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Reviewed Article:

Neolithic Bow Build at Kierikki Stone Age Centre (FI)

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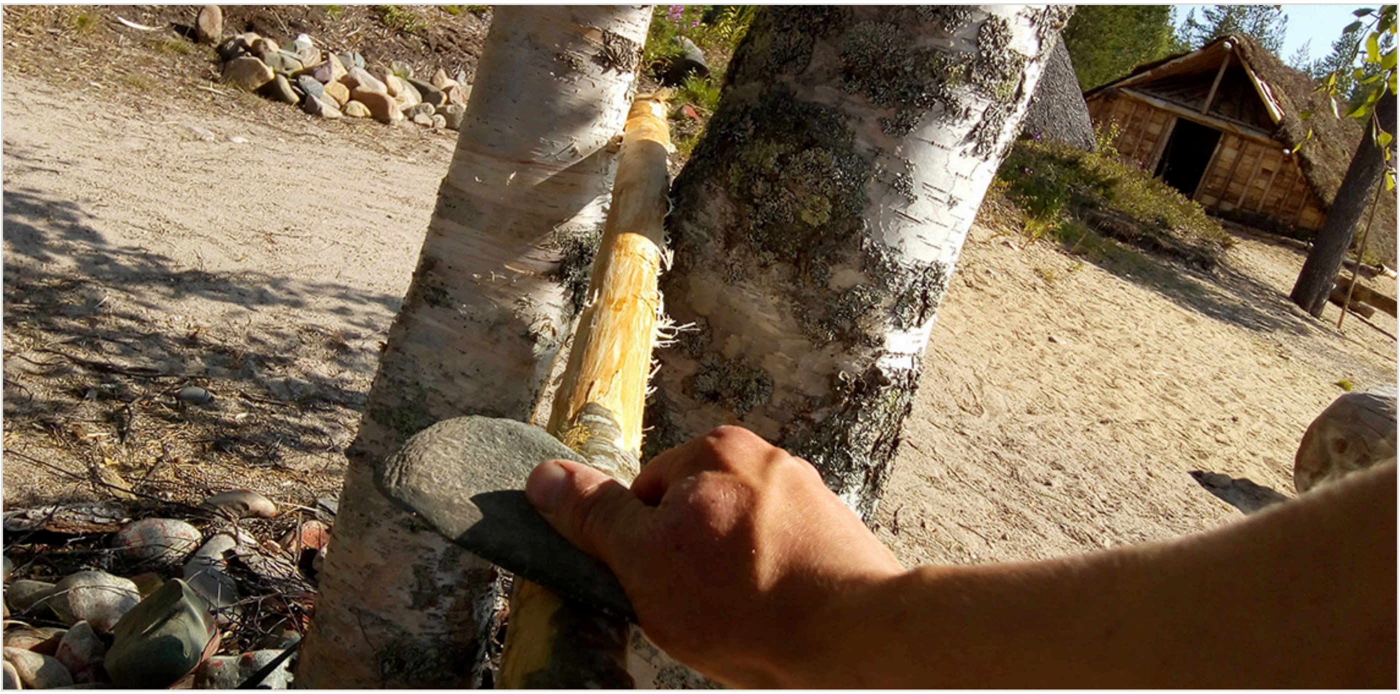

In July 2019 a group of students from the UK participating in the Placements in Environmental, Archaeological, and Traditional Skills (PEATS) Erasmus + Work Placement, attended the Kierikki Stone Age Centre, Pahkalantie, Finland. Group projects included experimental/experiential projects producing willow fish traps, pottery, and tanning, coordinated by Dr. Peter Groom of the Mesolithic Resource Group. This individual Neolithic bow building project was undertaken by Chris Woodland, archaeologist, craftsman, primitive skills, and bushcraft practitioner.

> In some cases, Neolithic methods or tools even proved to be advantageous over their modern-day counterparts for example stone tools held a sharper edge longer than steel. The quality, accuracy, and longevity of the bow is perhaps questionable and worthy of further experimental research.

Background

The emergence of the bow and arrow as tools for hunting and warfare in the Upper Palaeolithic is well known (for example Marlowe, 2005; Hoadley, 2015). Evidence of Microlith hafting points towards the appearance of the bow, perhaps as early as 60-70000BP in South Africa (Marlowe, 2005 ; Lombard & Phillips, 2010).

With wooden self-bows, preservation occurs only in rare instances. Despite this, a plethora of Neolithic and Mesolithic bow remains are known from Europe (Piqué *et al.,* 2015). Most notably these include Ötzi's bow, 5300BP (Baugh, Brizzi and Baker *l.*, 2006), the La Draga bows from the Iberian Peninsula, 7400BP (Piqué *et al.,* 2015) and the Holmegaard bows, preserved in the Danish peat bogs typical of Northern Europe, 10000BP (Comstock, 1992 ; Stanley, 2019). Most importantly for this project, Neolithic archery and probable reindeer hunting, is known from the Norwegian snowfields on the mountain slopes near Oppdal (Callanan, 2013). Especially relevant are the ground slate arrowheads found there. At Kierriki, both imported flint, and ground slate arrowheads have been discovered during the public excavations, as well as the use of locally-produced quartz microliths being probable (Viljanmaa, 2020. See also Figure 1). Undeniably, bows and arrows would have been in the hunting arsenal of the dwellers of the Kierikki site.

Kierikki is one of Finland's most important Neolithic sites for interpreting subsistence and trade, peaking around 5500BP. There is plentiful evidence of all-year dwelling on sites and other sedentary evidence (Vaneeckhout, 2008); excavations have taken place since the 1960's. Although during the Neolithic the Kierriki site was fairly coastal compared with today, and the community largely dependent on fishing, their diets would have been supplemented through hunting seal, land mammals and water fowl (Koivisto and Nurminen, 2015, p.68). These would have been hunted either by trapping or using bows and arrows. Finally, due to a lack of agricultural adoption (Lahtinen and Rowley-Conwy, 2013), they likely relied on trade and hunting more heavily than other contemporary European Neolithic communities.

Finally, in climatic terms relatively recent in the Holocene, pollen evidence points to a climate not dissimilar to what it is today in Scandinavia (Seppä and Birks, 2001).

With the above facts in mind, the primary goal of this project was to build a bow and arrow with locally sourced materials and Neolithic tools and methods at the Kierikki site, thus exploring how this could have been achieved there around 5000 years ago.

Materials and Tools

For the bowstave, rowan (*Sorbus aucuparia*) was chosen and the bowstring was of elk (*Alces alces*) rawhide. The arrow shaft was of willow (*Salix sp.*). The fletchings were most likely goose (*Anser*) feathers, left over from a previous project at the museum. All bindings were elk achilles (calcaneal) tendon fibres and the adhesive used was birch (*Betula*) bark tar. The arrowhead was made from grey slate. An antler axe and a polished flint axe, as well as a ground slate wedge and birch mallet were used for the rough shaping of the bowstave. Three different flint blades and scrapers were used for the finer carving and smoothing, along with a slate drawknife and bone chisel for de-barking and knot removal. Additionally, a piece of charcoal was used for marking, an open fire aided various stages and a granite slab for grinding the arrowhead and slate tools. Sand and fine wood shavings were used for sanding and final polishing, using a leather sleeve (See Figure 2 for the entire toolkit).

All materials were sourced within walking distance of the Kierikki Stone Age Centre and there is no reason why the tools could not have been produced at Kierikki in the Neolithic period; for example, the flint scrapers and slate wedge were all produced specifically for this project. Examples of tools similar to those produced for this project have been excavated at the site. Ground slate wedges, chisels and scrapers (See Figures 1 and 3), as well as imported flint blades are known to have been in use (Viljanmaa, 2020). For further reference, slate arrowheads, flint blades and slate axe heads, and wedges from Finnish Lapland were also inspected at the Arktikum Museum in Rovaniemi.

The project was entirely dictated by the raw materials available and the bowyer’s knowledge of their properties and suitability. Indisputably, Neolithic bowyers would have been more highly skilled, experienced, and knowledgeable of their natural world (Prior, 2000), but the builder of this bow still brought extensive bow-building, bushcraft, and primitive skills experience to the table nonetheless.

Methodology

Surveying Raw Materials

From the outset, it was simply planned to build a bow and arrow; the first step was to survey the locally-available materials.

Sandy soils and boggy terrain are typical of the area, providing an ample supply of pine and birch. Other trees found locally are alder, various willow species, rowan and aspen. Due to low population density in this area of Finland, reindeer are plentiful; elk have also been sighted in the area, and occasionally European brown bears as well.

The creative adaptation of previous bow building experience to suit the Neolithic toolkit and material processing techniques also played an important role.

At no point were modern tools used in any of the manufacturing steps of the bow. Wherever possible, the same principles were strictly applied for the procurement of resources as well although for hunting the elk, for example, it was not. This was to also explore effort and time involved in Neolithic bow manufacture.

Production of Custom Tools

Several tools were identified by the bowyer as being essential for the project, and it was decided it was worth investing the time to produce these custom tools before beginning the bow building. Through inspecting the site's museum collection of slate wedges chisels, axeheads and flint blades (See Figures 1 and 3) and also thinking about the Neolithic equivalents of modern bow building tools, the most promising were identified. The slate wedge, as a rough cutting and shaping tool, the slate scraper for debarking like a drawknife and fine flint blades for finer shaving work.

