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STONE AGE SLEDGES OF CENTRAL-GROOVED TYPE: FINNISH RECONSTRUCTIONS

Abstract

Among Finnish Stone Age finds there is a group of Neolithic sledge runners known as the central-grooved type. The name is derived from the long narrow groove upon the runner. The runners have been preserved in bogs and lakes.

The central-grooved runner type has no clear ethnological counterparts. The existence of very few remains of other parts of the sledge make the reconstruction of the sledge problematic. However, the central-grooved runners are especially interesting because they have features which might indicate the existence of both one- and two-legged sledges. The first to suggest the existence of a one-legged central-grooved sledge was Aarne Kopisto who compared its structure to North-American toboggans. To test Kopisto's proposal, a test sledge was made and tested. It was found that a one-legged central-grooved sledge is practical if the runner is long enough.

This is purely a technical study of one type of prehistoric sledge and, at the same time, part of a more extensive sledge study. The social functions and meanings of the sledges and other means of winter transportation will be discussed in a later paper.

Keywords: experimental archaeology, means of transportation, sledges, bog finds.

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INTRODUCTION

Finland's bogs and lakes have revealed numerous finds of skis, sledge runners, dugouts and boats. The age of sledge runners extends from the Mesolithic Stone Age to historically documented times. I had an opportunity to reconstruct a sledge based on one of those runner finds, the Kullaa Tuurujärvi find in Satakunta, in 1989 at Turku Provincial Museum's Kurala Kylämäki experimental archaeology workshop. The runner find is dated to the Neolithic Stone Age (Table 1) and represents the so-called central-grooved runner type.

During prehistoric times, especially in winter, in regions of tundra-, birch- and coniferous forest the only means of land transport were sliding equipment such as sledges and skis. These were suited to an economy based on hunting and seasonal movement in regions which were covered with snow during the greater part of the year (see e.g. Clark 1952: 293). It was easier to move on frozen lakes, rivers and bogs. In the summer lakes and rivers were good passages, but the bogs were mostly unfit for traffic. The means of transportation were very important for hunting, trade and the social life of the population. Changes in means of transportation may indicate important changes of economic life and/or environment (Taavitsainen 1999: 312). For many reasons, means of transportation are a valuable subject for research.

Among the Stone and Bronze Age runner types, the central-grooved runners are especially interesting because during the period of their use there may have been a radical change in the construction of the sledge. The runners contain

CENTRAL-GROOVED RUNNERS														
CATALOG NUMBER			PARISH	LENGTH OF COMPLETE RUNNER MM	BREATH MM	THICKNESS MM	STRUCTURAL FEATURES REAR	MIDDLE	FORE	SUB-TYPE	^{14}C DATE	± σ	LAB NO	^{14}C RELATED REFERENCES
KM/eh	16108		Alahärmä		98	35		R2	K3	Sloping-posted				
KM/eh	16110		Alajärvi		92	32		R3		Vertical-posted	4640	40	Su-2831	
KM/eh	16224	1	Alajärvi		95	28		R2	K1	Sloping-posted				
KM/eh	16224	2	Alajärvi			29	P2	R2		Sloping-posted				
KM/eh	16224	3	Alajärvi		94	27		R3	K1	Vertical-posted	4530	40	Su-2832	
KM/eh	16543	A	Alajärvi		136	49		R3		Vertical-posted				
KM/eh	16543	B	Alajärvi		102	19		R1		Sloping/vertical				
KM/eh	16543	C	Alajärvi			18								
KM/eh	16543	D	Alajärvi			23		R3		Vertical-posted				
KM/eh	20163	1	Alajärvi			26								
KM/eh	14738	A, B	Inkoo		108	48	P2							
KM/kt	7056		Kiuruvesi	4100	120	30	P3	R1	K4	Sloping/vertical				
KM/eh	23896		Kullaa		100	28		R2	K3	Sloping-posted	4430	110	Hel-2525	Huurre 1991
KM/kt	7356		Kuortane	3175	123	25		R1	K5	Sloping/vertical				
KM/eh	20117		Kuusankoski		170	55	P2	R1		Sloping/vertical	5090	130	Hel-1095	
KM/eh	16109	1,2	Lappajärvi		96	24	P2	R2		Sloping-posted				
SatM	18464		Noormarkku		73	21		R2	K2	Sloping-posted	4900	150	Hel-1096	Aalto, Taavitsainen,
KM/eh	12057	1	Orimattila		160	58	P2	R1		Sloping/vertical				Vuorela 1981
PPM	5595		Pudasjärvi	3960	130	30	P3	R3	K1	Vertical-posted				
KM/eh	23583		Pyhäselkä		80	14								
KM/kt	2007		Rantasalmi				P2	R1		Sloping/vertical				
Kuopion														
museo	2776		Rautalampi		87	35	P3							
PPM	4023		Temmes		90	65	P3							
KM/eh	11875		Temmes		108	60	P4	R1		Sloping/vertical				
KM/eh	2216	873	Ylistaro		150	40	P3							

Table 1. Central-grooved runners in Finland.

features possibly indicating the existence of both one- and two-legged sledges (Fig. 1). Contrary to earlier and later runner types (troughed and ridged types), there are very few finds of other sledge parts. This makes reconstructions problematic. Aarne Kopisto has suggested that variants with sloping sledge-posts have belonged to the one-legged sledge type (Kopisto 1964: 23-24).

The purpose of reconstruction is to test Kopisto's idea and to find out the structure of the sledge. Also earlier and contemporary reconstruction proposals will be discussed. This is purely a technical study of one type of prehistoric sledge and, at the same time, part of a bigger sledge study. The social functions and meanings of the sledges and other means of winter transportation will be discussed in a later paper.

Research history

In ethnological research, winter transportation is usually a part of general works on transportation. One of the earliest general works is O.T. Mason's Primitive Travel and Transportation printed in 1896. Interesting for Finnish studies is Swedish Gösta Berg's classic Sledges and Wheeled Vehicles printed in 1935.

In Finland general transportation and its history have been treated by U.T. Sirelius in 1919, Kustaa Vilkuna and T.I. Itkonen in 1934 and in the same year Ilmari Manninen.

Prehistoric sledge runners have been studied most actively by T.I. Itkonen (1930-1949) and Ville Luho (1945-1957). T.I. Itkonen was the first to suggest the typological development of ancient runners found in Finland. Later scholars, Unto Salo and Aarne Kopisto have made a reconstruction and proposal for reconstruction after runner finds (Salo 1965; Kopisto 1964). Kopisto's proposal for a central-grooved sledge is the starting-point for my central-grooved reconstruction. Hannu Kotivuori and Mara Kiviluoto have made a central-grooved reconstruction which was constructed somewhat differently (Kotivuori 1996).

Typology

The typological order has been formed according to structural features of runners and ethnological analogies. The direction of development has been thought to go from primitive to more

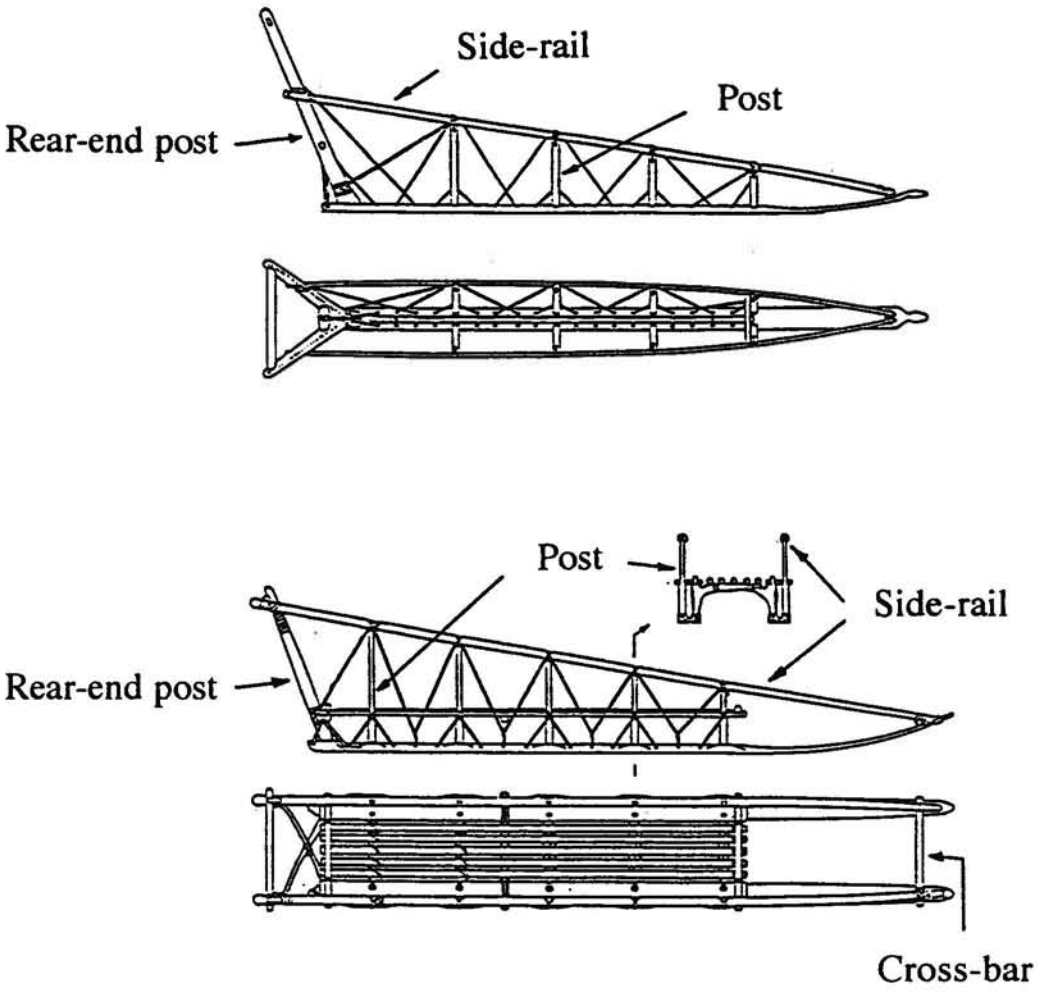


Fig. 1. Terminology used (Berg 1935). One-legged and two-legged sledge. Drawing by the author.

developed forms.

