SCYTHIAN BOW FROM XINJANG

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It should be highly unlikely that bows could be preserved for 3,000 years, and yet miraculously, in China's archaeological record, this has happened. The first source of these preserved bows is the frozen, arid deserts of Xinjiang and Qinghai. The second are the anaerobic, wet burials of Shandong and Henan Provinces.

The Yanghai cemetery in Xinjiang (Shanshan County, Xinjiang Uighur Autonomous Region) contains many tens of burials[1]. The corpses found in many of the graves were of Indo-Aryan type and all male burials were accompanied with bows and arrows. The type of burial and the grave goods, together with the design of the arrows, arrowheads and the chamois leather gorytoi in which many of the bows were placed, confirm the origin of the bows as Scythian. Unlike the Scythian bows from the western steppes of Russia and Ukraine[2], which most likely were of all-wood, laminated construction, these bows are true composites of horn, wood and sinew.

The term 'Scythian' derives from Herodotus and is traditionally used to refer to peoples of the Pontic Steppes who traded and interacted culturally with the Greek cultural sphere during his time. The accounts given by Herodotus are interesting but very incomplete. Later historical records do not give us a great deal of additional material.

Almost certainly illiterate, the people of the Pontic steppes nevertheless had a high cultural level. They were proficient in bronze and iron working and advanced in domestication of animals and use of the horse. They are known to have (in common with other groupings in Eastern Siberia) a taste of animalistic art.

They were pictured prominently in Greek art and finely-made ritual and utility items that appear to have been manufactured in Greek-controlled territories and then exported to the Pontic steppes. As reflected in Greek art, these people dressed distinctively in padded jackets and trousers, and were often shown wearing a distinctive, forward-pointing 'Phrygian' cap . Bows, which were depicted sporadically – most dramatically in the gold vase of the Kul Oba treasure – were of a distinctive type with sinuous limbs and curling tips. Images of battle scenes between Chinese troops of the Han Dynasty and western border states similarly depict a mounted people with beards, Phrygian caps and distinctive, sinuous bows.

There are too many similarities between these people as illustrated in ancient art from the East and West to dismiss the likelihood that both the western and eastern groups shared a strong cultural interaction.

Nevertheless, we should be aware that we should not assume any ethnic links. While well-preserved mummies with western racial characteristics have been excavated from tombs in Eastern Xinjiang, the ethnic diversity of the tomb-owners differs little from that found in the same area today. It is likely that in the Bronze Age, the regions stretching from the Western Pontic Steppes to the Western borders of Han China were inhabited by a racially and linguistically diverse group with a common tradition of metalworking and horse domestication with a liking for animalistic art possible linked to shared totems and mystical beliefs. Among the animalistic art of the South-Eastern Siberian region, images of ibex and mouflon are particularly prominent.

Yanghai cemetery produced a large number of bows of the 'Scythian' style, with sinuous limbs ad sharply curved tips. Other types of bows found there include narrow-limbed composite bows and simple self bows. Arrows, bow-strings and combined bow-holsters/quivers (gorytoi) were also found.

Figure 1. Bow from the Yanghai Cemetery (1000-400BCE). (Composite of three photographs)

Figure 2. Drawn from a vessel depicting Scythians. Scythian/Greek style, 2nd half of the 4th century BCE., Ukraine, Kul'Oba kurgan. The State Hermitage Museum, Saint Petersburg

Construction of the Yanghai Scythian style bows

The construction of these bows is quite consistent and the crude length hardly varies from 112cm. The length along the back of the bow (the part that faces away from the archer when it is used) is 130cm, and the measurement along the curve on the belly side is 141cms. Other than one very large specimen (some 15% larger than the norm) and one bow that was obviously made for a child, the variation in the relationship between the crude length and the length as measured along the limb was hardly more than ± two centimeters. This suggests that the shape of bows as found represents the real profile of the bows when they were unstrung, allowing for some relaxation over time. These bows were invariably highly asymmetrical.

The construction of the bows is fairly consistent. Most sections of the wooden part of the core are around 15cm in length, with the result that there are a number of splices along the core. However, these splices are not necessarily symmetrical around the belly-back plane, nor do the splices fall at identical points along the length of the limb in the various specimens that were examined.

The bow has a three-element core along most of its length: a central core of horn sandwiched between two laths of wood.

Figure 3. Section of limb (from the back) showing the horn core

It needs to be said at this point – because there will be those who argue that such construction is not possible – that an inspection of over twenty samples and fragments demonstrates that a horn core is invariably present, although not on all parts of the limb.

