The Two-Wood Bow

Ragnar Insulander

Introduction

The invention of long-range weapons has played an important role in the evolution of human culture. The evolution of the bow in particular has held a central position in this process. A reconstruction of the steps by which the bow evolved is therefore of considerable interest. In this process the use of two separate types of wood, the invention of strong glues, the evolution of stiff ends, which act as levers, and the discovery of the mechanical characteristics of horn and sinew are key technical innovations.

Previous research has often focussed on the evolution of the horn bow, or the composite bow as it also is called. On the other hand, the type of bow that is typical of northern Asia, the two-wood bow, has attracted little interest. This paper treats the evolution of the bow in Scandinavia, with focus on the two-wood bow. To put the two-wood bow in perspective, archaeological records and rock-carvings are analysed. This study highlights some new aspects of the early evolution of the bow, where the two-wood bow is, for the first time, assigned an important role. It is classified as a distinct type, which, moreover, formed an important stage in the evolution of the bow.

The two-wood bow: characterisation and distribution

As a basis for the discussion of the role of the two-wood bow in the development of the bow, I present below a new classification of the various historically attested types of bow.

A classification of bows may be based on a variety of criteria. Leakey (1926) based his classification of the bow in Africa on the mode of attaching the string to the bow. He claimed that this classificatory scheme ensured a good reflection of the common cultural origins of bows. On the other hand, he considered the size, materials and shape of the non-functional parts of the bow

to be less significant, being more influenced by local conditions, such as the availability of materials, and the personal preferences of the bowyer (Leakey 1926: 259).

Rogers (1940) summarised earlier efforts to classify bows in a table. The degree of overlap and ambiguity of the various classificatory schemes is striking. He also presented a classification of his own, which was intended to apply to both East Asian and North American bows. In this system, the two-wood bows are assigned to the group "Composite bows", and are not considered a type of their own.

Previously, Balfour (1890: 240) had instead classed the Saami bow as a variant of the simple or self bow, though strongly influenced by the horn bow. Luschan (1899: 226), on the other hand, assigned two-wood bows to the composite type. Adler (1902: 21) and Rausing (1967: 19, 65) followed Luschan in classifying the Saami bow as composite, while Alm (1930: 63) calls the type reinforced.

One of the main reasons that the two-wood bow has been scantily and inconsistently treated is that none of these earlier classifiers has regarded it as a distinct type. The result of this has been that its importance in the evolution of the bow has been largely ignored. Below I present a classification based on the composition of the bow. Like all classificatory schemes this one has both strong and weak points. In this case the main advantage is that such a classification facilitates a discussion of the process by which the various types have evolved.

Simple bows – wood

The oldest type of bow was made from a single piece of wood. To this group belong, for example, the Mesolithic Holmegaard bows from Denmark (*c*. 7000 BCE) which are made of elm (*Ulmus*) (Callahan 1994) and the Neolithic long bows of yew (*Taxus baccata*) from Switzerland (Clark 1963: 66). The English medieval long bow was also made from a single piece of wood.

Reinforced simple bows – wood/sinew

This was the typical bow of the North American natives during the eighteenth century and later (Wallentine 1988: 12). In this type of bow, the sinews are glued to the wood while moist and form a layer of varying thickness on the back. Some Inuit bows instead use thick bundles of pleated sinews, which are lashed to the back (Callahan 1990: 21 f.).

Two-wood bows – wood/wood (see Figs. 1, 7 and 8)

The oldest record of a two-wood bow is from Korekawa, Japan. The wooden fragment is dated to 2600 BCE (Rausing 1967: 121), and consequently belongs to the Jomon culture. This type of bow is otherwise considered typical of the Finno–Ugrian tribes (Sirelius 1919; Kiil 1954: 135). According to Adler (1902:

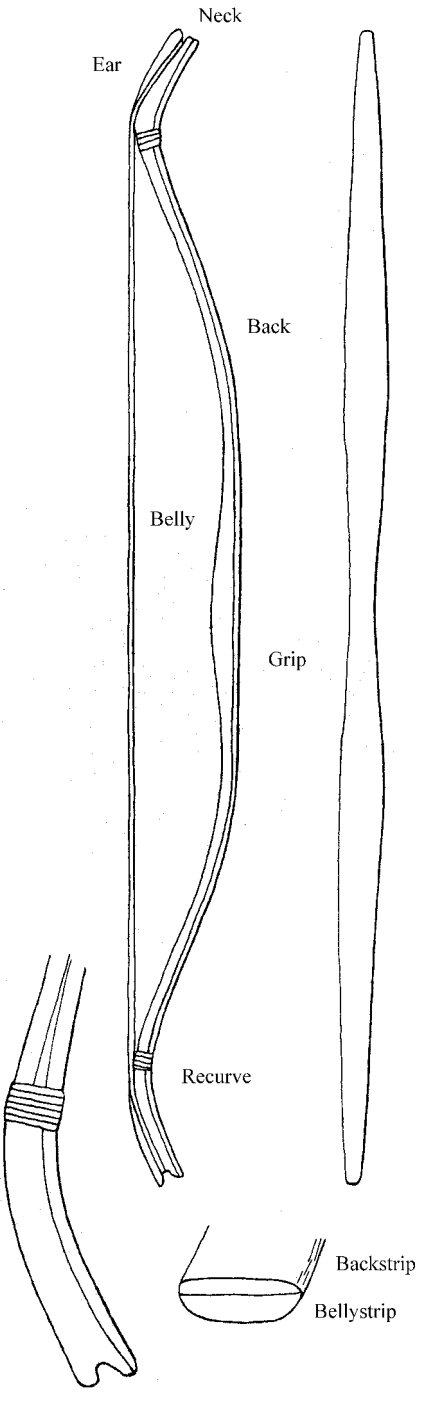


Fig. 1. The different parts of the Fenno–Ugrian two-wood bow.