By far the most useful and versatile tool made was a wedge of green slate, chipped and then ground on a large flat granite slab (See Figure 2, 4th from left, bottom). Initially, a miniature polished stone axehead was envisaged. However, after days of grinding the primary bevel, it became clear that it was more important to have a functional tool, than a beautiful polished stone axe. Thus, the secondary bevel was ground and the hafting and polishing abandoned. A slate scraper, roughly equivalent to a drawknife was also ground (See Figure 2, 2nd from right). This proved to be of less use, but was still good for de-barking and removing small amounts of wood.

A selection of flint blades and scrapers were then knapped; these proved to be superb equivalents to spokeshaves and cabinet scrapers (See Figure 2, 4th from the left).

Production of the Arrow

Because the most suitable local timber for the bowstave was still being contemplated, it was decided to start producing the arrow first. Informed by the previous time-consuming process of slate-grinding, an arrowhead-shaped piece of slate was carefully selected. Slate was chosen due to its greater abundance in Finland compared to flint and also its ease of grinding. Due to its crystalline structure quartz was disregarded, as it is almost impossible to achieve non-microlith arrowheads. The leaf-shape profile was ground first by grinding perpendicular to the flat face of the arrowhead (See Figure 4). Sand was added as an abrasive and water as a grinding fluid to make a coarse paste. Once the even leaf-shape had been achieved, the edges of the tip were bevelled and the point sharpened, resulting in an arrowhead 35mm long, 19.5mm at its widest point and 6.5mm thick (See Figure 5). Then all surfaces were polished on a finer granite slab. Finally, the hafting notch was cut into the slate arrowhead using a sharp edged stone.

The arrow shaft (c. 75cm long) was scavenged from willow off-cuts that were being used to make fish traps on-site. The willow was easily peeled by hand and then steam bent by heating the green wood over the fire in order to straighten the shaft. A piece of leather wrapped around the shaft and filled with sand, acted as improvised sandpaper and was used to sand the shaft down to a smooth, uniform thickness.

The arrow nock, a groove in the end into which the bowstring slots, and the notch in the tip for the arrowhead were sawn out using a flint blade that had a pressure-flaked serrated edge (See Figure 6). The notched tip was also sharpened to fit the arrowhead better; then it was hardened over the fire to make it less likely to break on impact.

Feathers were split and cut to size for the three fletchings (c. 85mm long, protruding c. 22mm) and tendon prepared for the bindings, both tasks used sharp flint blades. The tendon was the achilles tendon from a locally hunted elk. It was cut from the hoof using a flint blade and then dried out over several days. Following drying, it was pounded with a smooth stone and a mallet to separate the fibres (c. 20cm long). These were teased out to provide strong bindings for both the arrowhead and the fletchings.

Birch bark tar was used as an adhesive. Thickened on a rock by the fire, then applied to the arrowhead and fletchings with a stick (See Figure 7). When binding the arrowhead, it was discovered that single strands of tendon were neither strong enough, nor long enough. Thus dozens of fibres were twisted into cordage (See Figure 8), using the combined S- and Z-twist method (see Groom *et al*, 2019, p.432, Figure 2). The resultant piece of cord (c. ⌀1-2mm & 30cm long) lashed the arrowhead to the shaft and was then covered with tar to protect the bindings (See Figure 9). All tendon bindings were wetted before being tied, so that they tightened further as they dried out.

Three single strands of tendon were used to bind the fletchings, as well as dots of tar at either end (See Figure 10). The radial three veined method was used, placing the feathers at equidistant points, naturally parallel at 120° from each other (Sarich, 2011, p.23). The resultant arrow was 76cm long, ⌀10.5mm and weighed 44g (See Figure 11).

Production of the Bow

While the arrow was being assembled, a reasonably straight-grained fallen rowan tree (*Sorbus*) was spotted near the site. Rowan was selected for three main reasons.

Firstly, extensive reconnaissance had revealed the only other options were willow (*Salix sp.*), aspen (*Populus tremula*), alder (*Alnus glutinosa*), birch (*Betula*), spruce (*Picea*), pine (*Pinus*), and juniper (*Juniperus*).

Willow was refused as being too pliable and not very springy, thus the limbs would have had to be thick and long to achieve even a moderate draw weight. It also has a naturally weak pithy middle. Aspen and alder are too soft and not very dense, their properties totally unsuited to withstanding the forces a bow is subjected to. Birch, although strong, dense, and good in compression, tends to lend itself better to laminated bow designs to improve tensile strength but it could have been a viable option. Pine and Spruce were rejected for being fast-growing softwoods, whose cells don't stand up to compression and tension. They also harden over time due to a high resin content, causing brittleness. Juniper could have been a reasonable choice as its heartwood withstands compression well and the sapwood stands up to tension, but none of satisfactory size was found nearby.

Rowan was also most similar to other woods the bowyer had built successful bows out of in the past eg. ash (*Fraxinus*). Therefore, familiar workability and properties made the successful production of a functional Neolithic bow more likely.

Finally, the stave selected was easily harvestable as it was from a well-suited fallen tree. This is significant when working with stone tools and perhaps points to a more opportunistic mindset, with effort weighed against functionality.

The sapling (c. ⌀5cm) was de-branched at its original location to make it less cumbersome to carry to the Stone Age Centre. Once there, it was carefully examined and the best section of the c. 180cm stave selected for the bow. This section had almost no knots, was the straightest, and of most uniform thickness. The surplus end was cut off using the slate wedge and mallet. Most effective, were two opposing c. 45° cuts (See Figure 12). Note: the bow-section was carefully selected so that only one laborious cut would have to be made; the other end was the base of the fallen tree.

The c. 166cm bow stave was then de-barked, removing both inner and outer bark. Several tools were tried for this. The slate wedge and bone chisel were most effective. The slate drawknife was only good for removing the outer bark. Flint blades were too sharp and brittle for the tough surface and didn't cut deep enough (See Figure 2 for tools).

At times it was helpful to wedge the stave between two trees and brace it to stop it from sliding out; this formed a simple but effective clamp or shave horse substitute, which made working on the stave far more efficient (See Figure 13).

In the centre of the bow stave a handle was marked (c. 12cm long), meaning the two limbs of the bow could be a maximum of 77cm. Then the best orientation of the bow within the stave was identified ie. Where the belly and back of the bow should be was determined by the wood's grain, knots, and shape.

Once this had been established largely by eye, the tapers of the limbs could be roughed out. This was done by placing the end of the bow on a chopping block, or beside it depending on which part of the limb was being worked on, and removing large amounts of material with both the antler and polished flint axes (See Figure 14). The aim was to create even tapered limbs, so that the bow would not have any weak points and flex in a uniform manner when drawn. The axes proved to be good tools for this job as large amounts of material needed to be removed. However, because they were less well balanced than modern day equivalents and less sharp, only very rough shaping could be achieved without endangering the integrity of the bow.

Once rough shaping was complete, the slate wedge and various flint blades were used to remove smaller amounts of material and focus on a uniform taper. At this stage, knots were also carefully carved down, but an excess of material was left around these fundamentally weak points of the bow to compensate.

The centre lines of the limbs were aligned with the direction of the grain, with the very centre of the sapling forming the centre of the bow's belly and handle. Most of the material on the limb's tapers was removed from the belly of the bow. The back of the bow was carved evenly, but otherwise its natural shape was retained, with the outside layers of the sapling forming the back of the bow. This resulted in a D-shaped profile for the limbs; a very forgiving design for self-bows made out of saplings, as its shape allows it to withstand the tension through the back and the compression through the belly well. This is particularly important as it was far from an ideal piece of wood that was being worked green.

It was judged by eye where smaller amounts of material had to be removed from the limbs to ensure they were evenly tapered, identical and their D-shaped profiles parallel. These small adjustments were made with the slate wedge. Some material was also removed from the back of the bow and the grip, to ensure symmetrically tapered limbs.

The bow was then cautiously flexed for the first time. This was done by placing the bow's tips on logs and leaning on the grip. This rudimentary tiller served well for the whole tillering process. Through observing how evenly the limbs flexed and if there were any stiff or weak points when pressure was applied to the middle of the stave, areas where material had to be removed could be marked with a piece of charcoal (See Figure 15).

Smaller amounts of material were shaved off with flint scrapers. The process began with flint blades that removed a lot of material, but less than the wedge or axes; perhaps as much as a spokeshave. As the adjustments became more minor, scrapers were used that removed tiny shavings, fine-tuning the bow to its final form. These scrapers removed material in a way similar to a cabinet scraper.

The tillering process was time-consuming; by far the longest stage of construction, but the most important. If weaknesses in the bow were not identified at this stage and addressed, the bow would have snapped on its first draw. Additionally, the repetitive flexing of the bow 'teaches' it how to bend.

Different parts of the bowstave had to be reduced down, with constant checking for an even flex. This was done gradually. At first hardly any pressure was applied to the bow. Then adjustments were made and a bit more pressure could be applied. This was a continuous process, with adjustments becoming slighter, as the bow approached a near-perfect flex.

