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SAARENOJA 2 – AN EARLY MESOLITHIC SITE IN SOUTH-EASTERN FINLAND: PRELIMINARY RESULTS AND INTERPRETATIONS OF STUDIES CONDUCTED IN 2000 AND 2008–10

Abstract

This article presents the material acquired from the excavations of Saarenoja 2, an Early Mesolithic site in south-eastern Finland and one of the oldest sites in the eastern part of the Baltic Sea. Based on radiocarbon datings, it was occupied for a relatively short time, c 8750–8550 cal. BC. The dwelling site was situated on a small island that was separated from the mainland by a shallow but wide inlet. A relatively large amount of flint and quartz discovered at the site offers a unique opportunity to compare different knapping techniques in different lithic materials in Finland. The flint material from Saarenoja 2 derives from two different directions: the Upper Volga and Belarus/Lithuania. In both cases, the raw material was transferred more than 500 km from its point of origin. Both source areas are also discernible in the distinct reduction methods and artefact forms. Raw material uses as well as similarities in stone technology and tool shapes indicate the presence of broad social and technological networks in the eastern European forest zone of the Early Mesolithic. These networks enabled the trade of raw material, both as semi-finished artefacts and finished tools. The colonisation of new areas was apparently relatively rapid and broad-based, and it was carried out by groups from an area ranging from the eastern Baltic to the central parts of European Russia. Sparse population encouraged trade, and the flint trade possibly served as a material form of communication, which helped to preserve and emphasise a sense of unity. Exogamy could also explain contacts between distant areas at a time when the fringes of these networks had only been initially occupied by a limited population. During the final phase of this expansion, the social networks were reorganised and transformed in the process. The areas connected by these new networks were considerably smaller than before. Simultaneously, contacts with the areas of origin diminished drastically, and were eventually almost completely broken, as local raw materials became dominant in tool production. In Finland, the change in lithic raw material from flint to local quartz was relatively rapid and took no more than a few hundred years.

Keywords: Early Mesolithic, social networks, dwelling sites, Finland, Saarenoja, flint, quartz

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INTRODUCTION

The origins of the postglacial settlement of Finland and the early mechanisms of colonisation of north-eastern Europe and Scandinavia have been important points of interest among archaeologists since the beginning of archaeological research in Finland. Initially, in the late 19th century, the stimulus for archaeological studies concerning the origin of the earliest settlement of Finland was mainly given by the larger programme of defining the 'Finnish people' organised along the thoughts and ideology typical of national romanticism (Salminen 2003: 22). Consequently, it was not until in the early 20th century, when Julius Ailio concluded that some of the stone artefacts found from the municipality of Suomusjärvi in southern Finland were preceramic (Ailio 1909: 98–100), that true, methodical research of the Finnish Mesolithic Stone Age began. Other scholars studying preceramic artefact types in the early 20th century included particularly Sakari Pälsi (e.g. 1913; 1915) and Aarne Europaeus (e.g. 1915; 1916a; 1920). It was indeed Europaeus who used the term 'Suomusjärvi culture' for the first time on 2 March, 1916, while giving a lecture at a meeting of the Finnish Antiquarian Society (Europaeus 1916b; see also Luho 1967: 15). In published literature, C. A. Nordman was the first scholar to make use of the term Suomusjärvi culture in 1921 (Nordman 1921: 326).

Archaeological fieldwork in the 1940s and 1950s in Askola, southern Finland, produced the material that enabled Ville Luho to make a distinction between the Suomusjärvi culture and the preceding Askola culture, based on the differences he observed in quartz materials from different sites (Luho 1956: 116–7). Subsequently, the concept of 'Askola culture' has been criticised (e.g. Siiriäinen 1981: 14–5), and eventually discarded. Following serious criticism directed at the methods of analyzing quartz materials, the earliest occupation phases in Finland were for many years mostly studied on the basis of material from earlier excavations, the only exception being the Ristola site in Lahti excavated in the 1970s. Torsten Edgren discovered similarities between the finds of Ristola and those of Pulli in Estonia, the latter being dated to the Early Mesolithic. Based on this comparison, he dated Ristola as also partly belonging to the Early Mesolithic (Edgren 1984: 22). Later, Heikki Matiskainen (1996) postulated the possible existence of a more extensive settlement pattern dating to the Early Mesolithic. The study of Hans-Peter Schulz (1996), however, was epoch-making in indicating that several known sites from southern Finland belonged to the Early Mesolithic judging by their find material (quartz) as well as shore displacement chronology.

At the end of the 20th century and the beginning of the 21st, several surveys with more emphasis given to studying the shore levels of the Ancylus Lake (c 9000–7200 cal. BC) were completed. As a result, new sites dated to the Early Mesolithic have been found in Finland almost annually. The first systematic archaeological survey of the shorelines of the ancient Ancylus Lake was carried out in 1999 in the municipalities of Imatra and Joutseno in south-eastern Finland, near the Russian border (Jussila 1999). Later surveys specifically aimed at locating the earliest occupation have been conducted, among others, by groups organised by Hannu Takala (e.g. 2004; 2009), Petro Pesonen (2005), Tuija Rankama and Jarmo Kankaanpää (e.g. 2005; 2008; 2009).

The above-mentioned 1999 survey in the municipalities of Imatra and Joutseno was a clear breakthrough in shedding light on the Early Mesolithic colonisation of Finland. Altogether 16 sites along the shorelines of the ancient Ancylus Lake were discovered from the district of Kuumanpohja, south-eastern Finland. In the year 2000, small-scale excavations were conducted by the authors of this article at three of the sites (Jussila 2000a). By the end of the year 2000 there were 18 sites in southern and central Finland that, according to shore displacement chronology, were older than 8000 cal. BC. In addition, 23 sites were dated between 8000–7200 cal. BC (Jussila 2000b).

During the summers of 2000 and 2001, the authors made surveys in the Karelian Isthmus, near the site of the 'Antrea net' -find, a famous discovery of an Early Mesolithic fisherman's kit (Jussila 2000c; for the Antrea net, see e.g. Pälsi 1920; Carpelan 2008). As a result, 10 new sites were discovered, and all of them dated to the Early Mesolithic based on their location near the shores of the Ancylus Lake. Along with sites found at Kuurmanpohja in Finland, these sites form an impressive group reflecting the Early Mesolithic colonisation process of south-eastern Finland and the Karelian Isthmus. A radiocarbon dating made from a fragment of burnt bone from the site of Ozero Borovskoe (Fi. Suuri Kelpojärvi, cf. Fig. 1) gave a result of c 8500 cal. BC (Hela-931: 9275±120 BP). Recently, several other sites have been discovered from the vicinity of Ozero Borovskoe in projects launched by the Lahti City Museum (Takala 2004: 152, 154).

In recent years, a wealth of material relating to the earliest occupation of Finland has been obtained. The greatest challenge has been to establish links between Finnish Mesolithic find assemblages and the wider settlement contexts of eastern and northern Europe of the same period. This can usually be achieved by comparing different artefacts from different sites. However, flint is not naturally present in the Finnish bedrock, and thus the stone tools are mostly manufactured from local quartz, whereas in most neighbouring areas, flint is the dominant material for tool production and the proportion of quartz is rather small. Remarkably, among the Saarenoja 2 settlement finds flint is dominant and, thus, for the first time, it enables a comprehensive comparison and discussion of the earliest Finnish settlements and the settlement networks of eastern and northern Europe. At the same time, the quartz assemblage of Saarenoja 2 makes it possible to compare it with other Finnish Early Mesolithic quartz finds.

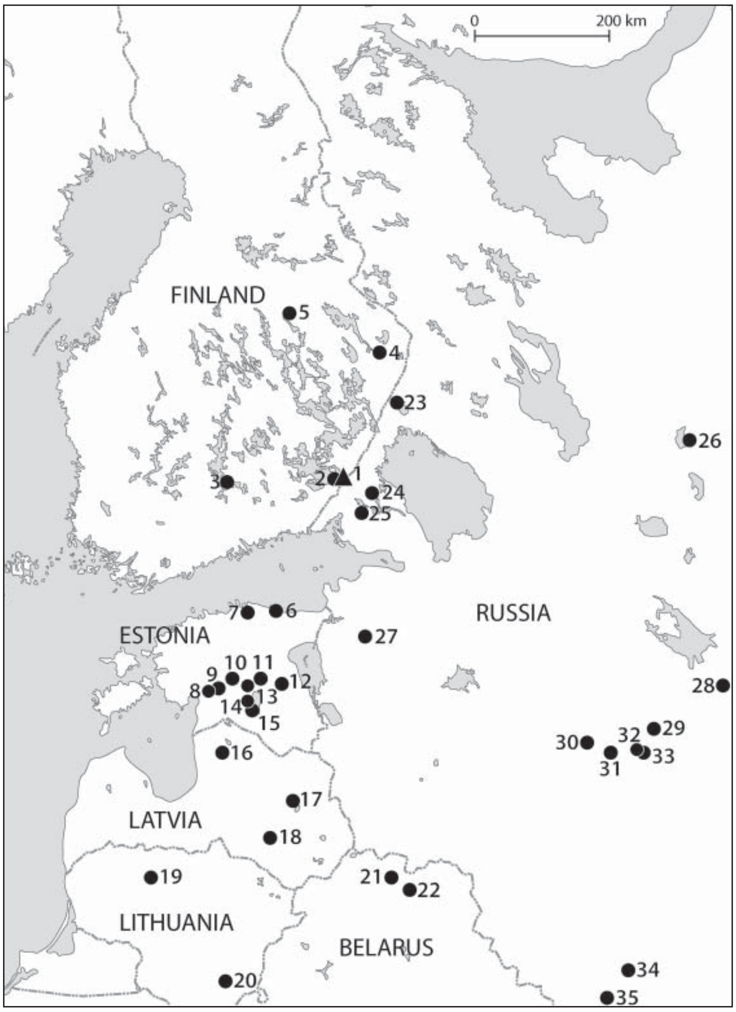

Fig. 1. Stone Age sites mentioned in text. Finland: 1. Saarenoja 2, 2. Muilamäki and Mielikonoja, 3. Ristola, 4. Helvetinhaudanpuro, 5. Rahakangas; Estonia: 6. Kunda Lammasmägi, 7. Vihasoo III, 8. Pulli, Sindi-Lodja I and II, 9 .Päästale, 10. Lepakose and Jälevere, 11. Kivisaare, Leie, Lohu and Siimusaare, 12. Kavastu and Ihaste, 13. Lalsi III, Oiu I and II, 14. Ridaküla, 15. Sõõrikunurme; Latvia: 16. Zvejnieki II, 17. Sūlagaļs, 18. Jersika; Lithuania: 19. Dreniai and Biržulis, 20. Margionys; Belarus: 21. Krumpliovo and Zamoshe, 22. Plusy; Russia: 23. Kirkkolahti 1, 24. Ozero Borovskoe (Suuri Kelpojärvi), 25. Veshevo 2 (Tarhojenranta), 26.Verete 1, 27. Sokolok, 28. Sanovoe 4, 29. Tihonovo, 30. Ozerski 5 and 16, 31. Butovo 4A, 32. Prislon, 33. Okaemovo 4, 34. Resseta, 35. Krasnoi 3 and 8.

