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Iron Age Finger-Loop Braiding

Finds from the Hallstatt Salt Mine

Introduction

The salt mine at Hallstatt in Austria is known for its rich organic finds from the middle Bronze (1600-1200 BC) and early Iron Age (Hallstatt Period, *c.* 800-400 BC), including wood, fur, leather, tree bast and textiles. It has been explored archaeologically by the Prehistoric Department of the Natural History Museum in Vienna (Reschreiter 2005; Kern *et al.* 2009), under the direction of Fritz-Eckart Barth in the years 1960-2000 and Hans Reschreiter since 2001. The textile finds (Grömer *et al.* 2013) are mainly products in different weaving patterns made on the warp-weighted loom (tabby, basket weave, twill variants), and of band looms (tabby rep ribbons and tablet weaving) decorated in different patterns with natural-shade and dyed yarns. With the help of dye analysis methods (chromatography), experts were able to confirm that complex dyeing techniques such as vat and mordant dyeing were known as far back as the Bronze Age and the Hallstatt period. Woad has been identified as a blue dye at Hallstatt, as well as weld and scentless chamomile for yellow and hedge bedstraw and dyer's madder for red. The fabrics from the salt mines are mainly made from wool, and some are of extraordinarily fine quality. Hallstatt presents a unique situation, and the textiles found there allow us to study in detail the development of textile technology in the period from 1500 to 400 BC.

Among the narrow fabrics there are two fragments which were made using braiding techniques (HallTex 301: Inv.Nr. 73.399 and HallTex 306: Inv.Nr. 75.936). In the present article, the focus will be on those braids because they represent a technique which had not previously been found at Hallstatt. We will discuss different braiding techniques and explore the possibility of tracing the fragments back to an early version of loop braiding. The bands in question were found during archaeological excavations in 1961 and

Fig. 1. HallTex 301 (below) and 306 (above): Braided bands from the Hallstatt salt mine, early Iron Age (Photo: Sebastian Becker, © NHM Wien).

1966 by Fritz-Eckart Barth in the early Iron Age part of the Hallstatt salt mine (Fig. 1). The braided fragments were found in the *Kilbwerk* (excavation reports: Barth 1969 and 1974) but in a part called *verlaugtes Heidengebirge*, meaning prehistoric layers that were disturbed during salt extraction in early modern and recent times. The prehistoric origin of the textiles in question was thus unclear going by the archaeological context, as prehistoric as well as modern items could be found in this part of the mine. Additionally, the appearance of the bands is similar to modern shoelaces still used in the Salzkammergut region of Austria, and no comparable finds were known from the Iron Age in Central Europe at the date of the excavation. So the items were considered modern intrusions in the disturbed area of the mine; a scientific analysis has been neglected till now.

^{14}C dating carried out within the *DressID* EU project yielded the surprising result that the braids are of Iron Age origin (Fig. 2). The radiocarbon dating showed a range of dates from 800 to 500 BC, and after calibration the age spans a period of ca. 340 years between 756 and 414 cal BC (van Strydonck and Grömer 2013, 191).

Technical description

HallTex 301 (Fig. 3-4)

HallTex 301 (Inv.Nr. 73.399) is the longer of both pieces of band. It is torn at both ends, but the width is complete. The remaining length is 14.5 cm with a width of 1 to 1.1 cm in the more compact part. It is braided from 15 ends. The colour sequence is one dark (blue or black) followed by one red, repeated four times, then seven green-bluish ends. The seven bluish-green ends might originally have been four green-blue and three greenish ends, but the colours are now not different enough to tell for sure. Most of the ends consist of two single yarns running double as a pair. Only two of the dark ends are made of a pair of plied yarns. The two threads in each pair lie completely parallel to each other, without crossovers. This suggests in our opinion that the band was made in a loop-braiding technique.

Characteristics of the threads:

- *red*: 0.8 mm z-twist single yarn, wool
- *dark blue:* 0.8-0.9 mm Sz-twist two-ply yarn, wool (2 pairs of threads)
- *green-blue:* 0.9 mm z-twist single yarn, wool (2 pairs of threads)
- *green*: 0.6-1.1 mm s-twist single yarn, wool.

The green threads are the most irregular in thickness; on average, they are about 0.9 mm in diameter.