21) it is mostly found in the western parts of North Asia. The Saami bow also belongs to the two-wood type (Insulander 1995, 1996, 1998a–g, 1999a–f). The bows of the Ob-Ugrians (Xanty and Mansi) were made from two or three layers of wood (Manninen 1932: 343). Luschan (1899: 225 f.) describes a peculiar Indonesian variety of the two-wood bow, where the wooden staves are lashed together with pleated rings instead of being glued to each other.

Reinforced two-wood bows – wood/wood/sinew (see Fig. 2)
This type of bow has not attracted much interest from researchers. Adler (1902: 21) states that it is common in northern Asia. An interesting archaeological record of a reinforced two-wood bow is the so-called Novgorod bow (Thompson 1967). Farbregd suggests that the Novgorod bow is an old Russian type that evolved from the Scythian bow and was used throughout the Rus Empire during the tenth century (Farbregd 1972: 81 f.).

A variant of the reinforced two-wood bow is the Chukchi bow described by Alm (1930: 75). The Chukchi bow is made from coniferous wood, birch wood and two pleated strands of sinew on the back. According to Kiil (1954: 132 f.) similar reinforced two-wood bows were also used by the Jukaghirs and the Lamuts.

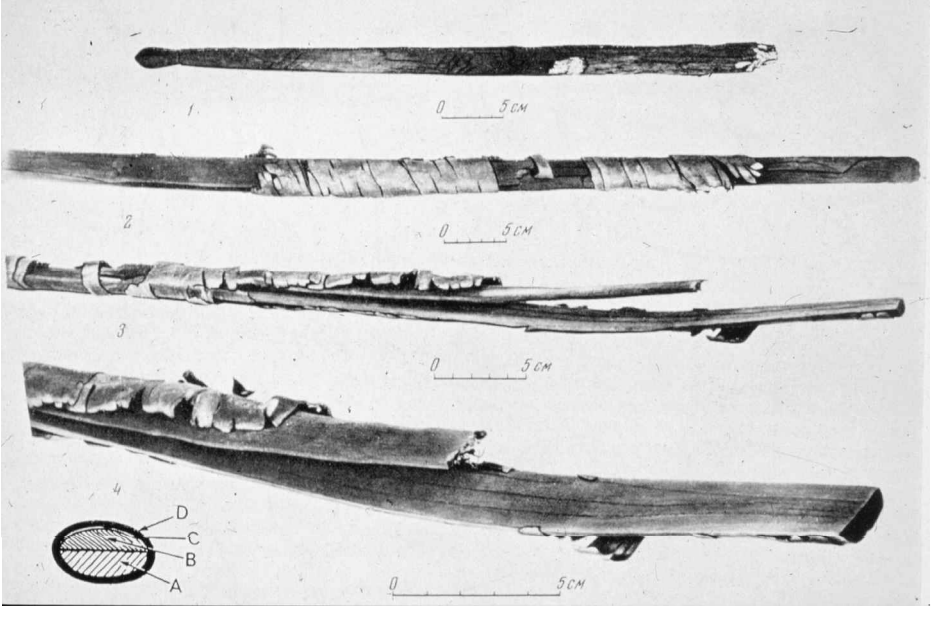


Fig. 2. A reinforced two-wood bow from the 12th century found in Novgorod. After Thompson 1967. A = juniper, B = birch, C = cavity after a decayed sinew-layer, D = birch-bark.

Simple horn bows – horn/sinew
Alm (1930: 73) describes an Inuit bow made from a reindeer rib and sinew. North American Indians also used simple horn bows with sinew glued directly to the belly of a horn strip (Hamilton 1982: 9).

Composite horn bows – horn/wood/sinew
This, the "classical" composite bow, often of an extremely complex construction and manufacture, has a long history. Below, this type is termed horn bow for simplicity. The oldest finds of this type of bow are from the Pri'baikal area, north-west of Lake Baikal in Siberia, where horn strips dating to the end of the third millennium BCE have been found (Rausing 1967: 119). There are more complete Egyptian specimens from the age of Rameses II, nineteenth dynasty, *c*. 1270 BCE (Luschan 1893: 266), and from the eighteenth dynasty, *c*. 1350 BCE (Rausing 1967: 70 f.), but it seems almost certain that this type of bow was an indispensable adjunct of the chariotry forces that dominated the military scene in the Near East from approximately the eighteenth to the twelfth centuries BCE.

The Tartar bow, the Turkish bow and the Chinese bow were of this type. Buschan (1926: 884) figures a composite bow from Bashkiria that has three layers: a belly of horn, a wooden layer and a bundle of sinew. For efforts at a morphological classification of the composite horn bow and its precursors, see Balfour (1890: 244) and Grayson (1993: 153).