RESEARCH HISTORY OF THE SAARENOJA 2 SITE

Timo Jussila discovered the Saarenoja 2 site (Fig. 1) in 1999, while surveying shore levels of the Ancylus Lake, as mentioned earlier. The initial finds consisted of some quartz flakes and one quartz implement (KM 31677:1–2).

In the year 2000, three small trenches were excavated at the site, their total area being 8.5 m² (Jussila & Matiskainen 2003: 669). The purpose of this small-scale excavation was to obtain a radiocarbon date for the site, and also to recover some find material which would shed light on the cultural affinities of the site. A charred piece of a pinecone scale was selected for radiocarbon dating, because in 2000 it was not yet possible to acquire reliable datings from burnt bone. The result was, however, disappointing (Hela-470: 7720±115 BP, median 6568 cal. BC). More detailed research has subsequently indicated that this dating most probably pointed to a random forest fire that had raged on the site long after it had been deserted.

Based on the hydrological history of the area, as well as some flint artefacts found from the site in 2000, Saarenoja 2 was nevertheless judged to be probably one of the oldest settlements in south-eastern Finland. This was confirmed in 2003, when a piece of burnt bone from the excavations carried out in 2000 was radiocarbon-dated and its median age was determined as c 8600 cal. BC (Fig. 2; Hela-728: 9310±75 BP; see Takala 2004: 150). The results of this small-scale excavation were very promising, and the flint artefacts strongly indicated eastern and southern contacts.

In 2008, a new research phase began at the Saarenoja 2 site, and since then excavations have taken place annually. The aim of this article is to present the material acquired from the excavations of 2000 and 2008–10. Altogether, a portion of 55 m² of the approximate total of 500 m² of the site has been studied.

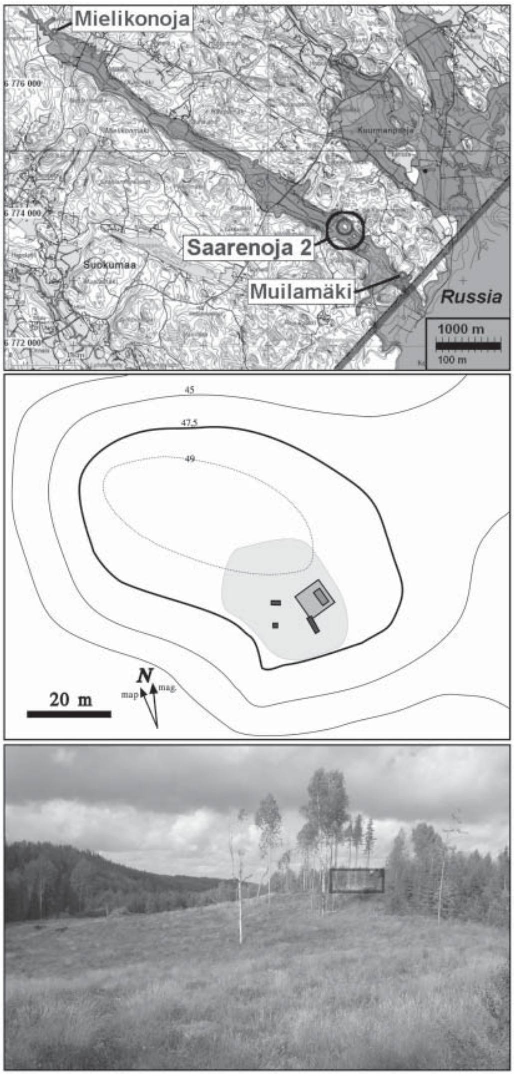

Fig. 3. A. The maximum elevation of the Ancylus Lake shoreline (c 8400 cal. BC) drawn on a map showing the present-day shores of the Baltic Sea; the Saarenoja 2 site, location N 61,0673 E 28,7225. B. General plan of the Saarenoja 2 site (grey area), with the excavated areas shown in black and dark grey. C. The site of Saarenoja 2 (marked with a rectangle) seen from south-east.

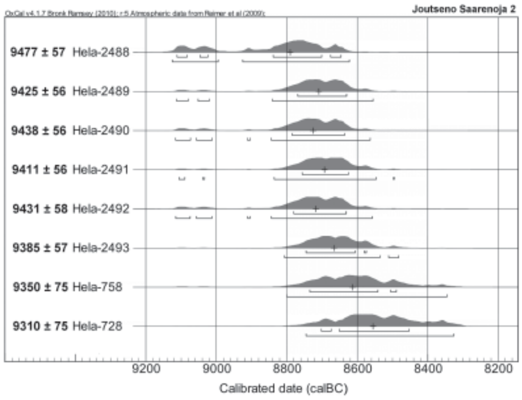

Fig. 2. Radiocarbon dates of burnt bone from the Saarenoja 2 site.

THE SITE AND ITS SURROUNDINGS

The site is located in south-eastern Finland (Figs. 1 & 3a), on the northern ridge of the Saarenoja valley, a narrow and short (little more than 7 km long in the south-east–north-west direction) river valley with the Saarenoja brook flowing at its bottom, located c 1 km north-west of the Russo-Finnish border. The width of the valley ranges from a few hundred metres to less than a hundred. The valley begins from the River Vuoksi valley in Russia, c 300 metres SE from the present state border. At the mouth of Saarenoja valley, the terrain descends steeply from a height of over 45 metres to a level of less than 25 m above present sea level, eventually merging with the valley of River Vuoksi. At the border zone between Finland and Russia, the Saarenoja valley is narrow and has very steep banks that, in the southern part of the valley, are quite rocky. There the valley is c 120 m wide at the 40 m a.s.l. elevation, narrowing down to c 50 m wide at the 30 m elevation. The level of the valley bottom at the Russo-Finnish border is c 20 m a.s.l., rising evenly to almost 40 m a.s.l. in the north-western end of the valley. The elevation of the valley bottom at the Saarenoja 2 site is 26 m a.s.l.

The site itself lies on the south-eastern slope of a small hillock (Figs. 3b–c). The gently sloping top of this convex hillock is about 65×45 m in size, and the edge of the hilltop is located at c 47.5 m a.s.l. The southern and south-western slopes of the hill are rather steep. From the top plane, the slope drops sharply about 17 m to a lower plane near the bottom of the valley, its elevation being c 31 m a.s.l. The northern and north-eastern slopes of the hill less steep. On the eastern and north-eastern sides of the hill, there is a 60 m wide flat ridge connecting the hill to the highlands of the northern banks of the Saarenoja valley. The length of this ancient, narrow isthmus is 180 metres. The soil on the southern and south-eastern sides of the hill is sorted sand and the topsoil has almost no stones. In the surrounding areas, the stones and boulders of various sizes are common.

On the eastern and south-eastern sides of the hilltop, as well as the southern side of the above-mentioned isthmus, a sandy ridge descends towards the river valley at an elevation of 41–3 m. a.s.l.

When the site was discovered, the vegetation on the hilltop was mixed forest (mainly spruce), but this was logged down in 2008. As a result of this logging operation, the topsoil at the location was partly exposed. Based on the distribution of artefacts found at the exposed areas, the size of the site can estimated roughly as 20 × 25 m. It covers almost completely the sandy and stone-free part of the hilltop.

Two barley kernels, complete with awn and husk, were found from the topsoil of the site and a thin, c 10 cm thick layer of grey sand was observed in the course of the excavations. We interpreted this as reflecting a farming phase, but none of the maps from years 1792, 1816, 1907 or 1930 bear evidence of a field or a meadow at the site. The modest thickness of tilled soil indicates a relatively short term of use or, alternatively, farming by primitive methods. The good preservation of the barley kernels implies that the field must be quite recent. Apparently, there was a short-lived barley field at the site sometime in the late 19th century or the early 20th century.

It is also worth mentioning that a fragment of a grenade or a bomb shell was discovered at the site. As noted, Saarenoja 2 is situated at a distance of just 1 km from the present national border, and was part of the warzone of the Russo-Finnish campaigns of WWII in the summer of 1941. However, as far as we know, no significant battles were fought nearby.

HYDROLOGICAL HISTORY

The Saarenoja 2 site is situated c 10 km south or south-east of the so-called first Salpausselkä end moraine, a major feature of the geology of southern Finland. This part of the country has been almost totally submerged during the Baltic Ice Lake stage of the Baltic Sea (c 10 600–9600 cal. BC), when the level of the Baltic was c 75 m above its present state. The following stage, or the Yoldia Sea (c 9600–9000 cal. BC), reigned at c 55 metres above present levels, and the maximum transgression level (8400–8200 cal. BC) of the Ancylus Lake (8900–7200 cal. BC) at Saarenoja was c 40–5 m a.s.l. The levels presented above were calculated using various large-scale maps that have been produced to illustrate sea levels at different periods of prehistory (Hyyppä 1966; Eronen 1990; Donner 1995; Saarnisto & Grönlund 1996).

The history of the waters north of the first Salpausselkä end moraine (the Saimaa water system), including its earlier phases, is well known, but when projected to the site of Saarenoja, it suggests a level of 34 m a.s.l., which is not credible. However, some theories claim that there is a hinge line somewhere at the level of the first Salpausselkä end moraine, between the Saimaa water system and Saarenoja (e.g. Saarnisto & Siiriäinen 1970; Miettinen 2002: 13). Because of this (so far hypothetical) geological formation between these two areas, the hydrological phases of the Saimaa water system cannot be directly projected to the site of Saarenoja.

For the time being, the shore displacement curve suggested for Vetokallio in the former Finnish parish of Heinjoki (present-day Veshchevo in the Karelian Isthmus) by Matti Saarnisto and Elisabeth Grönlund (1996) is the only source that can elucidate the early hydrological history of the Saarenoja area. It shows that the maximum transgression of Ancylus Lake at Vetokallio reached the height of c 27–8 m a.s.l. Vetokallio lies 45 km south-east of Saarenoja 2 when measured perpendicularly to land uplift isobases. The shore displacement curves on the southern side of the first Salpausselkä end moraine (in municipalities of Pukkila and Orimattila) indicate that the inclination values in the area lie between 0.42 and 0.43 m/km at the time of the maximum transgression level of the Ancylus Lake (Tynni 1966; Sirviö 2000). Given this inclination value, the level of the maximum transgression of the Ancylus Lake at Saarenoja would have been c 46–7 m a.s.l., as projected from Vetokallio. At the early stages of the Ancylus Lake, when the transgression began, the water level at Heinjoki parish was c 18 m a.s.l. (Saarnisto & Grönlund 1996), and, correspondingly, when projected to Saarenoja with a tilt of 0.47m/km, it would have reached the level of 39 m a.s.l.