According to T.I. Itkonen, the troughed type was the oldest runner type. It was followed by the central-grooved, ridged and flat-surfaced (with 2 post-rows) types (Itkonen 1938: 28). Ten years later Ville Luho agreed with Itkonen's suggestion with minor additions. The runner type represented by the Heinola runner was the first from which a troughed type was developed (Luho 1949: 13). This development is supported by 14C-dates.

Successive runner types dated to the Stone Age have similar features. The Heinola type and troughed type have a trough and side-holes. The troughed type and central-grooved type have rear-end post holes and thin board-like fore parts. The central-grooved type and ridged type have the same kind of rear parts and fore parts, and alternating post-hole/lashing-hole system. The ridged type has a central-ridge instead of groove. There are fewer lashing-holes and they are easier to make (Fig. 2).

Radiocarbon dates do not obviate the need for typology. Typological differences can give valuable knowledge. Different traditions and/or functions of use can be found in contemporaneous runners.

Dating

The chronology of the runners is best based on radiocarbon dating. Many runner finds have been dated geologically by studying pollen from the find

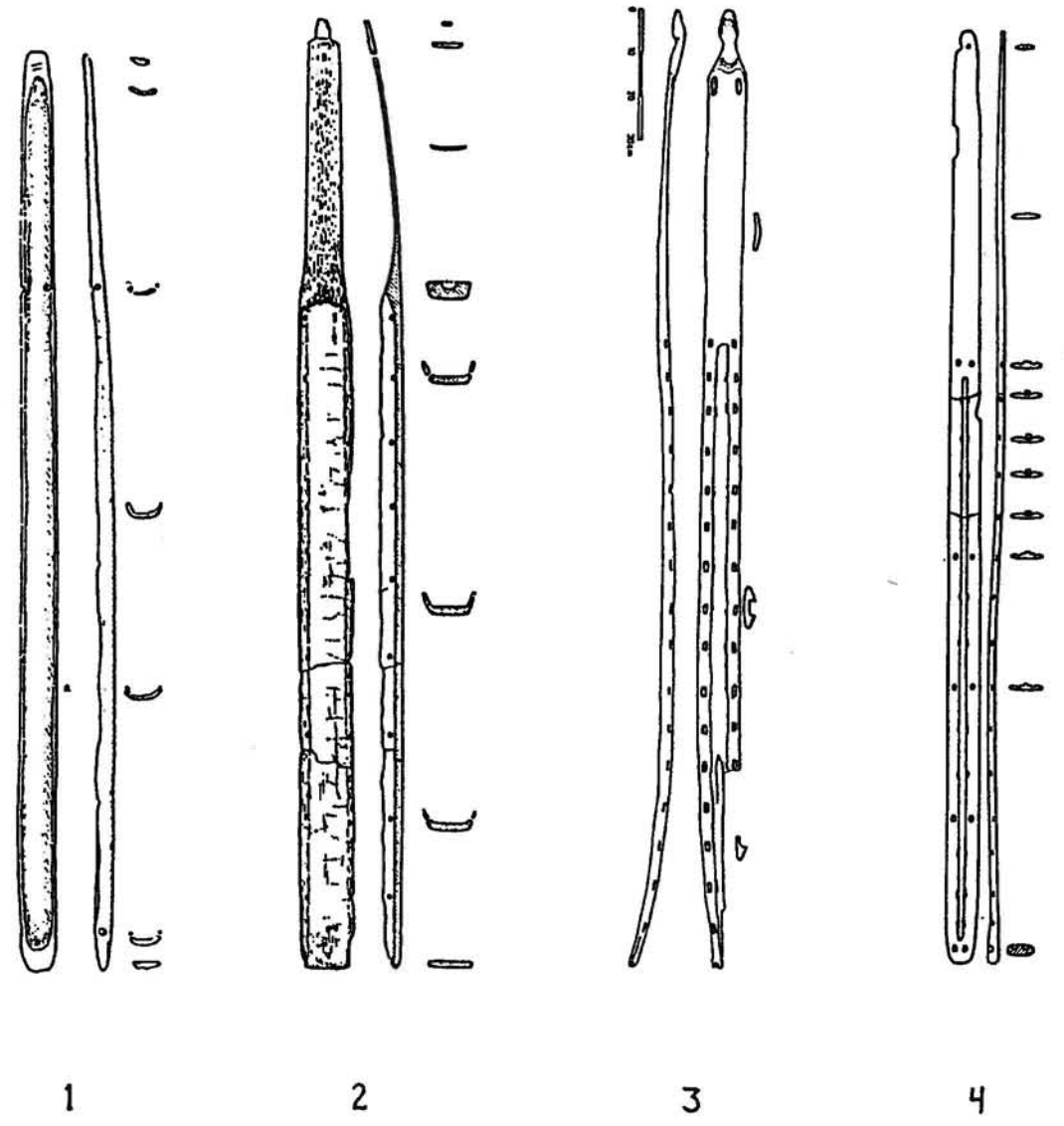


Fig. 2. 1 - The Heinola runner, 2 - The troughed type, 3 - The central-grooved type, 4 - The ridged type runners. (Itkonen 1935: Fig. 5A; Itkonen 1938: Fig. 6; Kuokkanen 1991: Fig. 1; Itkonen 1932: Fig. 2B)

layer or material stuck to a runner. A runner however may get into a layer the age of which is not the same as that of the runner. Information about find locations of older runner finds is often inaccurate. Several runners have been radiocarbon-dated (Aalto, Taavitsainen & Vuorela 1981; Edgren 1984; Huurre 1991; Salo 1965 and 1967; Seger 1988).

The dating of the runners has the problem that it is difficult to connect runners to near-by dwelling-sites or stray finds. The Orimattila runner may have the clearest connection to a dwelling-site as it was found quite close to a settlement. The dwelling-site is dated to typical Combed-ware period (Luho 1950: 7) which is dated to 4000-3600 BC (Carpelan 1999: 273).

Methods

The method used in reconstructing a central-grooved sledge is experimental archaeology. One

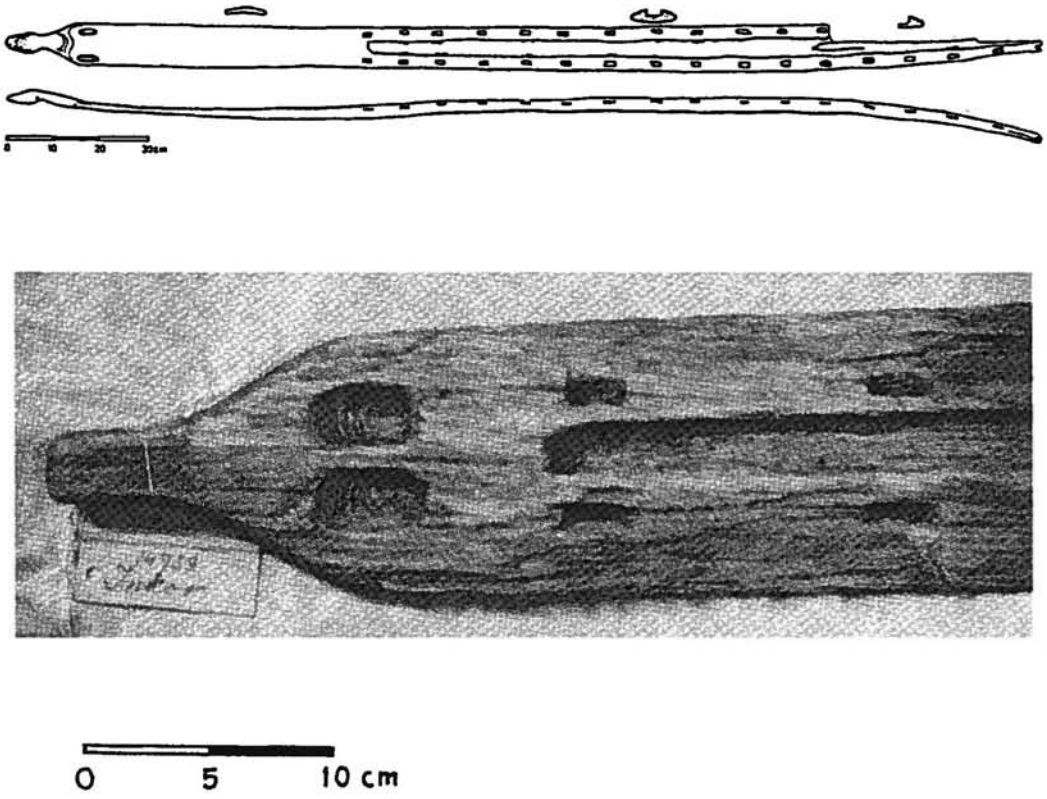


Fig 3. Top: the Kullaa Tuurujärvi runner (drawing by U. Lähdesmäki). The back part is missing. The runner curved while drying. Below: the back part of the Inkoo runner. (Kuokkanen 1991: 20-21, Figs. 1 and 2)

problem in practical experimental archaeology is that modern man is inclined to do things in too complex ways. Often we underestimate ancient man's inventiveness and ability to survive in the environment. Insufficient handiness and imperfect knowledge of old techniques make experimental study more difficult and may lead to erroneous interpretations. Moreover, the quality of raw materials available is not necessarily same as before. As stated by Coles (1973: 15), the criticisms directed against experimental archaeology are mainly due to the fact that its results are not conclusive. In spite of its limitations, experimental archaeology can reduce the number of possible solutions and exclude impossible ones.

