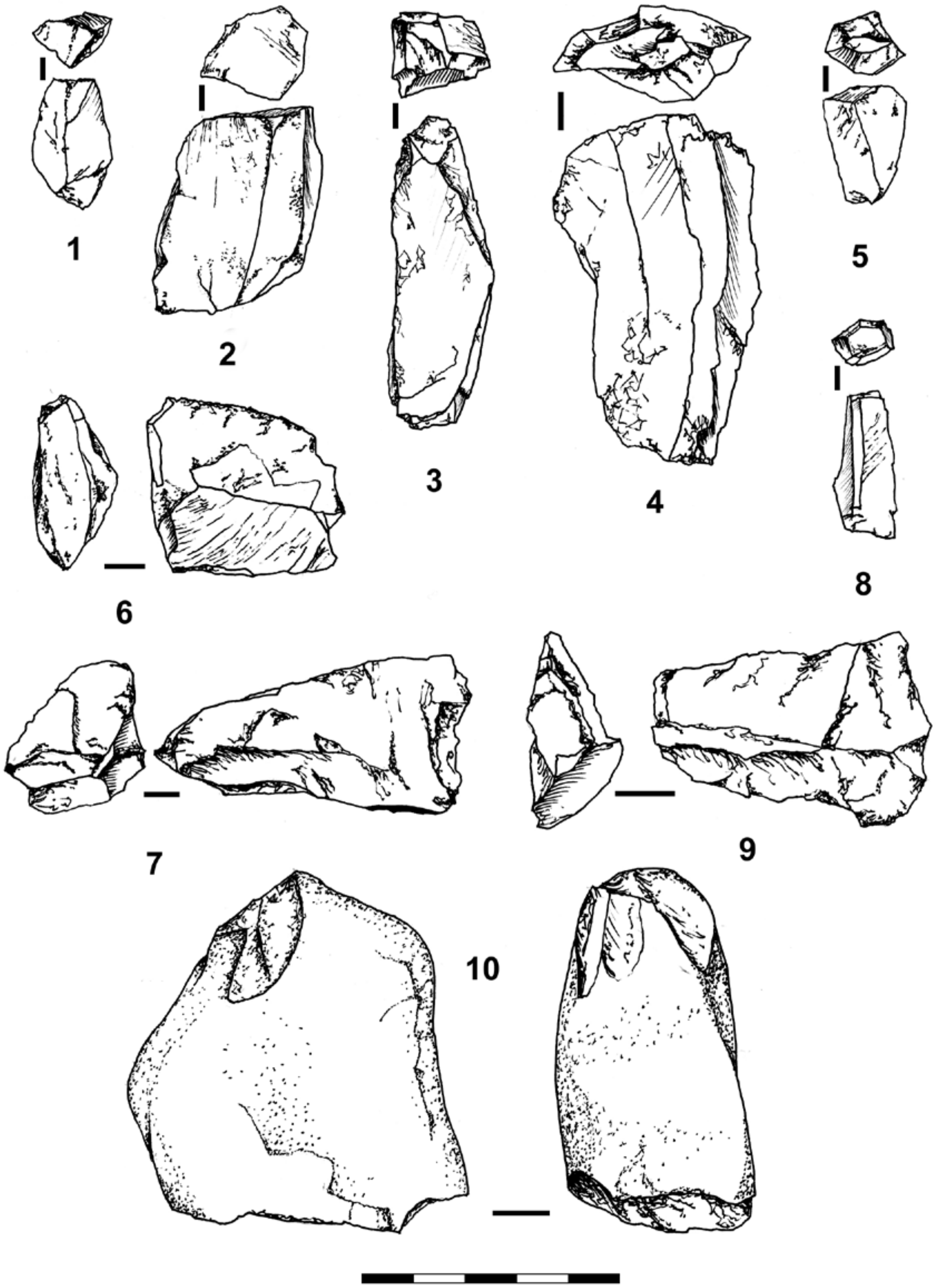

Fig. 7. Some bipolar cores (1, 3-7), platform cores (2, 8-9) and a platform-on-anvil protocore (10) made of quarz, from Helvetinhaudanpuro. (KM 35473:63, 111,348, 115, 31,469, 459,42,435, 117).