Saarenoja 2 is clearly older than the maximum transgression level of the Ancylus Lake, and, indeed, the Ancylus Lake phase never seems to have reached this site. During the occupation phase of Saarenoja 2, the water level of the Ancylus Lake and/or ancient Lake Ladoga was c 40–2 m a.s.l., as projected from the Vetokallio shore displacement curve mentioned above. The water level would have been almost eight metres below the lowest find concentrations of the site, on a rather abrupt slope of the hill. The horizontal distance from the southern and south-western slopes of the site to the waterline would have been c 40–50 metres, and thus the site would not have been directly connected to the waterline of the Ancylus Lake (for a discussion on the connections between shorelines and prehistoric sites, see e.g. Jussila & Kriiska 2006).

Still, there is some geological evidence to indicate that Saarenoja 2 was situated close to the ancient waterline. A phosphate sample line taken from the site down along the slope indicates that the water level on the site was 47.5 m a.s.l. during the occupation phase (Fig. 4). There is a peak of phosphate values at this elevation, while the values both above and below this point are considerably lower (for a more thorough discussion of this issue, see e.g. Broadbent 1979: 24, 28). The lowest level of artefacts found at Saarenoja 2 (from patches disturbed by forestry) lies 47.4 metres above present sea level. Below this level, no signs of prehistoric occupation have been found either on the hillsides below the Saarenoja 2 site or the gently downwards-sloping terrace to the south-east of the site.

If Saarenoja 2 was situated on the edge of an ancient waterline, on top of the slope at 47–7.5 m a.s.l., then the most probable explanation for the water level in the area is that there has been an isolated lake in the valley of Saarenoja. If so, the threshold of this lake must have been near the present Russian border, at the elevation of c 47 m a.s.l. The threshold is highly unlikely to have been any higher, judging from the marks left in the landscape. There are two 50 m wide valleys at the elevation of 47 m a.s.l. to the south-east of the Saarenoja 2 site, which exhibit no signs of major fluvial forces. At the present border zone, the Saarenoja valley is quite sandy, with the exception of its southern bank where some open rock formations are visible. For us, it seems most probable that the valley of Saarenoja was initially an isolated lake separate from the Yoldia Sea, and later a part of the Ancylus Lake, connected to the latter by a narrow and sandy passage situated at the present border zone between Russia and Finland.

Approximately 130 metres north-west of the threshold lies the Stone Age dwelling site of Muilamäki, situated on the north-eastern side of the Saarenoja valley (Figs. 1 & 3a). The lowest level of artefacts found at Muilamäki is 46.5 m a.s.l. One radiocarbon dating (of a piece of burnt bone) has been obtained from this site, and this gave the result of c 8400 cal. BC (Hela-2487: 9163±55 BP). Both radiocarbon dating and shore displacement curves indicate that this site was oc-

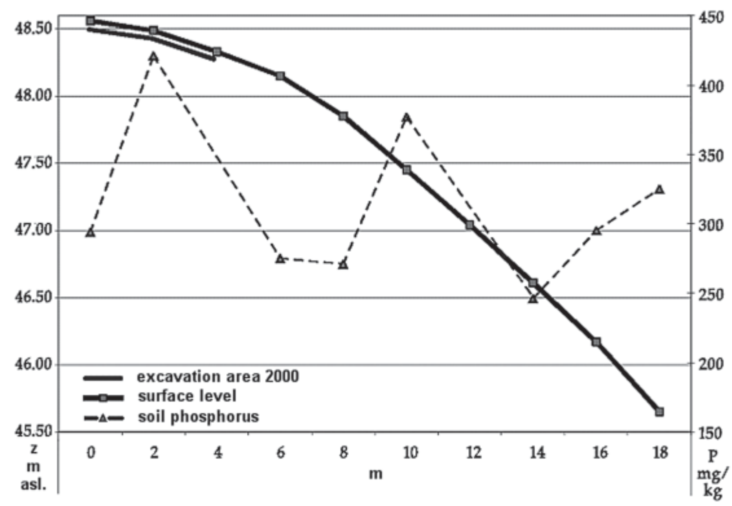

Fig. 4. The phosphate sample line obtained from the site down the slope and towards the Saarenoja brook.

cupied around the maximum transgression level of the Ancylus Lake or slightly earlier.

On the north-western side of the Saarenoja valley, c 6 km north-west from the Saarenoja 2 site, lies the site of Mielikonoja (elevation 42–3 m a.s.l.; Figs. 1 & 3a). A fragment of burnt bone from the site was radiocarbon-dated to c 8100 cal. BC (Hela-2486: 8939±56 BP). Apart from few small test pits, no significant excavations have been conducted on this site. According to the shore displacement data available, the ancient Lake Ladoga was cut off from the Ancylus Lake just before this date and would have reached the elevation of c 39 m a.s.l. near the site. It should be noted, though, that the Mielikonoja site is located in a rather inconvenient place on the bottom of a narrow bay, c 30 m from the shore, when compared to the water level at 8100 cal. BC. There would have been several more convenient locations to live in at the vicinity of Mielikonoja.

As a working hypothesis, we propose that the Saarenoja valley was cut off from the Yoldia Sea around 9200 cal. BC. Following that, the water level of 'Saarenoja Lake' would have stayed relatively stable (or, perhaps, fallen slightly) until the time of the maximum transgression level of the Ancylus Lake at 8400–8200 cal. BC. During this time, the water level of the Ancylus Lake would have risen very close to the threshold elevation situated near the present Russo-Finnish border. Eventually, the pressure and the erosion caused by rising waters would have broken this narrow isthmus, and the lake in the Saarenoja valley would have merged with the Ancylus Lake. After this event, any changes in the water levels of Saarenoja valley would have mainly followed the regression of the Ancylus Lake. Diminishing water levels at the Saarenoja valley reached the level of the ancient Lake Ladoga by c 8000–7900 cal. BC. It is possible, though, that even after this event, a lake regulated by the above-mentioned threshold existed in the Saarenoja valley for some time – and there may even have been several small basins separated by narrow straits at the present Saarenoja valley. Around 8000 cal. BC the water level of ancient Lake Ladoga was c 38–9 m a.s.l. In fact, the water level of Lake Ladoga probably reached all the way to the south-eastern end of Saarenoja valley before the emergence of River Neva circa 1350 cal. BC (Saarnisto 2008: 137).

The lake hypothesis for Saarenoja valley explains the location of the Saarenoja 2 and Mielikonoja sites better than changes in the water levels of the Ancylus Lake. According to this hypothesis, the dwelling site of Saarenoja 2 would have been situated on a small island that was separated from the mainland by a shallow, c 180 m wide inlet. Between the site and the southern shore of Saarenoja valley, there was a deep and more than 240 metres wide channel. However, the hydrological history of the area still requires much work, and the history of the Saarenoja valley and the sites situated along its ancient shores remains somewhat unclear.

LITHIC MATERIAL

On the research history of flint and quartz in Finland

Research on exotic lithic materials such as flint has been rather limited in Finland, as this raw material is not naturally present in the Finnish bedrock. The main focus of previous flint studies has been on the younger Stone Age, but recently more attention has been paid on flint assemblages dated to the earlier Mesolithic Stone Age (e.g. Hertell & Manninen 2006).

Typically, very few flint artefacts are found at Finnish Stone Age sites, the main exception being the Typical Comb Ware period (4100–3400 cal. BC), when the amount of flint artefacts increased considerably (e.g. Europaeus-Äyräpää 1930: 210; Manninen et al. 2003: 161). From the earliest days of archaeological research in Finland, it has been assumed that all flint artefacts found in Finland were imported. At first, it was assumed that flint was imported both from southern Scandinavia and northern Russia (e.g. Aspelin 1875: 27; Appelgren-Kivalo 1908: 40; Ailio 1909: 67–9; cf. Pälsi 1915: 122). In 1919, Ailio presented a model for the trading routes of Stone Age flint in northern Europe. He sketched a trading route from the Valdai region of Russia to Finland, in which the area of Aunus (Ru. Olonets, part of present-day Republic of Karelia, Russia) would have served as an important, interregional mediating link (Ailio 1919: 6–7). Even though this model was strictly theoretical, it was soon adopted by Finnish archaeologists almost without any change (e.g. Tallgren 1931: 69; Luho 1948: 44; Kivikoski 1961: 34; Vuorinen 1982: 65; Huurre 1983: 225; Edgren 1984: 40; Lehtosalo-Hilander 1988: 76 Salo 2008: 44; cf. Meinander 1954: 118–9).

The mineralogy of the Finnish flint assemblage has been investigated only sporadically. In practice, only a few articles have been written on this subject. The total amount of flint artefacts studied in this way in Finland is quite low; a little over 200 pieces have been analysed (Kinnunen et al. 1985; Matiskainen et al. 1989; Kinnunen 2002). The results suggest that most of the flints from the Comb Ware period originate from the eastern Carboniferous deposits. On the other hand, most of the Early Metal Period flints subjected to mineralogical analysis originate from south Scandinavian Cretaceous sources (Matiskainen et al. 1989: 637).

Only a handful of Early Mesolithic sites in Finland have been subjected to mineralogical analysis, and most of the artefacts studied so far are from the Ristola site. The classification between Cretaceous and Carboniferous flint at Ristola was done macroscopically for each individual find, the result being that 14.3% of the finds were Cretaceous and 85.7% Carboniferous (Takala 2004: 107, Fig. 109). However, microscopic examination of some of the Ristola flints gave a very different result: in this analysis, 44.5% of artefacts were Cretaceous and 55.5% Carboniferous (Takala 2004: Figs. 110–1).

Already in the 1960s, some Finnish flint artefacts were assigned to the Mesolithic (Meinander 1964: 56–7), but the first archaeologist to pay special attention to Early Mesolithic flint artefacts in Finland was Torsten Edgren in the 1980s (Edgren 1984: 22). Thereafter, quartz materials dated to the Early Mesolithic were also re-examined in the 1990s (e.g. Schulz 1990; Rankama 1997; Räihälä 1998; 1999), but intensive research on stone technology began only in the beginning of the 21st century (e g. Rankama 2002; 2003; Manninen et al. 2003; Takala 2004; 2009; Rankama & Kankaanpää 2005; 2008; 2009; Tallavaara 2005; Hertell & Manninen 2006; Jussila et al. 2006; 2007; Pesonen & Tallavaara 2006). Unlike the earlier research focused on the morphological features of the lithic material, this new wave of research has systematically studied the technological features and their details in trying to reconstruct the whole *chaîne opératoire*.