The wooden parts of the core are made up of fillets approximately 15cms in length, spliced along the length of the bow into two parallel, serpentine strips. In cross-section, each strip forms an approximate triangle with the apex on the belly side.

At the two severe curves along the length of the bow the body narrows and between them a lateral build-out is added making four wooden strips instead of two.

Figure 4. Back of the Yanghai bow

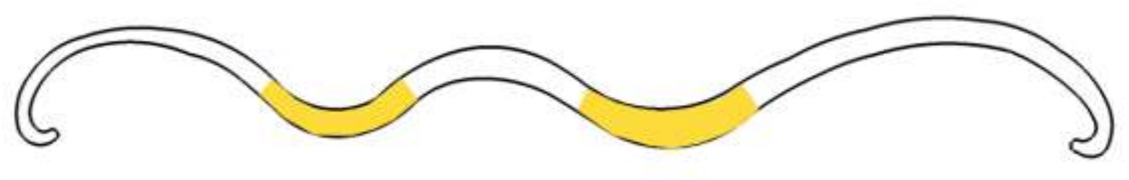

Figure 5. Areas of relative narrowing along the length of the limb

Figure 6. Exposed section of the belly where additional layers of horn can be seen over the core

At the widest, central part of the limb (grip), a build-out is formed by the addition of an extra pair of wooden core fillets on the outside of the main cores.

It should be noted, however, that the number and placement of fillets used to create this build-out varies between samples and can become very complex.

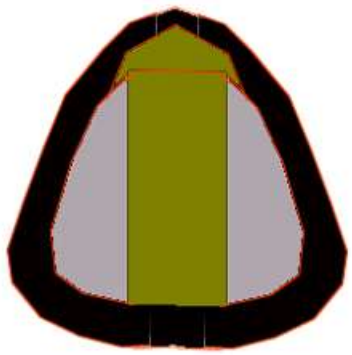

Figure 7. Typical limb cross-section showing addition of the horn plate at the belly (top), forming a sharp apex along the belly.

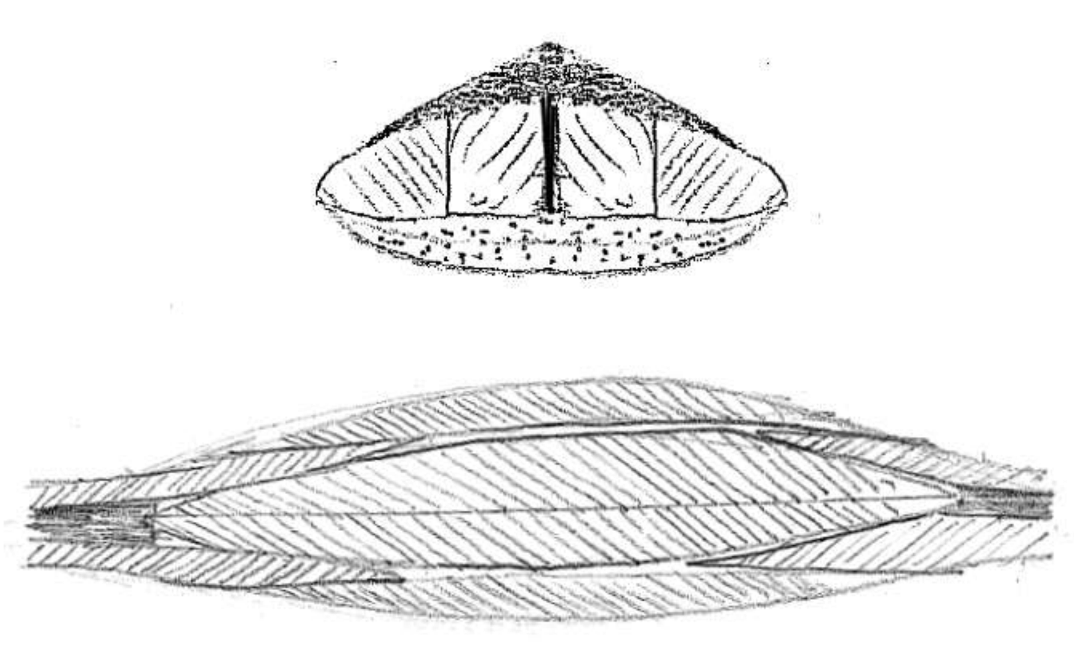

Figure 8. Cross-section and top view of the limb at grip.

The whole length of the bow was sinewed along the back in a 'conventional' manner. The sinewing was a consistent 3-4mm thick; layering could not be detected. Finally, the whole length of the bow was sinew-wrapped.

Figure 9. Remains of typical sinew wrapping.