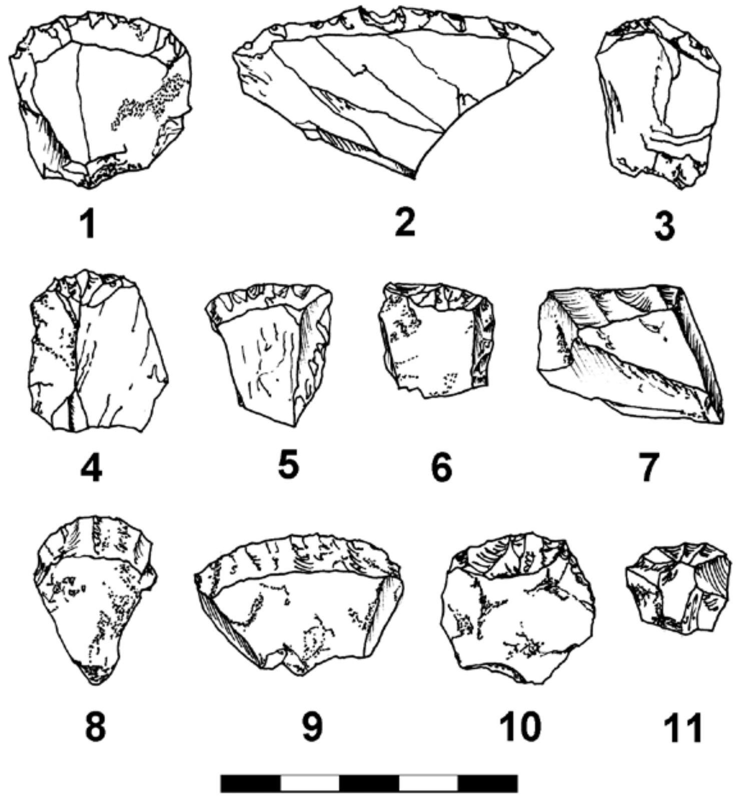

Fig. 8. Some end scrapers (4, 5, 8), side scrapers (7, 9), end-side scrapers (1, 3, 6, 10, 11) and a knife (2) made of quartz, from Helvetinhaudanpuro. Tools 1-3,9-10 from bipolar flakes, 8 from bipolar core, 6, 7, 11 from platform flakes and 4 from a fragment of a platform blade. (KM 35473: 439, 738, 1031, 630, 35, 1072, 1390, 151, 48, 420, 1185).

the edge of the core's striking platform. It features a trimmed platform remnant and three negatives of detached blades (fig. 9:4). The other flake (KM 35473:1377) is reddish grey, opaque, and quite poor in quality. The ventral side of the flake is cortex. One of the pieces is of grey opaque flint. It is a fragment of a scraper that has a convex edge with a sharp edge angle on both the side and the end of the implement (fig. 9:1). One fragment of flint is made from a nearly transparent reddish brown blade. On one side and end there is a retouched edge. Apparently we are dealing with a knife or an insert (fig. 9:3). Another possible fragment of an insert is a piece of greenish grey flint that has low retouch on one side (fig 9:2). In addition, there is a chunk of brown flint (1,2×1,0×0,8 cm), bearing no marks of modification (KM 35473:552). Since natural deposits of flint do not exist in Finland, it must have been imported here. It must therefore originate in moraine layers further east or south of Finland. This piece of flint is so small that it was probably not carried to the site as raw material for tools.

Flakes made of other material than quartz or flint totalled 8 pieces. Furthermore, the finds included an adze (7,0×5,5×1,3 cm) that was worked with both the bipolar and the platform technique.

Other finds from the dwelling site included 5 relatively soft stones (according to the Mohs hardness scale) that we interpreted as anvil stones or their fragments. The largest of them has dimensions of 21,0×14,0×6,5 cm. On both of its wider sides there are several indentations of different sizes that derive from using the stone as an anvil (fig. 10).

The finds include one possible hammerstone. It is an irregular pebble of granite some 9×7×6 cm in size. Several indentations indicative of the bipolar technique could be detected on the sides of this artefact.