Again, the bowstave was often clamped between the two trees so even shaving strokes could be applied. It was also rested on a log and a stone, to allow shavings to be taken off the sides of the limbs (See Figure 16). The final tapered belly on the limbs was 31.5mm at the handle to 14.4mm at the bow tip's nock. The sides of the limbs tapered from 34.5mm at the handle to 21.5mm at the nock. The bow's total length was 166cm, with limbs of 77cm and the handle 12cm (See Figure 17).

Working with flint scrapers for hours on end meant the bowyer had to improvise a hand-protector, by wrapping a piece of leather around the dominant hand (See Figure 16). Perhaps hafted flint tools would have been better, but hafting tools is a complex and arduous process.

Once satisfied the bow's flex was as even as the tools, methods, and wood choice would allow, the surface had to be finished. Care was taken not to remove lots of material and to remove it evenly, as otherwise the bow would have had to be retillered. Initial smoothing was done with fine flint scrapers, shaving out any rough patches, dents, and scratches.

A large piece of leather was then used as a sleeve around the bow. Filled with sand, it could be rubbed up and down the stave to sand it smooth (See Figure 18). Final finishing was done with handfuls of fine shavings, polishing the surface.

An elk hide was soaked in the lake for several days prior to being processed for other projects and the bowstring. Soaking opened up the pores making the hair fall out and softened the hide sufficiently for it to be workable. It also allowed fish and other small organisms to start the defleshing process. Once out of the lake, it was dehaired and defleshed by laying it over a fleshing beam and scraping both sides vigorously until all hair and fatty membrane scraps were gone.

The wet rawhide was laid flat on the ground and the longest strip possible meticulously cut using a flint blade. Because of the difficulties of cutting thick elk skin with a flint blade, the width of the strip varied slightly (c. 3-6mm) and a total length of 142cm was achieved. This was not quite sufficient for the length of the bow, so an additional strip of c. 40cm was cut and tied to the first. The strip was then twisted to improve its tensile strength, and consequently achieve a more uniform thickness. The loops were tied while the rawhide was still wet, and it was stretched from a rafter and weighted down with stones so it couldn't unravel. After air-drying for several days the stiff, but very strong (capable of bearing at least 75kg) bowstring, with a final length of 159cm, was finished.

Nocks were cut into the bow tips using a serrated flint blade and the bow carefully strung for the first time (See Figures 19 and 20). After checking that the bowstring, knots, centreline and equal tension and flex were satisfactory, the bow was cautiously 'trained' to respond well to the bowstring. This was done by repeatedly flexing it a little bit at first. Gradually, the amount of flex was increased and the bow trained to each new draw length. At least 10-20 repetitions were done at each increased stage, until the bow could be drawn sufficiently to shoot an arrow.

The first arrow was loosed from roughly a half-draw, as the bow wood also has to be 'taught' to shoot an arrow. Gradually, the tension was increased and the arrow shot with more force (See Figures 21-24). It was never dry fired.

The bow's draw weight exceeded expectations, 80-85 pounds at 26 inch draw, and was too much for the archer to achieve anything more than a ¾ draw. The arrow flew true, due to its heavy slate tip and fletchings. Initial shooting tests were conducted at 10-15m, but due to the large draw weight, a degree of accuracy was lost. In the right hands, or with a reduction in draw weight, the bow could certainly be lethal and accurate at twice the distances tested, if not more. Although basic, made with Neolithic tools and from suboptimal timber, it was sufficient for target shooting and certainly could have killed.

Conclusion

Irrefutably, a powerful hunting bow and arrow could be produced at the Kierikki Stone Age Site. This is possible to do using only Neolithic tools and methods; solely from the following locally sourced materials: a rowan bow stave, willow arrow shaft, slate arrowhead, elk tendon and rawhide for the bindings and bowstring, goose feather fletchings and birch bark tar adhesive. A reasonably experienced bowyer was able to produce an adequate bow, along with the fundamental tools needed, under these conditions in around two weeks (See Table 1). A Neolithic bowyer could have doubtlessly produced a higher quality weapon faster.

Task	Hours	
Tool Production	**Total:**	**9h**
Slate Wedge – finding, chipping, grinding & polishing	5h	
Slate Scraper/Drawknife – finding, grinding & polishing	2h	
Flint Blades – finding & knapping	2h	
Arrow Production	**Total:**	**10h**
Shaft – finding, peeling, steam straightening, sanding to uniform thickness, cutting notches	4h	
Arrowhead – finding, chipping, grinding, cutting notches & polishing	2h	

Tendon String – cutting, drying (3 days), teasing out fibres, making cordage	2h	
Fletching – cutting feathers to size, refining birch bark tar, gluing & binding feathers	1h	
Hafting Arrowhead – gluing & binding	1h	
Bow Building	**Total:**	**23h**
Harvesting Stave – reconnaissance, harvest & transport	3h	
Initial Processing – debarking, debranching & knot shaving	2h	
Roughing out Bow Stave – rough tapering using axes & wedge	2h	
Tapering Limbs – shaving with flints	3h	
Initial Tillering – marking areas for material removal	1h	
Tillering & Fine Tuning Limbs – shaving small amounts of material off belly & back to achieve even flexing & retesting flex	4h	
Fine Shaving – removing small amounts of material for initial surface finish	2h	
Sanding & Polishing Stave – surface finish and aesthetic	2h	
Cutting Nocks – in the bowtips for the bowstring	1h	
Training the Bow – gradually increasing drawlength and teaching the timber how to flex (over 3 days)	3h	
Bow String Production	**Total:**	**7h**
Soaking Elk Hide – in river for 3 days		
Defleshing/Dehairing – scraping membrane & hairs off over a fleshing beam	4h	
Cutting Band of Rawhide – laborious cutting of tough hide with flint	1h	
Making Bowstring – twisting, stretching, strength testing & length adjustment (3 days drying time)	2h	
Estimated Production Time	**Total:**	**49h (+6 days drying time)**

TABLE 1. ESTIMATED EFFORT IN HOURS

Effort plays a large role; thus, materials or methods are sometimes a compromise in terms of their quality. If the task can be completed to a satisfactory functional standard, corners are sometimes cut to get there. Of note is also the opportunistic nature of this project. For example, adequate materials were scavenged or bartered from peers where possible and function was deemed more important than aesthetic. Manufacturing steps were analysed more closely than if the effort to complete them had been less. However, this was partly because the project's sole aim was to produce a functional Neolithic bow and arrow out of local materials, nothing more. Besides, it is likely some 'effort corners' were only cut because the bowyer was 'tainted' by modern tool use and production methods and therefore occasionally frustrated by the effort and time involved in the Neolithic equivalents for example the grinding of the slate axe head. Working to a two-week deadline will have also undoubtedly influenced choices.

Despite this, elements of the modern-day manufacturing process were surprisingly simple to adapt to feasible Neolithic alternatives. For example clamping, shaving, sanding, and polishing.

In some cases, Neolithic methods or tools even proved to be advantageous over their modern-day counterparts for example stone tools held a sharper edge longer than steel.

The quality, accuracy, and longevity of the bow is perhaps questionable and worthy of further experimental research. Worth mentioning is perhaps the social implications of mutually beneficial raw material sharing.

Overall however, a functional Neolithic self-bow can be produced at the Kierikki Stone Age Centre. Thus this should have been perfectly feasible in the Neolithic, at the climax of the site's use around 3500BC.

Acknowledgements

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Keywords bow and arrow

Country Finland

Bibliography

Baugh, D., Brizzi, V. and Baker, T., 2006. Ötzi's Bow. *Primitiveways. p*, pp.1-7.

Callanan, M., 2013. Melting snow patches reveal Neolithic archery. *Antiquity*, 87(337), pp.728-745.

Comstock, P., 1992. Ancient European Bows, pp. 87-88. In: *The Traditional Bowyers Bible* Volume 2. The Lyons Press

Groom, P., Pickard, C. and Bonsall, C., 2019. Early Holocene Sea Fishing in Western Scotland: An Experimental Study. *The Journal of Island and Coastal Archaeology*, 14(3), pp.426-450.
Hoadley, M., 2015. The Archaeology Of Archery Origins. 12th Anniversary Lecture, *The Ancient World Society*

Koivisto, S. and Nurminen, K., 2015. Go with the flow: stationary wooden fishing structures and the significance of estuary fishing in Subneolithic Finland. *Fennoscandia archaeologica*, 32, pp.55-77.

Lahtinen, M. and Rowley-Conwy, P., 2013. Early farming in Finland: was there cultivation before the Iron Age (500 BC)?. *European Journal of Archaeology*, 16(4), pp.660-684.

Lombard M., and Phillips L., 2010. Indications of bow and stone-tipped arrow use 64,000 years ago in KwaZulu-Natal, South Africa. *Antiquity*. 84 (325), pp.635–648.

Marlowe, F.W., 2005. Hunter-gatherers and human evolution. *Evolutionary Anthropology: Issues, News, and Reviews: Issues, News, and Reviews*, 14(2): 15294, pp.54-67.

Piqué, R., Palomo, A., Terradas, X., Tarrús, J., Buxó, R., Bosch, À., Chinchilla, J., Bodganovic, I., López, O. and Sana, M., 2015. Characterizing prehistoric archery: technical and functional analyses of the Neolithic bows from La Draga (NE Iberian Peninsula). *Journal of Archaeological Science*, 55, pp.166-173.