THE CENTRAL-GROOVED TYPE

The material at my disposal is not complete. In Finland there may be runners or parts of runners that are unknown to me. I also know only a few of the Scandinavian and Russian finds. The publication of the whole material would be extremely important.

Because the central-grooved runner type has no clear ethnological counterparts, runner finds are practically the only thing hinting at the structure of the central-grooved sledge type. Other sledge parts are known to only a small degree and preserved parts are of no great help. The reconstruction must be based on the structural features

of the runners, which inform about missing structures. Also, preserved parts and structures of other prehistoric and historic sledges may be of help. In this case, the differences in the directions of post-holes in the runners may be the result of different ways of construction.

Runners

On the upper side of the runners there is a relatively narrow groove apparently to make the piercing of lashing-holes easier. The lashing-holes have been pierced from the upper-side of the runner and from the groove. The fore part is often made thinner and resembles a board. In the rear part there are usually two rear-end posts side by side. Kullaa (KM/eh 23896) and Inkoo (KM/eh 14738) runners may serve as typical (Fig. 3).

The central-grooved type is the most numerous Stone Age runner type in Finland. In Finland there are twenty-five finds (Table 1). Radiocarbon dated finds (5 dates) are from the typical and late Combed-ware periods, 4000-3600 BC and 3600-2800 BC respectively (Carpelan 1999: 273). The finds are distributed relatively evenly south of the province of Lapland. An exception is Vaasa province where there are 13 finds in a small area (Fig. 4). Alajärvi parish stands out with nine runner finds. Outside Finland there are at least two runners, in Sweden and Russia.

I did not have an opportunity to inspect two central-grooved runners (Alajärvi KM/eh 20163:1 and Pyhäselkä KM/eh 23583) as carefully as the others. In the assemblage Alajärvi KM/eh 16543:1-3 I identified parts from four separate central-grooved runners (A, B, C and D).

In central-grooved material only three runners have been preserved complete (Kiuruvesi KM/kt 7056, Kuortane KM/kt 7356 and Pudasjärvi PPM 5595). The rear parts of twelve runners have been preserved, and the fore parts of five runners have been preserved. Only a piece of the central-part of three runners have been preserved. The better state of preservation of rear parts may be result of the more fragile nature of the fore parts. Thin board-like fore parts break more easily. The lengths of the complete Kiuruvesi, Kuortane and Pudasjärvi runners are 410 cm, 317.5 cm and 396 cm respectively. The breadth of central-grooved runners is between 7.3 - 17 cm (Table 1). Average breath is about 11.1 cm. The Orimattila and Kuusankoski runners (resp. KM/eh 12057:1 and

Fig. 4. Central-grooved runner finds. Upper map: Swedish and Russian finds (known to the author).

KM/eh 20117) are clearly broader than the others (16 and 17 cm). The greatest thickness of runners is between 1.9 - 6.5 cm, being on the average 4 cm. The thick rear-end of many runners falls within the calculations. If we measure the thickness at the central-part of a runner, then thickness is between 1.4 and 4.8 cm. Average thickness is 2.8 cm. If the average breath and thickness are used, we get an average area of cross-section of roughly 31 cm^2.

In the rear end of fourteen runners there is a tip through which has been pierced a horizontal lashing-hole (Fig. 5). In front of it there are two rear-end post holes side by side. In the Kuortane runner there is only one rear-end post hole.

Usually the central-groove begins in front of rear-end post holes. On both sides of the central-groove between the rear part and bow there are paired post-holes and lashing-holes so that between pairs of post-holes there are one to four pairs of lashing-holes. The sequences are repeat-

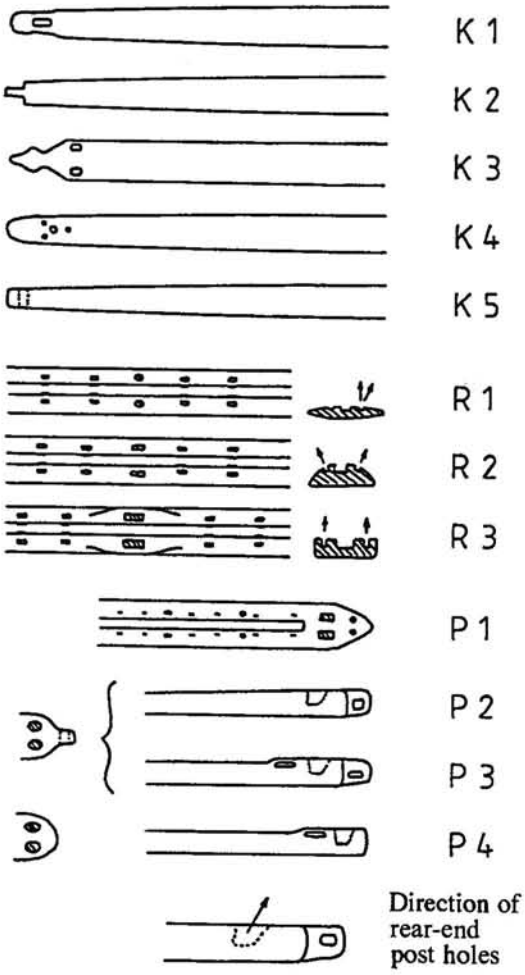


Fig. 5. Structural features of central-grooved runners (combinations - see Table 1). K 1-5 = Forms of the fore-part, R 1-3 = Grooved part and post holes, P 1-4 = Forms of the rear part

ed: pair of post-holes, pairs of lashing-holes, pair of post-holes and so on. The repeating number of pairs of lashing-holes is usually the same. Since some runners have only one preserved sequence between two pairs of post-holes we cannot verify the repeated sequences.

Most of the runners have been broken and the front end is missing. Therefore we cannot properly link together the structural features of runner rear-ends and those of foreparts. A common feature in almost every fragmentary runner is the form of the cross-section and the structure of the post-hole. Based on that, the runners seem to fall into three groups. I call them vertical-, sloping- and sloping/vertical-posted sub-types A, B and C respectively.

In a vertical-posted sub-type A (Fig. 5, R 3) the posts have been vertical. The posts are stout and they fit tightly into the post-holes. This is often indicated by a reinforcement around the post-hole (Fig. 6). And the post-holes are bigger than the lashing-holes. All this indicates that the posts carried a great load. When the posts are abreast and upright and something has been fastened to the runner with ample bindings it follows that most probably the runner belonged to a two-legged sledge.

In the clearly sloping-posted sub-type B (Fig. 5, R 2) the posts fit loosely but snugly into the post-holes. Apparently the intention was to keep lower end of the post in place. The post-holes clearly incline sideways. There are usually no marks of collapse or wear immediately around the post-holes. There was no excessive loading caused by the posts. It seems to confirm Kopisto's idea that the posts are a part of a cargo space. The upper-side of the runner is more or less convex.

In the sloping/vertical-posted sub-type C (Fig. 5, R 1) the posts fit loosely into the post-holes. In a few runners, for example Kuusankoski and Orimattila runners (Fig. 7), the post-hole is only a shallow, rounded depression. The post-hole is only in support of the lower end of the post. The runners are quite flat. Often the upper sides of the runner are even concave on both sides of the central groove. In principle it is possible to make a two-legged sledge based on runners of sloping/vertical-posted sub-type.

The number of pairs of lashing-holes between the pairs of post-holes does not seem to depend on the sub-type of the runner. The bindings have been important even in the runners of the sub-type A.

The bottom of the runners is usually slightly convex or flat. The upper sides of most runners are more or less convex on both sides of the central groove. Few runners have flat or concave upper sides as stated above. In that case the edges of the runner are vertical. Because of the fragmentary nature of most runners the form of cross-section cannot clearly linked together other features of the runners. Exceptionally, flat and broad Orimattila and Kuusankoski runners seem to form a separate variant. The cross-sections are similar, runner rear-ends resemble each other and

both have shallow rounded post-holes (Fig. 7).

Two runners have whittled animal heads in the end of the bow. The Kullaa runner has the head of a water fowl and perhaps this is also the case with the Alahärmä runner (KM/eh 16108). Only these runners equipped with animal heads have two binding holes abreast in the bow. Perhaps it is a mere chance but there are also two side by side binding holes in two ridged runners equipped with animal heads.

The Alajärvi runners KM/eh 16224:1 and 16224:3 have one rectangular hole and taper in the bow. The hole is either a binding hole or the hole into which the end of the side-rail has been put. In the last case the tapering would be natural. The end of the side-rail easily cleaves the bow without binding around the end of the bow.

In the bow of the Noormarkku runner (SatM 18464) there is no binding hole but a long narrowed tip. On the end there could have been a cross-bar with a hole like some troughed-type runners have. Some sort of cross-bar could have also been in the forward end of the Kuortane runner where there is a horizontal hole.

There are so few preserved runner bows that we cannot link certain bow variants together with other features of the runners for certain. However both runners with animal heads belong to the sub-type B. One of the two runner bows with a long rectangular hole belongs to the sloping-posted sub-type B. Another is of the sub-type A.