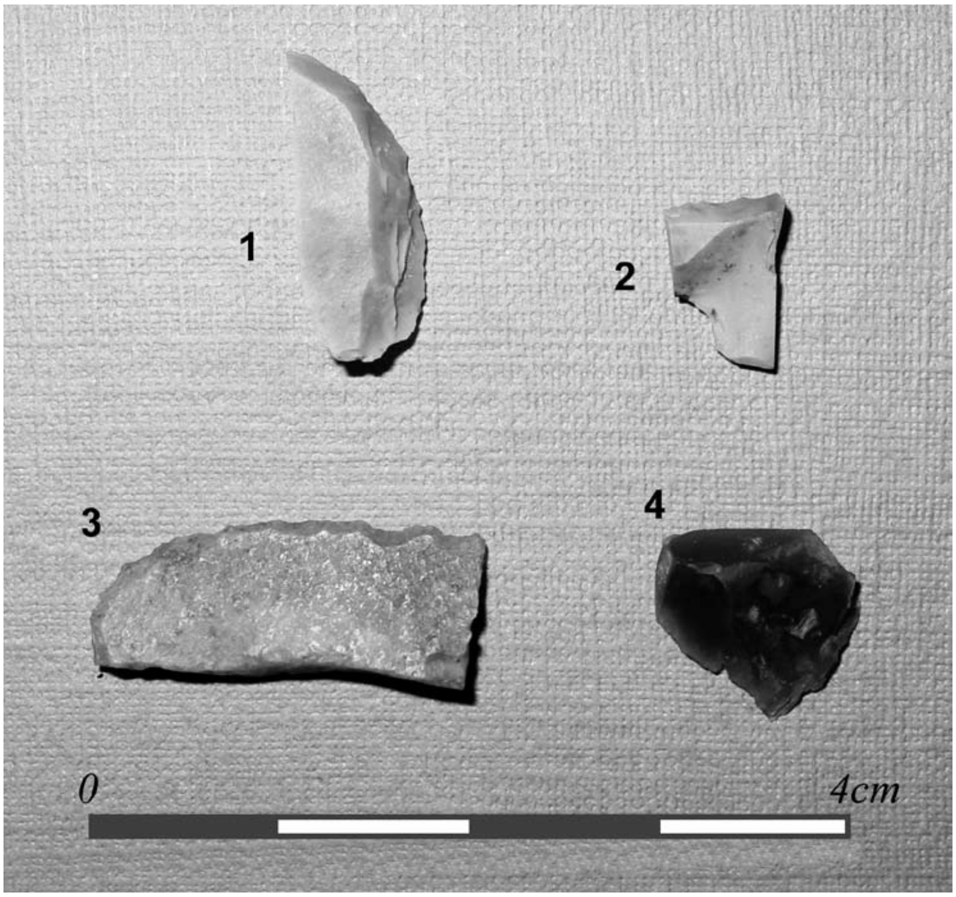

Fig. 9. Flint artefacts found from Helvetinhaudanpuro in 2004; 1. Fragment of a scraper (KM 34661: 245), 2. Fragment of a possible insert (KM 34661: 246), 3. Fragment of a knife or insert (KM 34661: 248), 4. A flake (KM 34661: 247).

The indentations are about one centimetre in diameter and their measured depth is a few millimetres. It appears that quartz could have been worked with a hard hammerstone against a softer anvil stone.

Regularities can be detected in the distribution of the artefacts. The greater part of the flakes and blades are concentrated in two areas: in the centre of the excavation area and in its northeastern sector. Even though some individual cores and tools were found inside the concentrations, most of them were not. In the southeastern section of the excavation area there are plenty of cores, indicating a cache. Weakly stained soil correlates well with the concentration areas.

3.2.2 Likolampi in Tuusniemi

This dwelling site produced 2920 lithic artefacts, of which 2916 were made of quartz and 4 of other lithic materials. The find density was relatively high, over 292 pieces/sq. m. The largest group among the quartzes were flakes and blades/blade fragments, which totalled 2853 pieces. Blades and blade fragments came to 235 pieces, which is 8,1% of the total number of quartzes. Cores and protocores numbered 61, equivalent to 2,1% of the total amount of quartzes.

Only two quartz tools, both scrapers, were identified (0,1% of all quartzes). In addition, there was one tool fragment of other lithic material, probably a part of a polished adze or axe.

The scrapers were made from flakes. One was an end scraper and other was a side scraper. On both scrapers the cutting edge was convex and the angle of the edge was blunt (over 45°).

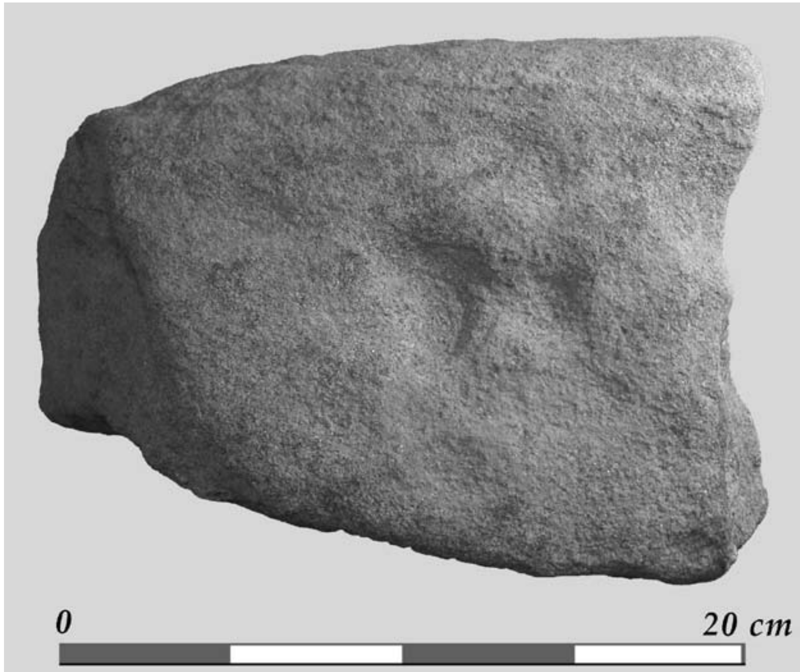

Fig. 10. Anvil stone from Helvetinhaudanpuro (KM 34661:344).

4. BONE MATERIAL

Both sites produced only a small amount of burnt bone material. A detailed analysis was carried out only on the bones found at the Helvetinhaudanpuro site, where 12 burnt bone fragments were identified out of an overall bone material of 56 fragments. Bones of elk were the largest identified group (6 fragments), and some fragments of fish bones were also observed, including bones of pike (Esox lucius) (1), perch (Perca fluviatilis) (1), and daces (Leuciscus sp.) (2). This result agrees well with the Preboreal stadial (ca. 9600-8200 BC, calibrated dates based on Andrén et al. 1999, 369; Raukas et al. 1995, 202) and its presumed fauna.