The nocks were formed by an extension of the horn core and wrapped with sinew. The strings were made from twisted sinew and the loops were wrapped in soft chamois leather. On the back of the limb tip, adjacent to the string nock a trough was formed, extending about 15cms along the length of the back of the limb.

Figure 10. String nock and string loop

A summary of measurements that might assist those who wish to reproduce this bow are as follows:

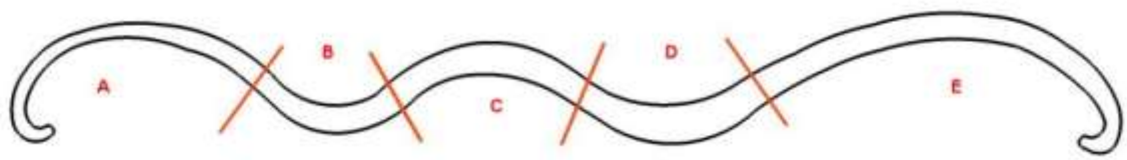

Figure 11. Sections of the bow

Crude length	112cm
Length measured along the limb at the back	130cm
Length measured along the limb at the belly	141cm
Width of the limb Segments A & E	2.5cm
Width of the limb Segments B & D	1.9cm
Width of the limb Segment C	3.5cm
Depth in the belly-back dimension	2.5cm

The materials used in the construction of the original bows have not been established, however. The wood could be tentatively identified as that of tamarisk, which is available abundantly in the region and is known to have been the material used to make bows in other periods. The horn remains unidentified; but it is worth noting the striking resemblance between the profile of the ends of the limbs and the natural curvature of the horns of the Ibex, which are commonly found in Xinjiang, even now. There were later (100BCE) bows of the same side profile, but with no inner horn in the core, following the typical composite construction.

Figure 12. Siberian ibex (courtesy of Milan Korinek). The inner horn strip for the core of bow is cut from the side of the horn.

Construction of a replica

The most unusual characteristic of the bows is the extreme curvature of the end sections, pointing away from the archer (reflexed). The inner strip of horn, laminated vertically inside the core of the bow has the thickness of approx 1.2cm to 1.5cm in (back-to-belly dimension) and approx. 0.6cm width (side-to-side dimension). Since the inner horn strip curves in the plane of the greater width, it would be impossible to make such strip to bend over the tight radius at the tips, if starting from a flat and straight band of horn. On the other hand, if the core strip was cut from the side of ibex horn, it would automatically have the desired curvature at the tips. The sides of the ibex horn would then provide the ready source of material for the inner core of the bow.

While the tips of the ibex horn determine the reflex at the bow's ends, the central section of both limbs, unlike the ibex horns, is severely bent towards the archer (deflexed). Ibex horns gently curve there in the opposite direction (in reflex). The mid-limbs are bend in deflex over a small radius of no more than 6-10cm. The bend as severe as that could not be achieved merely by stringing a new bow with near-straight limbs, given the great thickness of limbs in this area. It is apparent, the limbs had to be bent with heat and pressure prior to the use of bow. One approach to achieve such curvature could be to separately pre-bend the components of the limb: the wood laminations and the horn strip and then laminate all together for the limbs' core. Heat bending a wood sapling followed by splitting into two equal halves for the two sides of the laminate does not present a problem for a bowyer. However, to achieve such curvature in the flat strip of horn, to bend sideways in this case would be very difficult. Such bending would require a special jig to hold the horn while the heat and pressure is applied to soften it. While not impossible, the operation would call for a level of control one does not expect from an ancient bowyer in primitive conditions, with the potential waste of expensive material. Such elaborate and tedious build-up of the limbs would be counter-intuitive for a “professional” bowyer, either now or in the past. Simpler and more practical means to follow the shape of the limbs were needed.

The heat-induced deflex curvature of mid-limb was tried first on the limbs of a finished bow. The limbs were laminated as in the original bow including all components of the core, the horn plate on the belly, sinew on the back and the lateral binding of sinew. There was no deflex in the limbs, only a slight reflex to follow the shape of ibex horns. The limbs were humidified at 70-75%RH (relative humidity) for several days, heated to approx. 60 ^{0}C and bent over forms. No difficulty was encountered in forcing the limbs to the new position. Unfortunately, despite repeated attempts, the horn plate at the belly buckled under the strain of compression, despite the binding of sinew. Moreover, it was difficult to control the direction of bending, since the side-to-side dimensions of the limbs, as in the original bow, were less than their thickness. The surface strains in the belly horn and in the back sinew were indeed extreme and could be roughly calculated at about 16%. For comparison, the strains in a composite bow usually do not exceed 10%, while in an all-wood bow are no more than 1.5%. It was decided that a different method had to be adopted. The first limbs were discarded (the curved tips were re-used in the second attempt).

