ARCTIC BOWYERY – THE USE OF COMPRESSION WOOD IN BOWS IN THE SUBARCTIC AND ARCTIC REGIONS OF EURASIA AND AMERICA

MARCUS LEPOLA
PhD Student
Department of Ethnology
Åbo Akademi University
Domkyrkotorget 3, 20500 Åbo, Finland
e-mail: mlepola@abo.fi

ABSTRACT
This paper* is a study of the traditional use of a special kind of wood in bow construction in Eurasia and North America. This special kind of wood, called compression wood and coming from coniferous trees, has unique qualities that makes it suitable for bow construction. Bows made using this special wood have been referred to as Finno-Ugric bows, Sámi bows, Two-Wood bows and Eurasia laminated bows. These bows appear to have developed from archaic forms of compression wood self bows that were made from a single piece of wood. Recently features similar to the Eurasian compression wood bows have been discovered in bows originating from Alaska, and the use of compression wood for bow manufacture has been known to some Canadian Inuit groups. This paper addresses the origin and possible diffusion pattern of this innovation in bow technology in Eurasia and suggests a timeframe and a possible source for the transfer of this knowledge to North America. This paper also discusses the role of the Asiatic composite bow in the development of bows in Eurasia.

KEYWORDS: bowyery • self bow • compression wood • Finno-Ugric bow • Eskimo bow • primitive hunting

INTRODUCTION

The ability to efficiently hunt large prey animals has been of key importance for human habitation of the Arctic and Subarctic regions of Eurasia and North America. Ancestral Eskimos developed intricate harpoons that enabled them to make use of the marine life in the icy water of the North. The bow and arrow appeared in Europe during the Upper Palaeolithic period, and this innovation eventually found its way to the Arctic. Typically early European bows are self bows made of hardwoods.

As hunters migrated to more arid and colder areas they also adapted their technology to suit the requirements of their new environment. The cold and harsh tundra and taiga of the North offered little if any suitable wood for bow construction. Wood will

* The author received financial support from the Stiftelsen för Åbo Akademi and Birgit och Gad Rausings Stiftelse för Humanistisk Forskning. The author wishes to extend his gratitude to all scholars and institutions that provided valuable information needed to complete this study.

ISSN 1736-6518 (print), ISSN 2228-0987 (online)
Vol. 9 (1): 41–60

also become brash at very low temperatures. These disadvantages were overcome by technical adaptations such as the combination of materials with different mechanical qualities to produce serviceable bows. This is generally referred to as composite bow technology. The technical adaptations in bow construction in the Arctic can roughly be divided into two main geographical areas: (1) the Eskimo cable-backed composite bow tradition in the North American Arctic, southwest Alaska and the far eastern corner of Siberia and (2) the North Eurasian composite bow tradition stretching across the northern parts of Siberia to Finland and Scandinavia.

Many scholars adhere to the Asiatic origin of the Eskimo composite bow. Some go as far as to believe that the Eskimo free sinew backing or cable-backing is the ancestral form of the classic Asiatic composite bow used by several ancient nomadic peoples of the steppes (Balfour 1889; Hamilton 1970). Eskimo bows have also been subjected to intense typological study and local variations of bow types across the extensive Eskimo area have been mapped by early anthropologists (Murdoch 1890; Birket-Smith 1918).

There are, however, some practical problems that have to be taken in to consideration when studying Arctic bows. For one the area inhabited by the Eskimo is vast, stretching from the northeast corner of Siberia, across North America to Greenland with numerous localised variations. Furthermore, bows from this area are scattered in numerous museums and collections in America, Europe and Russia. This has obviously been of practical importance as most previous research has been limited to bows in the collections of a single museum. Non-resident researchers have had to settle with photos, sketches and second-hand information about bows scattered in ethnographic museums across North America and Europe. Furthermore, historical facts as well as issues of language have efficiently hindered access to collections in the former USSR. This veil has only recently been lifted and new ethnographic materials from both Alaska and Siberia have begun to feed in to the larger scientific community.

I have conducted studies of the constructional aspects of bows originating from 19th-century Alaska in several museums and collections in Finland, Estonia and Alaska. This research has resulted in a discovery of previously unknown structural similarities with Eurasian bows. In northern Eurasia, Finnish, Sámi, Khanty, Mansi and several other Finno-Ugric peoples used a special kind of strong wood from coniferous trees, known as compression wood, to make powerful bows. It was, however, not known that the same type of wood was also in use in parts of North American for the same purpose. This construction feature suggests that Eurasian and North American Eskimo bows may share a common origin. This common trait has remained unidentified in all previous studies that have attempted to trace the origins of composite bow technology in the Arctic. In this article I will discuss the significance of this find and how it relates to the origin and latter diffusion of bow technology in the Arctic.

PREVIOUS RESEARCH IN PREHISTORIC BOW CONSTRUCTION AND THE DEVELOPMENT OF COMPOSITE BOWS IN NORTHERN EURASIA AND THE ARCTIC

A bow in its simplest state is a stringed projectile weapon designed to shoot arrows. It consists of a slender stave (the bow-stick) and a cord fastened to each end under

a certain amount of tension. The archer holds the bow in one hand and draws the string along with the arrow in the other, until the stave reaches a sufficient bend and the string is released. The impelling force of the bowstring shoots the arrow forward at a high speed. Archaeological evidence suggests that the bow first emerged in Europe; the oldest surviving bows have been located at the Holmegaard site on the Danish Island of Zealand. These bows date to ca. 6000 BC (Bergman 1993).

There is also a considerably older bow that was discovered at Stellmoor, in northern Germany. This site yielded fragments of bows made from heart wood of Scots Pine. These bow fragments were, however, later destroyed in the violent bombing of Hamburg during the Second World War. As carbon dating was unavailable then, the age of the bow-fragments was attributed by archaeological association. The bows were associated with the Upper Palaeolithic Ahrensburgian culture that existed in northern Europe in the 11th–10th millennia BC. Ahrensburgian finds have been made in southern and western Scandinavia, in the North German plain and in western Poland. The Ahrensburgian area also included vast stretches of land now at the bottom of the North and Baltic seas. The cold spell of the late Weichsel glaciation resulted in deforestation and the formation of a tundra with bushy arctic white birch and rowan. The most important prey animal for the Ahrensburgians was wild reindeer. The Ahrensburg culture is considered to the earliest hunter-gatherers that used bow and arrow. (Rust 1937)

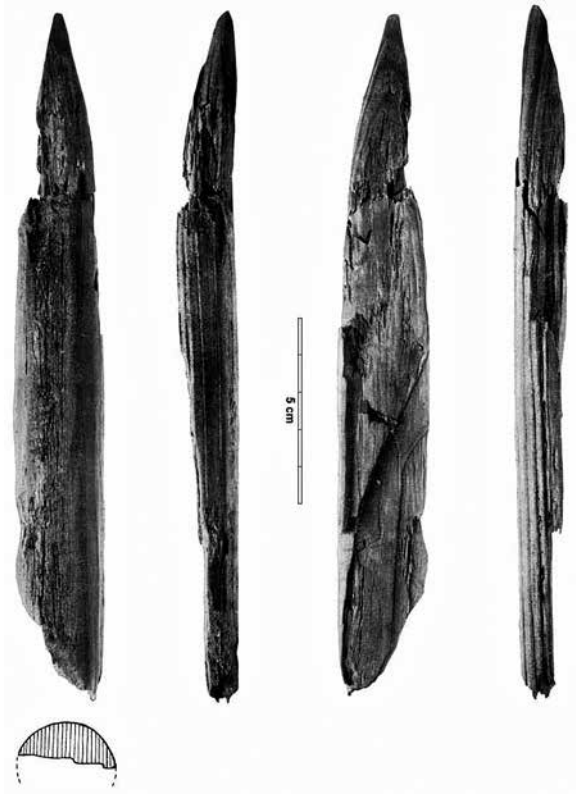


Figure 1. Ancient bow fragments of pine heart wood from Stellmoor (Rust 1943).