Although quartz was the most extensively used lithic raw material of the Finnish Stone Age, it has been studied very little until recently. One reason for this may be found in the critique aimed at quartz research after the excitement of the early years (e.g. Siiriäinen 1981: 14–5). It is also possible that quartz as a raw material has been viewed as too difficult and challenging, and thus the threshold for initiating research has remained quite high. Thus, for a long time, Finland practically had no tradition of quartz research whatsoever.

In the second half of the 20th century, Luho researched the earliest settlement of Finland and its quartz material by comparing its external features to those observed in flint assemblages. He emphasised that long blades and blade cores were more common at the sites of the Askola culture than those associated with Suomusjärvi culture, and concluded that this must be an old technological feature (Luho 1956: 116–7). Furthermore, the quartz technology of the Finnish Comb Ware culture would have continued the tradition of the Suomusjärvi culture without any greater technological changes (Luho 1967: 120).

Luho's analysis of the quartz material has later been criticised. According to Ari Siiriäinen, his uncritical use of typological terms related to flint technology inevitably led to false conclusions, as the technological fracture features are quite different, and because quartz became more common as a raw material, different technological methods soon replaced the ones used for flint (Siiriäinen 1981: 14–5; cf. e.g. Knutsson 1993: 12; 1998: 78 ff.). Based upon an analysis of its quartz material, Siiriäinen assigned the earliest settlement of Finland to the Suomusjärvi culture and, furthermore, maintained that this culture was quite homogeneous in Finland and also in the adjacent neighbouring areas to the east (Siiriäinen 1981: 18; see also Pankrušev 1994: 67).

Although the basic features of quartz technology differ from flint technology, some similarities can also be found. In our opinion, some of the fracture principles in flint and quartz are basically similar and thus comparable with each other. One of the main differences between quartz and flint is that the former is more easily fragmented, meaning that the same knapping technologies are not always practicable in working quartz and flint. Fragmentation is, in fact, one of the main properties to consider when investigating quartz and its knapping techniques. There are also some similarities involved in the secondary production of quartz and flint, which is why we believe the use of flint knapping terminology is reasonable. Quartz typology must therefore be primarily based on knapping techniques and not on the exterior shape of the artefacts (Schulz 1996: 18; Knutsson 1998: 78 ff.; Hertell & Manninen 2005: 84–5; cf. e.g. Callahan et al. 1992: 32).

The main problems in studying the lithic material of Saarenoja 2 had to do with differentiating between the various knapping techniques, with comparing the amounts of flint and quartz and, in addition, with trying to resolve the differences between the uses of flint and quartz at the site.

Methods and terms

In primary lithic reduction, two different striking techniques can be distinguished in Finland: the platform technique and the bipolar technique. In the platform technique the core is held in one hand and supported by the thigh, for example, and flakes or blades are removed from the core with some sort of a striking implement. 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 resulting from this method include bulbs, points of percussion or various sharp edges (e.g. Crabtree 1972: 11; Knutsson 1988a: 37).

When using the platform technique, an anvil can be used. A piece of raw material or a core is placed on an anvil, and flakes or blades are detached from it by blows directed at the platform. If the striking angle is less than 90°, the above mentioned features, diagnostic to platform striking, may be identified in the artefacts. In particular when working with quartz, the other end of the core, flake, or blade, is often crushed against the anvil. This method of working can easily be identified if an artefact is crushed at the other end and a platform can be distinguished. Some researchers view platform-on-anvil as an intermediate technique between the platform technique and the bipolar technique (e.g. Callahan 1987: 15–7; Knutsson 1988b: 89). When the raw material piece has been sufficiently reduced, the bipolar technique may be used to work it further, if necessary (Knutsson 1988b: 148–9; cf. Olofsson 2003: 5). Technically, the term 'bipolar blade production' introduced by Schulz may be regarded as belonging to this category (Schulz 1990: 12; see also Olofsson 2003: 71–2).

Basically, a stone can be worked with direct or indirect blows. Direct blows are executed with a hammer. Indirect blows, by contrast, are executed using some sort of an intermediary tool (punch) made of wood, antler, bone, or similar material, and applied between the core and the hammer stone.

An anvil is also used in the bipolar technique. In bipolar reduction, a chunk of raw material or a core is struck directly while resting on an anvil. As a result, the tension points in the stone give way and splitting occurs along the fault planes in the lithic material. Split or fragmented cores that are formed using this technique often resemble the 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 flakes produced using the platform technique, bipolar flakes usually do not feature remnants of a platform or clear bulbs of percussion. Scars of percussion do appear, and flakes produced using the bipolar technique can sometimes be even thinner and narrower than those made with the platform technique (Crabtree 1972: 10–1; see also Callahan 1987: 61; Rankama 2002: 7 with references). In some situations these artefacts can be more useful than flakes and blades made using platform technique.

The material analysed from Saarenoja 2 was divided into flakes, blades, cores, and tools. The definition of flakes is somewhat different from the traditional one in our classification, since we included in the 'flake' category both the results of primary reduction and debris. If a flake was more than two times longer than its width, it was classified as a blade (see e.g. Tixier 1974: 5; Patten 1999: 56). Microblades were not classified as a separate group in our research, even though this has been done in some analyses.

Blades were distinguished from other lithic materials in both the bipolar and platform techniques. If a blade was classified as complete, both the distal and proximal ends could be identified. If one end was missing, the artefact was classified as a blade fragment. The weights and lengths of complete flakes and blades were measured. This was done in order to find out whether the sizes of cores could be linked with the sizes of flakes and blades and, furthermore, whether these might reflect the possible changes in knapping techniques in the *chaînes opératoires*. In the course of knapping, cores naturally become smaller. Because of this physiological fact, one might well assume that it is not possible to acquire reliable information simply based upon the cores of an archaeological assemblage. For example, the chances of finding out the size of raw material lumps and cores used at the site are usually rather low. Information on the size of cores, however, is quite often preserved in the flakes and blades, and this can be statistically measured. Still, the extent of the largest flakes does not necessarily reflect the maximal dimensions of the core, because flakes and blades do not always get separated from the whole length of a core. In addition, quartz is quite easily fragmented, and it is not possible to acquire reliable measurements of the length of flakes and blades without refitting (Hertell & Manninen 2005: 88). Because of the above reasons, the length of the flake and blade fragments at Saarenoja 2 was generally not measured.

Based upon published literature on lithic technologies, the experimental lithic collections of Jacques Pelegrin and Are Tsirk, and observations made during lithic courses held by Tsirk, we have distinguished some differences in the stone knapping technologies at Saarenoja 2. Soft hammer percussion can be distinguished among the lithic material by observing certain special features; (1) Flakes/blades are of an irregular shape and the edges exhibit wave-like curves. Similar features can also be detected in the negatives of the cores. (2) Usually only weak marks of fractures can be detected on the dorsal side of the blade, or they are non-existent. (3) A gentle, oval and relatively large striking surface can often be detected on the proximal end of the flake/blade. In addition to this, a small flake may be detached from the striking surface during the knapping process. (4) Most of the blades made with soft hammer percussion are narrower at the distal end, forming a pointed shape. Blades that have been removed indirectly with a punch are usually more regular in shape.

Flakes made with hard hammer percussion often have fairly similar features to the ones made by soft hammer percussion. Some distinguishing features can be observed, though; (1) A more regular shape. (2) More than one flake is detached from the striking bulb, and the bulb as a whole is often more damaged than with soft hammer percussion. (3) There are some clear marks of crushing at the proximal end in the vicinity of the striking platform.

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

Both complete cores and fragments of cores were defined as 'cores'. The platform technique was identified from the cores if a striking platform was detected, striking scars initiating from a platform remnant were visible, negatives of striking bulbs were visible and/or the marks of previous strikes could be seen on the surface of the core. The main characteristics of bipolar cores were defined as crushed ends of cores and striking scars on both ends of the core. Only clearly recognisable ends of cores, and cores split in half along their longer axis, were classified as fragments of bipolar cores. It must also be taken into account that some cores may have been reshaped to form some kind of tools. In our research, we separated flake tools from core tools. Also, one must remember that with the bipolar technique it is possible to work the material as long as the core exists, and the 'final' core may no longer be identifiable (e.g. Knutsson 1988b: 174–6; Shott 1999: 220). Because of this, the amount of cores can only be regarded as suggestive.

The basis of our classification is morphological: an artefact is classified as a tool only if a distinct edge made by secondary working can be observed. The definition as such is quite subjective and based on the analyser's expertise in the details of quartz and flint reduction. The shape and striking technique of tools was defined with the bare eye, that is, without the use of a microscope. This method undoubtedly reduces the total amount of information extracted from the material, but it 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 this method makes it easier to compare the different materials. Had we used a microscope, the proportion of tools would most certainly have increased since the use-wear marks

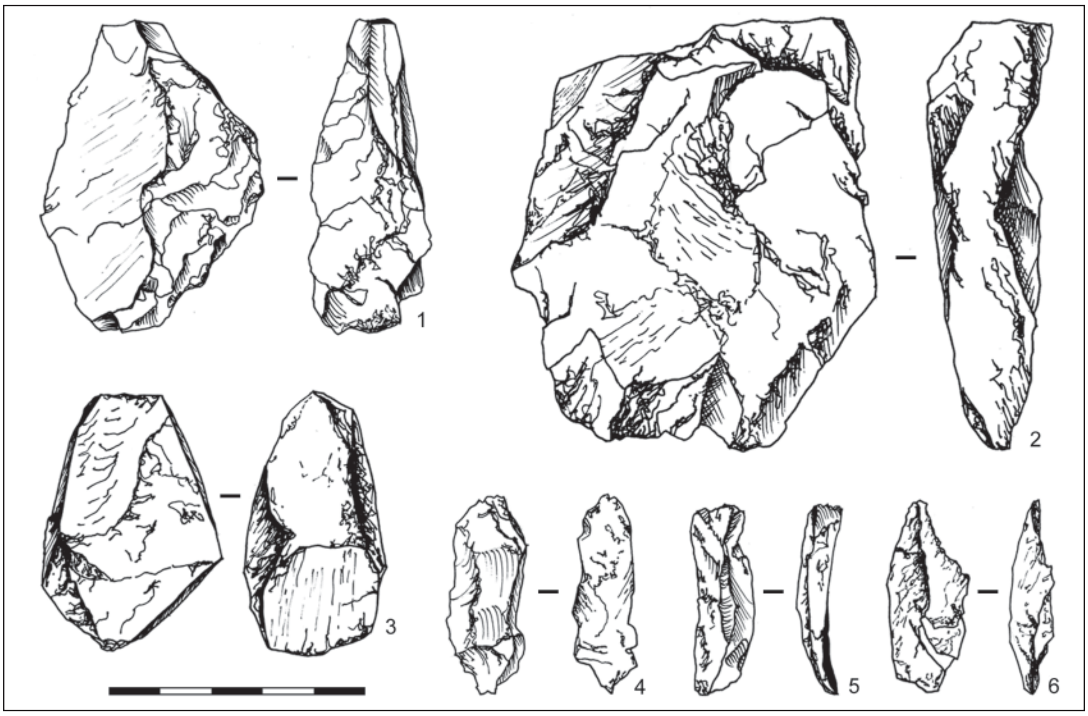

Fig. 5. Quartz artefacts from Saarenoja 2: a platform core (1), a platform flake (2), a bipolar protocore (3), a bipolar core (4), a platform blade (5), and bipolar blades (6) (KM 38104:45, 1150, 860, 81, 1035, 416).

on quartz would have been detected. The number of tools identified in our analysis thus probably does not correspond to the actual number of tools used at the dwelling site, since unretouched edges could be used at least for shorter periods (see e.g. Callahan 1987: 62; Knutsson 1988b: 14 with references; Yerkes 1990: 173).