In the construction of the replica, ibex horn was replaced with water buffalo horn. The final bow’s mass, cast and the draw weight of bows depend on the individual stiffness and strength of the components. Although the mechanical properties of ibex horn were not known, it is to be doubted if they differed significantly from the properties of buffalo horn. As a norm, the variability of material properties within the same species, for example between horn and sinew of young and old animals, could be quite dramatic and likely to be as high as the differences in properties between the species. Also, the small changes in dimensions of the components, together with the severity of use and the environmental conditions of ambient humidity and temperature would likely cause more substantial change in final draw weight and cast in any case. The same reasoning can be applied in considering the wood species for the core. Yellow birch and maple were used for the replica.

To follow the original construction, the wooden core components of the bow were spliced in several places: at the tips, between the limbs and the grip and within the grip itself. The splices were all scarf joints, not the common (or perhaps later) V-splice, often found in the composite bows. Since the V-splice requires a hand saw to cut the female part of the V, one can speculate the saws of sufficient quality were either unknown or not yet common in Central Asia at the time. The scarf joints can be easily formed with a sharp tool by whittling and scraping or by grinding the mating surfaces flat. The core of the bow was made by adding on the sections side to side on the base of the inner horn strip until a sufficient length and width was reached. Then the sinew and horn plates on the belly were added to finish the bow.

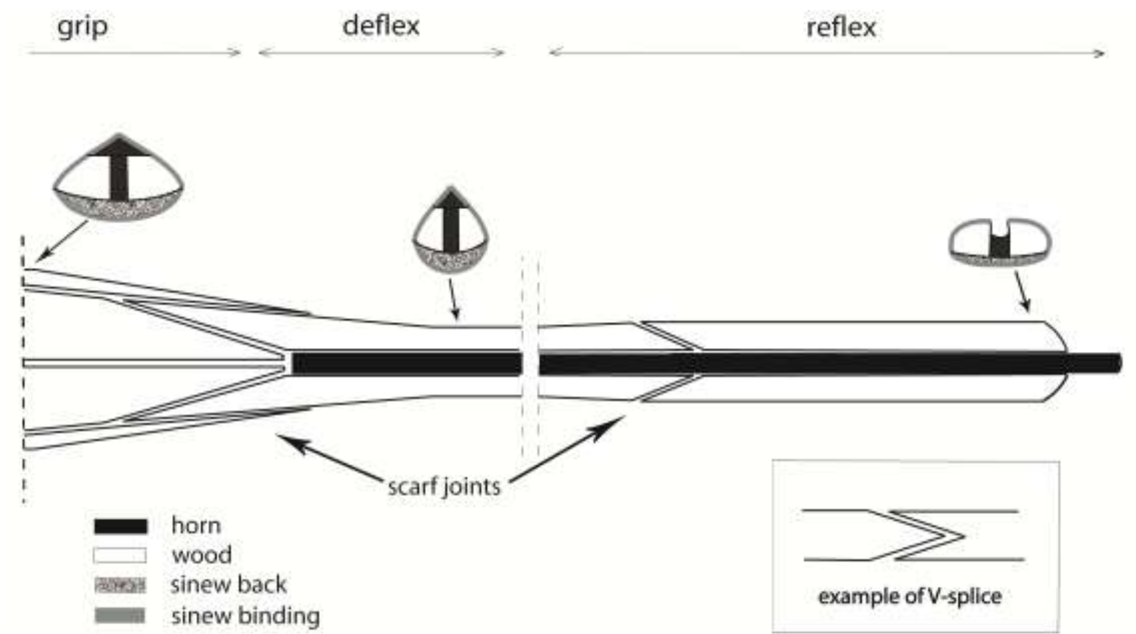

Figure 13. Schematic drawing of the core showing original construction, splices and cross-sections of finished limbs.

Although the replica bow was made with modern tools, a good understanding of construction and some experimentation made it possible to deduce the original methods. Archaeological data from the region support the use of variety of knives, chisels, scrapers, axes and adzes. Taking into account the known traditional technology of composite manufacture and the properties of materials, the ancient bowyer proceeded as follows:

1. Preparation of horn

The sides of ibex horns were separated from the flat outer surface and then the two inner core strips were cut following the curves of horn. One strip for each limb could be cut from each side of the same horn, although it should be tested in practice whether both sides are equally useable to yield good quality material. Since the bows are asymmetric with unequal length of the limbs, it is likely the horn strips for each limb were cut from horns of different length as well. Such asymmetric construction would be desirable to produce longer bows for greater uniformity and reduced stresses during use.