There are several intermediate types that do not self-evidently belong to any of the types described above. In this context, the Evenki (Tungusian) bow is of particular interest. This was basically a two-wood bow, but reinforced by sinew on the back and horn strips on the belly (Balfour 1890: 228).

There is also a number of interesting finds of medieval bow fragments from town contexts in Norway (Oslo, Bergen and Trondheim) (see Fig. 3). These will be described elsewhere (Insulander 2002), but it seems clear that they are fragments of some kind of two-wood bows, possibly reinforced ones.

Distribution of the two-wood bow

Alm (1957: 460) was apparently the first to connect the Old Norse term *tvividr* with the Saami bow. The term may be translated as "two-wood" or "double-wood", and alludes to the fact that the Saami bow was manufactured from two joined pieces of wood of different character, in contrast to the simple Norse bow of elm or yew. Another name was *finnbogi*, "Finnish bow", *finnar* being the traditional West-Norse name for the Saami and Kiil (1954) documents several instances of the use of the term *finnbogi* from the Old Norse literature. Manker (1947) used the terms Finno–Ugrian (*fide* T.I. Itkonen) or North Asian for the bows of the Saami and the other Finno–Ugrian tribes. In this paper I

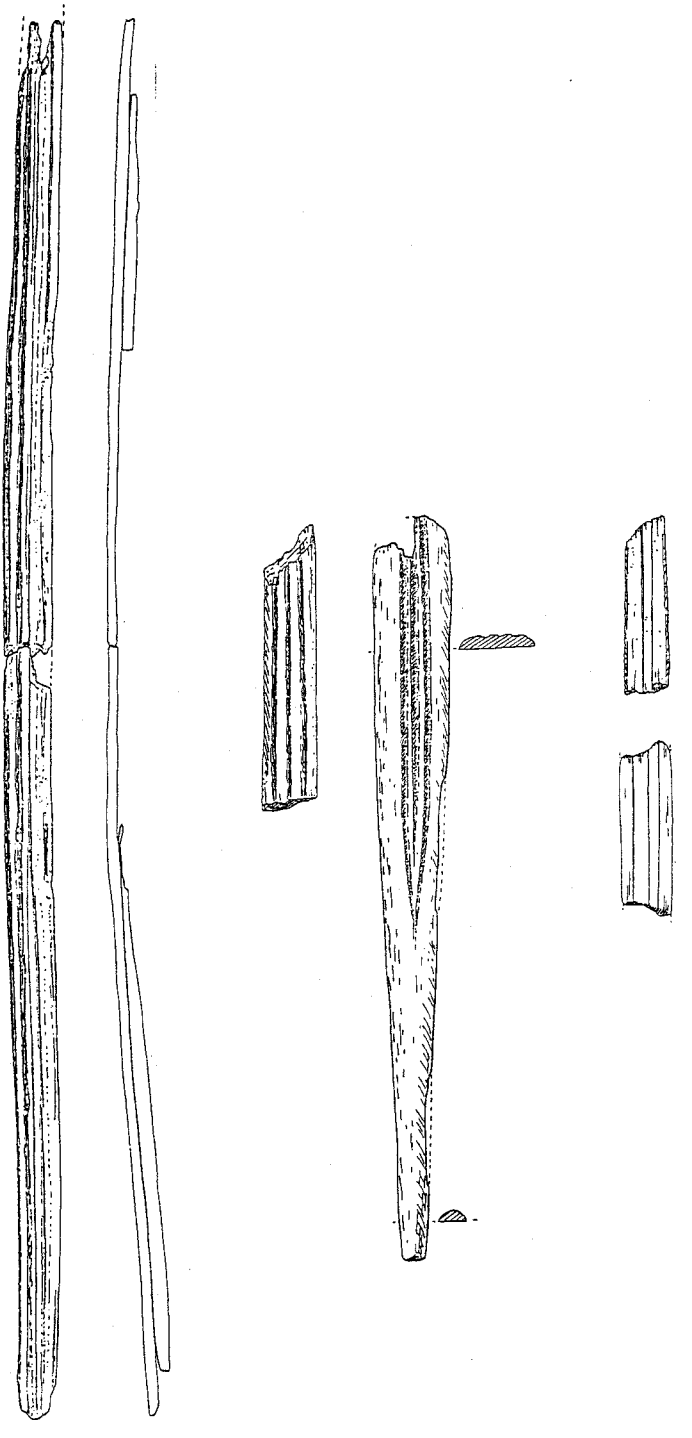


Fig. 3

have revived the descriptive and ethnically neutral term two-wood, a translation of the Norse *tviviðr*, and use it for all types of bows made from two joined pieces of wood with different characteristics.

Despite the two-wood bow having been one of the most important hunting and combat weapons over a wide area for centuries, and indeed probably millennia, information about this type of bow is quite sparse. The most important references are Adler (1902), Sirelius (1919), Alm (1936, 1952), Kiil (1954) and Farbregd (1972).

According to Adler (1902: 21) the two-wood bow has been used mostly in northern Europe and the western parts of North Asia. It is considered typical of the Finno–Ugrian tribes (Sirelius 1919; Kiil 1954: 135). The Finno–Ugrian languages have common roots for "bow" and "arrow". Further east in Siberia, similar bows were used by all tribes except the Chukchi and the Inuits (*fide* Bogoras; Kiil 1954: 132 f.).