Prior, S., 2000. The skill of the neolithic bowyers—reassessing the past through experimental archaeology. *Somerset Archaeology. Taunton, Somerset County Council*, pp.19-24.

Sarich, S.J., 2011. Variations in Arrow Technology: An Experimental Exploration of the Effectiveness of Fletching. *Nebraska Anthropologist* 166, pp.18-29.

Seppä, H. and Birks, H.J.B., 2001. July mean temperature and annual precipitation trends during the Holocene in the Fennoscandian tree-line area: pollen-based climate reconstructions. *The Holocene*, 11(5), pp.527-539.

Stanley, J., 2019. How Old is the Bow and Arrow. *World Archery*. [online]. Available at: < https://worldarchery.org/news/166330/how-old-bow-and-arrow... >[Accessed on 06 June 2020]

Vaneeckhout, S., 2008. Sedentism on the Finnish northwest coast: shoreline reduction and reduced mobility. *Fennoscandia archaeologica*, 25, pp.61-72.

Viljanmaa, S., 2020. Personal Communication with the Curator of Education at Kierikki Stone Age Centre about arrowhead finds

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FIG 1. SLATE WEDGE, ARROWHEADS AND FLINT ARROWHEAD FOUND AT THE KIERRIKI SITE BY VILIANMAA, S.

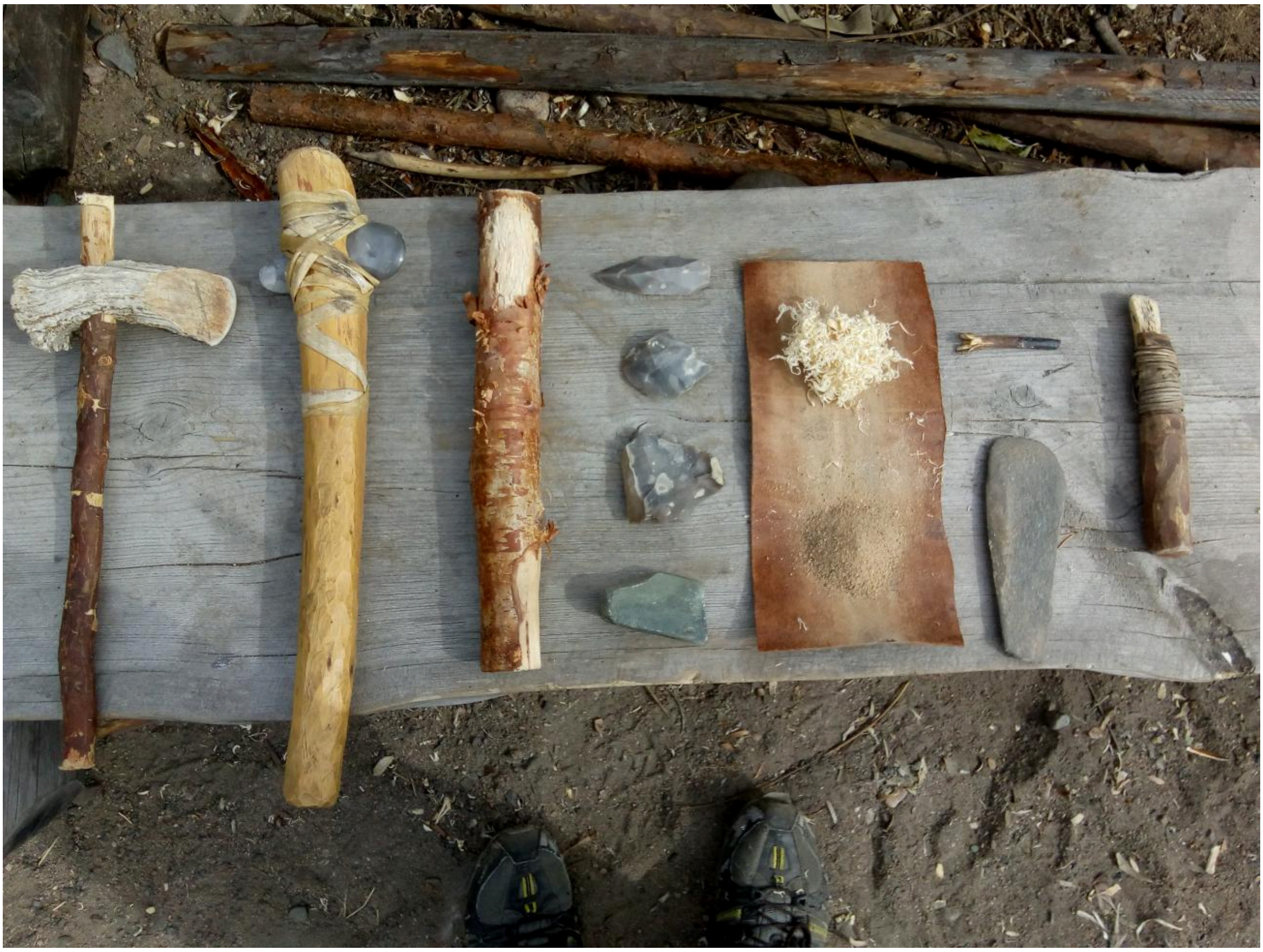

FIG 2. A NEOLITHIC BOWYER’S TOOLKIT. PHOTO BY CHRIS WOODLAND

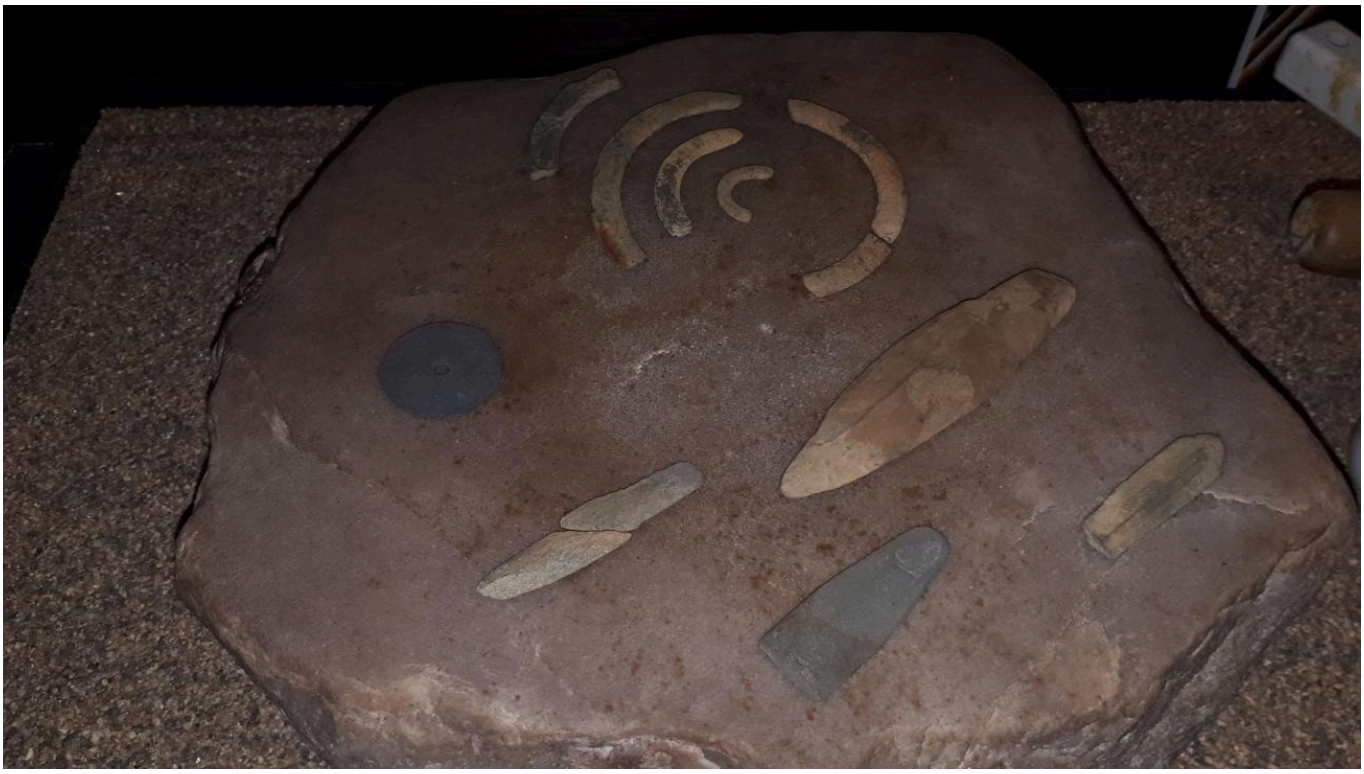

FIG 3. SLATE BLADES AND WEDGE AT KIERRIKI STONEAGE CENTRE BY VILIANMAA, S.

