



Celia Elliott-Minty

Exploring the construction of a Bronze Age braided band from Dartmoor, UK

Abstract

During the excavation of a Bronze Age cremation on Dartmoor, Devon (UK), the remains of a braided band of cow hair with metallic studs were found. A study of the braid structure was made using magnified digital images. Braiding was carried out with tail hair from two heritage breeds of cattle, using construction methods considered the most appropriate, given the age of the braid. Comparison of both the practicalities of the braiding process and the resultant structures leads to a conclusion that loop manipulation was the most likely method of production of this artefact in the Bronze Age although free-end braiding remains a possibility.

Keywords: Bronze Age, band, cow hair, Dartmoor, fingerloop braiding, free-end braiding

Introduction

During the excavation of a Bronze Age cremation burial cist on Dartmoor, Devon (UK) in 2011, the incomplete remains of a braided band made of cow hair and adorned with metallic studs were found alongside other artefacts. The estimated date for the completion of the cist and incorporation of the material into it is 1730 to 1600 BCE (95% probability calculated primarily using OxCal), although the contents of the cist represent materials of different ages (Jones 2016, 237).

The cist contained the cremation including bone dated 1930 to 1740 BCE wrapped in a bear pelt dated 1740 to 1560 BCE. There was also a basketry container dated 1870 to 1620 BCE (all dates 95% probability). The cremated bone is earlier than the pelt and the basket, indicating that the cremation was not buried immediately. Inside the basketry container were beads of various materials (not dated but reported as a mixture of old and new components), four wooden studs (one dated 2210 to 1980 BCE), a textile and animal skin object (undated but described as being in very good condition) and the braided band (undated). Therefore, some of this assemblage may have predated the deceased person (Jones 2016, 222 & 237-238; Marshall 2016, 186-187).

The braided band was found lying within the exposed interior of the basketry container, in which it curved back on itself and formed an uneven and truncated oval shape (fig. 1) (Sheridan et al. 2016). It was a fragment about 185 mm long, one end of which finished in a bobble-like terminal that appeared to be complete whereas the other end was frayed. At its widest around the studs, the band was 4.5 mm wide, narrowing to 3 mm in between the studs. The band appeared to narrow at its frayed end, forming a



Fig. 1: The braided band *in situ* (fig. 14.1 in Sheridan et al. 2016) (Image: © and courtesy of Cornwall Archaeological Unit)



Fig. 2: Part of the original braid with the hairs colour-marked digitally using Paint Shop Pro ® software (Image: Celia Elliott-Minty after original © and courtesy of Plymouth City Museum & Art Gallery)



Fig. 3: The structure of the braid and positions of the studs represented by the small dots (Image: Celia Elliott-Minty)

natural point of weakness. There was no sign of any other surviving fragment. The studs, although much corroded, appeared to be dumbbell-shaped and were made of tin (Jones 2016; Sheridan et al. 2016).

The paired strands with which the band was constructed were identified by Caroline Solazzo (Smithsonian Institute, USA) as hair from the genus *Bos* - a type of cattle (Solazzo 2016). The length needed for the braid led to the conclusion that it is likely to have been made using tail hair. An individual hair from the braided band measured approximately 100 μm in diameter using variable pressure scanning electron microscopy (VP-SEM), while a pair of hairs had an overall width of 300 μm (measured with digital callipers) (Cartwright 2016, 269-270; Susanna Harris pers. comm. 2020).

Analysis of the braid

Susanna Harris, University of Glasgow, one of the archaeologists involved in the investigation of the

cist, invited the author to investigate the braid's structure and how it might have been made. A study was made using magnified digital images taken after conservation by Plymouth Museums (UK). An area near the 'bobble' end with five studs in situ and spaces where two studs are missing is shown in fig. 2.

Each pair of hairs was digitally marked on the image with a distinguishing colour and its track through the braid followed for at least one repeat of the pattern. This showed that the structure is a two by two twill (i.e. under two, over two) made by interlacing 13 pairs of hairs. The tin studs were inserted every four or five intersections (see fig. 3 in which the small dots represent the position of each stud).