As a bow bends it is subjected to two different forces; the back of the bow (outside curve) is stretching when the belly (inner curve) is being compressed. This mechanical fact affects both the design and the material requirements of the bow as the wood has to be resilient enough to withstand the forces of bending. Many hardwoods as well as yew and juniper are well suited for this purpose, but these do not grow in the far north. Functional, although less efficient bows can be made of birch and willow, which is the case with some Athapascan tribes of Alaska (Mason 2007 [1972]: 47–49). The forests of the North thus offer little, if any, of the hardwoods preferred by southern bowyers. However, pine and spruce forests are abundant in coniferous trees growing slant due to the proximity of wetlands or rocky terrain, which gives little footing for roots to

grasp as heavy snow or wind push the tree down towards the ground. Compression wood is found on the underside curve of the coniferous trees (spruce, pine) growing in a slant position. This wood has completely different characteristics to those of ordinary coniferous wood. Compression wood is produced as the tree reacts to the gravitational pull on the tilted trunk and tries to align its top back to a vertical position. This reaction produces compression wood. Due to its high lignin content, thick cell walls and a special orientation of the microfibers in the cell walls, compression wood has unique mechanical abilities compared to ordinary pine or spruce (Insulander 1998). Ragnar Insulander (1999; 2000) argues that the benefits of compression wood as a raw material for bows has been known for quite some time as he maintains that the bow fragments found at Stellmoor were in fact compressed pine.

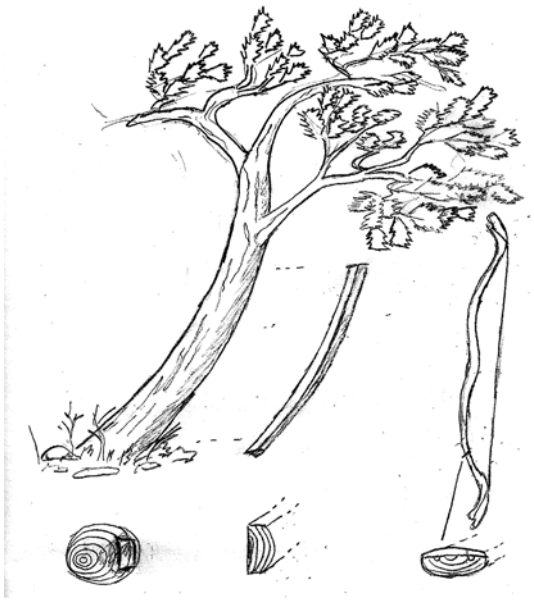


Figure 2. Compression wood and how it is used in the making of Finno-Ugric type bows.

In Finland and Scandinavia the Sámi and the Finns traditionally used this unusual wood to make special gliding skis (*lyly* in Finnish) as well as to make bows. These bows belonged to the Finno-Ugric type and were a lamination of between two and four different pieces of wood. In Finland and among the Sámi the back of the bow was made of birch and the belly of compressed Scots pine. This type of reaction[1] wood endures a lot of compression but fails in tension. The thin slat of birch that is glued on the back endures a lot of stretching and keeps the bow intact. Rigid *siyahs*[2] are either added to the bow as separate parts or cut out at the ends of a single birch back slate. Perch skin glue was used to hold the parts together, but as it is sensitive to water the finished bow was wrapped in birch bark for waterproofing. The wrapping also helped keep the bow intact even in cold dry weather when the wood became more brittle. The range of this model extends from Scandinavia eastward to the middle ground between the Ob and the Yenisey rivers. (Sirelius 1989 [1919]: 45–48)[3]

Compression wood bows do not form a separate class within established bow-typologies and this is in part also not necessary as a rigid classification would make it more difficult to discern the diffusion and later development of this singe technical innovation. Previous classification systems for different composite bows in Eurasia and North America have been inconsistent. Bows made from compression wood have not been singled out in these systems. Henry Balfour (1890: 240) has classed the Sámi bow as a variant of the simple or self bow, though strongly influenced by the horn bow. Felix von Luschan (1899: 226), on the other hand, assigned two-wood bows to the composite type. Bruno Adler (1902: 21) and Gad Rausing (1967: 19, 65) followed Luschan's classification

of the Sámi or Finno-Ugric bow as composite, while Josef Alm (1930: 63) refers to the same bow as reinforced. Spencer L. Rogers (1940) attempted to summarise earlier classification efforts in to a table. 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 composite bow group, and are not considered a type of their own. Insulander (2002) recognised the overlap and ambiguity of the various classificatory schemes and presented a new classification for these attested historical bow types because none of the previous systems regarded the two-wood bow as a distinct type. The relationship between the Finno-Ugric bow and the Asiatic composite bow is also unclear. Some see that the latter is influenced by the Asiatic bow (Balfour 1890: 240; Alm 1952: 205), whereas Insulander (2002) proposes that the Finno-Ugric bow is ancestral version of the Asiatic composite.

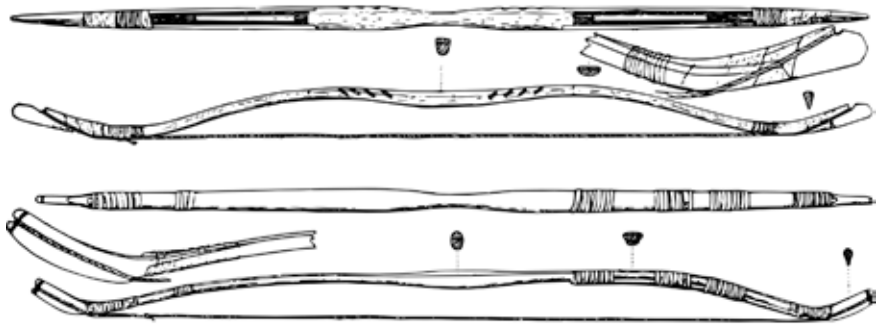


Figure 3. A Khanty and a Mansi bow by U. T. Sirelius in 1919 (Sirelius 1989 [1919]: 46).

The two-wood bow is according to Insulander (2002) analogous with the Finno-Ugric bow. However, in his system the compression wood component of the bow is of secondary nature as these bows can virtually be made up by any two types of wood fused together. A bow made of two different strips of wood from the Jomon culture in Japan dated to 2600 BC as well as an Indonesian variant of laminated bow are included in the classification presented by Insulander. As these bows derive from areas well outside the Arctic context, I believe it is unwarranted to include them in this study. Creating a typology of compression wood bows is further hampered by the fact that such bows can appear in all shapes and sizes which is evident when comparing Alaskan Sugpiaq bows with Eurasian Finno-Ugric bows. A compression wood bow does have some recognisable characteristics that set it apart from other bows:

1. The bow is constructed 'backwards'. As the compression wood grows on the underside of a slant tree it will curve inward. In order to benefit from the qualities of the compression wood stave the back of the bow (outer bending surface) has to be made of the inner part of the tree. It is more common to make the bow back of the external/surface side of a stave. This feature will be easy to discern if one is able to study a broken limb on a bow in a museum collection.
2. The compression wood bow is recurved when unstrung or has a very slight set even if it has been strung for long periods of time. Most other bows take a set

(the bow limbs follow the string) if kept strung for a long time. However, this is not a given identification as there might also be other reasons for a strong reflex in a stave.

3. Compression wood is dark and hard and does not resemble normal growth wood from spruce or pine. It is easily mistaken for yew heart wood due to its dark colour.

THE COMPLEXITY OF NORTH EURASIAN BOWS

Bows need a certain degree of elasticity to enable performance. Some areas of the world, such as the Arctic, the Steppes and Deserts in the Old World and Asia, are for the most part devoid of suitable bow woods. Different types of composite bows or backed bows emerged as an adaptation to these circumstances. Composite bows appear to have developed separately, but simultaneously, by both the state-level societies in Mesopotamia and Anatolia, as well as the tribal nomadic cultures in the steppe regions of central and northern Asia. Asiatic composite bows appear during the second millennium BC. Typically an Asiatic composite is constructed using a wooden core with added strips of horn on the belly to gain compression strength and a back reinforced with sinew to gain more tension strength. Separate *siyahs* are also added to the bow. (Bergman and McEwen 1997: 152)

These varied types of North Eurasian composite bow can be divided into two subcategories, the Finno-Ugric composite bow (Sirelius 1989 [1919]: 45–48) and the Siberian composite bow (Akbalyan 2005: 119). Both subcategories are very similar in appearance and size but are constructed in profoundly different ways. The Finno-Ugric composite is a wood lamination with the belly always made of compression wood. Insulander (2002) has proposed that the Finno-Ugric bow (or in this case the two-wood bow) would be regarded as a forerunner of the Asiatic composite. Ethnographic evidence, however, suggests the contrary and the archaeological record seems to support the idea that composited bow technology was introduced to the area from the East. In East Siberia the oldest discovery of a composite bow is a fragment from an Evenk burial ground dating to the beginning of the 1st millennium AD (Akbalyan 2005: 119).