FIG 4. GRINDING THE SLATE ARROWHEAD. PHOTO BY CHRIS WOODLAND

FIG 5. THE HAFTED ARROWHEAD WITH SCALE. PHOTO BY CHRIS WOODLAND

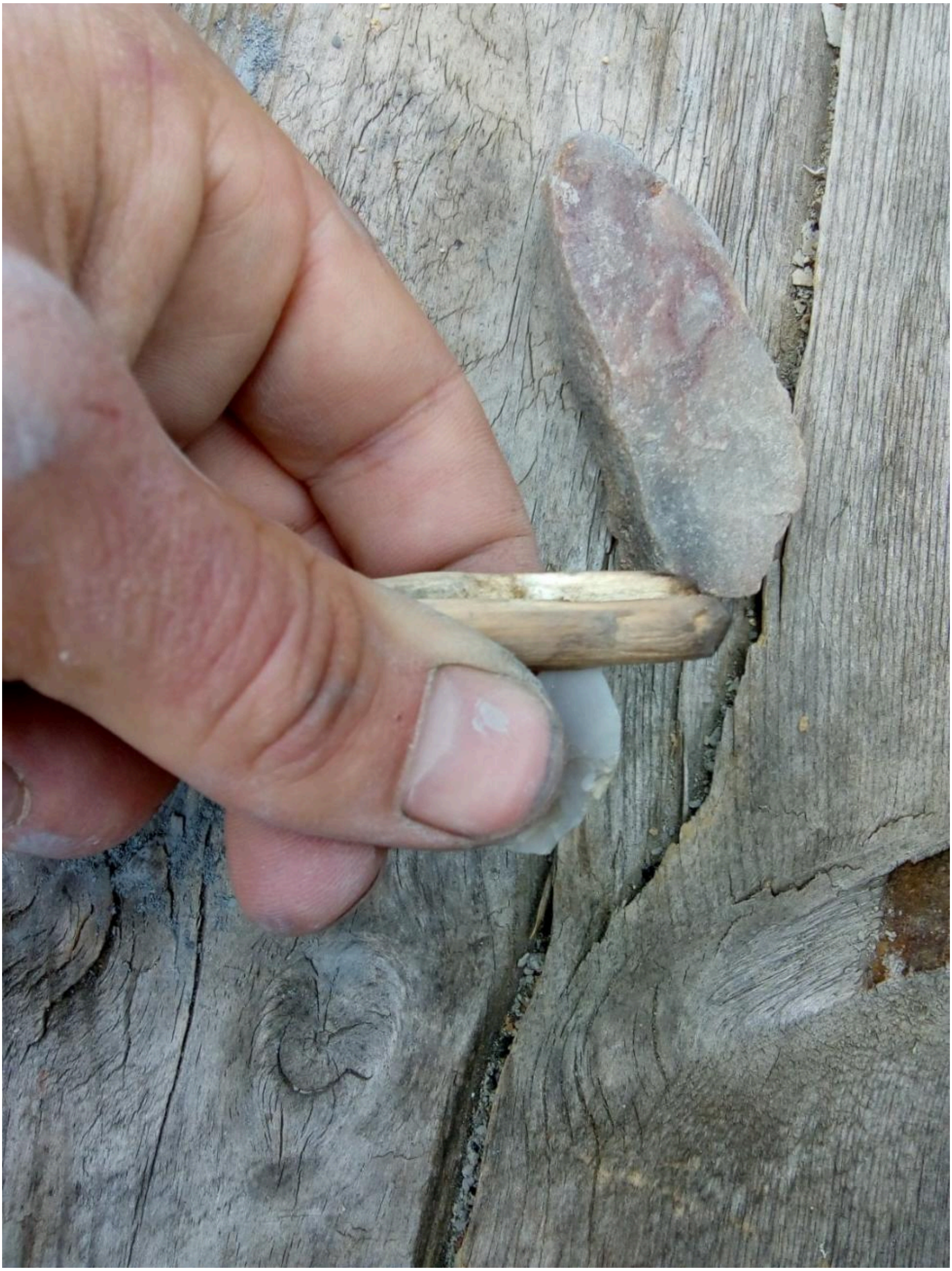

FIG 6. SAWING THE ARROW NOCK AND NOTCH. PHOTO BY CHRIS WOODLAND

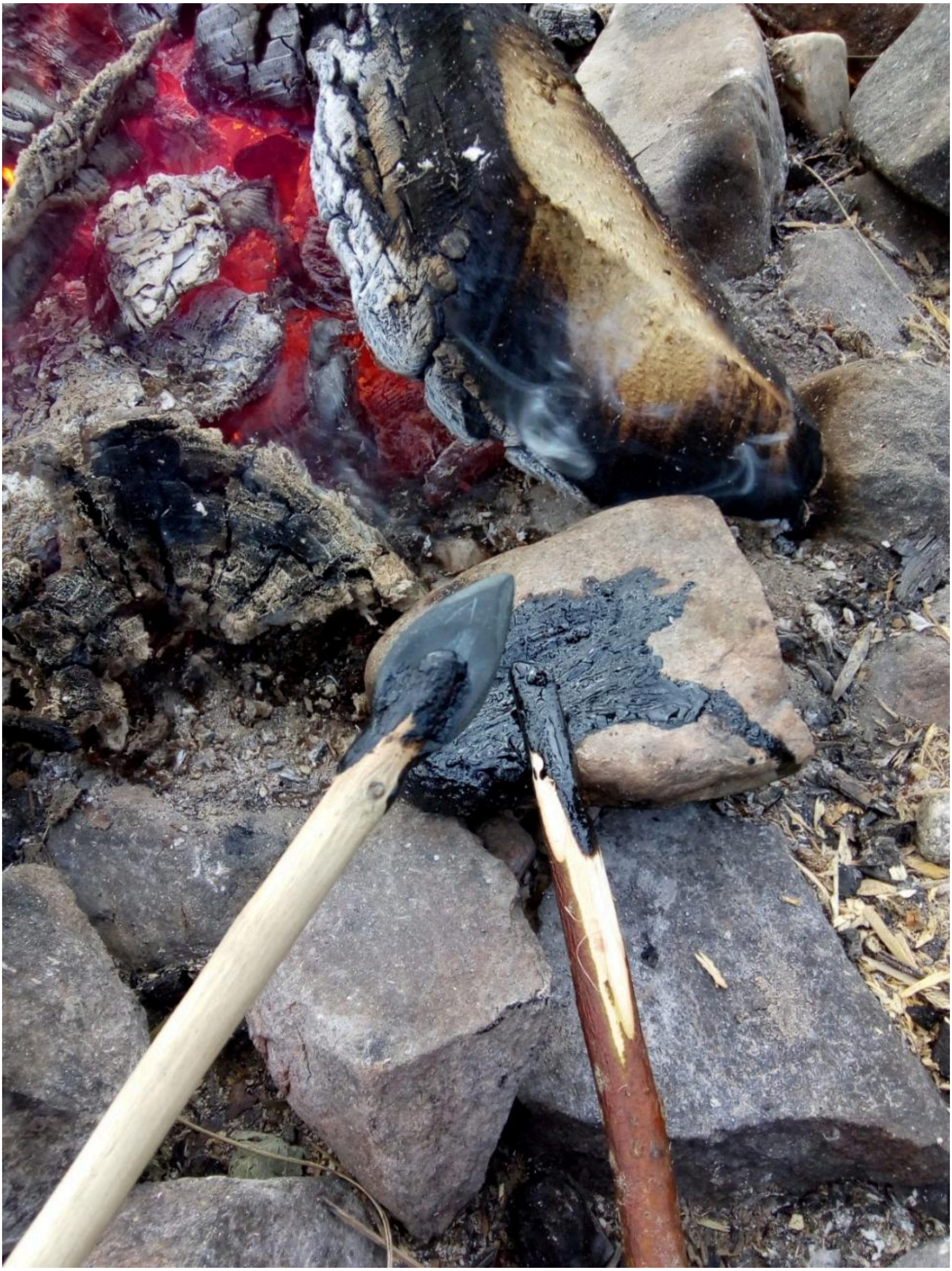

FIG 7. APPLYING BIRCHBARK TAR TO HAFT THE ARROWHEAD. PHOTO BY CHRIS WOODLAND

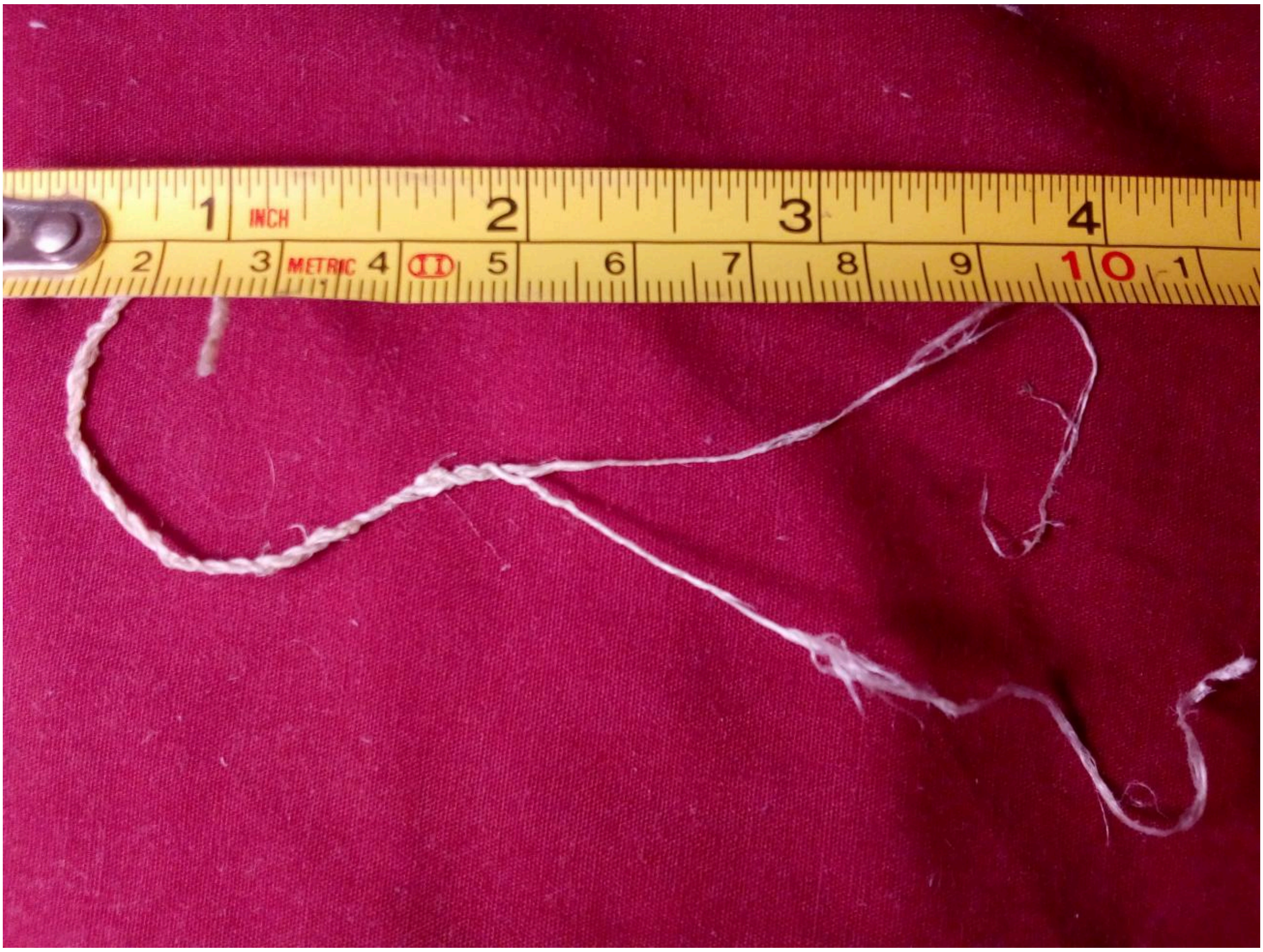

FIG 8. TWISTED ELK ACHILLES SINEW CORDAGE. PHOTO BY CHRIS WOODLAND