If the horns were too short, the inner strip of horn could be spliced of two or more pieces as well. No such splicing was, however, detected in the original specimen. In the replica bow the curved tips of the inner strips were scarf-joined to the straighter limbs section. Horn strips were then made smooth and lightly grooved with a toothed scraper (lengthwise) for better adhesion.

2. Construction of core

The construction requires several small diameter sections of wood, probably cut from saplings and tree roots. In the replica, the curved tip section was made from 2cm thick branches of yellow birch. The green wood was roughly shaped, soaked in water for a few days, boiled to soften it and bent over a form. This operation did not present any problems and did not require any particular effort. Once dried, the tip pieces were cut through the middle for the two sides of the core.

The gently curved, longer mid-limb sections were made separately from larger saplings (maple). No heat bending was required, since the curvature was much less. The two laminations for each limb were formed as thick as the horn strip (approx. 1.5cm in back-to-belly dimension), but wide enough to yield a core, after laminating all parts, at least 1.5 times wider than thick. The greater-than-final width was needed for safe bending at a later stage of construction. It means each of the side laminations was made about 1.2cm wide. Once laminated, the core was at this stage 1.2+ 1.2 + 0.6cm (for horn) = 3cm of total width. The two wood laminations had to be made long enough to accommodate the grip splice. If the bowyer did not use a saw to cut the splices, the inner horn strip would best remain shorter than the side laminations to facilitate carving the splice later. The wooden limbs' sections were scarf-joined with the tip section using hide glue. The mating surfaces with horn were then made even and smooth and lightly grooved with a toothed scraper.

Hide glue was used for wood-to-wood joinery and sturgeon bladder combined with tendon glue for horn–to-horn and horn-to-wood. The glues are traditionally made by boiling the respective animal tissues. Generally, fish bladder glues are preferred for difficult to glue materials, such as horn, for their better adhesion and greater elasticity in drier climate. However, all above mentioned glues are suitable.

The pre-made laminations of wood and horn were all joined together with glue in the usual manner, making sure the surfaces are well pre-sized with hot, thin glue.

The much-recurved wood pieces for the grip were cut from a section of tree root (birch). In the original bow, two pieces were laminated side to side first, then two additional pieces were added on at a later stage to increase the width of the grip and partly the limbs close to the grip. In the replica, since the limbs were already sufficiently wide, all four pieces for grip were laminated together in one operation.

The grip and the pre-made limbs were joined together with glue. The laminated grip section was cut into a V at both ends. The female parts of V-splice were carved at the ends of the limbs in the projecting extra lengths of the wood laminations at both sides of the inner horn strip.

Figure 14. Core parts (left) and bending the core (right).

3. Bending the limbs into deflex

The core's back was made round as the original's, scraped smooth, lightly grooved, well sized with glue and the limbs backed with sinew (soaked in 25% glue) over the (future) deflexed sections. This backing was done before bending the mid-limbs for the added security. The sinew did not need to be applied in the final thickness at this time. Since the heat required for bending could cause delamination of the limbs, the entire mid-limb section was then bound with sinew.

The ambient humidity should be no less than about 60%RH for the materials to have sufficient moisture content for bending. The 60%RH represents moderately humid conditions, which would likely be encountered in a human-occupied tent even in a dry climate of Central Asia, perhaps augmented by a pot with boiling water. The sections were exposed to slow heat, making sure the surface temperature did not exceed 60 ^{0}C, for about 1 hour. Then the limbs were bent over pre-made formers (similar to the Turkish tepeliks for the replica). The forces needed to flex the core were not excessive at all. The pressure was maintained until the curvature exceeded the desired profile to account for spring-back. Since the bow's core, unlike in the finished bow, was wider than thicker at this stage and the bending was done in the plane perpendicular to the greater dimension of the laminated limb, no problems with limb twist was encountered and the limbs remained perfectly aligned.

After the limbs had cooled, the sinew binding was removed, leaving the sinew backing in place. There was some slippage of the parts at one of the wood splices within the core, now visible on the belly. It did not, however, weaken the limb in any way and the splice held well. Interestingly, on the original bow's back, a small step was found at the location of one of the splices where the parts joined. If the step was caused by the slippage at the splice, it indicates the original bow could indeed be heat-bent after the core was laminated together, following the same methods as in the replica, with the slip under the sinew left unseen by the bowyer and never corrected. There is no doubt this method was the most logical and practical for the bowyer to force the limbs into the permanent deflex.