The burnt bone fragments were heavily concentrated in the southern part of the 2004 excavation area; the distribution was quite similar to that of the quartz material. From the Likolampi site only one fragment of burnt pike bone and one elk bone were identified in the overall bone material of 90 small fragments. Looking at the bone material as a whole, the fact that beaver is totally absent is worth noting. Beaver is quite common in Early Mesolithic sites in Estonia (Lõugas 1997, 66) and in Late Mesolithic sites in Finland (e.g., Ukkonen 1993, 256-257; 2001, fig. 2). The reason for the lack of beaver in the material may lie in the small amount of identifiable bone material found at the site.

5. ANALYSES AND COMPARISONS

5.1 QUARTZ

Taken as a whole, the quartz finds from Helvetinhaudanpuro and Likolampi include a large proportion of quartz cortex. This implies that most of the quartz has not been quarried from quartz veins but rather derives from quartz cobbles found in moraines. There are, however, also a number of pieces of quartz exhibiting features of vein quartz (angularity, jagged cortex surface etc.). When surveying the surroundings of both dwelling sites, we noted easily exploitable chunks of quartz 500 meters southeast of Helvetinhaudanpuro and 400 meters northeast of Likolampi.

The largest group in the quartz material from both dwelling sites consists of flakes. At Helvetinhaudanpuro the proportion of flakes was 97,2%, while the proportion of blades (compared to the total number of quartz flakes) is only 6,5%. In the dwelling site of

Likolampi the numbers are quite similar to Helvetinhaudanpuro; there the proportion of flakes was 97,8% and the proportion of blades 8,1%. The same phenomenon can be observed in other dwelling sites around the Baltic Sea. For example, in Finland at sites like Ristola in Lahti, Hopeanpelto in Askola, Pisinmäki in Kerava, Koppeloniemi in Hyrynsalmi and Äkäläniemi in Kajaani (fig. 1:1 and 5-8) blades have accounted for 2-3% of the whole quartz material (Schulz 1990, fig. 4). At Late Mesolithic and Early Neolithic (5800-4000 BC) sites in Estonian archipelago the percentage of blades has been 0,3-7,1% of the whole quartz material (Kriiska 2002, 38).

In the quartz material of Helvetinhaudanpuro, the reduction technique was identified in 22,6% of all finds. The bipolar technique was clearly more common than the platform technique. 15,8% of all quartzes were produced with the bipolar technique, while 6,8% were produced with the platform technique. If we consider only the quartzes whose reduction technique has been identified (2452 pieces out of 10 859), the proportion of bipolar technique is 69,9% (1715 pieces) and that of platform technique 30,1% (737 pieces)

It must be noted that the analysis of quartz fragments relies on subjective interpretation. The results depend on the quality of the material as well as on the expertise of the researcher. Looking at the finds from Helvetinhaudanpuro, we can see that the material is statistically representative enough to allow us to draw reliable conclusions.

A similar distribution of techniques can be observed in the flakes and in the tools; in both cases the proportion of identified bipolar quartzes is over 50%. The division into different reduction techniques is best seen in the blades/blade fragments, where the bipolar technique dominates with 84,8%. Of the cores, on the other hand, only 56,6% represent the bipolar technique.

In the quartz material of Likolampi in Tuusniemi the technique with which the quartz was reduced was identified in 26,2% of the whole material. In the identified material from Likolampi the bipolar technique was also clearly more popular than the platform technique. It was used on 20,9% of all quartzes. If we look at only the quartzes whose reduction technique was identified (768 pieces out of 2916), the proportion of bipolar technique was 79,4% (609 pieces) and that of platform technique, 20,6% (159 pieces).

The same type of division in reduction technique can be observed in the flakes and in the tools; in both cases the proportion of identified bipolar quartzes at Likolampi is over 65%. Just as at Helvetinhaudanpuro, the distribution into different modification techniques is best seen in the distribution of blades/blade fragments, where the bipolar technique dominates with 88,5%. As for the cores from Likolampi, 68,9% were reduced using the bipolar technique.

It is difficult to find reference material for this kind of investigation. In Finland, a number of comparisons between differences in bipolar and platform techniques in Mesolithic times have been carried out. For example, Schulz has presented five Mesolithic dwelling sites where he came to the conclusion that the bipolar technique was dominant in cores and came to over 85% (Schulz 1990, fig. 2). Because all of the sites Schulz investigated had been at least partly in use in later periods as well, the material as a whole is not comparable with Helvetinhaudanpuro or Likolampi.

The dwelling site of Salonsaari in Suomusalmi (fig. 1:9), northeastern Finland, has been in use partly in the Mesolithic Stone Age. According to Oili Räihälä (1998, 11), the bipolar technique was represented there in 45% of all material, rising to 50% when only cores were examined. This site too has been partly in use on later times, so conclusions concerning the quartz material cannot be directly compared with our material.

The best reference for the comparison of Mesolithic stone technology is the site of Pukinkallio in Mäntsälä (fig. 1:10), Southern Finland. From its Early Mesolithic material (median age ca. 8100 BC (Hela-706: 8960 ± 65); Takala 2004, fig. 159) Mikael A. Manninen has determined that the bipolar technique was clearly dominant with a share of 74% of all identified quartzes (pers. comm. 2.2.05).