The paired strands are evenly spaced from each other with no apparent interlacing errors. Each hair within a pair of strands stays parallel and they do not cross over each other, except perhaps occasionally (see arrows in fig. 4). This indicates that the method of construction

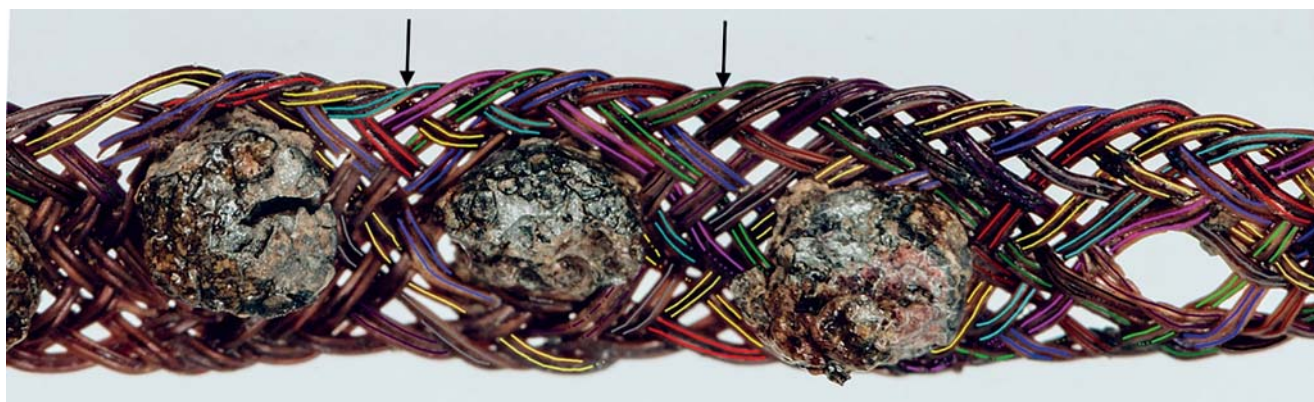


Fig. 4: Possible cross-over of individual hairs within a pair (Image: Celia Elliott-Minty after original © and courtesy of Plymouth City Museum & Art Gallery)



was one in which the paired strands were not able to readily twist around each other.

Possible braiding method

Interlaced braids such as this one can be made by more than one technique. Likewise, a single method of braiding can be used to create more than one type of structure. Therefore, one should be wary of assumptions about either structure or methodology.

The use of loop manipulation, a technique in which loops of yarn or other material are passed from finger to finger (or hand to hand) in a defined sequence, is a strong possibility for the making of this braid. It requires no equipment other than human hands, so evidence of this method is unlikely to survive from antiquity. The earliest known depiction of loop manipulation dates from a first century BCE bronze container from China, on which two of the decorative figures appear to be loop-braiding (Carey 2003). However, it is highly likely that it has been practised since long before this date. Two wool braids from the Hallstatt salt mine circa 700 BCE were very probably made this way (Grömer et al. 2015; Grömer and Rösel-Mautendorfer 2013, 570 & 573). By its very nature, loop braiding uses two strands, which may always be moved together, as in this braid. Alternatively, the loops may be manipulated in such a way that the two strands follow different paths in order to create a braid that is, in some cases, unique to loop braiding (Boutrup 2010, Speiser 1988).

Free-end braiding is also undoubtedly an ancient technique. The simplest forms (for example, the three-strand plait that is used to keep hair tidy) need no equipment. Plaiting with relatively rigid plant material such as straw can likewise be undertaken by just one pair of capable hands, but more flexible materials such as threads may require a different approach. As with loop braiding, the individual elements are best kept under an even tension. Over time, this has led to the development of equipment such as braiding with bobbins on a support, which helps to keep the threads tensioned and in order. A portable cushion, such as that still used in Oman, would leave no archaeological trace (for comparison, see British Museum, inventory number 2011,6003.51). The earliest depiction of braiding on a stand is in a French publication from the 18th Century (Diderot and Le Rond d'Alembert 1751-1772). Such a support is particularly useful when the material is slippery or otherwise difficult to work with. Any number of strands (elements) can be used per bobbin. Carey (2003) summarises the various types of equipment that are used across the world.