4. Attaching the horn belly and backing with sinew

Two thin fillets can be seen at the sides of the grip in the original bow. They were added to increase the width of the grip and partly the limbs close to the grip. Apparently the species of wood, possibly tamarisk, traditionally used for these bows, did not yield laths of sufficient size. It is unlikely the added fillets represent an attempt to improve the bow itself, in terms of cast or stability in use, although the practical tests may shed light on this feature of the bow. The fillets could be glued on at this stage, or later, after the application of belly horn.

The three horn plates for the belly cover the grip and about one half to two thirds of the limbs. The plates, cut from flat pieces of horn, presumably from the outer surfaces of the ibex horn, were pre-bent with heat to follow the deflexed curvature of the limb and the reflexed curvature of the grip. The bending was done by first boiling in water for a few minutes and forming by hand. The degree of curvature, with spring-back accounted for, should be at least as much as the relaxed curvature of the limbs. The strips of horn were made long enough to allow for the overlap of the sections. The horn plates, as well as the core's belly, were lightly grooved and well coated with thin glue Once dry, the plates were re-coated with thick glue and joined to the core.

The horn plates in the original bow are connected by scarf-joints. Scarf-joining the horn belly sections does not give the resistance to compression as the butt-joinery, commonly found in later composite bows. The tapered strips of horn tend to slide past each other under compression during the use of bow. In the initial trials, the author attempted to flex bow limbs, with the bellies covered with such scarf-joined sections of horn. The severe strains immediately caused the destruction of the joints, despite binding with sinew, proving the core of this bow had to be pre-bent in deflex before the horn belly was added to reduce the stress on the joints.

In the next operation, the sinew was applied to the back of the bow in several layers, in addition to the existing sinew already present at mid-limb. The sinew extended all the way to the tips, reaching the base of the projecting horn tips where the bowstring would later be tied on. The total thickness of the sinew layer was approximately 0.5cm at the limbs and at the grip, tapering down to about 0.2-0.3cm at the tips.

The entire bow was then formed into its final shape by filing and scraping to reach the dimensions of the original, less about 2mm for the lateral binding of sinew. The minimum width of limbs at both deflexed sections was brought down to 17mm (side-to-side dimension) and the thickness of the whole central section of bow between these two points was 23mm including the grip (back-to-belly dimension). The outer sections of limbs tapered in thickness evenly down to approx 12mm at the ends. The horn belly was formed into the characteristic ridge and the trough was filed for the bowstring at the tips.

After thorough sizing with thin glue, the bow was bound spirally with sinew: once over the whole length up to the tips, then once again in the opposite direction up to about 20cm below the tips. It was found the wrapping helped to stabilize the bow, by resisting the torque of the recurved tips and not allowing the narrow limbs to warp. The sinew binding had to be cut through at the location of the string grooves, thus potentially weakening the limbs at the tips, which could split under the repeated impact of the string. Some of the old bows had a plate of horn put on at the tips’ belly for reinforcement against such damage with the groove for the string cut in the horn plate.

Physical characteristics

draw weight @ 28in: 120lb
mass of bow: 540 grams
length of bow: 131cm between the nocks (the horn projections would add a few centimeters to the length)

length of string: 114cm, brace height: 18cm

The draw weight of the bow was tested one month and two months after the application of last layer of sinew. During that time the bow was kept strung to make sure the deflex in the limbs did not straighten out. It was felt such re-straightening of limbs might cause later difficulties with stringing and shooting the bow. At the first testing the degree of overall deflex was very close to the original bow and the draw weight did not change significantly at the second testing when the deflex increased by a few centimeters. It seems the bow is at fairly low stress at brace, thanks to the relatively low string tension, which allows for easy stringing by the "step-through" method.

The draw length was chosen as the standard 28 inches, although it is possible the bows were drawn further, up to 31 inches (arrows found with the original bows were 30-31 inches).

Figure 15. The replica unstrung and strung (finished).