The Finno-Ugric bow makes its appearance in Scandinavia during the Iron Age as the climate gets gradually colder. Compression pine belly slats have been discovered in bogs and lakes around Scandinavia with the oldest find in Finland dating back to 200–300 years BC (Vilkuna 1994: 208–223).[4] It would appear that the composite bow design, which included the use of compression wood, would have spread across northern Eurasia around the dawn of the first millennium. It is also likely that a primitive type of compression wood bow preceded the laminated Finno-Ugric bow in the taiga regions of Eurasia. Insulander (1999; 2000) raised the possibility that Upper Palaeolithic reindeer hunters in Europe were the first to use compression wood bows. The Stellmoor bow could in this respect be an old and archaic prototype for a simple self bow for areas devoid of other suitable bow woods. As the climate in Europe was warmed by the dawn of the Mesolithic, the reindeer migrated to the North and were presumably followed by hunters. Hunters in pursuit of migrating animals would spread bow technology to northern Russia and western Siberia. The area where this primitive compression wood bow could have been in use is vast and most of it is wilderness even today. It is there-

fore exceedingly difficult to find archaeological evidence to support this claim. Secondary evidence for the antiquity of possible compression wood bows in northern Europe is found in numerous rock carvings in Sweden and Norway in which archers and bows are depicted, some being as old as 6200 years[5] (Insulander 2002: 57). This evidence for the use of compression wood bows in Scandinavia in the Mesolithic and Neolithic periods is not conclusive as there is no sure way to determine if the depicted bows are made of several joined pieces or just a single stave. There is, however, ethnographic evidence that supports Insulander's theory. There are two self bows made of compression wood in the collections of the National Museum of Finland. These bows were collected by the ethnographer Uuno Taavi Sirelius in the late 1900s among the Khanty and Mansi of western Siberia. The Mansi self bow[6] was collected at the Sygva River. It is 185 cm tall and 4.7 cm wide. The bow appears straight and it is made of spruce compression wood with a string of plied hemp bast. According Sirelius' notes the man who offered Sirelius the bow told him that the self bow of compression wood was the archaic bow used by the Mansi before they learned how to make laminated Finno-Ugric bows. (Sirelius' fieldnotes 1898–1900; Sirelius 1983). The tradition of using compression wood has apparently also survived up to the present among some of the minor tribes in Russia and in Slovenia (Tomse 1996).

Old Norse sagas often refer to the excellent power of the "Finnbogi" bows that the Norse Vikings bartered from the Sámi (Kiil 1954: 102–108). In Finland and Scandinavia the Sámi were the last to use Finno-Ugric bows, which they did well in to the 18th century[7] (Sirelius 1989 [1919]: 47). The Finnish ethnographer Sirelius (ibid.: 45–48) established the range of the Finno-Ugric bow as being from Scandinavia and Finland in the west to the middle ground between the Ob and the Yenisey rivers in the east. In reality the bow type extended much further east due to native trade networks, which will be discussed later in the text.

Finno-Ugric bows were used by the Khanty and the bow-making process of the Khanty is well documented.

Figure 4. Large Khanty bow. (Finsch 1879)

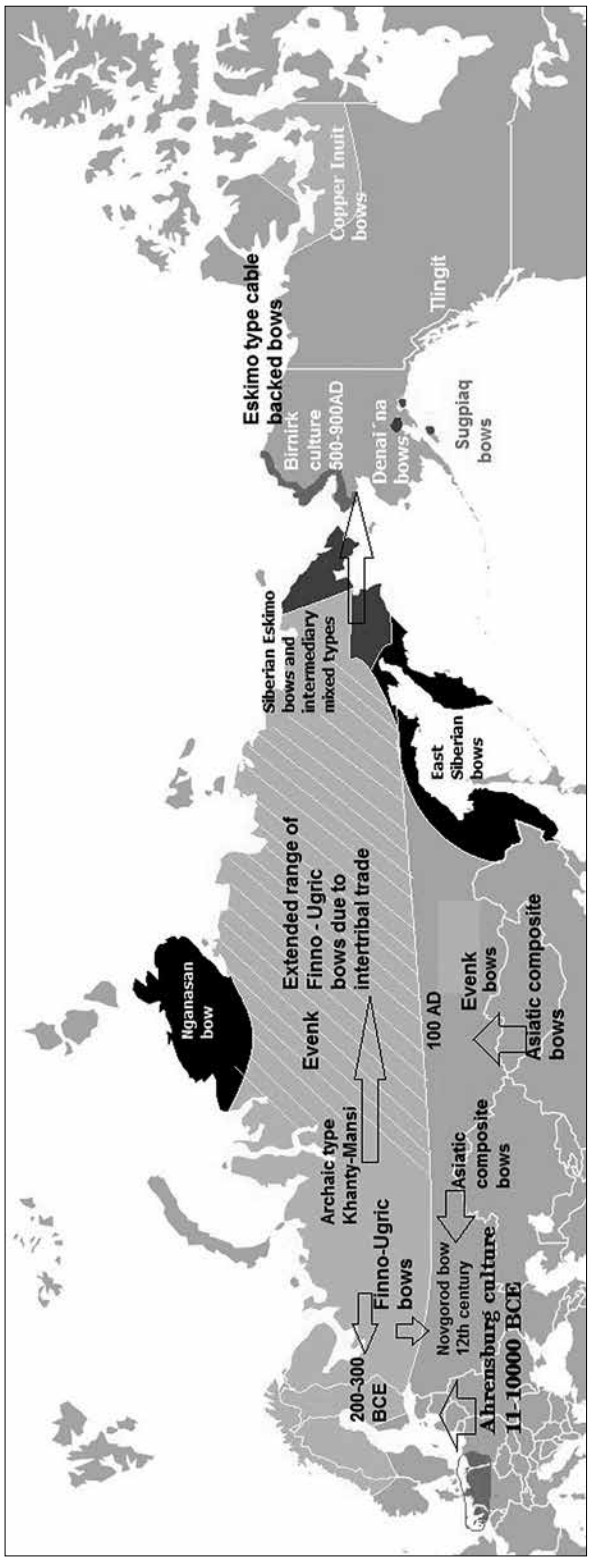
The Khanty heat tempered the compression wood bow-stave and rubbed it with pitch to add to its durability (Dmitriyev-Sadovnikov 2011).[8] The Finno-Ugric bows made by the Khanty and Mansi are tall, up to 193 cm[9] and exceedingly efficient. In this respect size alone separated these bows from the shorter Asiatic composites. The Siberian composite bow type becomes more predominant in the eastern parts of Siberia in close proximity to the Pacific Ocean with some interesting intermediary forms along the borders.