Kiil suggests that this type of bow has a very long history in northern Asia, and refers for instance to rock-carvings at Zalavruva near the White Sea in northern Russia (2500–1000 BCE). Among the human figures are some holding bows with long ears (Kiil 1954: 140). As already mentioned, the oldest archaeological record of a two-wood bow (made from bamboo) is from Korekawa in Japan, and is dated to 2600 BCE (Rausing 1967: 121). There are two finds of presumably Finno–Ugrian two-wood bows that may be quite old, from Paltamo, Finland and Senja, Norway. However, in both cases the dates are uncertain, as discussed below.

On the other side of the Bering Strait there is also evidence that some American Indians used a variety of reinforced two-wood bows. Laubin and Laubin (1980: 21) mention that the Chippewas used bows of ash (*Fraxinus* sp.) and "cedar" (*Juniperus virginiana*?) reinforced by a layer of sinew. The Paiutes and Chemehuevis sometimes made bows with a back of mesquite (*Prosopis* sp.), mountain mulberry (*Morus microphylla*) or mountain mahogany (*Cercocarpus* sp.), and a belly of juniper or "cedar" (*Juniperus* sp.) (Laubin and Laubin 1980: 28). Rogers (1940: 259), on the other hand, claims that the two-wood bow has not been used in North America. It is certainly clear that the typical North American bow was of the simple or self type. North American horn bows also existed and have been well studied. They are invariably described as being made of horn and sinew only.

Peoples normally associated with the composite horn bow were also familiar with the two-wood bow. In an Arabic manuscript of the sixteenth

Fig. 3. Fragments of medieval two-wood bows from Oslo. These bows and the ones from Bergen, Trondheim and Oppdal differ from the typical Saami Bow. They seem to belong to a special kind of two-wood bow, very little known and not described either. For a discussion about this see Insulander 2002.

century there are descriptions not only of the "classical" composite horn bow, but also of simple wooden bows, two-wood bows and an intermediate type between a reinforced bow and a horn bow (Elmer and Faris 1945: 10 f.). The manuscript is obscure on some points, and the translators do not exclude the possibility that one of the mentioned types of bow (*sharij*) may have been manufactured from three or more wooden layers. Elmer and Faris compare these with English long bows, which were sometimes "backed", i.e. reinforced by a particularly tough rib of wood on the back. The Arabic *hijazi* bow existed in three different varieties: *qadib* was a simple wooden bow, while *filq* and *sharij* were made of two or more layers of wood.

The text makes a clear distinction between reinforced bows (*mu'aqqabah*) and true horn bows (*masnu'ah*). *Mu'aqqabah* was basically a wooden bow, although reinforced with horn and sinew, and according to the text it was only used by "experts and people living close to water". The translators suggest that this may mean that such bows were exceptionally powerful and that they performed better in moist environments than true horn bows (Elmer and Faris 1945: 10 f.). This is an interesting comment, since it provides an "ecological" explanation why a reinforced two-wood bow would be superior to a true horn bow in some particular environments.

A laminated bow, reportedly made from willow (*Salix*) and alder (*Alnus*), is kept at the Institute of Archaeology in Ukraine. It is said to be one of only three known Scythian bows (Edwards 1996: 66). For several reasons, it is quite unlikely that this is a true two-wood bow. The types of wood seem extremely unlikely, and at least one is almost certainly wrong. Willow might be used as the back of a two-wood bow, but there are no indications that alder wood has ever been used for the manufacture of bows, and it has quite unsuitable characteristics for such a purpose. From the description it is clear that the bow, which is only 80 cm long, has a biconvex form, like a Greek sigma (Σ). This description seems to indicate a composite horn bow, the type of bow for which the Scythians were famous, rather than a two-wood bow.

Finally, it should be noted that the concept of reinforcing a bow by attaching a thin rib of resilient wood to a belly piece which is hard and tough in compression was adopted by French bowyers during the seventeenth century and spread to England where sporting bows were frequently "backed" (Luschan 1899: 226; Harris 1994). Alm (1936) suggests that the Saami two-wood bow may have inspired this development. This may seem far-fetched, but the impulse may have come by way of Schefferus' *Lapponia*, first published in 1673, in which the Saami bow is described and which attracted great attention throughout Europe.

The two-wood bow and rock carvings

Scandinavian rock carvings belong to two ecologically and stylistically distinct groups. The northern group, found in central and northern Sweden and Norway, belongs in a hunter–gatherer context and has a large temporal range (at least 6000–1500 BCE), while the southern group, mostly in southern Sweden with some outliers in southern Norway and Denmark, was produced by a farming society and is considered to belong almost exclusively to the Bronze Age (*c*. 1700–400 BCE). The carvings discussed below belong to the northern group, with one (indicated) exception.

In the northern rock carvings, the bow is a fairly common motif and several varieties are depicted, including the "biconvex bow". Rock carvings near Alta in Finnmark include several motifs with bowmen. Helskog (1983) lists no less than 19 depictions of bows and/or arrows. According to Helskog (1988) most of these carvings of bows and arrows are 6200–5600 years old. Several of the illustrated bows have a profile that seems to exclude a simple wooden bow.

One of the best-drawn bows is held by a man standing in a boat. The bow is as tall as a man, there is no indication of a bowstring, and the profile is clearly biconvex. This carving is found on the rock-carving group "Bergbukten IVB", dated to 4200–3600 BCE (Helskog 1988: 91) (see Fig. 4).