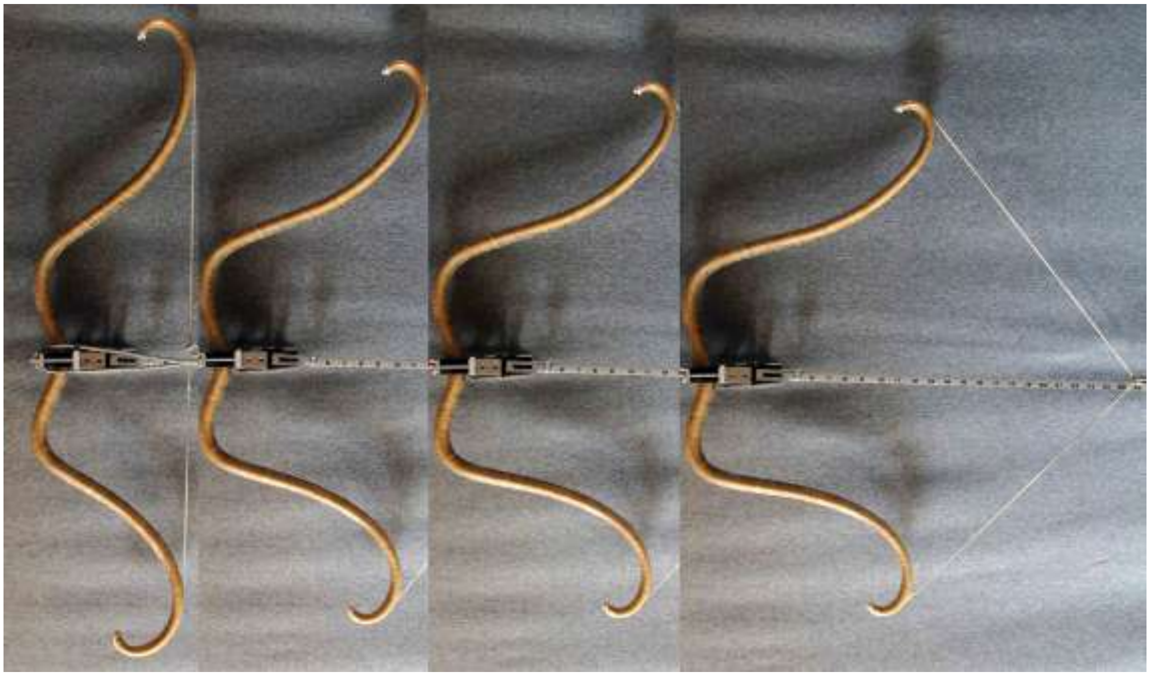
Figure 16. The replica strung and drawn in sequence.

It must be emphasized, the draw weight must be taken here as only an indication of the possible range for these bows. Very small variations in dimensions will result in substantial changes in weight. For example, a bow only 0.1cm thinner will be 15lb lighter, 0.2cm thinner about 30lb lighter. Narrowing the bow by 0.1cm will bring about 7lb drop in weight, by 0.2cm 15lb decrease. This could be indeed the case, if the sinew layer was thicker than the estimated 0.1cm. A 2cm longer bow will be about 5lb lighter as well. Moreover, the cross-sectional and side profile of the bows could vary between different specimens, as well as the flexibility of the outer sections of bows, which came to be nearly rigid in the replica. These, together with the physical degradation in use and with the changes of ambient humidity and temperature, do not allow for predictions greater than ± 30lb. It would be reasonable to estimate the draw weight range of Scythian[4] bows to be from 80lb to 140lb, which falls close to a similar estimate[3] for other composites.

There are pictorial representations of the bows in use. In one, the archer holds the bow below the apex of the grip's curvature. In another, the bow is held above it. The author tried both positions. While the high position could be maintained during the draw, the low position could not be comfortably held, given the forces of the draw. For that, the bow would require the upper limb to flex much more than the lower limb, which is impossible at the limb dimensions of the original bow. The most comfortable position of the bow hand was with the palm placed at the apex of the grip.

Conclusions

It is always tempting to speculate why this particular bow design had persisted for centuries. A modern bowmaker likes to see engineering advantages in ancient bows in the belief that people always aim to achieve the maximum technical efficiency in all endeavours. Progress of this kind, however, was much slowed when information was not passed on easily in the written form and not widely available as it is today. The craftsmen at the time had no way to detect small arrow velocity improvements and to accurately weigh the arrows and the materials in the bow. The tradition ruled, with small improvements compounded over generations. The Scythian bow represents one of the oldest composite bows in history at a very early stage of development.

However, despite the oddity of the profile, based on the ibex horn, the bow's performance should be reasonable[5]. The obvious advantage is its shortness for better manoeuvrability on the horse. The bow can be kept strung for long periods of time with less degradation in cast, since the stress in the strung bow is relatively low, given the deflexed profile. The bow could be easily strung in the field for that reason as well, as the contemporary art has shown. It could be manufactured from mere slivers of wood patched on for enough width of limbs. The thick, but narrow limbs represent an important advantage as well. Since the increase of the thickness, as opposed to the width of limbs, has much greater effect on bows' draw weight, the engineering efficiency of the bow is improved. In fact, the bow, with its limbs so narrow, has the materials utilized to a greater degree than any other known bow design.