Without taking any position on the functional use of the tools, we have, however, evaluated their suitability for different situations. Tools with edges that are suitable for scraping and cutting are here referred to as scrapers, while the tools we call burins are better suited for gouging and grooving. In the flint material we have also distinguished arrowheads, points, retouched flakes/blades and their fragments, and a 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 was over 45 degrees and sharp if the angle was less than 45 degrees. Burins were observed only from above.

Lithics at Saarenoja 2

In total, 1702 lithic artefacts have been recovered from the site in the course of the 2000 and 2008–10 excavations. Of these, 792 are quartz (47% of the total lithic assemblage), 870 flint (51% of the total lithic assemblage), and 40 of other lithic raw materials (2% of the total lithic assemblage).

Most of the quartz finds are flakes and blades/blade fragments (Fig. 5:2, 5, 6), this group amounting to 759 pieces. Of these, 129 (17% of this group) are blades/blade fragments, while 30 were distinguished as cores or protocores, amounting to 3.8% of the whole quartz assemblage (Fig. 5: 1, 3, 4).

The quartz material found at the site varies in colour and quality. The assemblage contains milky (e.g. KM 37866:12) as well as almost translucent material (e.g. KM 37866: 354; KM 38104:25). Additionally, different shades of grey and so-called smoky quartz are also present (e.g. KM 38104:973). The raw material was obtained both by extracting from veins (e.g. KM 37866:1, 11; KM 38104:860), and collecting as cobbles (e.g. KM 38104:214). The weight of lithic artefacts varies from 0.5 to 166.3 g.

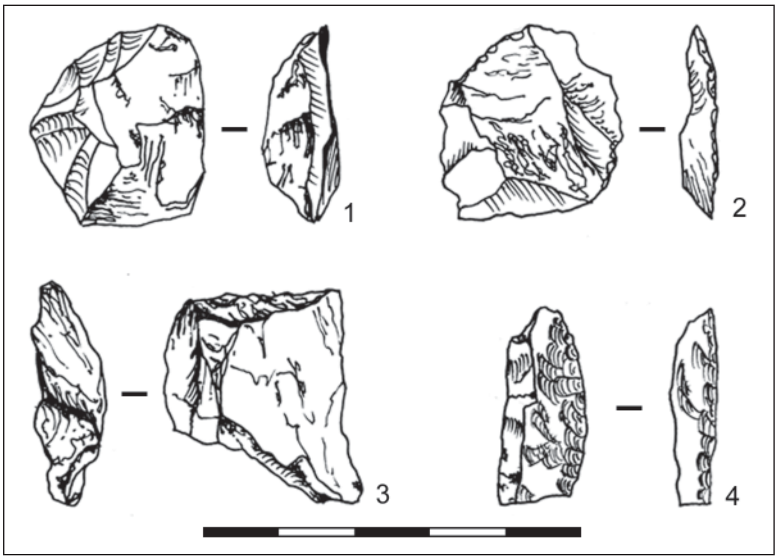

Fig. 6. Quartz scrapers (1–3) and a fragment of a scraper (4) from Saarenoja 2 (KM 38104:710, 1017, 224, 950).

In 431 cases (54.4%) of the 792 quartz finds, the production technique could be determined. 330 (76.6% of the identified pieces) were produced with the bipolar method: 74.8% of the flakes, 77.3% of blades/blade fragments, 71% of cores, and 77.8% of the finished artefacts. Platform percussion was used in 109 of the quartz pieces; 25.2% of flakes, 22.7% of blades/blade fragments, and 29% of the cores.

Altogether 115 tools could be identified in the lithic material. Of these, 15 were of quartz (1.9% of total quartz assemblage), 97 of flint (11.1% of total flint) and three of other lithic raw materials (7.5% of the other lithics). Of the quartz artefacts, 11 were scrapers (Fig. 6), two were burins, one a retouched blade and one a retouched flake. The edges of the burins were made by removing microblades. Almost all quartz tools were made out of flakes, with only one burin being made from a blade. When examining the position of the cutting edge, we found one tool with an edge at the end and three tools with an edge at the side. One tool has edges both at the end and at the side of the artefact. All edges except for one are rounded and, in two cases out of three, the angle of the edge is blunt (over 45°).

The number of flint pieces from the excavations of 2000 and 2008–10 is 869. The material varies in colour and to some extent also in quality. The colours identified are grey (44.3 %), white (24.5 %), brown (22.3 %), red (17 %), purple (10.9%), black (6.3 %), and yellow (6.6 %). In most cases a single piece is of uniform colour, but some are multicoloured (e.g. brown with red, grey with purple). Some of the flint pieces and fragments have been burnt, such as one fragment of an arrowhead (KM 37866:152), which has been exposed to fire after the fragmentation.

No mineralogical or other natural-scientific analyses have been made of the lithic material of Saarenoja 2. Nevertheless, in our opinion it is possible to draw some conclusions about the origins of the flint on the basis of colour, quality, and the comparative material assemblages from eastern and northern Europe. Some comparative spectrometric research on assemblages in western Russia and Estonia has indeed been carried out, and based on these studies at least a rough distinction between different sources of flint can be made (e.g. Ailio 1909: 68–9; Galibin & Timofeev 1993; cf. Kinnunen et al. 1985; Taavitsainen 1985). Colour determination can, however, occasionally be difficult and even questionable, especially in the case of burnt specimens. The translucent brownish black flint, as well as a part of the brown, white and grey flints, probably originate from Cretaceous sediments found in the surface soils in the form of nodules in southern Scandinavia, Poland, Belarus and Ukraine, and to some extent also in southern Lithuania (e.g. Jaanits et al. 1982: 32; Zhilin 1997: 332; Herforth & Albers 1999; Koltsov & Zhilin 1999a: 66; Sulgostowska 2002: 9; Lisitsyn 2003: 45; Baltr nas et al. 2006a: Abb 1). In our opinion, southern Scandinavia is not a very probable source of origin for this flint, because the reference materials for artefacts and lithic technological features strongly point to the direction of Belarus and Lithuania.

The red, purple and yellow flints – and some of the brown, white and grey types – presumably derive from the Carboniferous sediments of the Volga Plateau in Russia (Zhilin 1997: 332), but similar flint can also be found in the glacifluvial moraine sediments of the Valdai region (e.g. Zhilin 1997: 331; Takala 2004: Fig. 112; see also Kinnunen et al. 1985: Fig. 1). The purple flint, which was widely dispersed in the Baltic Sea area during the Neolithic period, has been specifically localised to the Volga Plateau on the basis of spectrometrical analyses (Galibin & Timofeev 1993). Even today its nodule form is abundant in the Volga River and its tributaries (Zhilin 1997: 331).

Approximately 65% of the flint material found in the Saarenoja 2 dwelling site probably originates from the Upper Volga area, and 35% from Belarus/Lithuania. In both cases, the raw material was transferred more than 500 km from its point of origin.

Most of the artefacts found from Saarenoja 2 are from primary production; 773 pieces (89.9% of all flint artefacts). There are 292 pieces of blades and blade fragments (33.5% of all flint artefacts, see Fig. 7:2–5) in the flint assemblage and 577 pieces of flakes and flake fragments (66.4% of all flint artefacts). Besides, one fragment of a platform core has been detected (0.1% of all flint artefacts, see Fig. 7:1).

All the identified pieces have been manufactured using the platform technique. Both soft and hard hammer percussion was used, and some pressure flaking can also be observed. It was possible to identify the percussion technique of 470 (54.4% of total) blades and flakes; in all of them the proximal end of a flake/blade was still present. Judging by the shape of the flint artefacts, though, almost all of the flints found from Saarenoja 2 seem to be manufactured with the platform technique. Of the identified flints, 234 pieces were struck by means of soft hammer percussion, 18 by means of hard hammer percussion, and in six cases narrow blades have been removed by pressure flaking. Additionally, one flake has apparently been removed indirectly with a punch. The flakes also include maintenance flakes removed to rejuvenate the side and platform of the core, i.e. core tablets. Some blades have been segmented deliberately. Several deliberately snapped segments of single blades have been found at the site.

One fragment of a conical blade core was found at the site. It is of black flint and at least in the final stage soft hammer percussion has been used. There are several marks on the side of the platform indicating platform rejuvenating (Fig. 7:1).

Of the 97 tools (11.1% of total flint assemblage), most have been manufactured from retouched blades (40 pieces, 41.2% of tools) or flakes (12 pieces, 12.4% of tools). The tools comprise nine burins (9.3% of tools), 13 scrapers (12.4%, see Fig. 8:1–2), 12 points (Fig. 8:5 & Fig. 9), of which 11 are arrowheads (11.3%), 10 inserts (10.3%, see Fig. 8:6, 7), and one chisel. Unretouched flakes, blades and their fragments may also have been used as tools. This is suggested by the shiny or worn edges observed on some pieces.