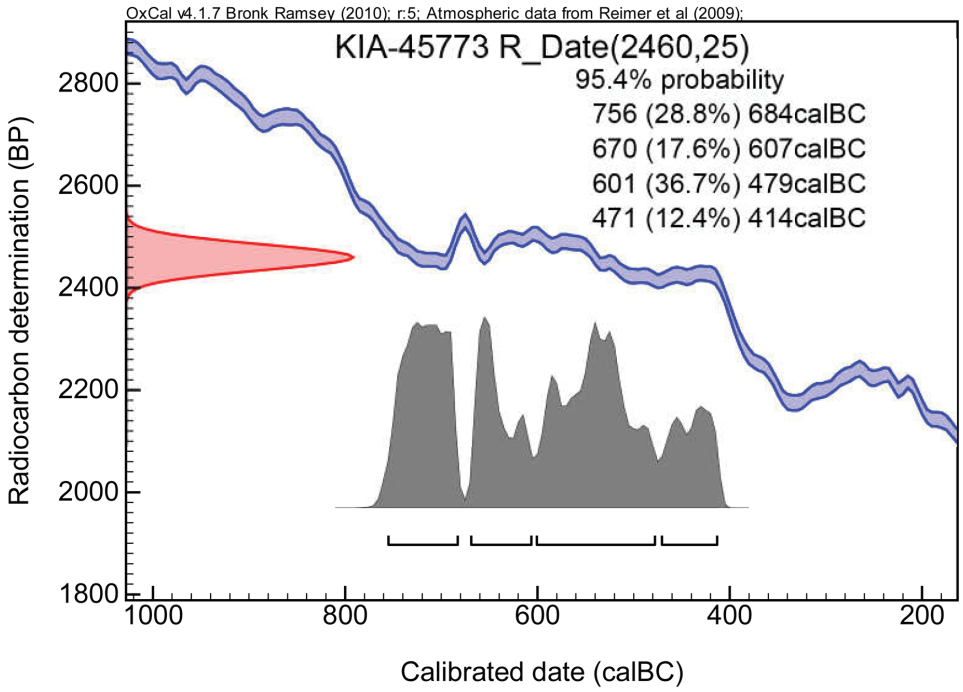

Fig. 2. ^{14}C-dating of braid HallTex 301 (Graph: Mark von Strydonck, © KIK/IRPA Brussels).

Fig. 3. HallTex 301: a) structure of the band; b) microscope image of the plied dark thread; c) detail of the reddish yarn, DinoLite Digital Microscope 250x (Photos: a) Sebastian Becker, b)-c) Karina Grömer, © NHM Wien).

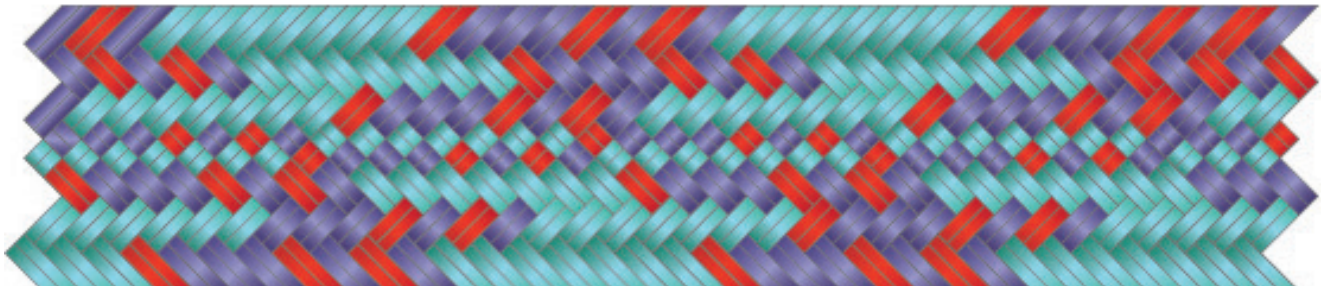

Fig. 4. Schematic image of the braided band HallTex 301 (Drawing: Joy Boutrup).

Fig. 5. HallTex 306: a) structure of the band; b) details; c) microscope image of the green thread; d) detail of the reddish yarn, DinoLite Digital Microscope 250x (Photos: a) Andreas Rausch; b)-d) Karina Grömer, © NHM Wien).