In an experiment to create a replica of the Dartmoor

braided band, Linda Hurcombe, University of Exeter, experimented with a method of free-end braiding that involved pinning pairs of horsehairs on a macramé board (Sheridan et al. 2016). Therefore, this particular approach was not studied further. Both loop manipulation and free-end braiding by another method were explored when trying to replicate this Bronze Age band.

Choice of hair

In the Middle Bronze Age, northern European mixed farming was based on cattle husbandry and cereal production, including the use of cattle for traction. Beef played a major role in Bronze Age diets and finds in the Netherlands and Denmark have shown that cattle contributed 75 to 80% of animal remains (Bartosiewicz 2013). The Early Bronze Age round barrows at Irthlingborough, Northamptonshire and Gayhurst, Buckinghamshire (UK) contained remarkably large quantities of cattle remains (*Bos taurus*) and a small number of skeletal elements from aurochs (*Bos primigenius*) (Towers et al. 2010). Across Europe there was increasing variability in Bronze Age horn shapes and body size, even in localised populations (Bartosiewicz 2013).

The Welsh Black breed of cattle is one of the oldest in Britain, having reportedly inhabited the hills of Wales since pre-Roman and pre-Christian times (Welsh Black Cattle Society). The majority of Welsh Blacks are horned (The Cattle Site). It has been speculated that the now extinct black cattle of Cornwall were a closely related breed to the Welsh Black.

Highland cattle originated in the Highlands and Western Isles of Scotland and were first mentioned in the sixth century CE. They have long horns and a double coat of hair - a downy undercoat and a long outercoat which may reach 33 cm, and which is well-oiled to shed rain and snow.

Samples from the tails of both of these breeds were obtained. The Welsh Black came from the bull "Llaneurgain Bolt" owned by Bridget Osborne in Conwy (UK). Highland cow hair came from a herd owned by Nigel and Tracy Bishton in Shropshire (UK). All of the hairs came directly from the animals. They were soaked in cool water to allow the dirt to float off, then rinsed several times, laid on a towel and allowed to dry naturally.

The Welsh Black tail hair was very dark brown, quite curly and formed locks. It had been cut from the bull while he was in a cattle crush for tuberculosis testing, and the lengths varied from 3 to 40 cm. Samples were wet-mounted in glycerine and examined by microscopy: the diameter of the main part of the hair



was 120 μm (range: 170 μm towards the root end, decreasing to 30 μm at the tip). The pigment appeared evenly spread throughout the hair, although lighter at the tip.

The Highland cow tail was very pale and slightly less curly. This hair had been collected after it was shed naturally: the hairs were between 30 and 50 cm long. The diameter of the main part of the hair was 110 μm (range: 160 μm near the root end, decreasing to 40 μm at the tip). Towards the root end, no pigment was evident. It appeared as scattered dots which spread out to the rest of the hair towards the tip end. With the naked eye, this appeared to be a darkening of the hair from virtually colourless to a pale brown. In comparison, an individual hair from the original braided band measured approximately 100 μm diameter (Cartwright 2016).

All microscopy was carried out on a Brunel SP75P light transmitting microscope. The measurements were made using an eyepiece graticule checked with a Bressler calibration slide. Eyepiece calibration at $\times 100$ ($\times 10$ eyepiece, $\times 10$ objective) could be taken as 100 μm per marked unit i.e. 10 μm per subdivision within about 1% accuracy.