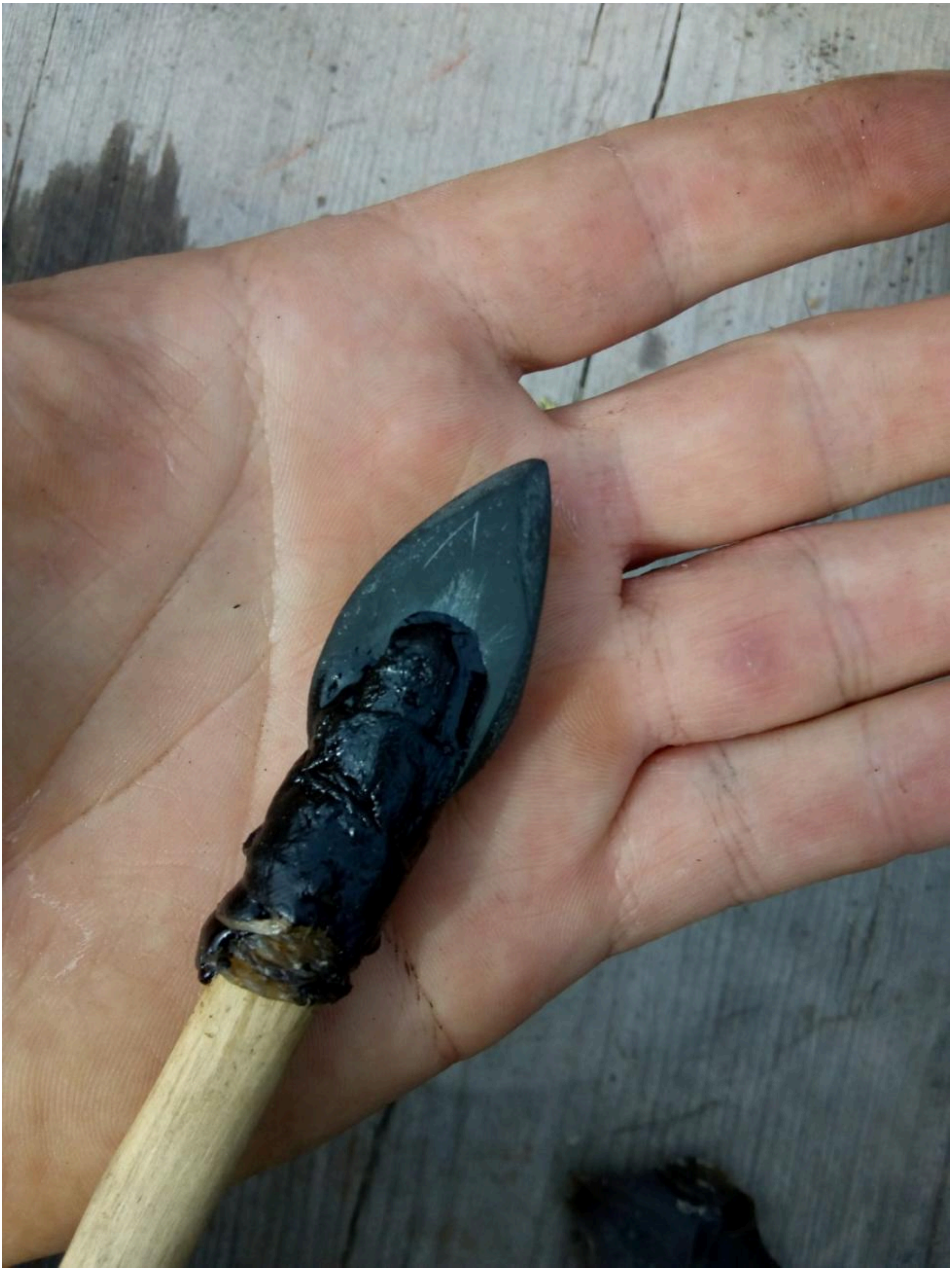

FIG 9. THE SLATE ARROWHEAD HAFTING. PHOTO BY CHRIS WOODLAND

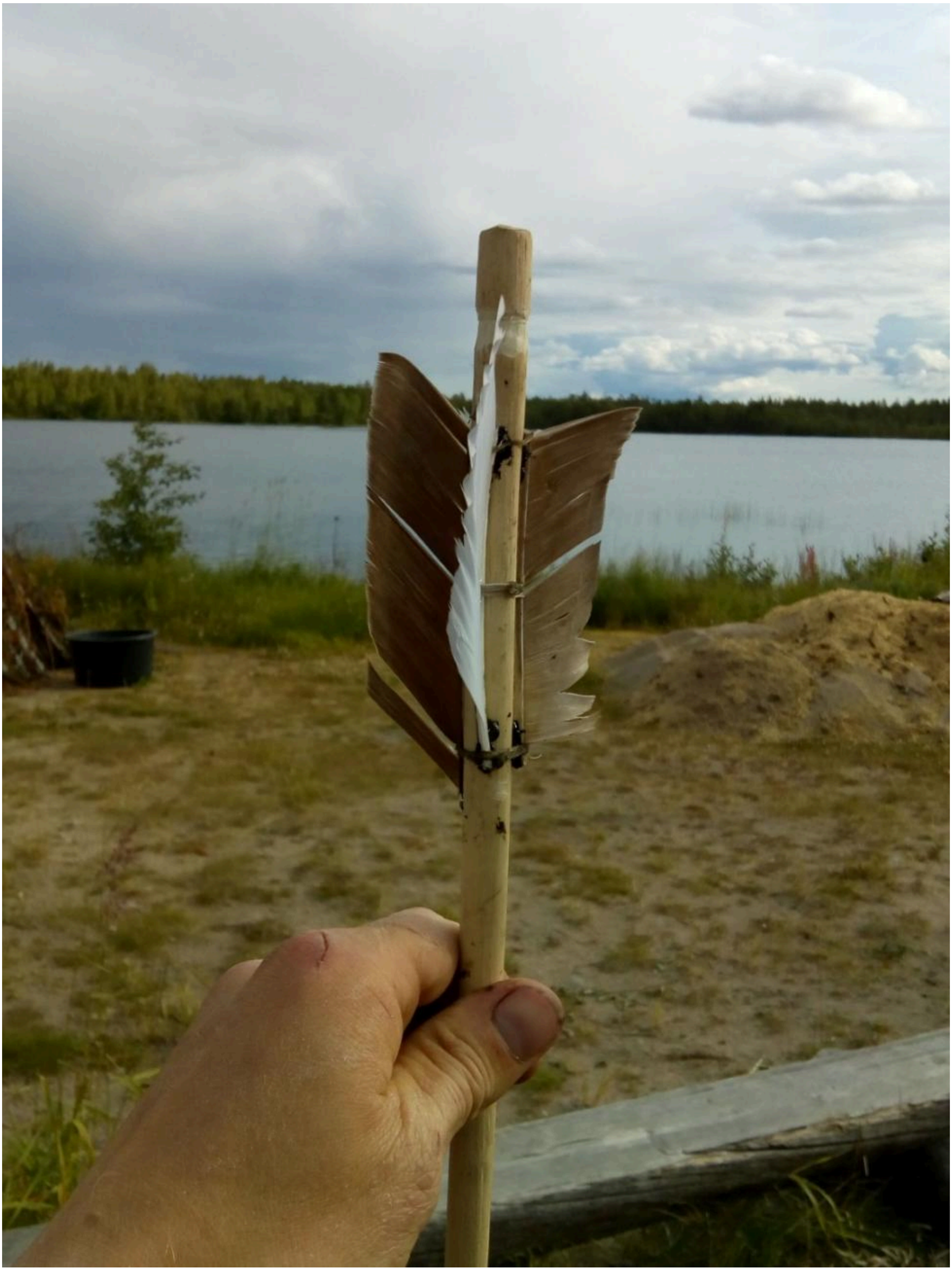

FIG 10. THE FULLY FLETCHED ARROW. PHOTO BY CHRIS WOODLAND

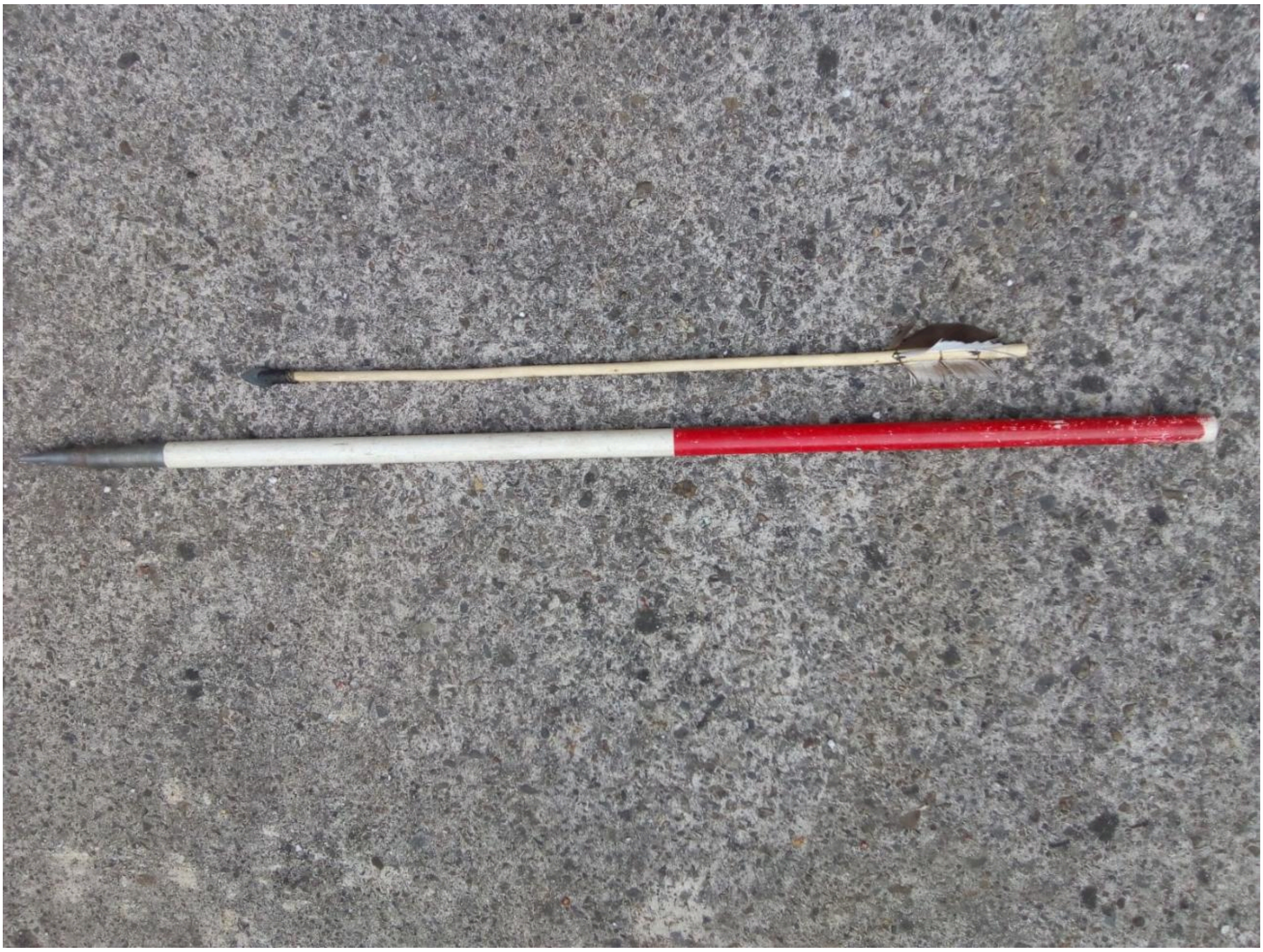

FIG 11. THE ARROW. PHOTO BY CHRIS WOODLAND

FIG 12. CUTTING THE BOWSTAVE TO SIZE. PHOTO BY CHRIS WOODLAND

FIG 13. A NEOLITHIC SHAVE HORSE OR CLAMP: TWO TREES. PHOTO BY CHRIS WOODLAND