The Temmes runner (KM/eh 11875) has a narrow furrow that connects the post-holes and the lashing-holes. As noted by Itkonen, they may be decorations (Itkonen 1949: 39).

Runners have been made, as far as they are defined, of *Pinus sylvestris*, *Pinus cembra* or conifer.

Central-grooved runners were mostly made with the lower side of the runner towards the core wood of the tree. One important exception is the Alajärvi runner KM/eh 16543:A, the upper side of which is towards core wood. The runner is the most massive of the central-grooved runners. Remembering that with a few troughed-type runners the direction is the same the choice is perhaps intentional. Why it is so I am not sure. The reason might be connected with woodworking techniques and bending and cracking of wood while drying.

Runners have plenty of working and wear marks. The after part of the Kullaa runner has apparently worn in use so much that the runner has broken at the lashing-holes (Kuokkanen 1991: 21). The bottom of the Orimattila runner was also worn near the breaking point (Itkonen 1949: 37). Wear can be one reason in the breaking of the rear-end hole. There are wear marks in many post-holes. That means that the structure has had some slackness.

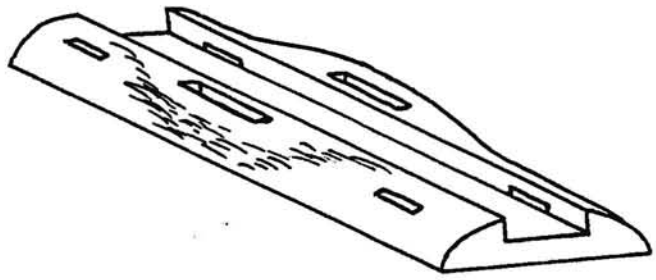


Fig. 6. Reinforcement left around the post-hole.

Runners in Sweden and Russia

The westernmost example of the central-grooved runner has been found in Norrbotten, Sweden (Piteå Gråträsk) (Berg 1935: 37, Fig. 11). It is flat and broad, a clear central-grooved runner which does not have normal rear-end tip. Instead of that the rear is narrowing like a broad wedge. Behind the rear-end post holes there are exceptionally two upright binding holes side by side. The post-holes are longer than the lashing-holes. The posts can have been as well upright as sloping (Fig. 8). I do not know if the runner is radiocarbon dated.

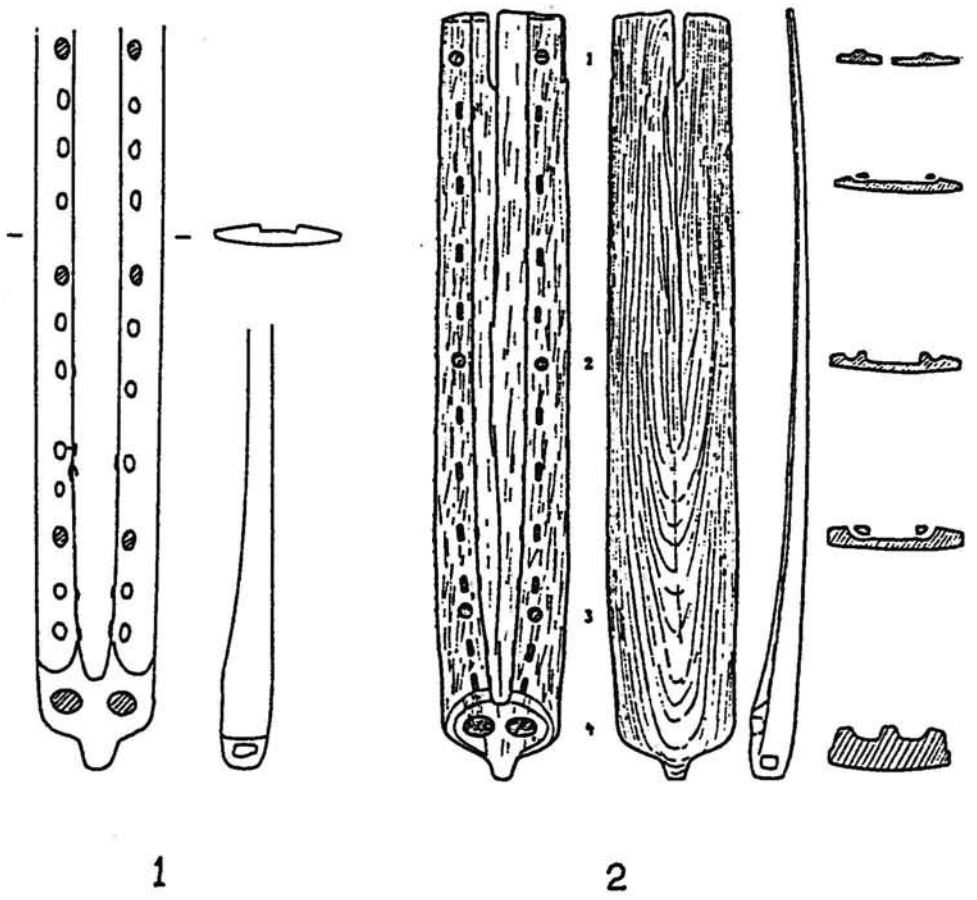


Fig. 7. 1 - the Kuusankoski runner, 2 - the Orimattila runner (Itkonen 1949: 38: Fig. 7A).

A central-grooved runner has been found in the Urals, west of Tobolsk (Tagil, Gorbunova) (Eding 1929: 9 > Itkonen 1932: 62-63). It is not as clear a counterpart for the Finnish central-grooved runner finds as the Piteå runner. Apparently the forepart of the runner is missing. In the rear-end there are two clearly backwards sloping rear-end post holes but no lashing hole. The post-holes are big and vertical. The mortices of the posts seem to have been tight. Between pairs of post-holes there are two pairs of lashing-holes. Judging from the cross-section the upper-side of the runner is towards the ore wood (Fig. 9). The runner is a counterpart for the runners of the sub-type A.

Other parts of central-grooved sledges

Together with central-grooved runners have been found only a few pieces of wood which have apparently belonged to a sledge. They are not of much help in reconstructing the sledge.

Found with the Alajärvi runner (KM/eh 16224:3) was a thin strake of wood (108 x 3.5 x 1 cm). In the middle of it there was a hole measuring 2.7 x 0.5 cm. In the other end there were remnants of a similar hole. The distance between the holes was 50 cm. There was no preserved successive post-holes in the runner. There are weak indications that the distance between pairs of post-holes has been around 50 cm. However it is not possible to say if the strake is a piece of side-rail or a piece of cargo platform.

In the assemblage Alajärvi KM/eh 16543:1-3, where there were parts of four different runners, there was a similar wooden strake (87 x 3.8 x 1.2 cm). In the strake there were two holes measuring 2.6 x 0.5 cm and 4.6 x 0.5 cm respectively. The distance between the holes was 51.5

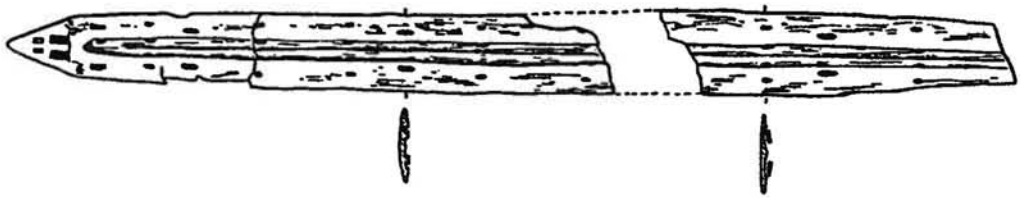


Fig. 8. The Piteå runner (Berg 1935: 37, Fig. 11 > Luho 1949: 9, Fig. 7).

cm. If we suppose, as above, that the distance between the holes is the same as the distance between the posts, the strake cannot be connected with any of the runners in the assemblage.

With the Lappajärvi runner (KM/eh 16109:1 and 16109:2) a piece of board measuring 49.5 x 9.6 x 1.6 cm was found. At both ends of it there were pairs of holes. The distance between them was 44 cm. The board is broken at the holes. Because of its breath and thickness it could be a bow part of a runner. If there were pairs of holes only at the one end, it could be a bow part. Another pair of holes is a problem. The board might be some other part of a runner.

In the assemblage Alajärvi KM/eh 16543:1-3 there were also other pieces but it is not sure if they belong a central-grooved runner. The pieces are fragmentary and unidentifiable.

With the Gorbunova find in the Urals there were pieces of wood. D. Eding wrote in a letter to G. Berg that he regarded them as posts (Berg 1935: 39, Fig. 13). Their minimum length was 52.5 cm.

RECONSTRUCTIONS OF CENTRAL-GROOVED SLEDGES

Looking at the earliest proposals for reconstruction we see that shortage of finds has made reconstruction very difficult. Because the central-grooved runner type has no clear ethnological counterparts reconstruction was more or less guesswork.

Earlier and contemporary reconstructions

There are three proposals for reconstruction based on the central-grooved runner. Besides these there is a contemporary reconstruction in the Lapland provincial museum. I came to know of its existence after I had made my own reconstruction.

1) First proposal for reconstruction by U. T. Sirelius

The first proposal for reconstruction of a sledge based on the central-grooved runner type was made by U.T. Sirelius, who had at his disposal very scanty and fragmentary finds (Fig. 10:1). He misinterpreted the rear part to be the bow (Sirelius 1919: 391, Fig. 348). He based his interpretation on the runners from Ylistaro (runner found in 1883) and Rantasalmi (Sirelius 1918). It seemed that he had a Cheremish ice sledge as a later counterpart. Sirelius thought that the central-grooved runner type belonged to a hunter's one-legged sledge (Sirelius 1919: 389-391).