On the same rock there is another boat with a bowman. Judging from a photograph, the shape of this bow is angled rather than biconvex (Helskog 1988: 25), which is even clearer in the illustration in Sveen (1996: 27). Another hunter is depicted nearby, apparently standing on land and holding a biconvex bow (also figured by Sveen 1996: 23). Several reindeer are carved between these two hunters, and Helskog suggests that the scene represents a form of reindeer hunting where the animals were stampeded into water and then killed from land or from boats.

More common is the type of bow found on the rock carving "Ole Pedersen IX"; i.e. a short biconvex bow with the string indicated (Helskog 1988: 55). On the carving "Bergbukten I", dated to 4200–3600 BCE, a bow with a simple angled profile is depicted (Helskog 1988: frontispiece, also p. 103). On this carving there are also several bows drawn as rather short, almost straight lines without any bowstring.

In Sweden biconvex bows are depicted on Bronze-Age rock carvings at Fossum in Tanum parish, Bohuslän (Kiil 1954: 42) (see Fig. 4). Their appearance is identical to the ones described above from "Ole Pedersen IX". The Tanum carvings belong to the southern Bronze-Age group.

Kiil suggests that these biconvex bows can hardly have been simple, but that it is not possible to determine just what type of bow is being illustrated (Kiil 1954: 43 f.). Further, he suggests that it is plausible to postulate a common origin for the biconvex bows that are illustrated both in northern Europe and

Fig. 4. Rockcarvings depicting bows. From Alta, Norway, 4200–3600 BC (after Helskog 1988, p. 91), Salawruga, White Sea coast, Russia, Neolitic (after Rausing 1967, fig 15) and Bohuslän, Sweden, Bronze Age (after Kiil 1954, p. 43).

the Mediterranean area (Kiil 1954: 45 ff.). Based on finds of prehistoric arrows in northern Europe, he also associates a powerful type of bow with the Late Neolithic Peri-Baltic Pitted Ware culture. A connection may exist between this powerful bow and the composite (i.e. two-wood) bow used in more recent times by the Saami (Kiil 1954: 49).

Although Kiil suggests a connection between the biconvex bows illustrated on the rock carvings and the Saami two-wood bow (Kiil 1954: 49), it seems that he considered it more likely that the bows depicted on the rock carvings were actually composite. In his paper he accordingly classes these biconvex bows as "Horn bows" rather than as "Finnish bows" (*finnbågar*), the group to which the Saami two-wood bow belongs.

Rock carvings are usually very schematic, and the conclusions drawn about the construction of the illustrated bows are correspondingly uncertain. No previous effort at interpretation has seriously considered the possibility of two-wood bows, perhaps reinforced ones.

The earliest archaeological record of a two-wood bow from northern Europe is the Paltamo bow, which is slightly over 2000 years old (Edgren 1980). The C14 dating is, as already mentioned, rather uncertain, since it was performed on another wooden object found at the same stratigraphic level in the bog. It is, however, possible that the bow could have been deposited as a

sacrifice by being inserted into the soft bog (Insulander 1999a), in which case it might be much younger than indicated by the stratigraphic level. The Senja bow is only loosely dated as being "prehistoric" (i.e. pre-medieval) and it would be highly desirable for C14 datings to be made directly on these two bows. Notwithstanding the uncertainty of these dates, the rock-carving evidence suggests that the two-wood bow as a type may be several thousand years older than the earliest archaeological finds.

The two-wood bow – a missing link

As noted by Bergman (1993), the development of the bow has always attracted the attention of prehistorians, although they have tended to focus more on when and where the bow was first used, rather than how its form and function have evolved. Important stages in this evolution were when glue was first used for bow making, and it became possible to combine different types of wood, and at a later stage the incorporation of horn and sinew. Another important innovation was the introduction of reflexed ends of the bows.

The development and dispersal of the two-wood bow has unfortunately been very little studied. On the other hand, the origin and development of the horn bow has been exhaustively discussed by prehistorians. A brief outline of some of the theories that have been aired are useful as a background to the discussion of the evolution of the two-wood bow below. The most important contributions to the history of the horn bow are Balfour (1890), Bonnet (1926), Brown (1937), Kiil (1954), Clark (1963), Rausing (1967) and Grayson (1993). More recently, horn bows have been treated by Bergman et al. (1988). They suggest that the composite horn bow probably evolved from a bow made exclusively from horn and sinew, and that wood was subsequently incorporated into the construction. The same authors also state that the bow has evolved along different lines in Europe and Asia, and that the horn bow originated somewhere in Asia (McEven et al. 1991: 50).

Several clues suggest that the horn bow evolved during the third millennium BCE, more or less simultaneously in Mesopotamia/Anatolia and on the Eurasian steppes (McEven et al. 1991: 54).

The reasons for the development of the horn bow have been commented upon by a number of researchers. The oldest theory is that the horn bow was developed in areas where suitable wood for bow making, such as yew and elm, was unavailable (Pitt-Rivers 1877; Balfour 1890: 220 f.; Clark 1963: 50 f.). These early researchers did not believe that the composite horn bow had any intrinsic points of superiority over the yew longbow. However, later research has shown that the horn bow is significantly superior to the simple bow in several respects (Bergman et al. 1988).