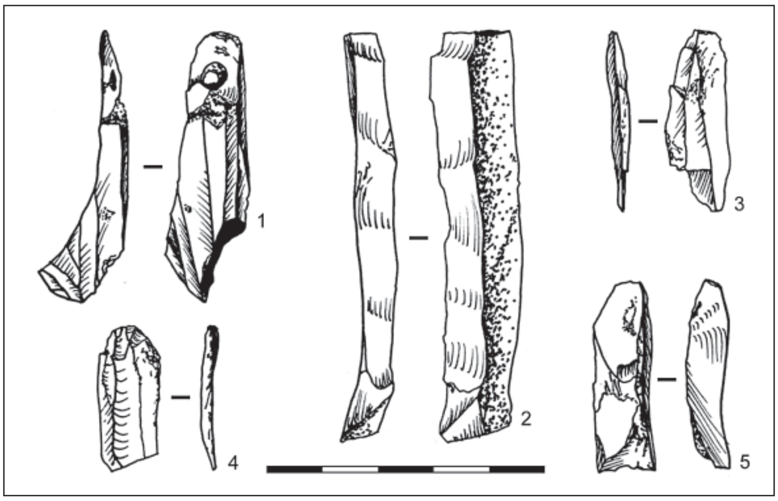

Fig. 7. Fragment of a flint core (1) and fragments of flint blades (2–5) from Saarenoja 2 (KM 38104:444, 1052, KM 37866:511, KM 38104:315, 1040).

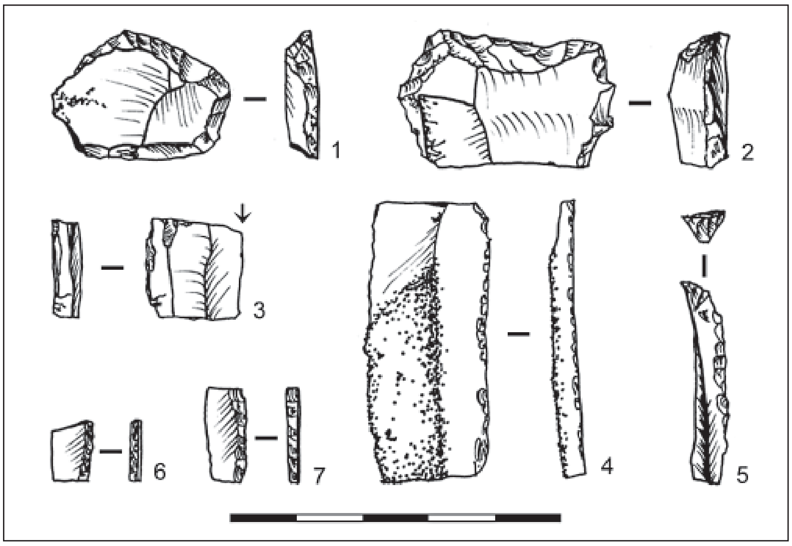

Fig. 8. Flint scrapers (1–2), a burin (3), a retouched blade (4), fragment of a narrow flint point (5), and inserts (6–7) from Saarenoja 2 (KM 37866:221, 111, 102, 466, 158, KM 38104:430, 351).

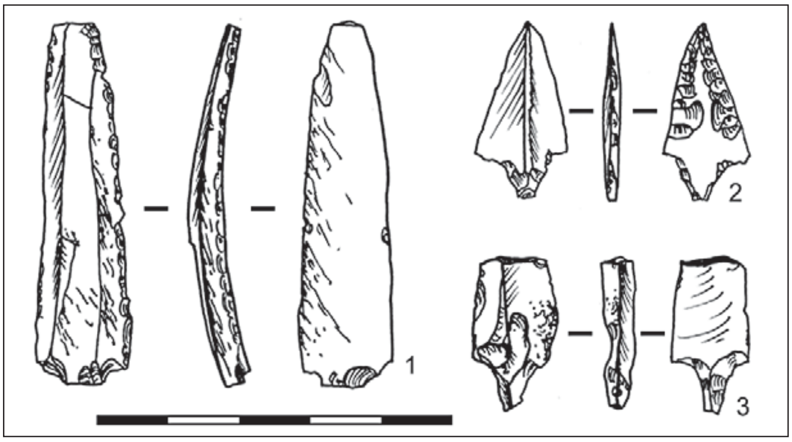

Fig. 9. Fragments of flint arrowheads (1, 3) and a complete flint arrowhead (2) from Saarenoja 2 (KM 37866:1524, 26, 152).

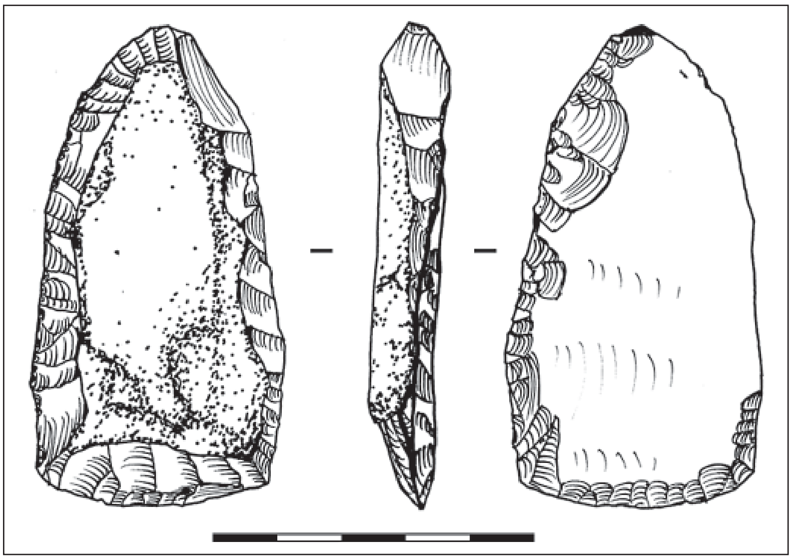

Fig. 10. Flint chisel from the Saarenoja 2 site (KM 37866:533).

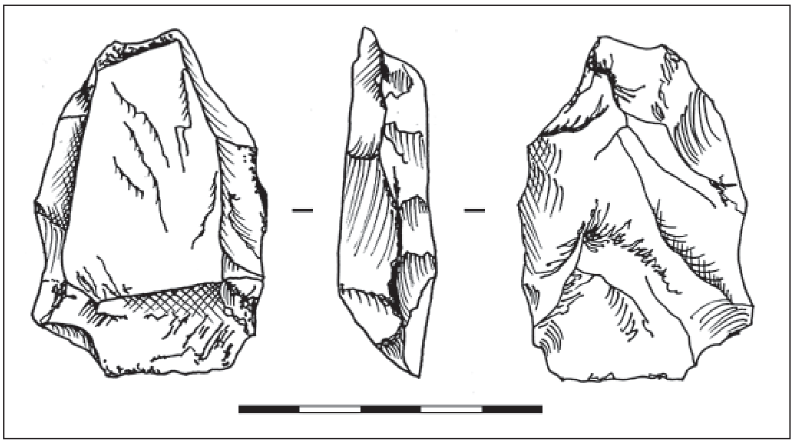

Fig. 11. Stone chisel from the Saarenoja 2 site (KM 37866:531).

Burins have been made from fragments of blades (7 pieces, Fig. 8:3) or flakes (2 pieces). Their size varies between 1.3.–2.2 cm. On five of the burins the edge is on one side of the artefact. On one burin there are two edges on one side of the artefact, and one edge on the other side (KM 37866:206).

Of the 11 arrowheads or arrowhead fragments, only one is complete (Fig. 9:2), although its small size (length 2.5 cm, maximum width 1.3 cm) indicates that it was probably made by reshaping a larger piece. It was manufactured from a black flint blade fragment. More than 2/3 of the ventral face of the blade part has been retouched, the tang is small and steeply retouched on its dorsal face. Two slight barbs have been shaped at the shoulder. Another arrowhead fragment includes the tang (Fig. 9:1), made from a crest-shaped tapering distal end of a grey blade. One edge of the arrowhead has been retouched on the dorsal face, while the other edge is worn. The shoulder contains retouched barbs on each side. A third arrowhead fragment is a tang made from a white flint blade (Fig. 9:3). Both edges of this tang have been steeply retouched on the dorsal face. Most of the other fragments are smaller parts of a tang or a point. Of them, six are made of Cretaceous flint and two of Carboniferous flint.

Only one chisel (length 7.3 cm, maximum width 4.0 cm) was identified in the flint assemblage. It has been shaped from a reddish brown flint flake. On the dorsal surface, all the edges have been retouched. Some cortex remains at the centre. The tip and one edge of the ventral surface have been retouched completely, whereas the other edge features retouching only along its tip area (Fig. 10).

Of the lithic material, 40 finds consist of stones other than flint or quartz. Most of these are flakes and blade fragments made from at least three different types of green or grey stone. The same reduction methods have been used as with flint, and even the soft hammer technique can be seen in some pieces. Blades have also been split into segments, partly in the same way as flint blades. Some of the stone flakes possibly represent debitage produced during the shaping of a stone axe or chisel. One piece is possibly a small chisel manufactured from a greenish grey flake (length 5.6 cm, maximal width 3.7 cm) by using the percussion technique (Fig. 11). In addition, one half-finished greenish grey chisel, one borer, and a grinding stone made of sandstone were identified. Both sides of the borer were retouched, with the backside exhibiting a shiny surface.

DISCUSSION AND SUMMARY

Connecting the material discussed above to the wider context of eastern and northern European settlements of the period presents a great challenge for the research of early Finnish dwelling sites. However, it is possible to establish connections by comparing the assemblages found in different regions. Until recently, the artefact assemblages from Finland have mostly consisted of the local material, quartz, while the predominant tool material in the neighbouring areas has been flint. Thus, a comparative analysis of the finds has not been possible. The research carried out at the Saarenoja 2 site during the last few years has been characterised by the diversity of the lithic material, containing both flint and quartz, thus producing an unusual 'missing link' between two different stone working traditions.

The Saarenoja 2 dwelling site is one of the earliest of its kind in Finland. On the basis of radiocarbon datings, it was occupied for a relatively short time, c. 8750–8550 cal. BC (Fig. 2). Presently, it is impossible to say whether the site was occupied for several shorter periods or one longer period of time. However, the finds make it possible to draw the conclusion that artefacts have been imported, manufactured and used as well as abandoned on the site.

As we argued above, the site was apparently situated on an island in a small lake. At the time of its use, various occupation strategies were employed in the area to the east of the Baltic Sea, but the current view is that during the early phase of occupation the shores of the Baltic Sea basin were not inhabited. Instead, the habitation centred along the riverbanks and lakeshores some kilometres away from the basin. This can be seen in such riverbank sites as Pulli and Päästäle in Estonia and lake sites such as Sokolok (Russia) and Rahakangas (Finland) (Pesonen 2005: 3–4; Kriiska & Lõugas 2009: 171; Gerasimov et al. 2010: 31). Also, two sites in the area resemble the Saarenoja site in that they are located on islands of a lake – namely Kunda Lammasmägi in Estonia and Kirkkolahti 1 in Karelia (e.g. Kriiska & Tvauri 2002: 29; Shakhnovich 2007: 172) – even if both of them are slightly younger than Saarenoja 2.