2) Reconstruction proposed by T. I. Itkonen

T.I. Itkonen made his reconstruction based on the Kuortane runner (KM/kt 7356) which was found in 1931. He suggested the sledge had been two-legged (Itkonen 1932: 60, Fig. 2, A1). In his proposal (Fig. 10:2) the straps keep the fore parts of the runners bent up. The horizontal holes in the tips of the runners are connected with a cross-bar. An interesting feature in Itkonen's proposed sledge are "side-boards" where there are pairs of holes abreast for the pairs of posts. There is no handle in the reconstruction, but if needed the rear-end posts could be lengthened. The Kuortane runner is the only one to have just one rear-end post hole in the strengthened rear-end.

The cross-bar should be loosely fitted in the holes, because the holes can be broken by an uneven movement of the foreparts of the runners. Another possibility is to replace the straps with wooden rods.

As to the side-boards mentioned above, the Lappajärvi runner was found with a part of that kind of board. But the distance between the pairs of post-holes in the Lappajärvi runner was different from the distance of pairs of holes in the board.

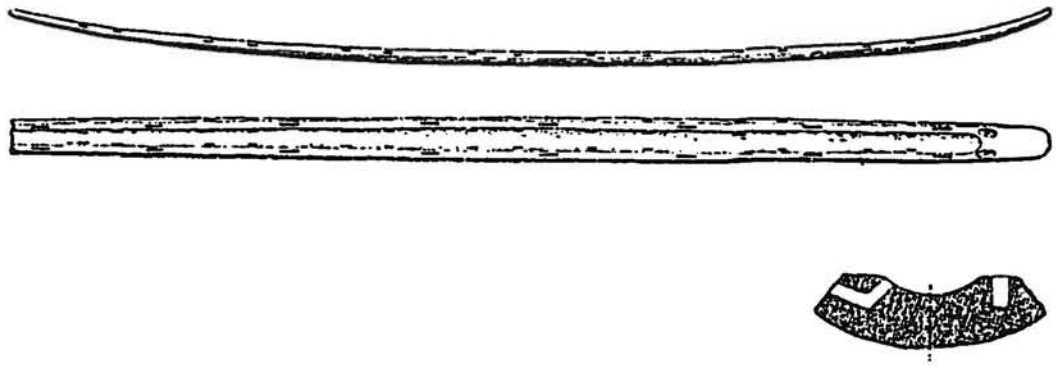


Fig. 9. The Gorbunova runner (Eding 1929: Fig. 1:7 > Itkonen 1932: 60, Fig. 2C).

3) Reconstruction proposed by A. Kopisto

The central-grooved runners have always been found as single finds. Aarne Kopisto suggested that the Kuortane runner could have been part of a one-legged sledge. He thought that the reconstruction by Itkonen was too complex. The Keuruu runner of troughed type (first parts found in 1948) had belonged to a one-legged sledge (Luho 1957: 14, Abb. 7). Central-grooved runners had outward sloping post-holes. He compared this kind of central-grooved runners to the toboggans of Canadian Indians (Kopisto 1964: 23-24). In the reconstruction suggested by Kopisto (1964: 24, Fig. 9) the side-straps connect rear-end posts and the cross-bar of the upturned bow. Upper ends of sideways sloping posts have been bound both with side-straps and binding holes of the runner (Fig. 10:3). The cross-bar of the bow is a weak point. The cross-bar is affected with great forces, because there must be enough tension in the side-straps. Therefore Kopisto states that the side-

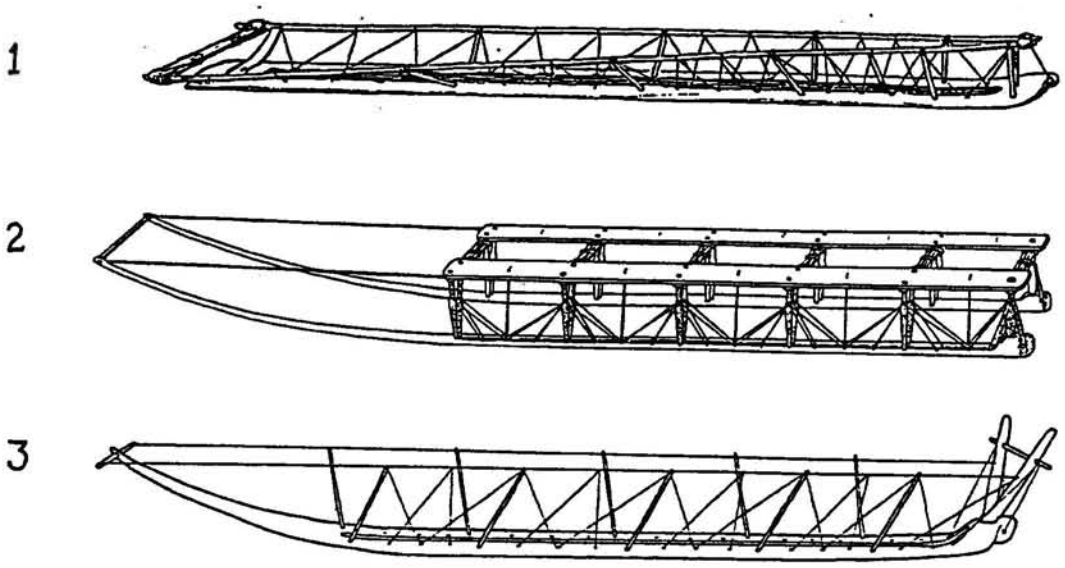


Fig. 10. The suggested reconstructions by: 1 - Sirelius (1919), 2 - Itkonen (1932), 3 - Kopisto (1964). The drawings are not to the same scale.

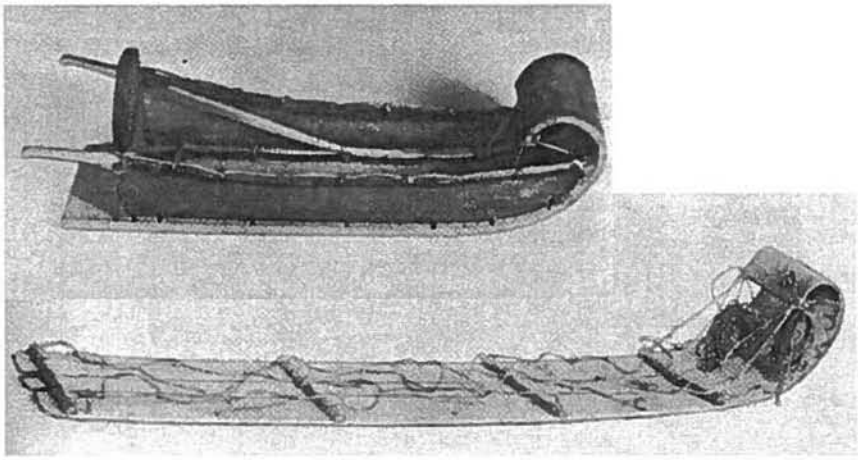


Fig. 11. Toboggans. Top: a toboggan equipped with handles from the Upper Yukon. Apparently a miniature model. (Miles 1963: 224-225, Figs. 12.14 and 12.15)

straps could be fastened straight to the hole in the tip of the bow, or wooden side-rails could be used instead of the side-straps.

Perhaps a European reader is not very familiar with the toboggan. Basically, the toboggan is a sledge pulled by a man or dogs. It is usually made of two thin and narrow boards. The fore parts of the boards are tightly curved by heating (Fig. 11).

Usually a toboggan was man-hauled using snowshoes. This kind of toboggan was suitably narrow to be comfortably pulled in the snowshoe trail. In order to carry enough cargo the toboggan was long in proportion to its breath. Large toboggans were pulled by dogs. The cargo was wrapped in a long package tied to the toboggan. The flat toboggan was good on powder snow in woodland. When there was a little snow or the snow was crusted, the Ojibwa Indians would use a legged toboggan (MacDonald 1978: 60). For different functions and different climatic conditions there was specially designed equipment for transportation.

In both use and features a toboggan, at least man-hauled, corresponds to a hunter's boat-sledge. The drawback of a toboggan is that unprotected cargo easily gets wet. In a big toboggan the sides can be covered with cloth or skin as has been done in the miniature model in figure 11. On ice a runnered sledge is stronger than a toboggan. With a runnered sledge it is possible to carry heavier cargo with smaller pulling forces (Gjessing 1953: 261-262).

4) Reconstruction made by H. Kotivuori and M. Kiviluoto

Hannu Kotivuori designed, together with Mara Kiviluoto, a one-legged central-grooved reconstruction for an exhibition at the Lapland Provincial Museum in 1995 (Fig. 12). Mara Kiviluoto made the reconstruction. The runner is not a copy of any specific runner find, but a compromise between different runners. It belongs to sub-type A.

The elk hide is an integral part of the sledge. An interesting detail are two lengthened posts serving as auxiliary handles. There are certain benefits in the structure compared to my reconstructions. The binding straps are short and therefore their relative elasticity is small. The cargo in the skin helps to push the posts into their holes. At the same time the structure protects the cargo. A drawback is that the skin adds to the weight of the sledge. The weight of a dry elk skin is around 8 kg. The cross-bar connecting rear-end posts could be beneficial. The reconstruction has not been tested but it seems to be serviceable. The bow part has been curved so much that the reconstruction could be used on uneven terrain. The reconstruction proves that it is possible to make a one-legged central-grooved sledge based on the runner of the vertical-posted sub-type A.