The Siberian composite bow occurs in some unique local variations. Siberian composite bows appear very similar to the Finno-Ugric type, there are, however, some key differences in construction. The Siberian bows are usually made of a single piece of wood with steam bent re-curved ends. Furthermore, compression wood is not used as exclusively as in western Siberia and North Eurasia. The bow is fitted with a moulded sinew back covering. The sinew backing or the whole bow is sometimes covered with rawhide or thin strips of birch bark. Some of the bows that belong to this type also have separate string bridges fitted on the *siyahs*, a feature that is not found on Finno-Ugric bows. The Siberian composites were made from many different types of wood. The Nanais and Orochs used beech for bows; the Nivkhs used ash, poplar, and willow; the Chukchee gathered driftwood to make their bows (Akbalyan 2005: 119). Koryak bows are apparently made of birch.[10] There is also a single odd bow type that was used by the central Siberian Nganasans. Their composite bow was made of a several pieces of resinous strips of larch root that were glued together with codfish glue and wrapped with birch bark. A string bridge was also added to the bow. A bowstring of thong was fastened to the outer curve of the bow, a feature which also distinguished the Nganasan bow from bows used by neighbouring peoples. (Popov 1966: 22–24)

Because of the many localised variations in both bow design and materials used for construction, the term "Siberian composite" has to be considered a working term that includes all composites that cannot be considered Asiatic horn bows, Eskimo cable-backed bows or Finno-Ugric bows. Other localised variations include large bows used for war by the Even and the Evenki that were made of three glued pieces of wood of different kinds, larch and birch (Nefëdkin 2013: 122). The construction details of this bow are uncertain. There is also another type of bow that appears to be an intermediary version of the Finno-Ugric bow. This type of powerful bow could be more than two meters long, was made from two strips larch and cedar or fir and birch, dried for two years, and glued with fish glue (ibid.).[11] These incomplete descriptions might well refer to a single type of bow. It is unclear if compression wood was used in these bows or not and further examination to clarify the matter is needed.

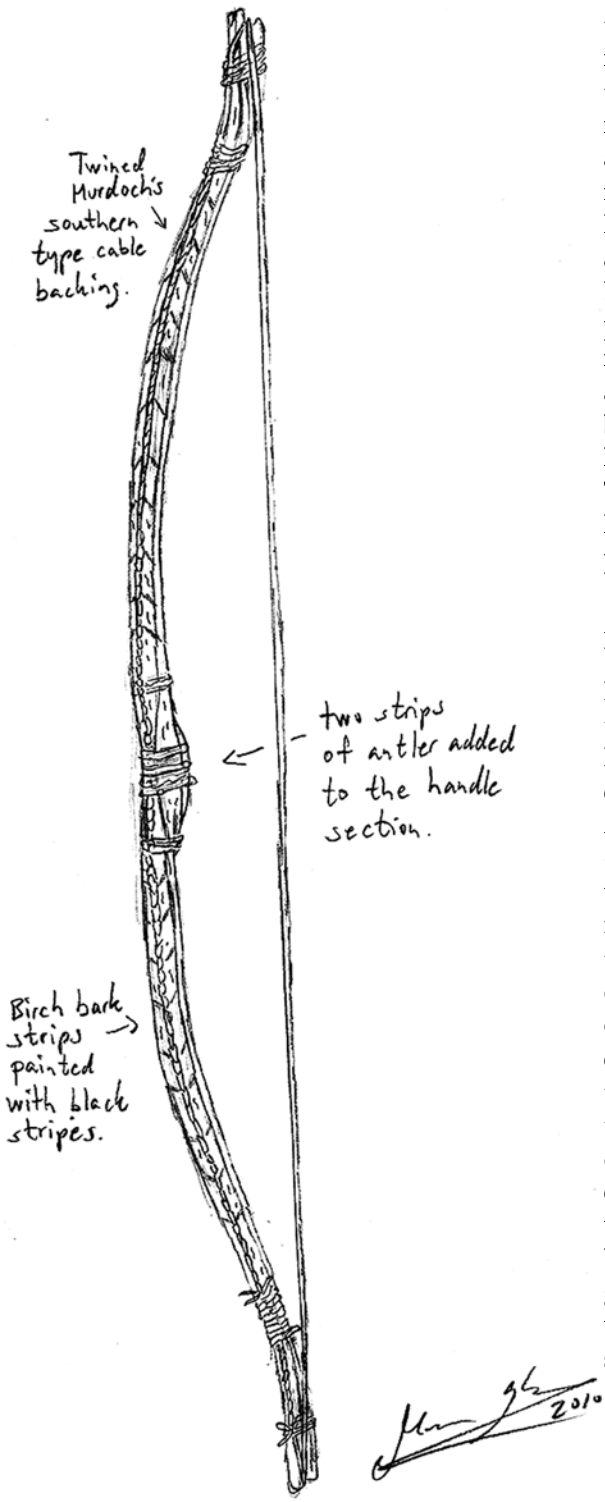
Intertribal trading and warfare were key factors in spreading new types of bows across Siberia. The Nganasan bartered more efficient bows from the Yakut and bows were also traded from the Ket; these latter bows where known as 'Ostyak' (Khanty) bows of the Finno-Ugric type (Popov 1966: 24–25). The Nganasans also had access to 'Tatar' bows (Asiatic horn bows) although these were not as popular as they were considered too weak (ibid.). Bows traded from neighbouring peoples replaced the old Nganasan bow long before firearms were introduced. Large bows were generally perceived as war bows in Siberia, smaller bows were made explicitly for the purpose of hunting as they were more practical to carry (Nefëdkin 2013: 122).

The Nganasans inhabited a virtually treeless tundra and wood was a scarce commodity. This explains why they had to use such inferior materials as roots for their bows. The Nganasan bow might well represent the last line of an archaic Arctic bow-



yer tradition, technically very closely related to multi-piece Eskimo free-cable composite bows. An interesting intermediary form that combines traits from the Finno-Ugric bow and the Asiatic horn bow is demonstrated by the Evenk (Tungus) bow. The traditional Evenk home territory in the Lake Baikal area can be characterised as a border area wedged in between the open steppe in the south and the forested taiga in the north. Although the Evenk bow has the same outer appearance as the Finno-Ugric type, the bow is very differently constructed. The Evenk bow is essentially a two-wood bow that has been reinforced with sinew on the back and horn strips on the belly (Balfour 1890: 228). The heterogeneity of bows in East Siberia is in part the result of intertribal trading and subsequent addition of secondary features on the bows by the new owners. The Yakut (Sakha) were key distributors of bows, and their bows were traded from the Ket, who in turn received them from the Khanty. Bows such as these were in wide circulation and were even traded to the Chukchee. The Chukchee further improved these bows by adding a sinew cable and sometimes even antler reinforcements. A good example of a bow with mixed features is the Chukchee bow in the American Museum of National History (catalogue no. 70 / 6981). This circulation of traded bows in Siberia has caused some confusion among scholars, being unaware of the intricacies of intertribal trading. Alm (1930: 75) describes the Chukchee bow as a bow made from coniferous wood, birch wood and

Figure 5. Map showing where compression wood bows are found in Eurasia and North America.



two pleated strands of sinew on the back. Insulander (2002) briefly mentions the same Chukchee bow type but is unaware that the bow is in fact a Finno-Ugric bow with added Eskimoan features. According to Vilhelm Kiil (1954: 132) similar reinforced two-wood bows were also used by the Yukaghirs and the Lamuts. Several functional compression wood bows with broken or intentionally removed *siyahs* were also collected from the Chukchee by Adolf Erik Nordenskiöld during his voyage with Vega in 1878–1879. These bows are included in the collections of the Museum of Ethnography in Stockholm.[12]

The relationship between the Asiatic horn bow and the Finno-Ugric bow is discussed by Insulander (1997, 2002) who presents the two-wood bow as the missing link in line of bow development that eventually lead to the creation of the Asiatic composite bow. Insulander (2002: 59) maintains 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". He elaborates on Rausing's (1967: 148) hypothesis, that bows of the Holmegaard type may have been ancestors of the horn bow and presents intermediary types of bow to complete an evolutionary series from the simple wooden bow to the composite horn bow. Insulander (2002: 62) also suggests that the area west and northwest of Lake Baikal would be the site where this evolution would

Figure 6. Chukchee bow with added free sinew cable backing. American Museum of National History, catalogue no. 70/6981.

reach its pinnacle. Insulander's theory is lacking in evidence as it is not supported by the apparent age difference in the archaeological record, in which the Asian composite bow by far predates the Finno-Ugric bow. Insulander does not take into account the fact that oral tradition among the Mansi identifies simple compression wood self bows as a type used before the introduction of the Finno-Ugric bow. It would seem reasonable to suppose that the idea of improving the design of the simple compression wood self bow by adding a birch backing and separate *siyahs*, could have been the result of interaction with the steppes, possibly through extended trade networks. The Evenk bow is not necessarily an indication of a gradual development from a two-wood bow to an Asiatic composite, it is likely that it displays features of both Asiatic and Finno-Ugric bows due to its intermediary position between the two areas. It can be considered as a southern variation of the mixed-feature Chukchee trade bow.