The quartz finds from the Saarenoja 2 site offer a good chance to analyse the changes in stone technology that were caused by the adoption of a new raw material in the Early Mesolithic period. The change in raw material occurred rapidly, and in fact there were no real alternatives for people migrating into regions that lack natural flint resources. Stone technology was based on flint, and this was the point of departure for developing methods to suit quartz knapping. The quartz finds from Saarenoja 2, especially the platform blades, show clear evidence of flint percussion technologies. In many cases, quartz has been struck in same ways as flint, and it has also been snapped into segments in the same manner. However, the bipolar method – a common feature of quartz knapping in the Baltic Sea area throughout the Stone Age (e.g. Jussila et al. 2007: 155 with references; Tarasov 2007) – was adopted in a very early phase.

As noted above, the flint material from Saarenoja originates from two different directions. Cretaceous flint (mainly of a black, dark brown or grey colour and of high quality) originates from sources in Belarus/southern Lithuania, while Carboniferous flint (being red, purple or yellow, but sometimes also brown, white or grey) most probably originates from the Volga Plateau and its surroundings in Russia. During the Mesolithic, and particularly in its early phase, both Cretaceous and Carboniferous flint were used in large parts of eastern and northern Europe. Both flint types have been transported into areas without natural flint resources (Finland and a large part of Karelia). They were also transported into areas with poor quality flint (Estonia, Latvia), and even into areas where better quality flint is available (the area between the Volga and Oka Rivers in Russia). Some of the flint has travelled almost 1000 kilometres from its place of origin (Fig. 12).

In addition to Saarenoja, Cretaceous flint has been recovered from at least two Early Mesolithic sites in Finland: Ristola, located in the outskirts of the city of Lahti (Takala 2004: 107), and Helvetinhaudanpuro in the Akonpohja area of the town of Juankoski (Jussila et al. 2007: 157) (Fig. 1:3, 4). In addition to these sites, a single find from Nilsiä must be mentioned (Manninen & Hertell 2011: 124). It seems that flint from the same sources has been common also in Lithuania (e.g. the sites of Dreniai, Biržulis and Margionys, see Ostrauskas 2002: 94ff; Baltrūnas et al. 2006a: 23; 2006b: 43ff; Fig. 1:19–20), Belarus (the Krumpliovo, Zamoshe and Plushy sites, see e.g. Ksenzov 2001: 20; Fig. 1:21–2), and in the swampy forests of Russian Zhizdra (sites like Krasnoi 3 and 8 and Resseta 2, see Sorokin 2002: 100; Fig. 1:34–5).

Some Cretaceous flint has also been found in Estonia (sites of Pulli, Päästäle, Kunda Lammasmägi, Lepakose, Sindi-Lodja I and II, Kivisaare, Leie Lohu, Siimusaare, Jälevere, Lalsi III, Oiu I and II, Ridaküla, Kavastu, Ihaste and Vihasoo III; see Jaanits 1989: 32; Kriiska 1997: 24; Kriiska et al. 2003: 33; 2004: 44; Moora et al. 2006: Fig. 12; Tvauri & Johanson 2006: 42; Kriiska & Tvauri 2007: 42; Fig: 1:6–14), Latvia (sites of Zvejnieki II and Jersika, see Jaanits 1989: 13; Zagorska 1999: 153–4; Janis Ciglis pers. comm. 22 May 2006; Fig. 1:16, 18), Karelia (the site of Veshchevo 2 [Fi. Tarhojenranta], see Takala 2004: 156; Fig. 1:25), and at the Mesolithic sites of the Volga-Oka region in Russia (e.g. Sanovoe

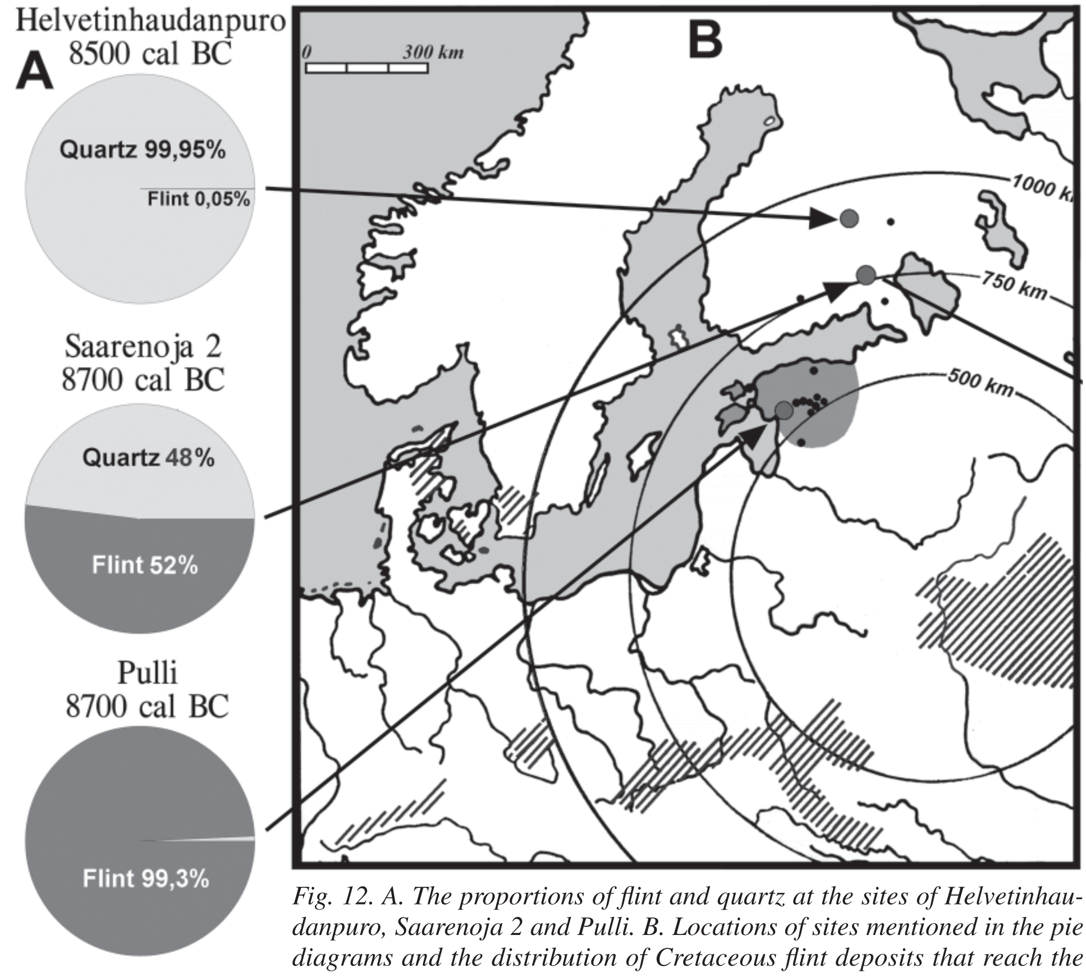

Fig. 12. A. The proportions of flint and quartz at the sites of Helvetinhaudanpuro, Saarenoja 2 and Pulli. B. Locations of sites mentioned in the pie diagrams and the distribution of Cretaceous flint deposits that reach the surface (cross-hatching).

4, Butovo 4A and Prislon, see Zhilin 1998: 26; Koltshov & Zhilin 1999a: 62; Fig. 1:28, 31, 32).

In addition to Saarenoja, Carboniferous flint has been recovered from the Ristola, Helvetinhaudanpuro and Muilamäki sites in southern and south-eastern Finland (Takala 2004: 107; Jussila et al. 2007: 152; Fig. 1:2–4). This flint type is common especially at the sites of the Volga Plateau (e.g. Zhilin 1997: 332), but it can also be found in the eastern Baltic, such as the sites of Pulli, Kivisaare, Sõõrikunurme and Oiu I in Estonia (see Jaanits 1989: 32; Kriiska et al. 2003: 34; 2004: 44; Kriiska & Lõhmus 2005: 35; Fig. 1:8, 11, 13, 15) or Zvejnieki and Sūļagals in Latvia (Loze 1988: 16; Fig. 1:16, 17), and in parts of Russia located close to the Baltic Sea (such as the sites of Kirkkolahti I, Veshchevo 2 and Sokolok, see Galibin & Timofeev 1993: 15; Forsberg 2006: 13; Takala 2009: 35; Fig. 1:23, 25, 27). In the Early Mesolithic period, the high quality flint of the Volga Plateau was also transported hundreds of kilometres eastward (Zhilin 1997: 332; Koltsov & Zhilin 1999b: 347). Observing the sites mentioned above reveals that the portion of Carboniferous flint at Ristola is 85.7% (Takala 2009: 107), but at Pulli consists of just a few finds, amounting only to c 8% of the material (Jaanits 1989: 32).

Both directions of the sources, south and east, can also be observed in the reduction methods and artefact forms. Narrow blades and inserts (e.g. Takala 2009: 34 with references), as well as the versatile application of percussion techniques (such as the use of pressure flaking and indirect percussion), and the relatively high proportion of blades (which at Saarenoja 2 reach 33.5% of all identified artefacts) are typical of the eastern Baltic and the Volga-Oka region of Russia during the Early Mesolithic (e.g. Jaanits & Ilomets 1988: 54; Zhilin 1998: 30; Koltsov & Zhilin 1999b: 347–8; Kriiska et al. 2004: 44; Takala 2004: 138). Likewise, the segmentation of blades by means of a simple breaking technique points to the same two directions of sources. In Estonia, there is a clear chronological trend in the use of blade technology, with the amount of blades diminishing in the course of the Mesolithic period. For example, at Pulli (dated to c 8700–8550 cal. BC) the proportion of blades, blade fragments, and artefacts made thereof is 40.1% (Jaanits & Ilomets 1988: 54), at the Ihaste site (c 8000 cal. BC) 28.3% (Moora et al. 2006: 154), at the Sindi-Lodja II site (c 6900 cal. BC) 14.1% (Kriiska et al. 2003: 33; Kriiska & Lõugas 2009: Fig. 26.3), and at the Late Mesolithic insular dwelling sites (c 5800 cal. BC and younger) only 2.2–4.5% (Kriiska 2002: 38). The same phenomenon of a decrease in the proportion of blades has also been observed in the Volga-Oka region of Russia during the Mesolithic (Zhilin 1998: 29).