There have been claims that the recurved outer-ends of limbs in this bows increased the energy storage of the bow, due to the "lift-off" of the bowstring from the ends, which progressed as the bow was drawn, thus levelling out the forces for a smooth, stack-less draw. While the effect was possible to a degree in the case of low-strung bows with more recurved limbs, it is to be doubted the lift-off was ever intended in this design to increase performance. Many of the original Scythian bows have the limbs nearly straight with only a small recurvature, in some cases merely a hook to hold the string. Obviously, ibex horns were not the same and the lift-off effect cannot be recognized as an intended feature of the bows. The only apparent function of the recurved tips, similarly to other composite bows would be the added stiffness in the tips, which helps to increase the energy storage by forcing the limbs to bend closer to the grip.

The complexity of construction begs explanation. Since the bows were clearly made to follow the shape of the ibex horns, one can speculate the "first" bows of this kind were made of horn laths alone, laminated together side-by-side for sufficient width and then set on an all-wood grip. Since the horn strips, cut from the sides of the ibex horns are narrow, the desired draw weight could only be reached by using horn strips as thick as possible (in the back-to-belly dimension). This can explain why, for reasons of economy, the bows were made so thick, but narrow in the bending sections. The thickest strip of horn was positioned at the centre of the laminate for the best effect and for the symmetry, which explains the "ridge" along the belly as well. All the while the narrow limbs, to maintain stability, had to be severely deflexed. Then, as the demand grew, the side strips of horn were replaced by laths made of wood. As it could become difficult to procure the central horn strips of sufficient thickness, horn, or even wood plates were added at the belly, maintaining the traditional belly-ridged cross-section. Once the greater importance of horn at the belly of bows was realized, the inner horn was eliminated from the limbs' core altogether for the typical composite construction, while retaining the traditional profile. The authors are inclined to think the above sequence of "inventions" could have indeed taken place leading to the eastern Scythian bows found at the burial site.

One should not, perhaps, leave the discussion of the complex shape of these bows without making reference to their possible totemic associations. There is clear archaeological evidence[6] of cultic worship of the moufflon and ibex in ancient Central Asia. Ranging from realistic representations to stylized representations, the ibex and moufflon decorated horse trappings, personal jewellery and ritual utensils. We do not preclude the possibility, therefore, that a visual rendering of the ibex horn was considered a necessary magical property for the effective use of such bows, possibly overriding engineering considerations. It would be an interesting further study to ascertain the extent to which the temporal and geographic range of such bows coincided with that of peoples for whom other archaeological remains suggest adherence to the moufflon/ibex cult.

Figure 17. Scythian horse plaque.

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1. The author (Stephen Selby) wishes to thank the Cultural Relics Bureaux of Shandong Province and Turfan, Xinjiang for the support he received in researching the finds.

2. E.W.Chernenko, *Skifskiye luchniki*, 1981, Institute of Archaeology, Ukrainian Academy of Sciences.

3. A.Karpowicz, 'Ottoman bows – an assessment of draw weight, performance and tactical use', *Antiquity*, 81 (2007): 675–685

4. Dr.Erhard Godehardt has researched a sinewed, wooden (laminated) bow of similar style (V.Alles (ed), *Reflexbogen, Geschichte und Herstellung*, Verlag Angelika Hoernig, 2009). However, due to difficulties in manufacture and uncertainty of the original dimensions, the results were not conclusive. After a recent careful examination of the photographs of this bow, Dr.Godehardt is quite sure that the original bow was composed of three layers of wood. He is no longer sure that the half round staves (Halbrunndstaebe) are located at the sides of the bow. This new conjecture is now supported by the pictures and drawings of the bow found in Arzan (Tuva) in 2002 (K.V.Cugunov, H.Parzinger, A.Nagler (eds.), *Der skythenzeitliche Fuerstenkurgan Arzan 2 in Tuva*, Verlag Philipp von Zabern, 2010). Hoever, the possibility that both bows are "funeral bows" only has still to be considered. The reconstruction of the Arzan bow shows a model which is not useable (personal communication with Dr.Godehardt).

5. At the time of writing this article, a shooting machine was not available to

do any further testing of this replica. Since the performance of bows is greatly influenced by many factors, reliable results can only be expected when more such specimens are made and tested.

6. Jeannine Davis-Kimball, 'Tribal Interaction between the Early Iron Age Nomads of the Southern Ural Steppes, Semirechiye and Xinjiang', in *The Bonze Age and Early Iron Age Peoples of Eastern Central Asia*, Ed. Victor H. Mair. Institute for the Study of Man. 1998. p. 238. ISBN 0-941694-63-1.