Bow development in Eurasia and Siberia seems to be the result of reciprocal cultural contact between the North and the South that extends over a long period of time. This long-term interaction also explains the construction differences between the Finno-Ugric bows and the Siberian composites, of which the latter seems to represent a simplified version of the Asiatic composite. Siberian bows lack the typical slats of horn found on the belly of Asiatic composite bows but do have a moulded sinew backing. Another example of continuous interaction between the regions is a Medieval bow found in Novgorod, Russia. Horn bows were common in the ancient Russian kingdom during the 10th century and at least two different types of Asiatic horn composite bow were used by the Russians (Mikhailov and Kainov 2011: 242). A later 12th century bow found in Novgorod (Thompson 1967: 78) displays mixed Finno-Ugric and Asiatic features. The bow is, contrary to other Asiatic composites, made of two slats of wood which have been glued together and wrapped with birch bark. A layer of moulded sinew back was added to the bow but has rotted away. An empty cavity between the bow back and the bark wrapping indicate where the backing used to be. The belly slat of the bow is juniper and the back is made of birch. Insulander (2002: 62) refers to this as a reinforced two-wood bow.

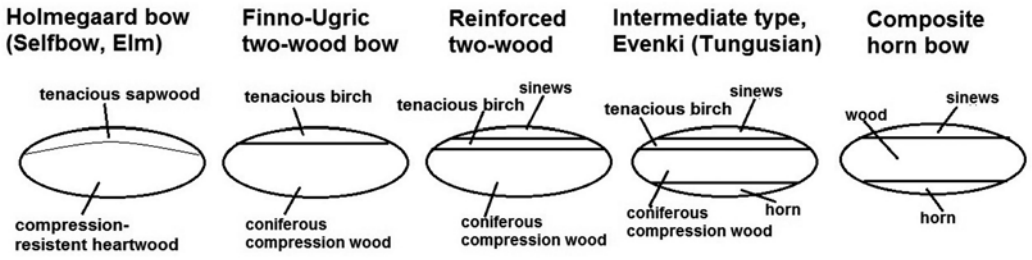


Figure 7. Proposed line of development of the Asiatic composite. Cross-sections of five bow types. (Insulander 2002). However, this chronology is not supported by the archaeological records.

I believe it is be possible that the wood on the belly of the Novgorod bow has been misidentified as juniper. Compression wood spruce can resemble juniper due to its similar colouration. Nevertheless, this bow as well as the Evenki bow in Figure 7 has intermediary features typical of what might be expected of bows in areas where different types of bow overlap. North Eurasian bows could also influence the later develop-

ment of Asiatic composite bows (Grayson 2007: 11). The Chinese Manchu introduced a larger composite bow in the 17th century. The Manchu bow was made with a bamboo core, horn belly, sinew backing and wooden tips and handle. These bows were capable of propelling heavy arrows with great force but due to their size not suited for use on horseback. Previous bows had been considerably smaller. The Manchu bow was durable both in battle and hunting, and became the standard bow in China as well as Mongolia and Tibet (ibid.).

It seems plausible that the Finno-Ugric bow could have been developed in the taiga area of eastern Siberia or as a result of intertribal contact between the west and east. The apparent diversity of different composite bows in the eastern part of Siberia suggests a longer history of composite bow construction. The Finno-Ugric area in the west is more homogenous in terms of variations in bow construction and materials. This goes against Insulander's (2002) proposition that the Finno-Ugric bow could be regarded as a forerunner of the Asiatic composite.

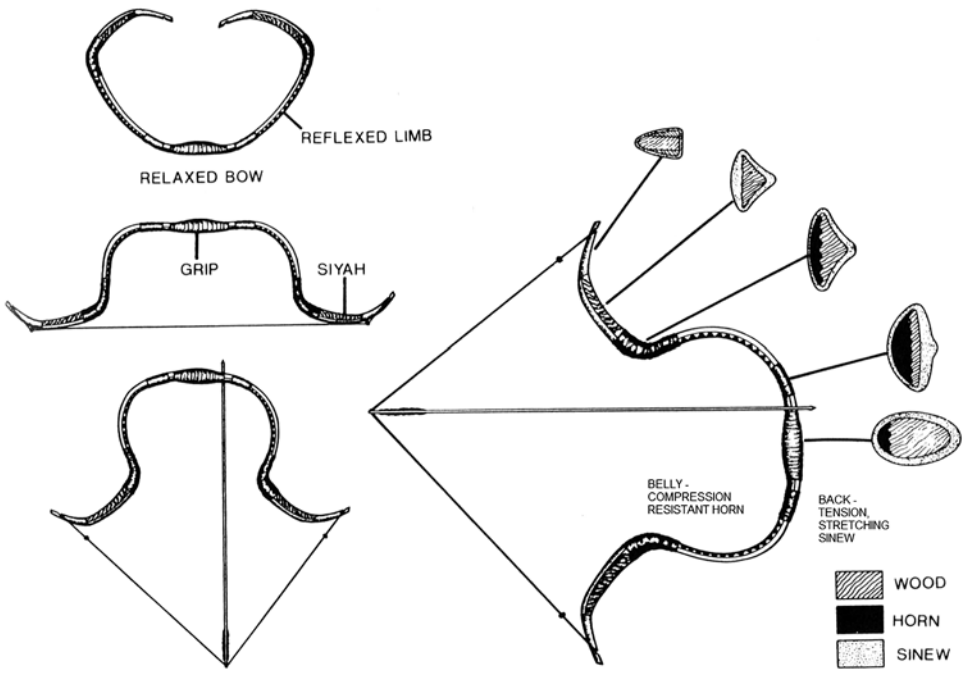


Figure 8. Asiatic composite bow construction and materials.

COMPRESSION WOOD IN NORTH AMERICAN BOWS

The true relationship with the Asiatic composite and the Eskimo bow as well as other North American bows has remained inconclusive, although vestigial features such as non-functional *siyahs* on some Eskimo bows are interpreted as evidence of Asian origin (Hamilton 1970). When comparing the North Eurasian composite bow with the Eskimo bows of East Siberia, North America and Greenland, the Eurasian bows seem surprisingly homogenous in their appearance in contrast with the rich variation in materials

and designs demonstrated by the multitude of Eskimo cable backed composite bows. The North American Eskimo area is more diverse and varied, ranging from lush coastal forest in southwest Alaska to freezing tundra in the East Arctic. The taiga environment of Eurasia in Siberia provides similar raw materials for bow construction throughout the region, but the Eskimos have had to adapt their bow designs to accommodate a great deal of local variation in available raw materials for bows.

The bow and arrow seem to have been introduced to the North America Arctic in a much earlier stage than in the more temperate regions of North America. The earliest bow find originates from the eastern woodlands around 600 AD (Nassaney and Pyle 1999). In the American and Greenland Arctic a possible bow fragment of whale bone along with arrowheads has been found at the Saqqaq culture site of Nipisat in West Greenland. This find was in association with the Phase 1 inhabitation of the site ranging from 2020 to 1740 BC (Gotfredsen and Møbjerg 2004). Archaeological records from 2500–2000 BC indicate that people in the central Canadian Arctic hunted land mammals with bows and arrows (Maxwell 1984: 360–368). The Saqqaq culture is part of a broad terrestrial cultural entity that developed along the Alaska Peninsula around Bristol Bay and on the Eastern shores of the Bering Strait around 2500 BC (Fagan 2005: 179–181). The cultural groups belonging to the Arctic Small Tool Tradition were the first human occupants of Arctic Canada and Greenland. They had a highly distinctive toolkit based on microblade technology and many researchers believe that this culture was the first to reintroduce the bow and arrow to the American Arctic (ibid.).

Figure 9. Copper Inuit archers drawing compression wood bows reinforced with cable backing. Photo by George H. Wilkins, 1916. Canadian Museum of Civilization, catalogue no. 51166 LS.