Kauvonkangas in Tervola (fig. 1:11), Northern Finland, is a dwelling site from the Neolithic Stone Age (median age ca. 3000 BC (Hela-342: 4340 ± 75; Kankaanpää 2002, 68-69), where the platform technique was almost as popular as the bipolar technique. For flakes the proportion of platform technique was 47% of the identified material as against 53% for the bipolar technique. With cores, the proportion of the bipolar technique is little higher, about 64% (Rankama 2002, 83-84, fig. 4-5). Rankama suggests that this could be explained with the change of stone technology in the middle of the modification process, as also proposed by Swedish researchers. According to her, it seems possible that the stone knappers of Kauvonkangas could have knapped quartz cores first using the platform technique and later using a bipolar method of reduction (Rankama 2002, 85; see also e.g. Callahan 1987, 60-61; Knutsson 1988b, 148-149; Olofsson 2003, 5).

The same type of modification process can explain the fact that the platform cores of Helvetinhaudanpuro and Likolampi are usually larger than those made by the bipolar technique. So far, we have identified one quartz core bearing marks of both the bipolar and the platform technique (KM 35473:302). Based on this item, the writers of this article postulate that according to this material the technique of modifying quartz has been subject to change whenever needed, even during the process itself. The bipolar technique could also be used, e.g., for crushing smaller chunks of quartz (e.g. KM 34 661:61), so the working order between the different techniques varies, depending among other things on what kind of final tools are desired (see also Hertell & Manninen 2002, 96-97).

Examples of changing techniques are found in Estonia as well. For example, the Mesolithic dwelling site Kivisaare (fig. 1:14) in Central Estonia has produced one core made of flint that was first prepared for the platform technique in order to make several blades. Later on it was also worked with the bipolar technique (Kriiska et al. 2004a, 33)

In dwelling sites dating to the Middle Neolithic Stone Age in Sweden (3400-2300 cal BC, e.g. Lundfors A-G, cf. Bjurselet; fig. 1:39-40) bipolar quartz cores were modified into scrapers in the final stage. At the end of the Stone Age and later in the Bronze Age flakes were removed from the core as long as possible, and in the final stage the core was crushed to pieces using the bipolar technique. According to researchers in Sweden, this indicates that at earlier settlements quartz technology was highly methodical but in younger settlement stages it had at least partly degenerated (Knutsson 1988a, 174-176; see also Holm 1991, 117; Broadbent 1979, 206-207).

A methodical approach to reduction was still in use in Finnish dwelling sites at least regionally in the Neolithic Stone Age. A good example of this is the Neolithic settlement at Rävåsen in Kristiinankaupunki (fig. 1:12), on the central west coast of Finland. The quartz material of several excavation areas of this site has been analysed and the bipolar technique dominates quite clearly: 59-72% of the material was reduced using the bipolar technique. Based on their study of the material and also on other analyses, Esa Hertell and Mikael A. Manninen suggest that the large proportion of bipolar technique indicates a purpose-oriented stone technology in the area. According to Hertell and Manninen, it is possible that the people at the settlement at Rävåsen sought to produce especially thin flakes that were best suited for knives and other cutting edges. For this purpose, the bipolar technique is optimal, while the platform technique is better suited for producing more robust artefacts like scrapers (Hertell & Manninen 2002, 96-97 with references and fig. 2).

On the basis of the quartz materials of Helvetinhaudanpuro and Likolampi, a trend can be observed wherein the use of the bipolar technique increases at the end of Mesolithic Stone Age as compared to its older phase. The material of Pukinkallio in Mäntsälä confirms this hypothesis, but its find collection is so small (289 pieces) that it cannot be considered completely convincing statistically. In Pukinkallio, the proportion of platform technique is 26%.

The bipolar technique is widely known around the Baltic Sea, not only in quartz but also in other lithic materials. For example, in the Mesolithic material from Kivisaare in Central Estonia more than half of the flint cores are bipolar (Kriiska et al. 2003). In the quartz material of Estonia the bipolar technique dominates throughout the whole Stone Age. For example, in the Lemmetsa I (Late Neolithic, 3200/3000-1800 cal BC; fig. 1:15) and Lemmetsa II (Middle Neolithic, 4200/4000-3200/3000 cal BC; fig 1:15) dwelling sites in southeastern Estonia only bipolar quartz flakes are present, and often flint cores represent the bipolar technique as well (Kriiska & Saluäär 2000, 13,16, 30). In Sweden the development of quartz technology is slightly different. There the bipolar technique was relatively common in the Mesolithic Stone Age, while around 4500 cal BC the platform technique started to gain more popularity and was reflected in, e.g., cores made of quartz (e.g. sites Alträsket (5000 cal BC) and Lillberget (3900 cal BC) – Halén 1994, 177-178; fig. 1:37-38; see also Lindgren 2004, 248; Knutsson 2005, 64).

5.2. FLINT

The flint material found at Helvetinhaudanpuro has not been subjected to a minerological analysis, but based on the colour, quality and reference material from Eastern and Northern Europe it is possible to draw preliminary conclusions concerning the origin of the raw material. Black translucent flint most probably derives from cretaceous layers that reach the surface in Belarus and Ukraine (for more on this flint see, e. g., Jaanits et al. 1982, 32; Zhilin 1997, 331; Koltsov & Zhilin 1999, 66; Lisitsyn 2003, 45). Nodules detached from this layer of flint do occur in the soil north of this area and can be found even in southern Lithuania. This kind of flint has been widely used by the so-called Mesolithic Post-Swiderian cultures and its use decreases the further north one goes.