FIG 14. REMOVING MATERIAL WITH AN ANTLER AXE. PHOTO BY CHRIS WOODLAND

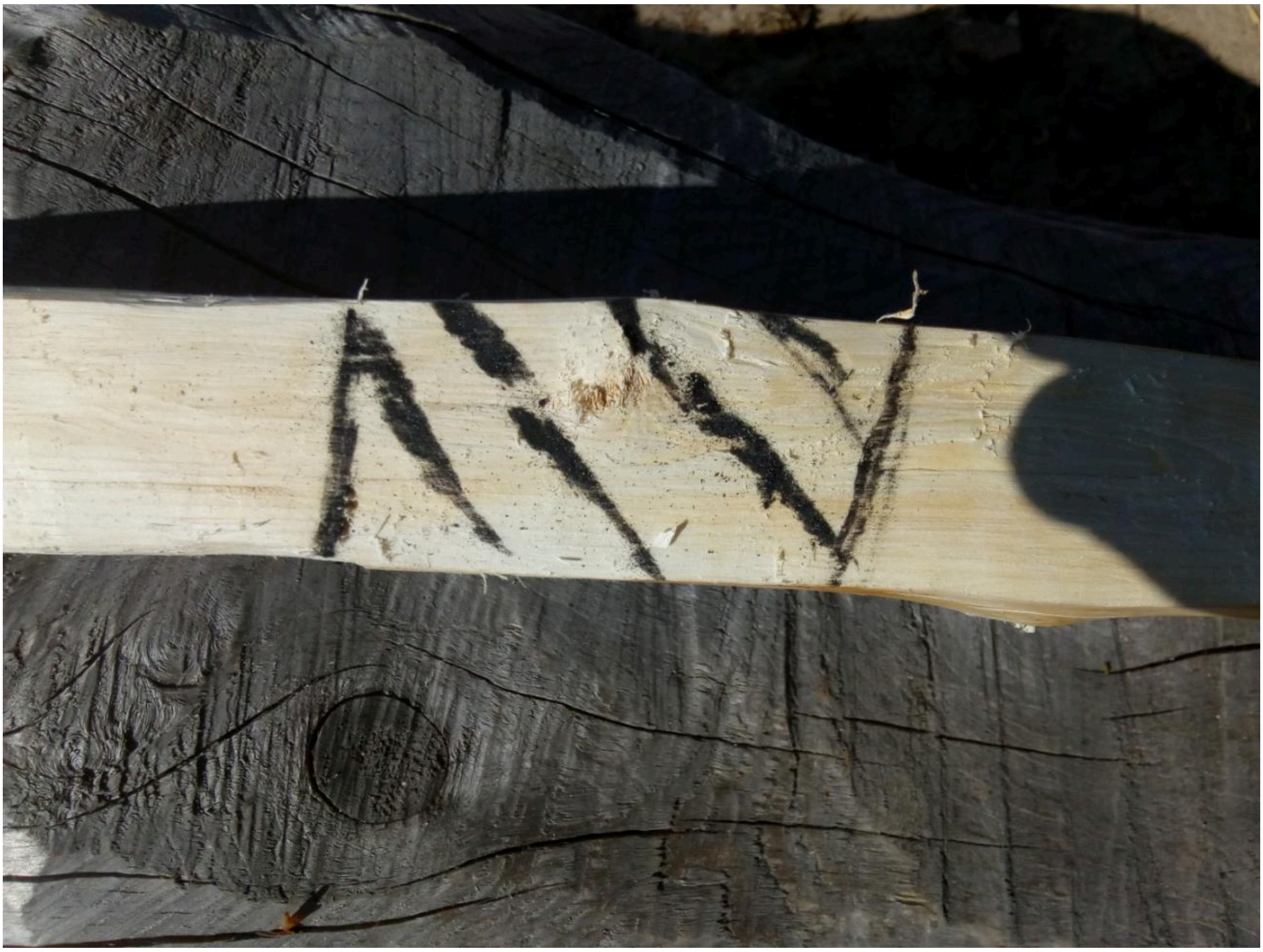

FIG 15. MARKING AREAS OF THE BOWSTAVE FOR REMOVAL OF MATERIAL WITH CHARCOAL. PHOTO BY CHRIS WOODLAND

FIG 16. THE IMPROVISED HAND GUARD AND WORKING THE BOW TIPS. PHOTO BY CHRIS WOODLAND

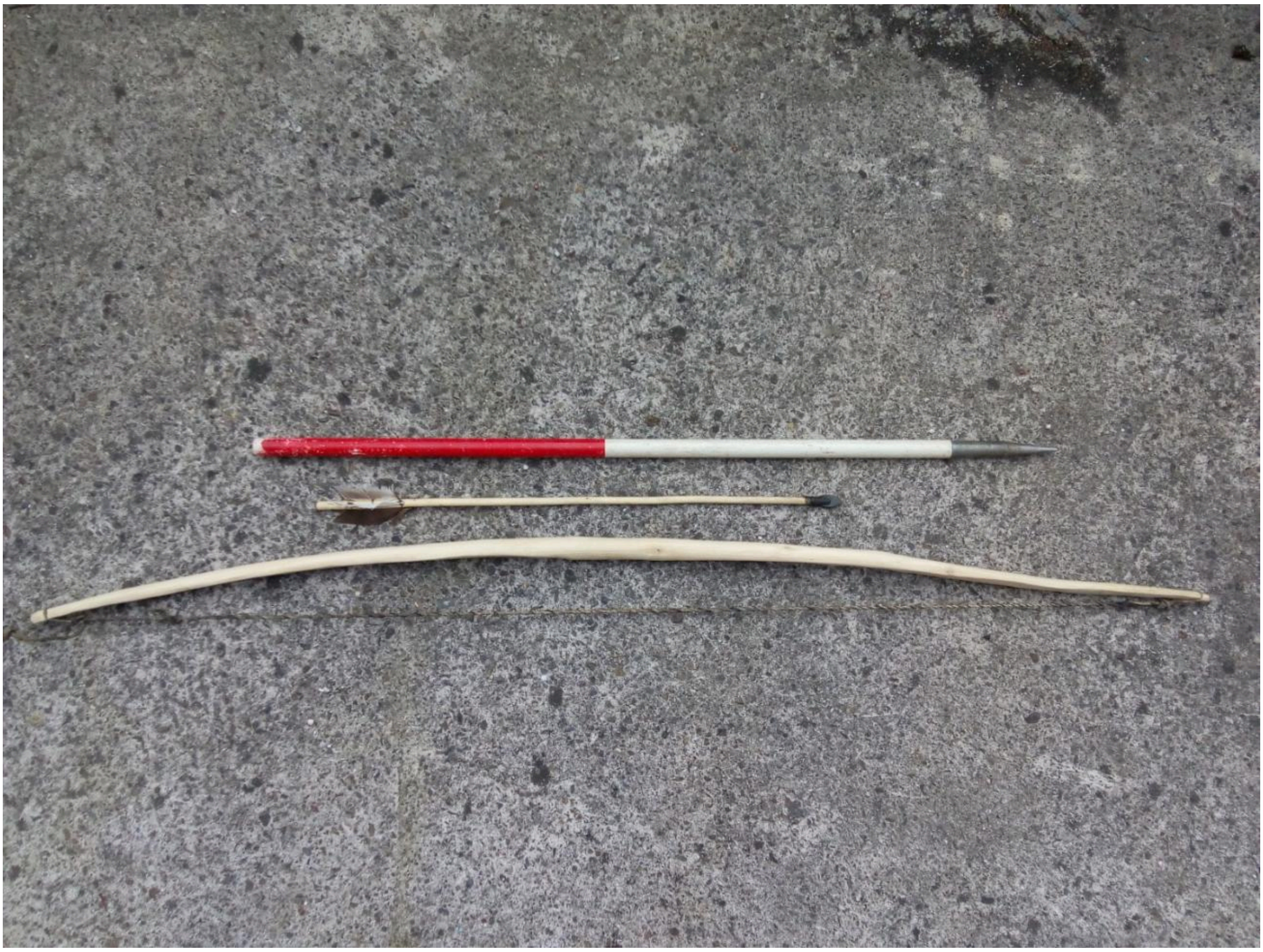

FIG 17. THE BOW AND ARROW WITH SCALE. PHOTO BY CHRIS WOODLAND