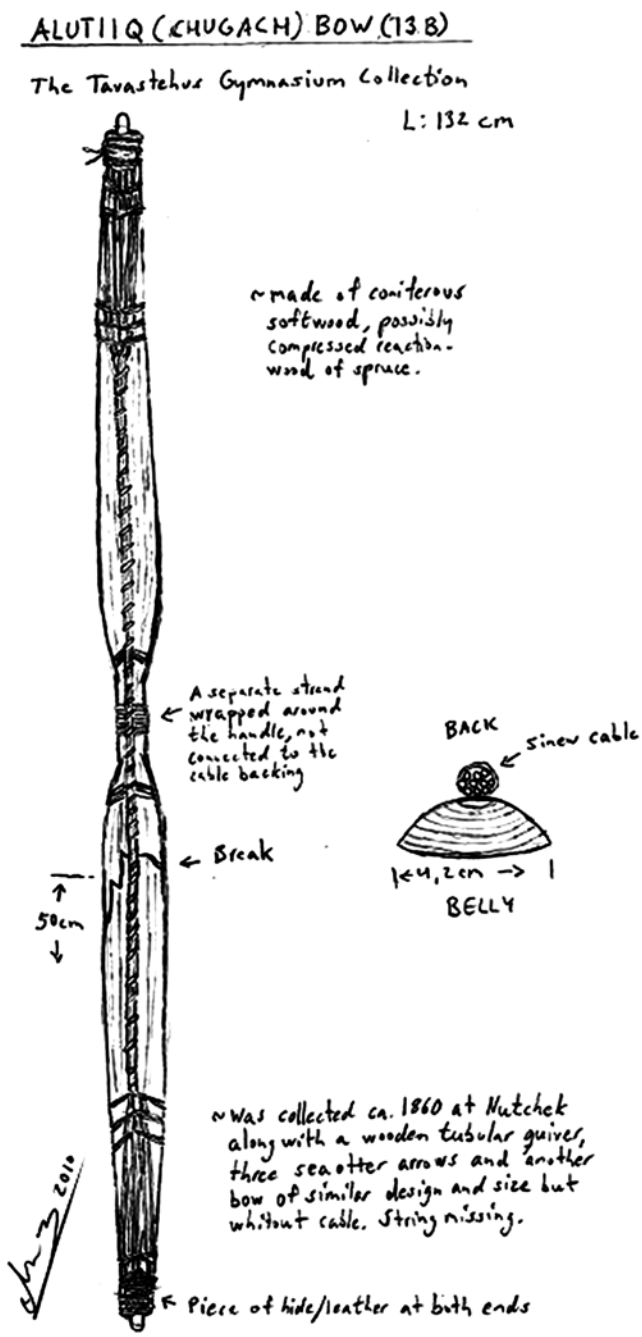


Figure 10. Sugpiaq – Alutiiq cable backed compression wood spruce bow from Prince William Sound, Alaska.

The development of the Eskimo bow was not a straightforward process. The archaeological record indicates that the bow and arrow disappeared from use across the North American Arctic during Dorset habitation (500 BC–1500 AD) (Maxwell 1984: 366). In Greenland bow and arrow technology was abandoned around 1310–810 BC (Gotfredsen and Møbjerg 2004). The bow and arrow reappeared in the North American Arctic with the arrival of the Thule culture which gradually replaced the Dorset people (McGhee 1984: 369–376). The American Arctic is an extreme environment for human habitation and populations were often afflicted by starvation caused by severe weather conditions. In some cases the death toll would be so great among the adult population that technological advances would be lost in the wake of the famine. An exceedingly large number of Polar Inuit in northern Greenland did die of starvation and as result the bow and arrow disappeared from use for generations. This was confirmed by the first Europeans who visited the Thule district in the 19th century and observed that the bow was unknown to the Polar Inuit (Birket-Smith 1918: 8). Bows and arrows were later reintroduced to the Thule district when Inuit from Baffin Island migrated to the area (ibid.).

Scholars recognise two main types of composite bow; the moulded sinew backed composite and the free sinew cable backing used by the Eskimo (Balfour 1890: 224). The free cable backing is more versatile and practical in terms of bow manufacture as it allows the Eskimo bowyer to make serviceable bows of almost any available materials such as antler, bone, wood and even baleen. The sinew cable can also be re-used to make another bow if the first bow brakes. Both of these two composite types are found among East Siberian Eskimo although the free cable backed bow is the only type of composite bow that made its way across to the North American Arctic. In Eskimo territory local differences in the availability of materials seems to have been the largest contributing factor for variations in design and construction. As many Eskimo people lived in areas that were devoid of trees they were for most part dependent on driftwood and in such conditions compression wood could not have been used. Further up in the high Arctic, antler and whalebone were frequently used to make bows. Bows of the Sugipaq in the more temperate southwest corner of Alaska show strong influences from the northwest coastal area. Many bows along the Bering Sea coast are influenced by Eurasian composite designs.

Eskimos in areas with access to living trees were aware of the positive traits of compression wood. Sugpiaq bows display features that are typically associated with the *lyly* in Finno-Ugric bows, such as the bow back is made of the inner part of the wood. The Sugpiaq did, however, not exclusively use compression wood in their bows as other bow woods were also available to them. A damaged free cable backed bow collected at Nutchek in Prince William Sound in the 1850s is constructed "backwards" using compression wood (Lepola 2013).[13] Another Sugpiaq bow in the Anchorage museum at the Rasmussen Center collections exhibits a very strong re-curved bend typical of other compression wood bows.[14] The Dena´ina Indians of Cook Inlet recognised the structural benefits of spruce heart wood and used it for bows (Osgood 1966 [1937]: 16). This dark wood was called *Ggek* (Russell 1995 [1987]: 28–29). It is not entirely clear if *Ggek* was in fact harvested from a tree that grew in a tilted position. The Tlingit Indians living further south down the Alaskan coast also knew the benefits of compression wood, although they preferred to use yew which is available in their territory. Some Tlingit bows were made of spruce selected from a tree growing on high land, and from a branch or young tree that curved in its growth (Emmons 1991: 127). The outside wood was used (ibid.).

The Copper Inuit/Innuinait successfully used compression wood for their cable-backed bows. Innuinait people would intentionally travel for the purpose of harvesting compression wood. If driftwood was used for bows it would have been the exception rather than the rule. In most of the Inuinnait territory living trees large enough to construct bows and other tools are not available. It was, however, possible to travel inland and find pockets of trees growing in river valleys with their own micro climates. Trees growing on the slopes of riverbanks in such areas are often curved. Black spruce was the wood of choice and compression wood used in bows was called *Itkiq*.[15]

Although possible, it is not likely that compression wood use in bows could have developed independently in the North American Arctic in such a short time frame. It is more likely that this technology was known to early ancestors of Eskimo as they migrated to the American Arctic. It is curious that compression wood was known to Athapascan groups such as the Dena'ina and the Tlingit. Further research is needed to

determine if this is due to later diffusion from Eskimo cultures such as the Sugpiaq or if this knowledge has been passed down through a more ancient ancestry. We do know that there has been frequent contact between the two continents as Siberian Chukchee traders and even war parties often visited Alaska (Fitzhugh and Crowell 1988: 234–236). It would seem that these later contacts across the Bering Sea did not transfer the knowledge of using compression wood as raw material for bows. The Alaskan Yup'ik on the Bering Sea coast apparently did not use compression wood for their bows. Frequent encounters with the Siberian Chukchee seem to have influenced the design of the re-curved bows used by the Yup'ik, which appear similar to the angular North Eurasian bows. For the purpose of establishing a rudimentary chronology for when compression wood technology might have transferred to North America the most likely candidate would be a pre-Thule culture in Alaska, called the Birnirk culture. Communities belonging to this culture are found from Cape Nome to Point Barrow between 500 AD and 1000 AD (Darwill 2008 [2002]). Birnirk assemblages contain many artefacts paralleled in the tool kits of modern Inuit such as bows and arrows (ibid.).