In Lithuania (e.g., Dreniai, Biržulis, Margionys – Ostrauskas 2002, 94ff; Baltrūnas et al. 2006a, 43ff; Baltrūnas et al. 2006b, 23; fig.1:35-36), in Belarus (e.g., Krumpliovo, Zamoshye and Plushy – Ksenzov 2001, 20; fig. 1:33-34) and in the marshy woodlands of Zhizdra in Russia (e.g., Krasnoi 3, 8 and Resseta 2 – Sorokin 2002, 100; fig 1:29-30) this type of flint is quite common; in Estonia, on the other hand, it is known only from eleven sites (fig. 11) and in Latvia from only a few Late Palaeolithic/Early Mesolithic sites like Lauksola in Salaspils, Zvejnieki II, and Jersika (Jaanits 1989, 13; Zagorska 1999, 153-154, fig. 1:21-23). Apart from the Early Mesolithic dwelling site Pulli in Estonia (fig. 1:16), this kind of flint occurs usually only in small quantities. The Pulli site produced 1500 pieces of black flint (Jaanits 1989, 32). On the Karelian Isthmus it has so far been found only in one site, Veshevo 2 (Tarhojenranta in Heinjoki in Finnish sources – Takala 2004, 156; fig. 1:25). In Finland black flint is known from Ristola in Lahti (45 pieces; Takala 2004, 108, fig. 109), Kuurmanpohja in Joutseno (2 pieces) and Helvetinhaudanpuro in Juankoski (1 piece). Further east black flint is known from a few sites in the region of the so-called Butovo Culture in the area between the rivers Volga and Oka, e.g., Butovo 4A and Prislon (Koltshov & Zhilin 1999, 62; fig. 1:26-27).

Black flint appears to have been a very popular material in the Early Mesolithic due to its high quality. It can be found not only in areas where naturally occurring flint is completely absent (e.g., Finland) but also in areas where the local flint is poor in quality (e.g., Estonia and Latvia). It also seems apparent that black flint has been transported to areas where the local flint is of high quality (e.g., Central Russia). The flint found at Helvetinhaudanpuro extends the distribution radius of black flint to 900 kilometres from its original source (fig. 11). It may be possible, although not certain, that the grey flint found at Helvetinhaudanpuro originates from the same cretaceous layers as the black flint because differences in the colour of flint do occur even in one and the same artefact (Kriiska & Tvauri 2002, 26).

The colourful reddish brown blade made of flint apparently derives from Central Russia. Pieces made of similar flint were also found at Kuurmanpohja in Joutseno and at Veshevo 2 on the Karelian Isthmus. Other pieces of flint pointing to the east have also been found at the Kuurmanpohja site. The same kind of flint material has also been found in Estonia, e.g., at the Mesolithic sites of Pulli, Sõõrikunurme and Oiu I (Kriiska et al. 2004b, 44; fig. 1:16-18). Central Russian flint is also known from the Latvian Early Mesolithic sites Zvejnieki II, Sūļagals and Laukskola in Salaspils (Loze 1988, 16, fig. 1: 20 and 22-23).

Greenish grey flint appears sporadically in the Estonian flint material. This flint obviously derives from Silurian limestone layers deposited in the Palaeozoic period (Jürgenson 1958). It reaches the surface only in Central Estonia but can also be found in Quarternary deposites in Estonia and northern Latvia (fig. 11). Among the local materials found in Estonia, greenish grey flint is likely the most suitable for making prehistoric tools. One greenish grey flint was also found at Kuurmanpohja in Joutseno. A few exceptions notwithstanding, Mesolithic flint in Finland mainly dates to the earliest settlement of Finland c. 8800-8400 cal BC. However, it appears that the use of flint continued to some extent through the whole Mesolithic Stone Age. It is possible that some Estonian flint was imported to the southwestern Finnish coast in the late Mesolithic Stone Age (Asplund 1997, 220; definition of flint made by Kriiska).