FIG 18. SANDING THE BOWSTAVE. PHOTO BY CHRIS WOODLAND

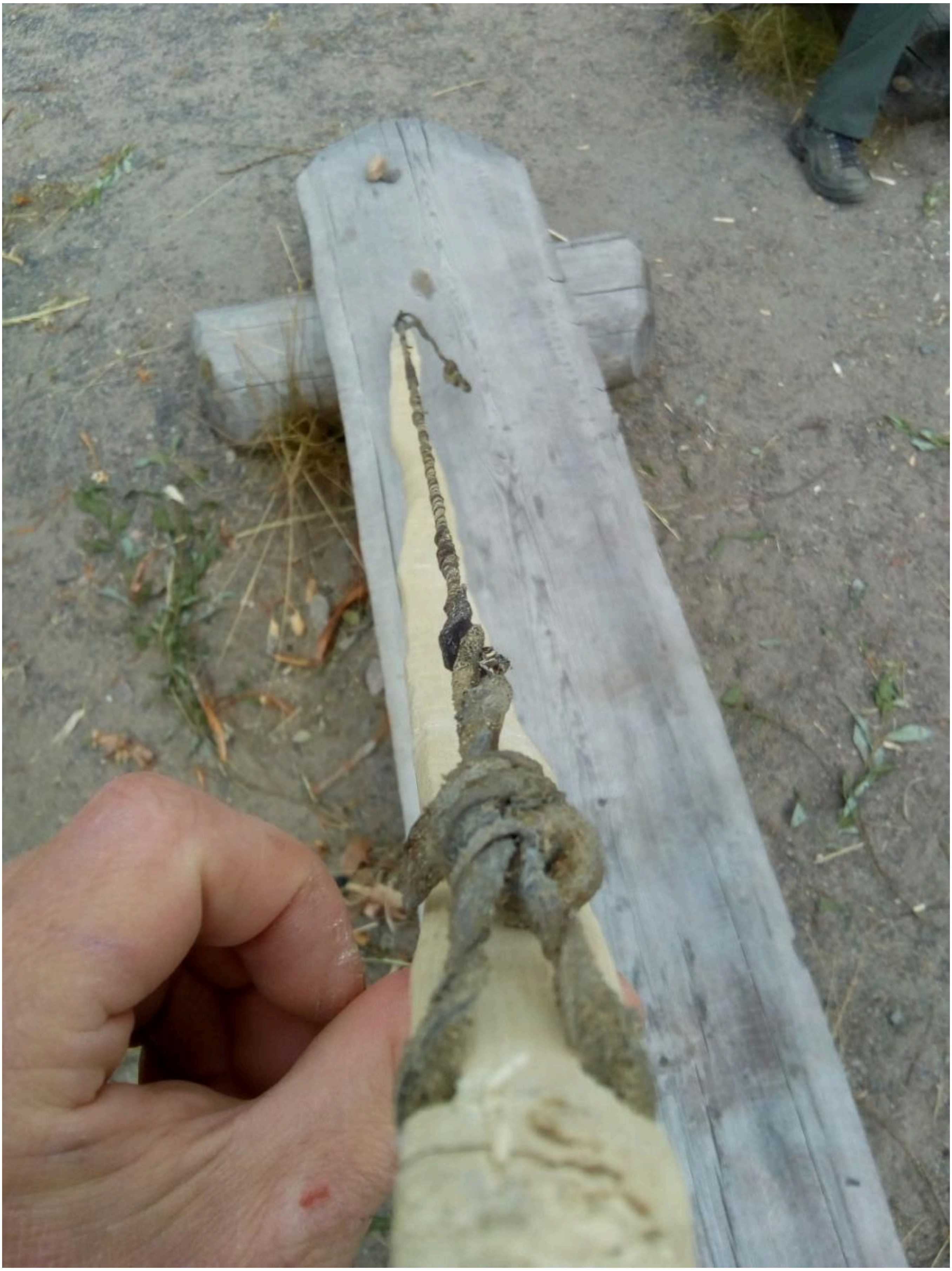

FIG 19. THE ELK RAWHIDE BOWSTRING. PHOTO BY CHRIS WOODLAND

FIG 20. CUTTING NOTCHES WITH A SERRATED FLINT BLADE. PHOTO BY CHRIS WOODLAND

FIG 21. AIMING THE BOW. PHOTO BY CHRIS WOODLAND

FIG 22. ¾ DRAW. PHOTO BY CHRIS WOODLAND

FIG 23. NEOLITHIC BOW IN THE WOODS. PHOTO BY CHRIS WOODLAND

FIG 24. TARGETS IN THE WOODS. PHOTO BY CHRIS WOODLAND