As of yet there is little if any archaeological evidence that would suggest that compression wood was used for bows in the American Arctic. However, researchers and archaeologists have not processed existing archaeological material with this feature in mind. Re-curved three-part bows excavated from the Birnirk site seem surprisingly modern (Ford 1959). They resemble bows used by later Copper Inuit and in this respect this would also suggest the possibility of compression wood usage. Researchers have determined that spruce was used in the construction of these bows. Further investigation is needed to establish if Birnirk bows are made from compression wood spruce. This would potentially establish a link between these early North American bows and the compression wood bows of Eurasia. The angular design on some Alaskan bows is an indication of Asian influences but Eskimo bows with Asian features are not necessarily made of compression wood. This to me is an indication that compression wood technology was well integrated in the cultural knowledge of the peoples migrating eastward across the Bering Sea and not the result of later cultural transfer from Siberia due to trade or warfare.

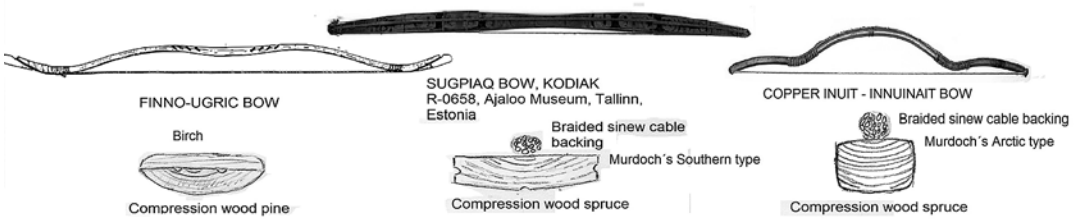


Figure 11. Three compression wood bow types from Eurasia, southwest Alaska and Arctic Canada.

CONCLUSION

Ragnar Insulander proposed that the benefits of compression wood use in bows was known to the earliest Arctic bow hunters, the Upper Palaeolithic Ahrensburg culture in northern Europe. Ethnographic data suggests that that the simple compression wood bow was in use in prehistoric times in northern Eurasia and was gradually replaced

by a new composite design, probably introduced through contact with horse archers from the steppe around the dawn of the first millennium AD. The compression wood stave would become the core feature of the later Finno-Ugric composite bow. Trade networks would extend the range of the Finno-Ugric bow to the Far East. Composite bows in eastern Siberia are found in many localised variations and this heterogeneity of bow construction can indicate that composite bows have been in use for a longer period of time in the East than in the West. This is also confirmed by the archaeological record. The ethnographic record confirms the existence of compression wood bow technology among some Eskimo and Native American cultures in Alaska and the Canadian Arctic. It is possible that the knowledge of how to make these bows was brought to North America with the pre-Thule Birnirk culture. Further research on the archaeological material is required to determine a time frame for when the technology transferred to the North American Arctic.

NOTES

1 Compression wood forms when part of a woody plant is subjected to mechanical stress, and helps to bring parts of the plant into an optimal position. This stress may be the result of gravity, wind exposure, snow buildup, soil movement, etc. This type of reaction wood is not externally visible, although asymmetric growth is a reliable indicator. The cork cambium in the affected part of the trunk is more active on one side, leading to thicker growth rings. Branches practically always have reaction wood, since they need support to maintain their horizontal or nearly horizontal position. There are two different types of reaction wood, which represent two different approaches to the same problem: (1) In angiosperms reaction wood is called tension wood. Tension wood forms on the side of the affected part of the plant, pulling it towards the affecting force. It is composed almost entirely of cellulose. (2) In conifers it is called compression wood. Compression wood forms in the bend on the opposite side of the applied force, thereby lengthening/straightening the bend. Compression wood is rich in lignin. (Wilson and Archer 1977: 23–43)

2 The stiffened end of the bow is a *siyah* (Arabic), *szarv* (Hungarian), *sarvi* (Finnish; both *sarvi* and *szarv* mean 'horn') or *kasan* (Turkish); the bending section is a *duster* (Arabic), *lapa* (Finnish) or *sal* (Turkish) (Maenchen-Helfen 1973: 222).

3 The establishing of the eastern range of the Finno-Ugric Bow at the Ob River is based on the studies of the Finnish ethnographer Uuno Taavi Sirelius. He also recognises the Finno-Ugric bow as a distinct type. His studies only range as far as to the Khanty who live along the Ob and their bow is of the Finno-Ugric subcategory.

4 There are nine archaeological findings of Finno-Ugric bows from Sweden, Norway and Finland. For the most part the findings have been dated to Iron Age and Medieval times. The late Ragnar Insulander has studied these bows extensively in his article (1999). More information about these findings is available in Vilkuna 1994.

5 According to Insulander the rock carvings suggest that the two-wood bow as a type may be several thousand years older than the earliest archaeological finds.

6 The Finno-Ugric Collections of the National Museum of Finland, catalogue no. SU 3904: 345.

7 Ragnar Insulander commonly refers to all Scandinavian and Finnish bow finds as the Sámi bows. This is not incorrect as the Sámi have inhabited the Nordic countries for a long time. However he ignores the fact that some later archaeological finds such as the Viitasari bow from the 14th century could well have been of Finnish origin rather than Sámi (Insulander 1999).

8 The book contains 27 photos depicting the bow making process taken in 1914 among the Khanty in the Tobolsk district of Russia (Dmitriyev-Sadovnikov 2011).

9 The Finno-Ugric Collections of the National Museum of Finland, catalogue no. SM 3904: 352.

10 Koryak bows in the American Museum of Natural History collections, catalogue nos. 70 / 3922 AB, 70 / 3943, 70 / 3508.

11 According to this source the bow limbs were "pasted over with birch" and wrapped on the ends with sinew. It would appear that there might be some error in translation as it seems that the author is referring to birch bark, not birch wood.

12 A bow collected by Nordenskiöld is 102 cm long and 4.4 cm wide. It is possible that the bow was intended for use by children. Catalogue no. 1880.04.0128.

13 Bow in the Furuhjelm Collection, Hämeenlinna City Museum, Finland, catalogue no. TAV13a.

14 Anchorage Museum at the Rasmussen Center, catalogue no. 1980.030.010.

15 Unpublished source: Personal e-mail-correspondence with Darren Keith, senior researcher, Kitikmeot Heritage Society (October 24, 2010).

SOURCES

Professor Uuno Taavi Sirelius' fieldnotes 1898–1900. Museum of Cultures Archives, National Board of Antiquities, Helsinki, Finland.

The collections of the Anchorage Museum at the Rasmussen Center, Alaska, USA.

The Division of Anthropology, American Museum of Natural History, New York, USA.

The ethnographic collections of Uuno Taavi Sirelus in the Museum of Cultures, National Museum of Finland, Helsinki, Finland.

The Furuhjelm Collection, Hämeenlinna City Museum, Finland.

The Museum of Ethnography, Stockholm, Sweden.

REFERENCES

Adler, Bruno. 1902. Die Bogen Nordasiens. – *Internationales Archiv für Ethnographie* 15 (2): 1–27.

Akbalyan, Yelena Rubenovna, comp. 2005. *Practical Dictionary of Siberia and the North*. Moscow: European Publications and Severnye Prostory.

Alm, Josef. 1930. *Bågar och bågskytte*. Stockholm: Sveriges Skyttetidnings förlag.

Alm, Josef. 1952. Örbyhusbågen. – *Livrustkammaren. The Journal of the Royal Armoury, Stockholm* 5 (10–11): 187–207.

Balfour, Henry. 1890. On the Structure and Affinities of the Composite Bow. – *Journal of the Anthropological Institute of Great Britain and Ireland* 19: 220–250.

Bergman, Christopher A. 1993. The Development of the Bow in Western Europe: A Technological and Functional Perspective. – *Hunting and Animal Exploitation in the Later Palaeolithic and Mesolithic of Eurasia. Archaeological Papers of the American Anthropological Association* 4, edited by Gail Larsen Peterkin, Harvey M. Bricker and Paul Mellars. Washington, DC: American Anthropological Association, 95–105.

Bergman, C. A. and Edward McEwen. 1997. Sinew-Reinforced and Composite Bows; Technology, Function and Social Implications. – *Projectile Technology. Interdisciplinary Contributions to Archaeology*, edited by Heidi Knecht. New York; London: Plenum Press, 143–160.