More recently the development of the horn bow has instead frequently been linked to equestrian tribes who need a powerful *short* bow suitable for use on horseback. This link has been suggested by several researchers. On horseback a long bow is unwieldy, and to shorten the bow while still maintaining its power requires the use of high-performance materials.

Wood alone is no longer good enough, so new materials like horn and sinew were added. Significantly, the evolution of the horn bow in North America coincides with the introduction of the horse during the eighteenth century. The introduction of the chariot during the mid-third millennium BCE would have reinforced the trend towards shorter bows (Miller et al. 1986: 182; Moorey 1986: 209).

In contrast to McEven et al. (1991), Rausing has suggested the western European bow of the Holmegaard type as a precursor to the horn bow (Rausing 1967: 148), and in this context points to the broad, flat profile of the bow. There are, however, other characteristics that may also be precursors of more complex bows. Recently, Callahan (1994: 56), Baker (1994: 44 ff.) and Heath (1995) have commented on the long, stiff ends of the Holmegaard bow. These may be interpreted as a primitive form of ears that developed into the reflexed ears found on two-wood bows and, later, on horn bows.

Rausing also emphasised the importance of glue boiling, which requires ceramic vessels, as being a necessary precondition for the development of the horn bow (Rausing 1967: 148). The method for making glue from the skin of perch (*Perca fluviatilis*) used by the Saami, and presumably by other Finno–Ugrian tribes, however, does not require the use of vessels for boiling, since the skins only need to be steamed to obtain a high-quality glue, suitable for bow making.

No previous study has explicitly discussed the two-wood bow and its role in the evolution of the bow. However, there have been hints that some form of two-wood bow might have represented an important step in the evolution of the bow. Rausing (1967: 138) comes closest to such a statement when he suggests that the earliest type of composite horn bow was made from wood and horn, or from several layers of wood only. It is not the North Asian two-wood bow he has in mind, however, but rather the Japanese bow, which was made from several layers of bamboo. Kiil (1954: 49) also mentions in passing that a connection may exist between the double-convex bows of the northern rock carvings and the Saami two-wood bow. In Cederlöf (1951: 127), the two-wood bow is mentioned as a precursor to the horn bow. Alm (1930: 72) indeed mentions these bows as being transitional between the simple bow and the composite horn bow, but it is clear from the context that this is to be understood in a strictly morphological or typological sense, not as a historical or evolutionary process (Alm 1930: 65).

The dominant view of the two-wood bow, if it is mentioned at all, is that it represents a less-than-successful effort by "primitive" tribes to copy the true composite horn bow. Alm (1952: 205) suggests that the two-wood bow has been subject to strong influences from the horn bow. Kiil (1954: 137) notes that the evolution of the northern *finnbåge* (i.e. the Saami two-wood bow) is not well understood, but that it has usually been seen in terms of an effort to emulate the composite horn bows found further south in Asia. He does, however, suggest that bows with long stiff ears have been in use since the Stone Age.

These preconceptions have meant that nobody seems to have seriously considered the rather obvious concept that the simpler two-wood bow was a precursor to the more complex composite horn bow, rather than the other way around.

My alternative hypothesis, first formulated in Insulander (1997), is that the two-wood bow and related types are representative of an *earlier* stage of the evolution of the bow than the composite horn bow. This interpretation is supported by the fact that the composite horn bow could not possibly have evolved from the simple bow in a single step. It must instead be the end product of a long evolutionary process, from the simple bow stave by way of a series of intermediate types to the highly sophisticated horn bow that we find among, for example, the Turks and Scythians.

Rausing's hypothesis that bows of the Holmegaard type may have been ancestral to the horn bow is worth developing further. A possible hypothesis is that development may have gone by way of the two-wood bow. The step from a simple bow of the Holmegaard type to the two-wood bow is not very large considering that the European Mesolithic bows are made almost exclusively from elm or yew. Both these types of wood have a well-demarcated hard heartwood and a more resilient sapwood. The Mesolithic archers would have been aware of the virtues of a belly that is strong in compression and a resilient back when they chose these woods for their bows. A logical next step would then be to join pieces of wood with the desirable characteristics taken from different trees. In this effort to improve on nature it was found that a combination of compression wood from conifers and resilient wood from some leaf-bearing tree would provide better performance than elm or yew alone. To improve performance further, the use of other materials such as horn and sinew would then be a logical next step, and I consider it likely that the horn bow did indeed evolve in this manner from the two-wood bow.

This next step would have been taken when it was realised that horn was an even better material for the belly and that sinew made the back even more resilient. The hard compression wood would either have been replaced by horn, or supplemented by a further layer. The two-wood bow occurs in several varieties where some are quite close to the true composite horn bow. Based on

the combinations of materials used in the various sub-recent bow types, it is possible to document a complete evolutionary series from the simple wooden bow to the composite horn bow (see Fig. 5). The reinforced two-wood bows, which are common in North Asia, are made from wood/wood/sinew.