The flint artefact forms encountered at Saarenoja 2 are common throughout the eastern European forest zone during the Early Mesolithic period. Tanged arrowheads manufactured from blades, with flat retouch on ventral surfaces, are known from the eastern Baltic as well as from western Russia (e.g. Jaanits 1989; Koltsov & Zhilin 1999a, 1999b; Oshibkina 2000; Ostrauskas 2000). Some scholars distinguish a separate group of arrowheads called the Pulli type, that are mainly found in Estonia, Latvia, Lithuania and Belarus (Ostrauskas 2000: Fig. 1; Girininkas 2009: Fig. 62), but occur as individual specimens also in the Volga-Oka region (Zhilin 1997: 332), and at the Ristola site in southern Finland (Takala 2004: 133). At least one of the Saarenoja 2 arrowheads fits the criteria given to this find category.

Striking implements made out of various raw materials are also characteristic of the Early Mesolithic in both regions. Flint chisels are common in the Volga-Oka region, while chisels and axes from the Estonian site of Pulli are made of other stone types. The best parallels for the Saarenoja 2 flint chisel (a unique artefact of this type in Finland) can be found from the Butovo sites in Russia (Zhilin 1996b: 282; Koltsov & Zhilin 1999a: Fig. 2). In addition, the large amount of burins identified at Saarenoja 2 is a typical feature of the Early Mesolithic sites of these regions. For example, at Pulli their proportion is 20.1% (Jaanits & Ilomets 1988: Tab. 2), and in the contemporary Tihonovo site at the banks of River Volga it is as large as 41.8% (Koltsov & Zhilin 1999a: 40).

The narrow flint points (Fig. 8:5) found at Saarenoja 2 are likewise unique finds, for which the authors have only found parallels in Finland and Karelian Isthmus; from the sites of Ristola (Takala 2009: Fig. 6.3.d), Helvetinhaudanpuro and Veshchevo 2 (Takala 2004: Fig. 158d). A fragment belonging to a rhomb-shaped arrowhead made of bone (KM 32558:13) was also recovered from Saarenoja 2. Parallels for it can be found in western Russia and the eastern Baltic, although these derive from slightly younger sites such as Okaemovo 4 and 5, and Ozerski 5, 16 and 17 (located between Rivers Volga and Oka), Verete 1 in north-western Russia, and Kunda Lammasmägi in Estonia (Indreko 1948: 259, Fig. 72; Koltsov & Zhilin 1999a: Fig. 23, 27; Zhilin 1999: Fig. 2, 3, 5, 12; Oshibkina 2000: 125, Fig. 3; for a detailed analysis, see Zhilin 1996a).

Raw material uses as well as similarities in stone technology and tool shapes indicate the presence of broad social and technological networks in the eastern European forest zone of the Early Mesolithic. These networks enabled the trade of raw material, semi-finished artefacts, and also of finished tools among peoples that took part in the networks. Occasionally, some raw materials and flint artefacts could be transported hundreds of kilometres by the trading communities. The colonisation of new areas was apparently relatively rapid and broad-based, and it was carried out by groups from the eastern Baltic area to the central parts of European Russia. Sparse population encouraged external trade, and the flint trade possibly served as a material form of communication, which helped to preserve and emphasise a sense of unity. Exogamy could also explain contacts between distant areas at a time when the fringes of these networks had only been initially occupied by a limited population (e.g. Hertell & Tallavaara 2011: 32–3 with references).

The ideas presented here are by no means new. There have been various attempts to locate the 'original home' of the Finnish population in the eastern Baltic, as well as in western Russia, resting on the evidence provided by individual finds or theoretical explanatory models (e.g. Núñez 1987: 9–10; 1997: 98; Matiskainen 1989: 72–4; 1996: 160–1; Carpelan 1999: 168; Pesonen 2005: 10). The origin of the earliest settlement has also been scrutinised based on the first considerable Early Mesolithic flint assemblage found in Finland, encountered at the Ristola site in Lahti (e.g. Takala 2004: 107, 177). It has also been argued that the extensive distribution of the naturally encountered flint types, as well as the similar stone percussion techniques, point to the existence of broad communicative networks in Mesolithic north-western Europe (e.g. Zhilin 1997: 332; 2003; Takala 2004: 169; Jussila et al. 2007; Gerasimov et al. 2010: 33). However, the Saarenoja 2 find material has for the first time made it possible to compare the Finnish Early Mesolithic sites and the find assemblages of the neighbouring areas, and to formulate general interpretations concerning the development of stone technology in this region.

It is pertinent to consider the two regions with natural high quality flint sources – the Upper Volga and Belarus/Lithuania, or their surroundings – as potential areas from where the settlers might have originated. These regions fall within a larger area that was colonised as early as in the Late Palaeolithic. The boundary of Palaeolithic occupation runs along the Daugava River from Latvia through the Pskov region up to Valdai region of the Upper Volga in Russia (e.g. Zagorska 1999; Vasilev et al. 2005: Fig. 2; Girininkas 2009: Fig. 47; Kriiska 2009: Fig. 1).

The Early Mesolithic of eastern and northern Europe has often been treated as a ‘Post-Swiderian’ cultural phenomenon – a product of an extensive, long-term migration from the Late Palaeolithic Swiderian technocomplex that prevailed in Poland, Ukraine, Belarus, Lithuania, southern Latvia, and western Russia (e.g. Zhilin 1997: 332; Koltsov & Zhilin 1999b: 359; Zaliznyak 1999: 216–8, Fig. 13). The central part of European Russia and even Palaeolithic groups living in Siberia are supposed to have contributed to this tradition and influenced groups belonging to other local Palaeolithic technocomplexes (e.g. Koltsov & Zhilin 1999a: 75; Sulgastovska 1999: 91). Sites associated with the Post-Swiderian phenomenon (technocomplex, cultural group, or however one wants to put it) have ranged geographically from Ukrainian Crimea up to northern Finland, and from the eastern Baltic to the Komi region in Russia (e.g. Burov 1999; Janevic 1999; Koltsov & Zhilin 1999b: 359; Zheltova 2000: 16; Kankaanpää & Rankama 2009: 43; Takala 2009: 35). However, a concept that is largely based upon flint arrowheads is inherently problematic, and in need of reinterpretation (the Swiderian cultural continuity is questioned, e.g., by Volokitin 2006: 48). Furthermore, there is a gap of several hundred years between the Late Palaeolithic settlements and the Early Mesolithic colonisation of Estonia, Finland and Karelia, on which sufficient information is lacking.

In any case, from the point of view of our research problem, it is essential and clear that the northward expansion of the forest zone induced colonisation of new areas, which resulted in the spatial extension of networks during several generations (Fig. 13). That, together with the ratio of flint from different sources, can point to the direction of the ‘motherland’ of this colonisation process. Based on the finds from Saarenoja 2, and more compellingly on the Ristola finds, it would seem that the ‘motherland’ can be situated at the Volga Plateau or its vicinity. However, the conclusion remains speculative, as it is impossible to argue the case any further in the light of the archaeological material currently available.

An intensive expansion of occupation into new areas followed the emergence of the forest zone. During the final phase of this expansion,

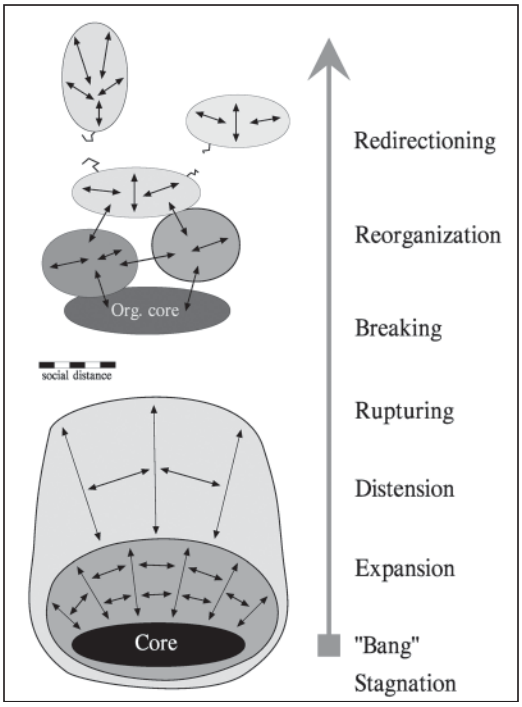

Fig. 13. Model for the development of social networks at the time of the colonisation of the ‘virgin lands’ of the eastern European forest zone.

the broad social networks took new forms and were reorganised and altered in the process. The areas connected by these new networks were considerably smaller than before. New, locally emphasised traits were developed in the course of the occupation of virgin areas in eastern and northern Europe. Simultaneously, the contacts with the areas of origin diminished drastically, and were eventually almost completely broken, as local raw materials became dominant in tool production. In Finland, the change in lithic raw material from flint to local quartz was relatively rapid and took not more than a few hundred years.

Demographical changes were probably the main reason for the reorganisation of the networks. Population growth provided a new basis for social organisation. Fulfilment of social as well as other needs could be attained in a much smaller area than before, and the significance of long-distance contacts waned. The existence of new local networks reaching out to new directions can be seen in the (initially gradual and eventually complete) substitution of flint by quartz or local, poor-quality flint. This is demonstrated clearly by sites dating approximately to 8500 cal. BC, such as Helvetinhaudanpuro in central Finland, where very little flint was used (0.05% of all lithics) and it must therefore have been of minimal significance to the community (Jussila et al. 2007: 149). Even so, the prevailing raw material (quartz) was to a considerable extent still worked using the old flint-knapping techniques, with for example, narrow, retouched points being made of both flint and quartz. The percussion method used at Helvetinhaudanpuro and Saarenoja for both quartz and other lithic raw materials, including the production of blades, was similar. In Mesolithic sites younger than Helvetinhaudanpuro, flint is practically absent, and it seems that the influence of flint technologies has almost completely disappeared from the quartz reduction techniques. A parallel to Helvetinhaudanpuro may be found in the almost contemporary Karelian site of Kirkkolahti 1, where the percentage of flint and alternative stone types is small and quartz dominates as the main raw material (Shakhnovich 2007: 167, Tab. 1, 2). The proportion of bipolar striking technique is larger, however (Tarasov 2007).

Likewise in Estonia, occurrences of 'foreign' flint come to an almost complete end by 8500 cal. BC, with flint finds now consisting mainly of the locally available Silurian flint (Kriiska 2001: 25; Kriiska & Tvauri 2007: 40–1). Still, some amount of continuity in the flint knapping tradition can be observed; soft hammer and hard hammer techniques remained in use, as did pressure flaking (e.g. Kriiska & Lõhmus 2005: 35; Johanson & Kriiska 2007: 145, 152). Similar lines of development can also be seen at the Volga-Oka region in Russia, where imported flint was rarely used at later Mesolithic sites, and lithic raw material was mainly obtained locally by collecting it from the immediate surroundings of the settlements (Zhilin 1998: 29).

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