Birket-Smith, Kaj. 1918. The Greenland Bow. – *Meddelelser om Grønland* 56 (1): 1–28.

Darwill, Timothy. 2008 [2002]. *The Consice Oxford Dictionary of Archaeology*. Oxford: Oxford University Press.

Dmitriyev-Sadovnikov, Grigoriy Matveyevich. 2011. *Luk. Oblas. Beresto: remeslennye protsessy Vakhovskikh khanty v opisanyakh i fotografiyakh G. M. Dmitriyeva-Sadovnikova*. Nizhnevartovsk:

Jugorskiy. [Дмитриев-Садовников, Григорий Матвеевич. 2011. *Лук. Облас. Берёсто: ремесленные процессы Ваховских ханты в описаниях и фотографиях Г. М. Дмитриева-Садовникова*. Нижневартовск: Издательский дом Югорский.]

Emmons, George Thornton. 1991. *The Tlingit Indians*, edited with additions by Frederica de Laguna and a biography by Jean Low. Seattle, WA; London: University of Washington Press; New York: American Museum of Natural History.

Fagan, Brian M. 2005. *Ancient North America: The Archaeology of a Continent.* (4th edn.) London: Thames & Hudson.

Finsch, Otto. 1879. *Reise nach West-Sibirien im Jahre 1876*. Berlin: Erich Wallroth.

Fitzhugh, William W.; Aron Crowell, eds. 1988. *Crossroads of Continents – Cultures of Siberia and Alaska*. Washington, DC: Smithsonian Institution Press.

Ford, James A. 1959. *Eskimo Prehistory in the Vicinity of Point Barrow, Alaska. Anthropological papers of the American Museum of Natural History* 45 (1). New York: American Museum of Natural History.

Grayson, Charles E.; Mary French and Michael J. O'Brien. 2007. *Traditional Archery from Six Continents: The Charles E. Grayson Collection*. Columbia: University of Missouri Press.

Gotfredsen, Anne Birgitte and Tinna Møbjerg. 2004. *Nipisat – A Saqqaq Culture Site in Sisimiut, Central West Greenland. Meddelseser om Grönland. Man & Society* 31. Copenhagen: Museum Tusculanum Press, University of Copenhagen.

Hamilton, Thomas M. 1970. The Eskimo Bow and the Asiatic Composite. – *Arctic Anthropology* 6 (2): 43–52.

Insulander, Ragnar. 1997. The Fenno-Ugrian Two Wood Bow. – *Northern Skills. The Bulletin of Primitive Technology* 14: 35–39.

Insulander, Ragnar. 1998. Ersatte trumman pilbågen? – *Populär arkeologi* 16 (4): 18–21.

Insulander, Ragnar. 1999. Den samiska pilbågen rekonstruerad: en jämförande analys av fynd från Sverige, Norge och Finland. – *Fornvännen. Journal of Swedish Antiquarian Research* 94 (2): 73–87.

Insulander, Ragnar. 2000. Der Bogen von Stellmoor – Der älteste der Welt? – *Traditionell Bogenschiessen* 16: 38–39.

Insulander, Ragnar. 2002. The Two-Wood Bow. – *Acta Borealia. A Nordic Journal of Circumpolar Societies* 19 (1): 49–73.

Kiil, Vilhelm. 1954. Hornboge, langboge og finnboge. – *Norveg. Tidskrift for folkelivsgransking* 4: 15–153.

Lepola, Marcus. 2013. Tavastehus gymnasiums Alaska-samlingar – Den Furuhjelmska donationen av etnografiska föremål 1863 (The Furuhjelm ethnographic collection of 1863 in the Tavastehus Gymnasium). – *Finskt Museum* 117 (2010–2011), edited by Ulrika Rosendahl and Anna Wessman. Helsinki: Suomen Muinaismuistoyhdistys, 46–66.

Luschan, Felix von. 1899. Zusammengesetzte und verstärkte Bogen. – *Zeitschrift für Ethnologie. Organ der Berliner Gesellschaft für Anthropologie, Ethnologie und Urgeschichte* 31: 221–239.

Maenchen-Helfen, Otto. 1973. *The World of the Huns: Studies in Their History and Culture*, edited by Max Knight. Berkeley and Los Angeles, CA; London: University of California Press.

Mason, Otis Tufton. 2007 [1972]. *North American Bows, Arrows, and Quivers. An Illustrated History*. New York: Skyhorse Publishing.

Maxwell, Moreau S. 1984. Pre-Dorset and Dorset Prehistory of Canada. – *Handbook of North American Indians 5: Arctic*, edited by David Damas. Washington, DC: Smithsonian Institution, 359–368.

McGhee, Robert. 1984. Thule Prehistory of Canada. – *Handbook of North American Indians 5: Arctic*, edited by David Damas. Washington, DC: Smithsonian Institution, 369–376.

Mikhailov, Kirill A. and S. Yu. Kainov. 2011. Finds of Structural Details of Composite Bows from Ancient Rus. – *Acta Archaeologica Academia Scientarum Hungaricae* 62 (1): 229–244.

Murdoch, John. 1890. A Study of the Eskimo Bows in the U.S. National Museum. – *Extract from the Smithsonian Annual Report 1883–1884* 2: 307–316, plates I–XII.
Nassaney, Michael S. and Kendra Pyle. 1999. The Adoption of the Bow and Arrow in Eastern North America: A View from Central Arkansas. – *American Antiquity* 64 (2): 243–263.
Nefëdkin, Alexander K. 2013. Some Aspects of Warfare of the Reindeer Lamut in the 17th Century. – *Arctic Anthropology* 50 (1): 120–137.
Osgood, Cornelius. 1966 [1937]. *The Ethnography of the Tanaina. Yale University Publications in Anthropology* 16. New Haven, CT: Human Relations Area Files Press.
Popov, Andrei Aleksandrovich. 1966. *The Nganasan. The Material Culture of the Tavgi Samoyeds*. Indiana University Publications Uralic and Altaic Series 56. The Hague: Mouton Co.
Rausing, Gad. 1967. *The Bow: Some Notes on Its Origin and Development. Acta Archaeologica Lundensia*. Series in 8° (6). Bonn: Rudolf Habelt Verlag; Lund: CWK Gleerups Forlag.
Rogers, Spencer. L. 1940. The Aboriginal Bow and Arrow of North America and Eastern Asia. – *American Anthropologist* 42 (2): 255–269.
Russell, Kari Pricilla. 1995 [1987]. *Tanaina Plantlore, Dena'ina K'et'una: An Ethnobotany of the Dena'ina Indians of Southcentral Alaska*. (2nd edn.) Anchorage, AL: National Park Service, Alaska Region.
Rust, Alfred. 1937. *Das Altsteinzeitliche Rentierjägerlager Meiendorf*. Neumünster in Holstein: K. Wachholtz.
Rust, Alfred, comp. 1943. *Die Alt- und Mittelsteinzeitlichen Funde von Stellmoor*. Neumünster in Holstein: K. Wachholtz.
Sirelius, Uuno Taavi. 1983. *Reise zu den Ostjaken*. Helsinki: Suomalais-ugrilainen Seura.
Sirelius, Uuno Taavi. 1989 [1919]. *Suomen kansanomaista kulttuuria 1: Esineellisen kansantieteen tuloksia*. Helsinki: Erika-kirjat.
Thompson, Michael Welman. 1967. *Novgorod the Great. Excavations at the Medieval City 1951–62*. New York; Washington: Frederick A. Praeger.
Tomse, Matjaz. 1996. Spruce as a Bow Wood. – *Primitive Archer* 4 (2): 8–12.
Vilkuna, Janne. 1994. Muinaisten metsänkävijöiden jousia. – *Metsä ja metsänvilja. Kalevalaseuran vuosikirja* 73, edited by Pekka Laaksonen and Sirkka-Liisa Mettomäki. Helsinki: Suomalaisen Kirjallisuuden Seura, 208–223.
Wilson, Brayton F. and Robert R. Archer. 1977. Reaction Wood. Induction and Mechanical Action. – *Annual Review of Plant Physiology* (28): 23–43.