Substitutes for the tin studs

In the original investigations, tin studs were expertly crafted to replicate the dumbbell shape that allowed them to sit securely within the band (Sheridan et al. 2016). Such expertise was not available for this reconstruction. For the initial experiments with horsehair (see below), moulded and baked Fimo® modelling clay was used as a substitute for the tin studs. Later, an improved alternative was developed by gluing pairs of galvanised glass seed beads onto a fine plastic rod, which fitted more securely into the braided hair. These 'studs' were 4.8 mm long, 2.9 mm wide at their widest and 2.3 mm wide at the narrowest point in the middle. This compares with the dimensions of the best-preserved original studs which were 4.1 mm long, 3 mm at their broadest and 2.2 mm at the narrowest point of their waist (Sheridan et al 2016, 76).

Braiding trials

Loop manipulation

Fingerloop braiding was initially trialled using horsehair. Hairs were paired up in the same orientation (i.e. butt ends together) and knotted at both ends to give a defined length. It was best to avoid using the very tip of the hairs because they tended to snap at the knot. It is standard practice amongst makers of hair jewellery to orientate the hairs in the same direction and begin braiding at the root ends (Sparr 2016). Because the hair in the original band was examined only through small samples, the researchers were unable to ascertain whether the hairs were all orientated one way (Susanna Harris pers. comm. 2020). However, the narrowing of the original artefact at one end suggests that the hairs may have been orientated in the same direction.

Once prepared, 11 pairs were tied together securely with thread at the butt ends for the earlier experiments although this was increased to 13 pairs for later experiments. An overhand knot was made as close as possible to this tie. A loop of strong thread was attached just above the overhand knot and the other end of the loop secured to a clamp for loop manipulation.

Holding the hair loops directly on the fingers did not work because they sprang off. This was solved by tying loops ('handles') of nettle yarn into the horsehair loops and looping these onto the fingers. Nettle was chosen because some of the woven fabric surviving in the cist was identified as being made from spun nettle fibre.

The two by two twill could be achieved with a sequence of simple transfers between the right and left hands. The equal movement of elements across both hands produced a V-shaped fell (so called because the strands that have been braided form a V-shape) into which a stud would fit neatly, although it was not possible for the lone braider to insert one without assistance.

Various treatments were applied to the horsehair in an attempt to make it less springy. Initially, each hair was

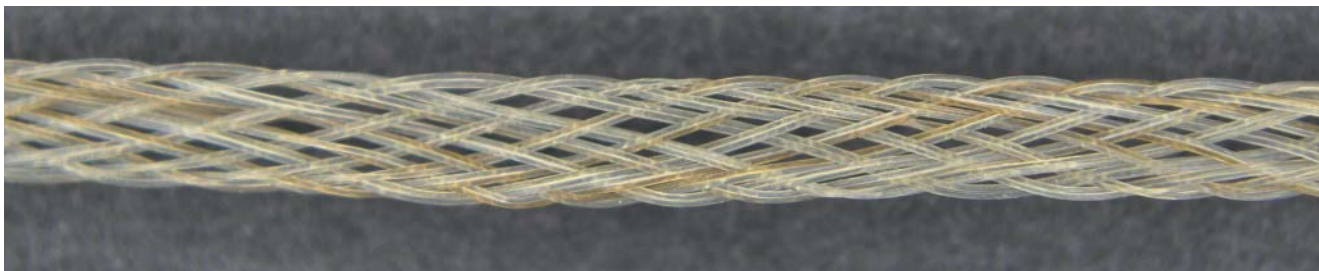


Fig. 5: Braid worked with Highland cow hair, single person loop manipulation (Image: Celia Elliott-Minty)

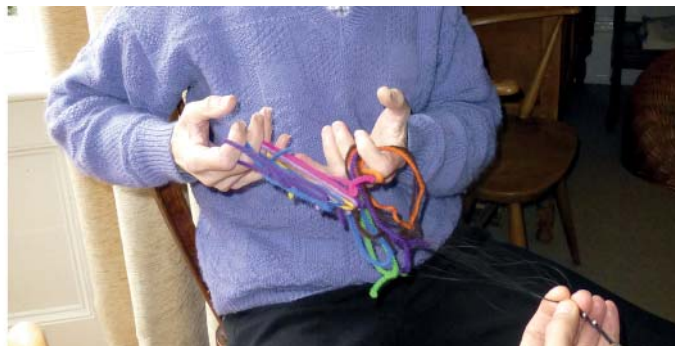


Fig. 6: A general view of loop manipulation of Welsh Black hair by Jacqui Carey (left) and Celia Elliot-Minty (right) with detail of the loop manipulation (Image: Jacqui Carey)