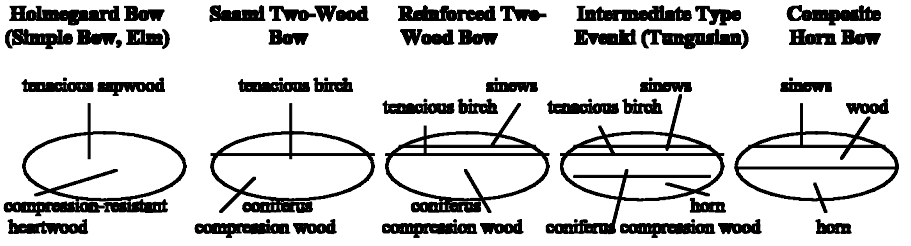


Fig. 5. Intersections of a Holmegaardbow, a Saami two-wood bow, a reinforced two-wood bow, the Evenki intermediate type of bow, and a composite horn bow. These five figures represent a possible line of development of the bow.

Interesting finds of early horn bows have been made in the area west and north-west of Lake Baikal (Pri'baikal) (see Fig. 6). Several very old (approximately fourth millennium BCE) fragments of bows have been found in this area. These fragments are horn ribs, from bows with an estimated length of 1 to 1.5 meters (Okladnikov 1950; Rausing 1967: 119 ff.). Okladnikov considers this type of bow to be the most important innovation made in the Pri'baikal area during the Neolithic.

I would suggest that these finds could also be interpreted as being from early reinforced two-wood bows, possibly similar to the hybrid type described by Balfour (1890: 228). This type, which was used by the Evenki, had, in addition to two wooden layers, sinew reinforcement on the back and a thin horn rib on the belly.

Okladnikov (1950) has determined that the long horn strips were made from reindeer antlers. The longest single strips are 87 cm, which excludes elk (*Alces alces*) or deer. Okladnikov also excludes mammoth (*Elephas primigenius*) ivory, due to its propensity for delaminating into thin layers. According to Okladnikov the horn strips were manufactured by first making two parallel cuts along the whole length of the antler with a flint knife. The intervening strip was separated from the antler, cleaned and then heated for a long period in hot ashes or water. Finally, the horn strip would be straightened and dried.

Perhaps it was in this area, or somewhere else on the border between the taiga belt and the Eurasian steppe zone, that the first steps were taken in the

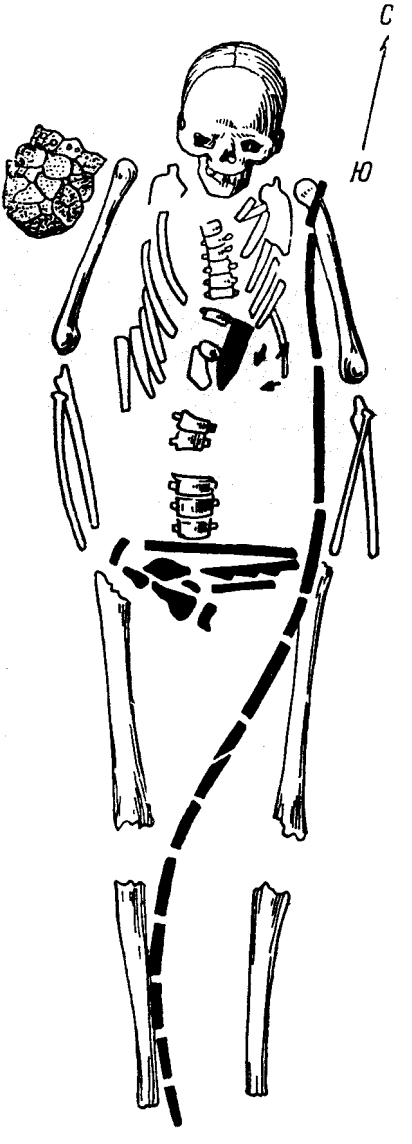


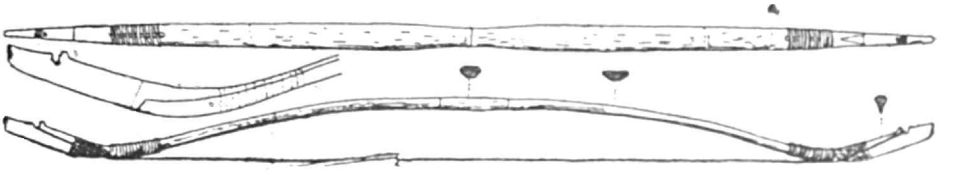
Fig. 6. The bow from Pribaikal, the fragments consists of horn ribs, and have been part of some kind of early composite horn bow, eventually an intermediate type with two layers of wood. After Okladnikov 1959.

evolution that would reach its pinnacle in the horn bows of various equestrian tribes such as the Scythians and the Huns.

The Finno–Ugrian two-wood bow may be the missing link between the simple bow and the composite horn bow. It is at least as strong a candidate for this as the Japanese bamboo bows (cf. Rausing 1967: 138). In this context it

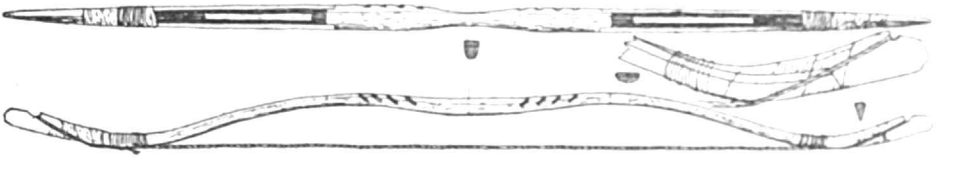
should be noted that there is ample linguistic evidence for early contact between the Finno–Ugrians and the Indo–Iranians of the steppe zone, while the Jomon culture of Japan was always quite isolated.