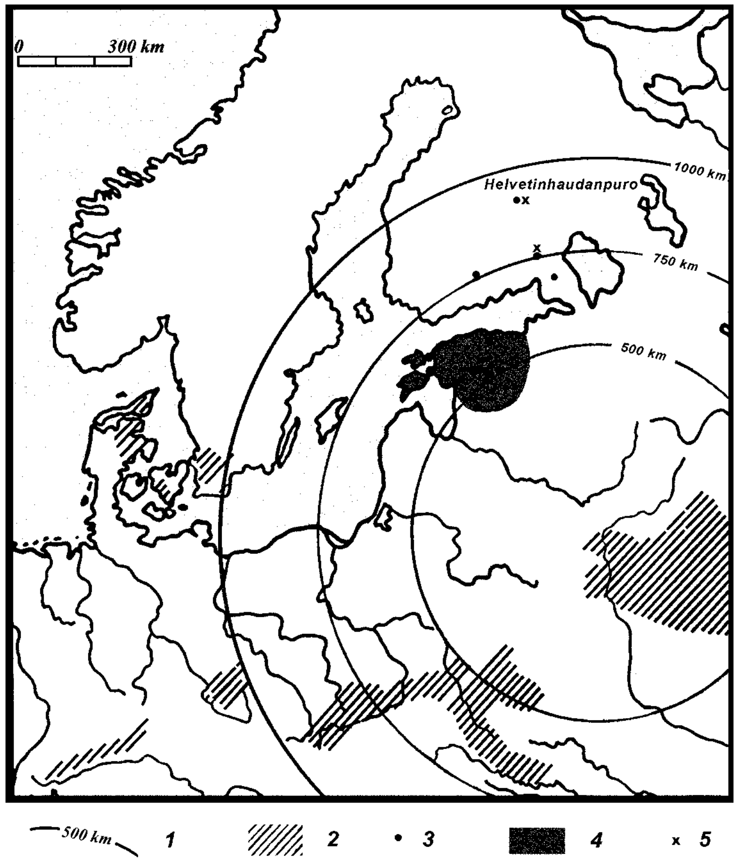

Fig. 11. 1) Distribution of artefacts made from Belorussia originating Cretaceous flint. Distance in kilometers. 2) Distribution of Cretaceous flint depositions reaching the surface. 3) Stone Age dwelling sites with Cretaceous black flint in Estonia, Latvia, Finland and Karelian Isthmus. 4) Distribution of Paleozoic flint on Quaternary deposits in Estonia and Northern Latvia (according to the investigations of A. Kriiska). 5) Early Mesolithic sites in Finland with flint resembling to Estonian flint.

6. DISCUSSION AND CONCLUSIONS

The Helvetinhaudanpuro and Likolampi dwelling sites reflect a long-term change in lithic techniques during the Mesolithic Stone Age of Finland. The Helvetinhaudanpuro site is a very important and useful source for research on the earliest settlement of Finland in the Early Mesolithic. Both dating methods, shore displacement chronology and 14C-dating of burned bone, produced the same Early Mesolithic date. The site is among the five oldest known sites in Finland and one of the two oldest in the area that was exposed by the retreat of the continental glacier after theYounger Dryas stadial (i.e. areas on the proximal side of the Salpausselkä end moraine), the other being Sujala in Utsjoki, northernmost Lapland (Rankama & Kankaanpää in press; fig. 1:13).

The location of the Helvetinhaudanpuro site indicates that the ecological resources of both land and water were utilized in many ways. The site itself is not very large, although the find material from it is quite diverse. The material from the site does not reveal whether the dwelling site was settled on several occasions for longer periods or more often for short periods. Based on the finds, artefacts have been manufactured, used, and abandoned at the site and also imported.

The best comparative material for the finds from Helvetinhaudanpuro is provided by the Mesolithic sites of Eastern Finland and the Karelian Isthmus. Analogical features like the presence of flint (partly from three different original sources) and the relatively high proportion of platform technique and blades in the quartz material can be observed in the lithic materials from Ristola in Lahti and from sites at Kuurmanpohja in Joutseno.

Particularly the presence of flint in the Early Mesolithic sites of Finland makes it possible to evaluate prehistorical contact zones. The natural presence of flint in a particular area does not automatically mean that the population of Helvetinhaudanpuro would have derived from these areas. Many sites in Northern and Eastern Europe indicate the presence of extensive contact networks in the Early Mesolithic. Through the help of direct and indirect contacts even exotic raw materials could drift hundreds of kilometres without major migrations.

Apparently the colonisation of the site took place from nearby areas. From the 14C-datings of Early Mesolithic sites in Estonia, the Karelian Isthmus, and Finland it can be concluded that over twenty generations lived in the areas where quartz and poor quality flint occur in soil before the site of Helvetinhaudanpuro was occupied. Adaptation to the local lithic materials had occurred already a long time before the Helvetinhaudanpuro occupation, but nevertheless traces of ancient knapping techniques can still be observed. Some features of working methods used on good quality flint have obviously survived while working with poor quality flint and quartz.

The difference in the quartz material of Helvetinhaudanpuro can clearly be observed upon comparison with Late Mesolithic materials from Finland and earlier sites in Estonia and northeastern Russia. The writers of this article consider the relatively large proportion of blades and the platform technique to be vestiges of the ancient method of shaping good quality flint. They are characteristic of the flint technology of Early Mesolithic sites in the Baltic countries and northeastern Russia and can no longer be so clearly observed in younger Mesolithic collections from Finland.

In spite of its plentiful finds, it is difficult to find parallels for Helvetinhaudanpuro. In areas where flint occurs naturally the amount of quartz used is very small. For example, in the dwelling site of Pulli in Estonia the proportion of quartz is only 0,7% compared to the number of flint artefacts. Besides, it is necessary to bear in mind that the total number of Early Mesolithic sites in Finland is still very small and in most cases the artefact material is mixed with later human activity in the area (e.g. Ristola in Lahti). Because of this, the plentiful and unmixed material of Helvetinhaudanpuro is a good reference material for investigating the stone technology of the earliest settlement in Finland and its adaptation to quartz.