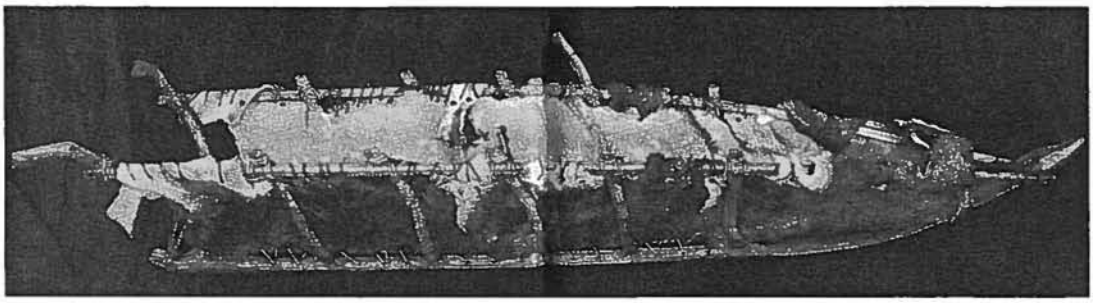


Fig. 12. Reconstruction made by Kotivuori and Kiviluoto (Kotivuori 1996: 96-97, Fig. 10).

Reconstructions made at Kurala Kylämäki

The first version of the reconstruction was made in the summer of 1989 in the archaeological experimental workshop at Kurala Kylämäki (part of the Turku Provincial Museum). I had two ancient central-grooved runners available as a model for a runner. The fore and central parts were made after the Kullaa Tuurujärvi find (KM/eh 23896). The runner is made of Eurasian stone pine or cembra pine (*Pinus cembra*) which grows on the Urals and Alps. The 14C-date of the runner is 3100 BC. The stern part was missing in Kullaa runner and that's why the back part of the reconstructed runner was made after the Inkoo find (KM/eh 14738). The Inkoo runner (no 14C -date) had its fore part missing. Both runner finds belong to the sub-type B (Fig. 3). That was essential because the reconstruction was made to test Kopisto's suggestion of a one-legged sledge.

Another one-legged central-grooved reconstruction was made in 1996 for an exhibition at Kuusankoski museum, after the Kuusankoski runner find (KM/eh 20117) (Fig. 7). The runner belongs to the sub-type C. The 14C-date of the runner is 3900 BC. The experience gained at Saarijärvi in 1992 while testing the above-mentioned Kullaa reconstruction was used in making the sledge. The Kuusankoski reconstruction has not been tested.

Raw materials and tools

Wooden parts were made of pine (*Pinus sylvestris*). Because of shortage of money it was not possible to get an elk or deer skin at first. The first binding material was tanned cow skin and sisal-rope. Borrowed skins could only be used as a cargo or protective wrappings. Only later could I use straps made from the raw hide of elk. It is very good material, and it was the natural material for ancient people. The Finnish material includes objects decorated with elk heads or modelled after the elk. Elk bone harpoon points have been found and there are elks in Finnish rock-paintings. Traditional iron and steel hand tools were used in the work.

The structure of the reconstructions

The Kullaa Tuurujärvi reconstruction was made of pine. The wood was quite fast-grown and not very strong. The fore part of the runner was bent by heating it in hot water, the temperature of which was near boiling point.

The central-grooved sledge reconstruction has had three different upper constructions. The first version had side-straps made of tanned skin instead of wooden side-rails. Also all the lashings were made of tanned skin. Rear-end posts/handles were fastened with lashings going from the lower cross-bar of rear-end posts to the forward tip of the runner (side-straps) and to the rear-end

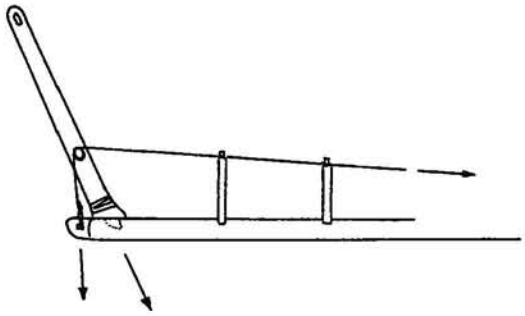


Fig. 13. Fastening sternposts with the runner.

hole of the runner (Fig. 13). The resultant forces in the straps press rear-end posts into rear-end post holes. However the structure was not particularly rigid with side-straps. If a driver pushes the sledge, all stress is concentrated on the rear-end horizontal hole. The hole can break very easily. The loaded sledge cannot be pushed with any confidence.

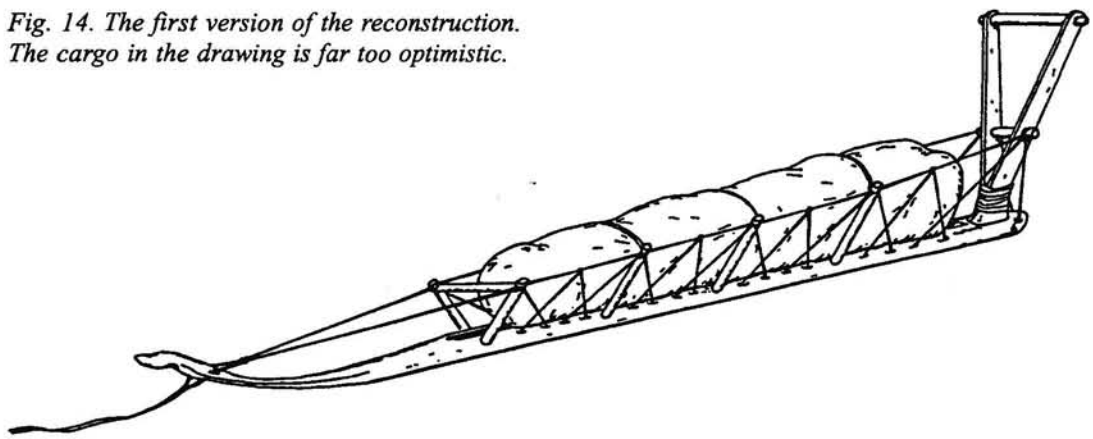
Sledge-posts were made loosely after the Gorbunova find. The upper-ends of the sledge-posts were lashed to side-straps and the lashing-holes of the runner. Post-holes are shallow, only about 0.5 cm deep. Therefore the lashings should be tight, otherwise the lower-ends of posts can come out of their holes. Between the foremost pair of posts were bound a cross-bar to spread the side-straps. The lateral rigidity of the structure with side-straps is weak, even in a sledge this short. With a longer sledge it could be practically nil (Fig. 14). During construction it was found that the structure cannot be the real solution.

A more useful structure was achieved when the side-straps were replaced with wooden side-rails. With the runner find Alajärvi KM/eh 16224:3 there had been a thin lath which had narrow holes. The runner belongs to the sub-type A and it is not known if the lath has been a side-rail. Wooden side-rails were made, based upon it. Nearly all the lashings were made with sisal rope. A few bindings were made with skin straps where resilience was needed. The lower-end of rear-end posts and the upper-ends of rearmost sledge-posts were connected with strong binding which anchored the tension caused by the up-turned bow and tow-line (Fig. 15). The same binding helped to withstand the stress if the sledge was pushed. Pushing the loaded sledge did not strain the rear-end lashing-hole. The hole was stressed only if the loaded sledge was lifted using handles.

The renewed upper-structure was quite rigid even when empty. In this form the reconstruction was tested at the Saarijärvi Stone Age village (Fig. 16). The mass of the sledge was about 10 kg.

In the spring of 1996 a one-legged reconstruction was made after the Kuusankoski runner find. The Kuusankoski runner is, like the Orimattila runner, a flat sub-type C (Table 1) with shallow and rounded post-holes. The lashing had to be tight in order to hold the posts in their holes. This time raw elk hide straps could be used. Sledge-posts were changed by adding a lashing-hole to lower part of posts. Now posts could be lashed to the runner with shorter lashings. There was not much harm of stretching raw hide lashings when they got wet. Cargo room was higher and the sledge more rigid (Fig. 17).

Fig. 14. The first version of the reconstruction. The cargo in the drawing is far too optimistic.



Raw skin lashings were made wet. While drying, raw skin tightens. Treating the raw skin lashings with train oil or grease protects them from getting wet.

Testing the reconstruction

The sledges can be pulled by a man, a dog or a reindeer. They can be pushed if the sledge has some sort of handles. It is usually easier to pull a sledge than to push it. Because of its one-legged structure the central-grooved reconstruction needs a driver to keep it upright and a man or/ and dogs to pull it. The reconstruction is too fragile to be pulled by a reindeer. And for a driver that would be difficult, because he or she cannot sit in the sledge. And the most important point is that as far as I know there are no certain indications of domestication of reindeer during Stone Age. Therefore the reconstruction was tested with dogs.

One of the oldest dog bone finds near Finland came from Pulli, Estonia (Benecke 1994: 30, 330). The dog remnants belong to the Mesolithic Kunda culture. The site has been radiocarbon dated. The oldest calibrated date is 8700 BC (Ta-245: 9600±120 BP) and the youngest 8300 BC (Ta-175: 9300±75 BP). Recent finds from Zhokov in northern Siberia hint at that already 8000 years ago there might have been dog-drawn sledges. In this tundra site dog bones and a light sledge-runner have been found (Pitul'ko 1998: 181).