drawn across a block of beeswax to thoroughly coat it before braiding. This helped a little but not enough for the method to be pursued. Another treatment tested was to soak the horsehair in tap water or human urine for a week, then rinse it in tap water before braiding. There was no obvious difference in the way the hair behaved. This was not unexpected since hair is water resistant and dries quickly.

The Highland cow hair was set up for finger loop braiding as for horsehair with nettle 'handles'. When fingerloop braided, the paired hairs stayed together very well and the resulting braid was smooth and slightly flexible (fig. 5). It was 3 mm wide. Providing that the 'handles' were transferred between fingers correctly, the hairs within a pair stayed parallel without twisting.

In fact, the braid was so smooth and fine that the studs would not stay in place. The structure was also considerably more open than the original, indicating that it had not been held under sufficient tension during the making process.

This fingerloop method with just one manipulator was also attempted with the Welsh Black hair but the tip ends of the hairs were too weak to withstand the tension.

When just one person (the manipulator) is making a fingerlooped braid, the density of the resulting braid is highly dependent upon the type of material being used. If the braider is working with wool, for example, the scaly surface structure of the fibres will stop them from sliding past each other and the plaited strands will stay in position. Plant-derived fibres such as hemp or cotton are smoother but are still rough enough to stay in place. Horse and cow hair, however, are very smooth and there is no resistance to movement, so they slip past each other and the braid becomes very open.

However, input from a second person (the helper) can solve this problem by tightening the braided section

as the work progresses. This also reduces the tension that has to be applied to the looped ends, which was observed to be a point of weakness especially when working with cow hair. For this prehistoric braid, the helper would also have served a second function, that of slipping a stud into the appropriate place as the braid grew, which a single loop braider would not have been able to do.

A subsequent group of experiments was carried out with the help of Jacqui Carey, a very experienced braider who acted as the tensioner and stud placer. A total of 26 lengths of Welsh Black tail hair were prepared in a similar way to earlier experiments to give 13 loops of hair. A 'handle' of coloured yarn was then threaded through each of the loops. The whole assemblage was carefully positioned by Jacqui Carey and the author, who sat facing each other with the hair loops stretched between them (fig. 6).

While manipulating the loops, Jacqui Carey held the grouped hairs firmly and moved the hair into place after each pass. Periodically, Jacqui Carey slipped a stud into place behind the foremost crossed hairs, as shown in fig. 7. Initially, Jacqui Carey released the braided hairs somewhat every time a pass was made, but this gave a rather open structure and did not hold



Fig. 7: Stud being incorporated into the braid (Image: Jacqui Carey)



Fig. 8: The result of tighter tensioning of the braid after the second stud was inserted. Braid was worked from right to left in this image (Image: Celia Elliott-Minty)

the latest stud securely. Therefore, after the second stud, Jacqui Carey held the braid more firmly and slid each new hair into place without releasing tension, although adding a stud did create some slippage. This revised method resulted in a much firmer band (fig. 8). The band was 2.5 mm wide before the studs were added, after which it increased to between 3 and 3.5 mm wide between the studs and 4 to 4.5 mm wide at the studs. Studs were added at different intervals, generally every four to five intersections. As might be expected, the closer the studs, the more open the structure became because the hairs had to pass around the stud.

As with the single person loop manipulation, the

hairs stayed parallel without twisting as long as the 'handles' were transferred correctly. In summary, loop manipulation could have been employed to create this braid but would have required cooperation between a manipulator and a helper.