Tools made of bone would help us to elucidate the picture of the Early Mesolithic, but unfortunately unburnt bone is preserved in Finnish soil only in special conditions and only a few individual bone tools have been found in Finnish soil. Nevertheless, the bone tools that have been discovered are quite important when forming an interpretation of the earliest settlement of Finland.

If the term “archaeological culture” is understood in an instrumental way as a similarity in artefact types, we can consider that the material of Helvetinhaudanpuro together with other Early Mesolithic sites in southern Finland and the Karelian Isthmus forms one “archaeological culture”. If some kind of continuity is essential here, the ”Kunda Culture” in eastern Baltic and the ”Butovo Culture” between the rivers Volga and Oka in Russia provide the best parallels. The oldest bone artefacts in Finland point to the same direction: the ice pick from Kirkkonummi (Äyräpää 1950, 9) and a fragment of a double cone-shaped arrowhead from Kuurmanpohja in Joutseno. There are good parallels for this kind of arrowheads in the so-called “Post-Swiderian Cultures” like “Butovo” (e.g. Okaemovo 4 and Ozerski 5 – Koltshov & Zhilin 1999, fig. 23 and 27; fig. 1:28 and 32), “Veretye” (e.g. Veretye 1 site; Oshibkina 2000, 152, fig. 3; fig. 1:31), and “Kunda” (e.g. the Kunda Lammasmägi site – Indreko 1948, 259, fig 72, 297 ff; fig. 1:19). The material we have investigated points to cultural relations to the South as well as to the East, but the direction of stronger cultural relations seems to point to the East Baltic region. The model we propose for the earliest settlement of Finland is not new, (see, e.g., Nuñez 1987; Matiskainen 1989; and Takala 2004) but its verification still requires further research.

The artefact material of Likolampi is smaller in amount than the material from Helvetinhaudanpuro and is slightly different. Likolampi produced no flint and only a few tools of quartz. The Likolampi site is located on the same ancient shoreline of the Ancylus Lake as the Helvetinhaudanpuro site. According to the radiocarbon date, however, it is Late Mesolithic, which means that the nearest shore during occupation has been out of sight, approximately 300 metres from the site. The location of this site differs clearly from the traditional shore-bound settlement model. At Likolampi, however, tools have been manufactured and some have also been left behind at the site.

A few sites in Finland and Estonia are not located directly on the ancient shoreline (Jussila & Kriiska 2006). The number of sites of this kind is very small compared to all known dwelling sites in Finland and Estonia. At the moment, there are only limited possibilities for interpreting the function of these sites. Ethnographical and anthropological descriptions have verified that the activities of hunter-gatherers have been extensive also beyond so-called base camps. Hunting and gathering, acquiring raw materials, and activities associated with religion or entertainment can leave permanent traces so ephemeral that they are difficult for us to recognize - as of yet.[2]

2 Acknowledgements: The fieldwork was financed by the J. E. Tuovinen Foundation of the Cultural Foundation of Savo. In addition, the town of Juankoski provided fieldworkers and other supplies. Microlith Ltd. supported the investigations with field equipment and other research supplies. The Foreign Exchange Foundation of the Estonian academy of Sciences and Arheograator Ltd. have also supported the writing of this article. The collection of Estonian reference material has been supported by research project no. 5328 of the Estonian Foundation of Sciences and the research project "Interdisciplinary archaeology: the interaction of culture and environment in the past" of the university of Tarto. We are grateful to all of the organizations mentioned above. We also wish to thank Kati Salo, MA, for the osteological analysis, Mikael A. Manninen, MA, for the information on Pukinkallio in Mäntsälä, prof. Högne Jugner, PhD, for radiocarbon dating, Kristel Külljastinen for artefact drawings, Jarmo Kankaanpää, PhD, for revising the English text, and also Jouko Aroalho, director of the Kuopio Cultural History Museum, for co-operation and most valuable background support.

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Lithics n	Helvetinhau-danpuro	Likolampi
Quartz	10859	2916
Flint	6	0
Other	15	4

Table 1. Lithic material from Helvetinhaudanpuro and Likolampi sites.

Quartz	Helvetinhaudanpuro			Likolampi	
	n	%		n	%
Total	10859			2916	
Flakes	10553	97,2	% of total	2853	97,8
blades	686	6,5	% of flakes	235	8,2
Cores	173	1,6	% of total	61	2,1
Tools	133	1,2	% of total	2	0,1
Identified	2452	22,6	% of total	766	26,3
Bipolar flakes	975	64,7	% of identified flakes	112	23,8
Platform flakes	531	35,3	% of identified flakes	358	76,2
Bipolar blades	582	84,8	% of identified blades	27	11,5
Platform blades	105	15,3	% of identified blades	208	88,5
Bipolar cores	98	56,6	% of identified cores	19	31,1
Platform cores	75	43,4	% of identified cores	42	68,9
Bipolar tools	60	69,8	% of identified tools	1	50,0
Platform tools	26	30,2	% of identified tools	1	50,0
Unidentifed	47	35,3	% of tools	-	-

Table 2. Quartz artefacts from Helvetinhaudanpuro and Likolampi sites.