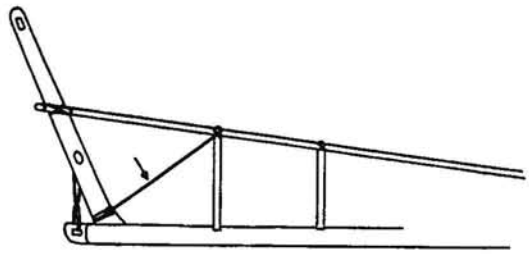


Fig. 15. Sloping binding.

A dog team can be formed in two ways. In a fan team every dog has its own tow line (Fig. 18). The dogs are like a fan before the sledge. Another

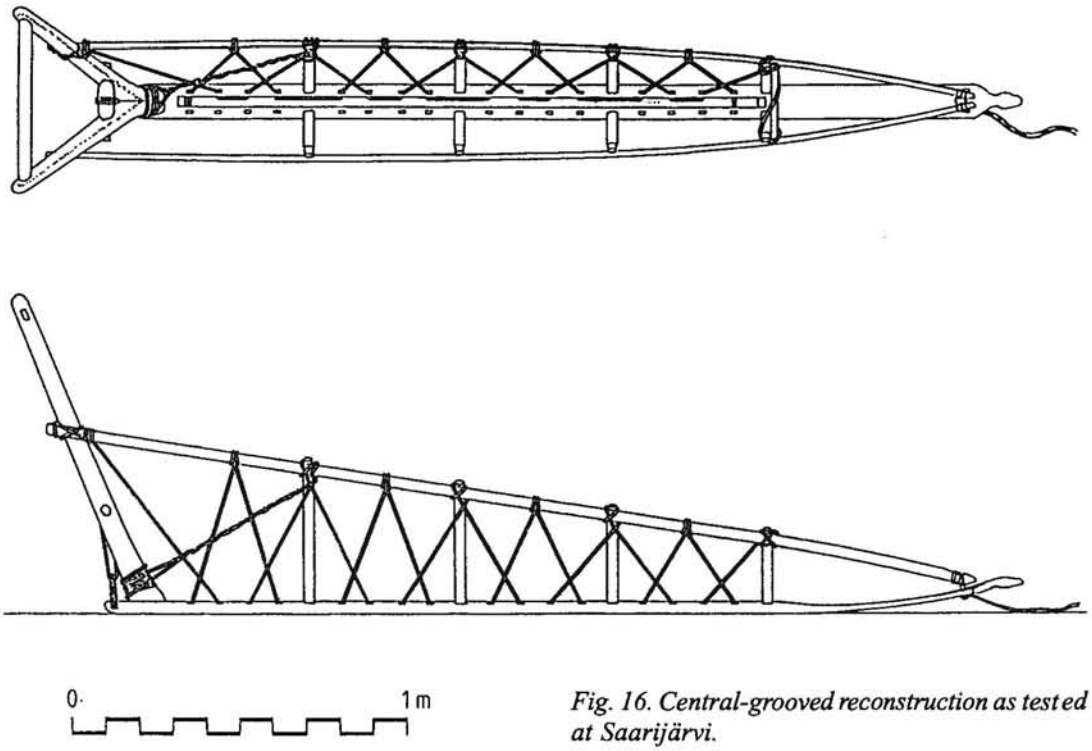


Fig. 16. Central-grooved reconstruction as tested at Saarijärvi.

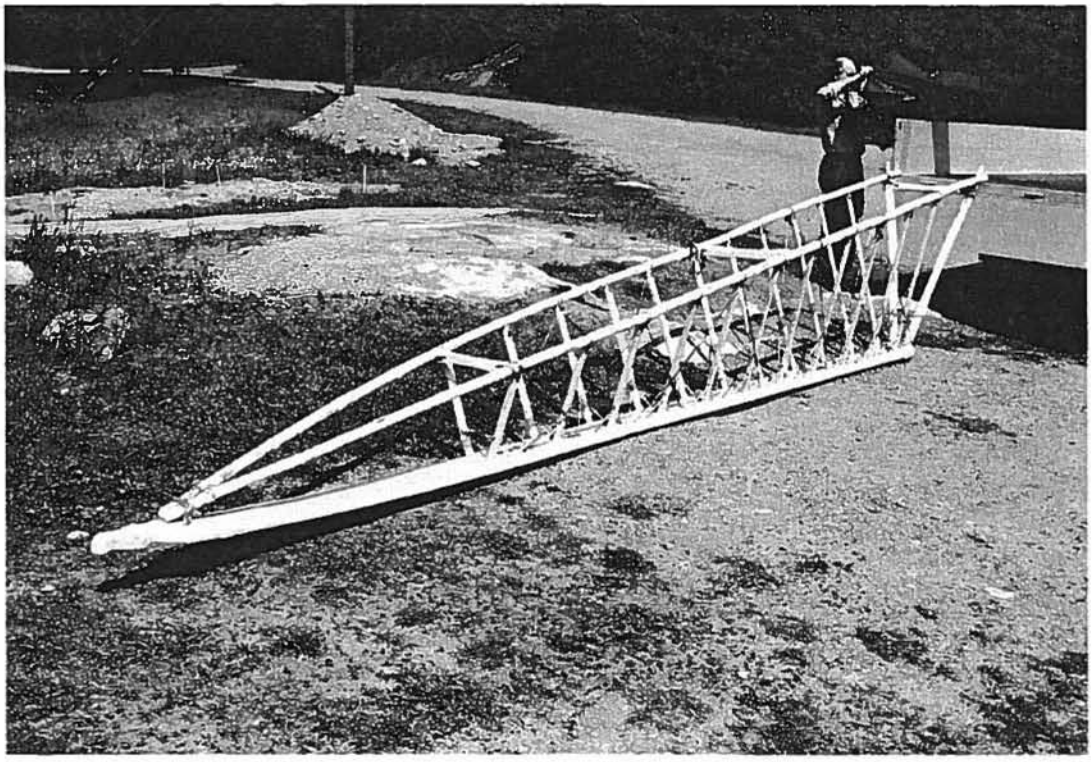


Fig. 17. The Kuusankoski reconstruction.

way is to fasten a long line to the sledge. Then dogs are fastened to the line side by side. The dogs in the team form a double queue. Often the foremost dog is the leader. This kind of team is called a tandem team (Mäntysalo 1989: 37). A fan team demands more room sideways. It is handy on ice. If one dog falls into a crack, it does not drag other dogs with it. A tandem team is more suitable in wooded or brushy terrain. When the reconstruction was tested with two dogs they were in tandem.

The structure of a one-legged sledge (troughed and central-grooved type) makes it possible for a driver to use skis. In the White Sea rock-carvings in Russia there are ski pictures which are considered to be of the Stone Age (Savvatejev 1983: 144-145). The oldest ski find in Sweden has been dated to the Stone Age (Naskali 1999: 304). Therefore it is quite reasonable to suggest that skis have been used in Stone Age Finland in spite of scarcity of Stone Age ski finds. There is a find from Salla (KM/kt 8227) the calibrated radiocarbon age of which is 3200 BC (Hel-1330: 4470±110 BP). The underside of the find has five parallel grooves. Because of that it resembles skis and Eero Naskali (1999: 296, 301) thinks it is a ski. The holes of its footspace are like post-holes in some runners of G. Berg's Morjärv type. I am inclined to think that the Salla find is a runner. To find out the real character of the find reconstructions should be made and tested. On the part of later periods there are numerous ski finds from Finland.

1) Tests in Turku

The first version of central-grooved reconstruction was tested in winter 1991. All the lashings were of tanned skin straps. Also side-straps were used. The sledge was pulled by a man. The cargo was a mere 6 kg. The package wrapped in skin was bound with leather straps which connected the side-straps. This made the structure a little bit stiffer sideways. However, the sledge had to be kept upright. Otherwise the weight of the cargo twisted the posts out of their holes. If this hap-

pened, the snow filled the holes, making repairs difficult. Tanned skin straps loosened their tension when wet. With the side-straps the structure was impractical. The structure had to be made more rigid. Greased raw skin straps would have been a much better solution but the sideways rigidity would not have been good enough. The reconstruction was quite short and many a central-grooved runner was longer. The longer the sledge is the worse is the sideways stiffness of the structure.

Next winter the side-straps were replaced with wooden side-rails and tanned skin straps were exchanged for sisal ropes. In this condition the sledge was tested at Saarijärvi.

2) Tests at Saarijärvi

The one-legged central-grooved reconstruction was tested in 1992 at the end of February at Saarijärvi Museum's Stone Age village at Summassaari, Central Finland. In the area there are plenty of prehistoric finds. At Summassaari alone there are nine Stone Age dwelling sites, most of which belong to Mesolithic Suomusjärvi culture (Saarijärven museon kivikauden kylän opasjulkaisu 1987: 9).

In the morning, temperature was a few degrees Celsius below zero. At noon the sunshine had raised the temperature to five degrees Celsius. The weather was calm for the whole day and a thaw set in during the tests. On the frozen lake there was water on the ice below snow cover.

Test driving was done during one day. The test driver was Eila Kuusinen, an experienced dog-team driver from Kangasniemi, Savo. She had seven dogs with her but only some of them were used in tests. The dogs which participated were Siberian huskies.

The time was limited and therefore the length of test trips were less than a kilometre. Water was below the surface of the snow and did not harm the sledge, but the dogs had to trample in icy water. That was another reason for the short trips. With the friendly help of Turku Provincial Museum, Saarijärvi Museum and many voluntary persons it was possible to arrange a day's test.

On the ice there were ski tracks running criss-cross and the dogs were inclined to turn to the crossing ski track. On a couple of occasions I walked in front of the dogs, and they followed my tracks. Even if the thickness of snow was not great, a ready-made track was easier for the dogs.