Free-end braiding

Attempts to free-end braid with the hair held under only light tension produced a structure that was considerably looser than the original (details not included here). Free-end braiding was therefore explored further using a system of weighted bobbins (each 26 g) held in place over a braiding stand. It is questionable whether Bronze Age inhabitants



Fig. 9: General view of Welsh Black hair being braided on a stand (Image: Celia Elliott-Minty)



Fig. 10: Close up of Welsh Black hair being braided on a stand (Image: Celia Elliott-Minty)



Fig. 11: The entire length made on the braiding stand and finished with a loop at one end (Image: Celia Elliott-Minty)

of Europe had access to such technology, although groups of spools have been found in Austria, Switzerland and northern Italy. These date from the Late Bronze Age onwards and have been interpreted as most likely used for storing yarn or as weights for threads in tablet weaving (Gleba 2007). Even older finds (circa 3500 BCE) are Late Neolithic spools from Austria (Grömer 2018, fig 11.1).

For the experiment, a modern braiding stand was used to demonstrate the technique. Pairs of hairs were prepared as for loop manipulation, then each pair was attached to a weight with fine, strong, thread. At the



Fig. 12: Comparison of three experimental braids with the original braid: a: Single-person loop manipulation, Highland Cow hair; b: Two-person loop manipulation, Welsh Black hair; c: Stand and bobbins, Welsh Black hair; d: Part of the original braid with the hairs colour-marked digitally. The original braid is 3 mm wide, so this was used as the unit length with which to compare the frequency of intersections (see double-headed arrows) (Image: Celia Elliott-Minty after original © and courtesy of Plymouth City Museum & Art Gallery)

far end, the whole group of hairs was secured to the roller on the stand (fig. 9 and fig. 10). Because the hairs were held under tension by the weighted bobbins, the hands were free to add the studs into the braid as the work progressed. The hairs were tensioned further after every move by pulling them with the fingers at the point of braiding (not via the bobbins because the hairs were liable to snap at the knots). Although in general the hairs behaved well during the braiding process, one had to be careful not to let the pairs twist. The resulting braid was 3.5 to 4 mm wide between the studs and 4 to 4.5 mm wide at the studs, and 320 mm long (fig. 11).



Fig. 13: Comparison of two-person loop manipulation (top) and stand/bobbin braids (bottom) when viewed from above (Image: Celia Elliott-Minty)



Fig. 14: Comparison of two-person loop manipulation (top) and stand/bobbin braids (bottom) when viewed from the side (Image: Celia Elliott-Minty)

Comparison between loop manipulation and free-end braiding

The braids created by these experimental methods were compared with the digital image of the original braid (fig. 12). Highland cow hair braided by single person loop manipulation (fig. 12a) was 3 mm wide and achieved 1.5 intersections per 3 mm; Welsh Black by loop manipulation using two people achieved 4 intersections per 3 mm between the studs (fig. 12b); braiding on the stand (fig. 12c) achieved 5 intersections per 4 mm between the studs, while the original braid (fig. 12d) had 5 intersections when measured outside the studs. Thus, the two-person loop manipulation and the stand-braided braids are closer to the original than are the braids made by the single person loop manipulation.

The appearance of the braids created by loop manipulation using two people and the stand/bobbin technique differs markedly (fig. 13 and fig. 14), particularly so when the braids are examined from the edge. The stand/bobbin braid is almost flat and relatively featureless whereas the one created with loops is more three-dimensional and has a prominent curl at the edges. This is probably due to the hair being stretched when weighted by a bobbin. Overall, the loop-created braid is visually more like the original as it is now, an impression confirmed by Susannah Harris who has worked closely on the original (pers. comm. 2018). In addition, pairs of hairs are more likely to stay parallel without twisting using loop manipulation compared with the bobbin method.

Conclusions

The experiments described here have shown that it is likely that this Bronze Age braid was made by loop manipulation although free-end braiding remains a possibility. Due to the springiness of hair, the result achieved with loop manipulation by a single person technique was inferior to the original. It was considerably improved by a helper who provided better tension and was also able to place the studs in the braid as it progressed.

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