Also, with respect to the design of the ears and the degree of reflex, the two-wood bow would fit well as an intermediate type. The two-wood bows have ears that are simpler and less recurved than those of the true composite horn bow (Fig. 7).

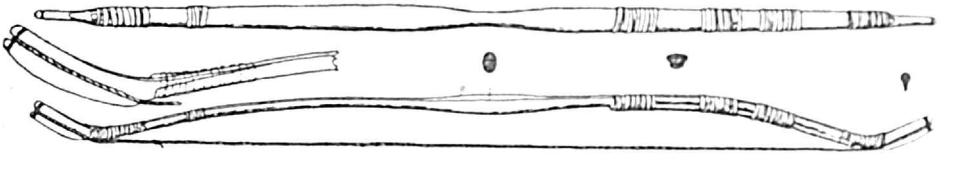


Kuva 16. Jurakkisamojedilainen jousi.

Kuva 17. Tšeremissiläinen jousi.



Kuva 18. Ostjakkilainen jousi. Vas-jugan.



Kuva 19. Vogulilainen jousi. Sosva.

Fig. 7. Fenno–Ugrian two-wood bows. After Sirelius 1919.

illustrations, seem to be made from quite small coniferous trees, which have only been whittled down at the thick end (Burov 1980: figs 1:1, 3:1, 4:4). Another possible interpretation is that they are made from branches from coniferous trees. In that case, they are similar to the Saami *hastbågar* ("hasty bows") (Insulander 1999c).

What Burov describes as arrow shelves could also be interpreted as aiming marks. This interpretation is supported by the fact that the illustrations show several "notches" cut into the side of the bow. Their form also makes it unlikely that they were used as arrow shelves; they are to shallow and too rounded in shape (Burov 1980: fig. 2:1).

Burov also describes experiments with reconstructed bows which threw a "massive" arrow 10 m. This abysmal performance suggests that unsuitable raw materials were used for the reconstructions. As I have shown, it is perfectly possible to make both "hasty bows" (Insulander 1999c) and bows from compression wood only (Insulander 1999b, 2000) which have considerably better performance.

The simple bow of juniper wood (*Juniperus communis*) found at Kangasala in Finland, dated to the Pyheensilta phase (1800–1600 BCE), may also be mentioned in this context (Edgren 1980: 69 f.; Edgren and Törnblom 1992: 103 f.).

Since the two-wood bow has attracted little attention, previous researchers have not realised that compression wood has completely different characteristics than ordinary coniferous wood. In connection with the finds of Iron-Age bows of coniferous wood from Nydam, Beckhoff (1963) wonders why prehistoric bowyers used such inferior raw materials. Nor is compression wood even mentioned in his exhaustive review of the types of wood used in prehistoric bows (Beckhoff 1968). It is also obvious that neither Rust nor Burov were aware of the virtues of compression wood as a material for bow making. Thanks to its high lignin content, thick cell walls and a special orientation of the mikrofibrils in the cell walls, compression wood has unique mechanical characteristics compared to ordinary coniferous heartwood or sapwood. For data on the characteristics of compression wood, see Insulander (1998f).

These exceptional characteristics were used by the Saami and other Finno–Ugrian tribes for the manufacture of sledges and skis in addition to bows. Compression wood was not used for two-wood bows alone; simple bows of compression wood were also made (Sirelius 1983). The tradition of using compression wood has survived up to the present among some of the minor tribes in Russia and in Slovenia (Tomse 1996).

Perhaps it was the people living closest to the receding glaciers in Europe or North Asia that first learned to use pine compression wood: originally by itself in simple bows, and then together with some more resilient type of wood

or together with horn and sinew. The hypotheses discussed above may be summarised as follows.

The horn bow may have evolved along at least four different paths:

1. It might have evolved directly from simple bows of elm or yew.
2. It might have evolved directly from simple bows of compression wood.
3. It might have evolved by way of the two-wood bow, and its various subtypes.
4. It might have evolved from bows of horn and sinew only.
5. The development of the horn bow seems to have been strongly influenced by the need for a short yet powerful bow for use on horseback.

Among the many factors that may have affected the development of the two-wood bow, the following are relevant in this context:

1. The invention of the two-wood bow may have been predetermined by the raw materials available in the far north, i.e. pine compression wood and birch.
2. It might also be an adaptation of the Horn bow to a cold, moist climate.
3. The two-wood bow might be the result of an effort to emulate the horn bow, i.e. it is a simplified version of the true composite horn bow.

To judge the validity of these hypotheses, the archaeological record and rock-carving data must be analysed further and co-ordinated with data on the distribution and dispersal of the Mesolithic populations of temperate and arctic Eurasia.

Acknowledgements

This is one of three papers that document the results of the Project "Tvåvedsbågen i Skandinavien". The first (Insulander 1999a) described all extant Saami bows, while a final paper (Insulander 2002) will review archaeological records of two-wood bows in town contexts. The project has been carried out with funding from Birgit och Gad Rausings Stiftelse. I would also like to thank Inger Zachrisson, Bo Gräslund, Tommy Tyrberg and Lennart Arvidsson for their valuable support of my work.

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Ragnar Insulander
Department of the History of Science and Ideas
Slottet
SE-752 37 Uppsala
Sweden
E-mail: ragnar.insluander@idehist.uu.se