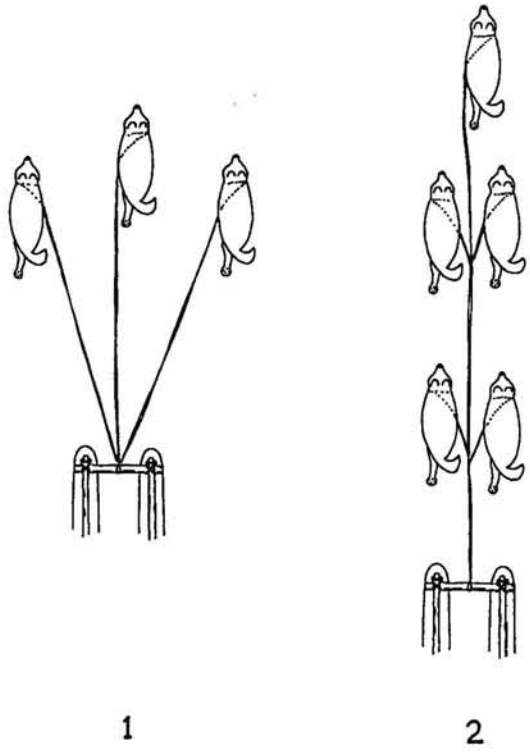


Fig. 18. Types of dog teams. Dogs 1- in a fan, 2 - in a line.

The cargo was very light, an elk skin weighing 8 kg. The sledge was pulled mostly by one dog and a few times by two. The driver walked behind the sledge except when she was using skis on trial (Fig. 19).

CONCLUSIONS

The reconstruction of the central-grooved sledge type without cargo was a little bit flimsy to drive because the tow-line raised the bow of the sledge all the time. After an elk skin weighing 8 kg had been put into the sledge handling became better. Part of time the driver used skis. It was easier to move in the snow.

The sledge was light to drive but its cargo carrying ability was quite small. It might be suitable for short trips, for example checking traps. However the Kullaa runner was made of Eurasian stone pine and that could be an indication of longer

Fig. 19. Eila Kuusinen driving the test sledge.

voyages because this pine has never grown in Finland. Several central-grooved runner finds are longer than the runner in the reconstruction, thus making more room for the cargo. The carrying capacity of the reconstruction is small compared to the amount of work that is needed to manufacture it. The reconstruction was made with iron and steel tools, but besides that I have tried to make different structures of central-grooved runner type with stone and elk bone tools. Working with them is slower. One could carry the same cargo with a little two-legged sledge or boat-sledge. Moreover one can pull them alone because their structure keeps them upright.

The bow part of a runner is sure to straighten more or less in the bog. It is difficult to say what was the original curvature of the bow. The bow of the reconstruction was quite low. On an even surface and on thick snow there was not excessive harm. A moderately curved bow goes easily through snow and lifts the fore part of a sledge upward without causing resistance. The cargo makes the sledge more back heavy and that lifts the bow more. While going on an uneven and especially moraine terrain a low lying bow does not work. Even if we suppose that ancient travellers have used as much as possible frozen lakes and bogs where the low-lying bow is not harmful, now and then they have had to move in the woods. Apparently the bow must have been more curved.

The bottom of the runner of the Kullaa reconstruction was smooth after sanding. There were no additions. While driving it was thawing but the bottom of the runner did not get stuck in the snow. It was only after longer standstills the driver had to pull the sledge backwards in order to loosen it.

The Stone and Bronze Age runners of Finland do not have runner rear parts upon which the driver can stand. The reason for that is clear when we have a one-legged sledge. The driver has to keep the sledge from capsizing. But perhaps with the two-legged sledge there was not much use for the above mentioned rear parts. On difficult terrain the driver have to help the dogs by pushing and pulling the sledge. In thick snow someone has to go before the dogs and make a trail. It can be assumed that most voyages were made at walking speed. There was no sense to waste energy unnecessarily. On the other hand, on hard-crusted snow the rear parts make possible greater speeds because the driver can stand upon the rear parts while the dogs are running fast.

In tests it was found that the one-legged central-grooved reconstruction did not work structurally when equipped with leather side-straps. When those were replaced with wooden side-rails the structure worked well. From the user's point of view the one-legged structure has some difficulties. The sledge capsizes easily while loading and unloading the cargo. The cargo has to be wrapped with some protective cover unless the construction by Kotivuori and Kiviluoto is used. The cargo capacity is relatively small and the centre of gravity tends to rise higher with larger loads, which makes keeping the sledge upright more difficult.

The Kuusankoski reconstruction has not been tested. Its length is comparable to those central-grooved runner finds which are complete, side-rails are situated higher and it follows that room for the cargo is bigger. In a one-legged sledge this room becomes narrower lower down. That is unfavourable because in order to help to keep the sledge upright the heaviest cargo should be put as low as possible. But here there is least room. The volume of cargo room cannot be fully used. On the other hand, the higher structure increases rigidity. With raw skin bindings the Kuusankoski reconstruction is more rigid than the tested smaller Kullaa reconstruction. Rigid it must be

because the runner of the Kuusankoski sledge belongs to the sub-type C with quite shallow post holes. The Kullaa reconstruction was later renewed using the Kuusankoski sledge as a model (Fig. 20).

Structurally, it seems that the central-grooved runner of sloping-posted sub-type B most probably belongs to a one-legged sledge. The structure is practical as a cargo carrier if the runner is long enough. The sloping/vertical-posted subtype C could be part of either a one-legged or two-legged sledge. The vertical-posted sub-type A is most probably part of a two-legged sledge. But it is possible to make a one-legged sledge based on the vertical-posted type as Kotivuori and Kiviluoto have demonstrated.

There can be several reasons to introduce a new runner/sledge type and to discard the old one. A structurally better runner or sledge can replace an older one. The purpose of use or circumstances can change. For example, an increased trade may demand bigger cargo capacity. New forms can be imported. Innovations do not necessarily remove the old sledge type from use. Old sledges may be used for other purposes. Some people or groups of people may be conservative and cling stubbornly to the old sledge type. Therefore new and old sledge types can coexist for a long time.

The two-legged central-grooved sledge has apparently developed in order to enhance cargo capacity. What could a two-legged sledge have been like? I loosely sketched two sledges loosely after Itkonen's proposal. I think Itkonen's proposal could be operable with less complex bindings and vertical post-holes. The runner was based on the vertical-posted Pudasjärvi runner, which is about four meters long. The first version is normal "travel sledge" (Fig. 21). Another is a flat "seal-hunting sledge" (Fig. 22). The latter is low and without side-rails. That makes loading a heavy seal easier.

There are four vertical-posted runners at Alajärvi (Kopisto 1964 and the personal observation of the writer). Perhaps it is not a local sub-type, because there is also one vertical-posted runner at Pudasjärvi. Vertical-posted runners seem to appear during the late Combed-ware period, 3600-2800 BC. That may indicate the birth of a two-legged central-grooved sledge. In spite of that the one-legged sledge remains in use. In order to get a more precise picture of development of the central-grooved sledge type we should have more dated runners and more testing.

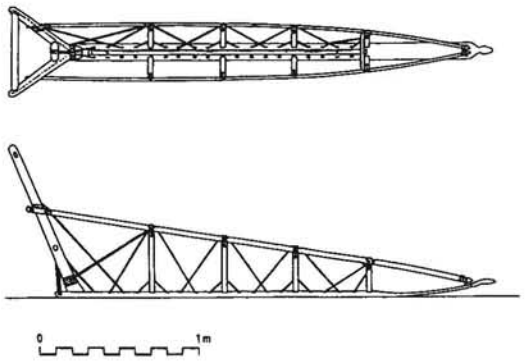


Fig. 20. Central-grooved reconstruction renewed after tests.

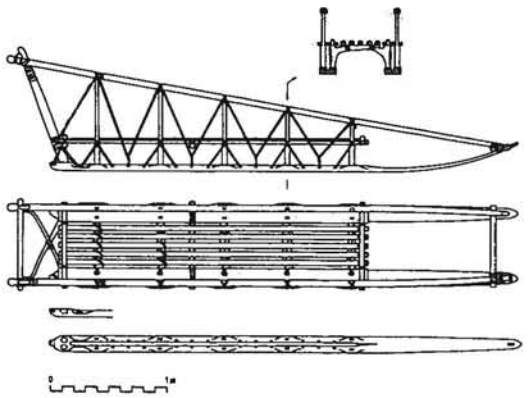


Fig. 21. Two-legged central-grooved "travel sledge".

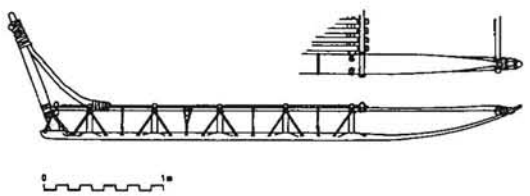


Fig. 22. Two-legged central-grooved "seal-hunting sledge".

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ABBREVIATIONS

KM/eh = Catalogue number of prehistoric department of the National Board of Antiquity
KM/kt = Catalogue number of ethnologic department of the National Board of Antiquity
MV ark. = Archives of prehistoric and ethnologic de partments of the National Board of Antiquity
PPM = Pohjois-Pohjanmaan museo (Oulu)
SatM = Satakunnan Museo (Pori)
SM = Suomen Museo
SUSA = Suomalais-Ugrilaisen Seuran Aikakauskirja (=Journal de la Société Finno-ougrienne)