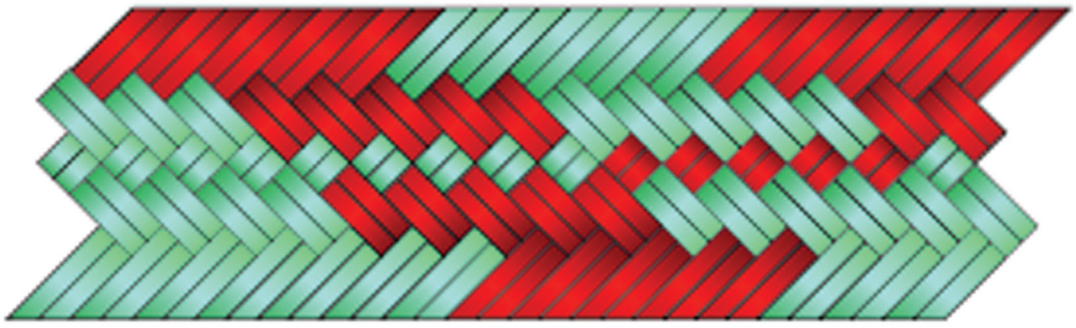

Fig. 6. Schematic drawing of the braided band HallTex 306 (Drawing: Joy Boutrup).

The microscope images show that the fibre material was carefully prepared (Fig. 3b-c): the fibres lie parallel to each other in the yarn, indicating that the wool was combed. The threads were spun with a high twist, resulting in high-quality, smooth, resilient threads. This kind of fibre preparation and spinning is very similar to other textile finds from early Iron Age Hallstatt (Rast-Eicher 2013, Fig. 60).

HallTex 306 (Fig. 5-6)

HallTex 306 (Inv.Nr. 75.936) is also a braided band, but significantly narrower than HallTex 301 and more damaged. The band is tied into a knot that is positioned close to the middle of the piece. The preserved length is 6.5 cm, the width is 0.6-0.8 cm. The band is braided from 10 ends, each consisting of a pair of yarns. The colour sequence of the ends is five green, five red. The ends are braided according to the following pattern (Fig. 6): under two ends, over two ends, under one, over two, under two.

Characteristics of the threads:

- *red*: 0.6-0.7 mm z-twist single yarn, wool
- *green*: 0.4-0.6 mm z-twist single yarn, wool

The fact that the two threads in each pair of yarn, in both bands, always run parallel to each other without crossovers may indicate that the band was made in a loop-braiding technique.

Braiding technique of the bands

As with many textile techniques, the end product does not always allow a detailed reconstruction of the technique employed. Just as different loom constructions can be used to weave a fabric with the same characteristics, several different braiding methods could have been used to braid the bands HallTex 301 and HallTex 306.

The patterns in both bands can be described as follows: the middle of the band appears to be braided in a basket weave-like braid, as the active end goes over one under one. The pattern on the sides are more reminiscent of a twill, going over two and under two ends. This change in the braiding pattern also results in a structural change, it might be part of the intended overall design of the bands. Though the narrower band also shows this, it is most clearly visible in the wider band HallTex 301. Both bands were probably made using a similar technique, with patterning achieved by using yarn in several different colours. Making bands like this is possible both with single ends and with loops using a loop-braiding technique. This is made by letting the fingers hold the individual loops, and then braiding by shifting them between the fingers, either by pulling them through the loops or just over and under in a weaving-like movement. Interestingly, the pairs of threads making up the individual ends lie very parallel to each other and do not cross over within the band. The bands do not correspond to the typical 'recipes' (descriptions) for loop-braiding (Speiser 2000, 20-21), where the threads are crossed by passing loops through each other. The odd number of ends and the two threads making up each end indicate that most probably a different technique was used – though this typical loop-braiding method cannot be excluded completely.

A slightly different loop-braiding technique uses both legs of one loop as one end. This technique is described in the Tollemache manuscript, dated to the 15th century (Tollemache 1997, fol. 41 v):

[62] A lace broad party of 7 bows not according to the broad lace of 7 bows parti a forseyd. Take 7 bows of 2 colours & thett 4 of one colour over A B C D left & 3 over another colour on B C D right. Then shall A right take the bow of D left reversed upward then low the left bows then shall A left take the bow of D right reversed upward & then begin again.

To make a band like HallTex 301 using the technique from the Tollemache manuscript, two people must work together to braid fifteen loops in the following way:

Person 1 holds four loops on the left hand (L1 a,b,c,d) and three loops on the right hand (R1 b,c,d). Person 2 holds four loops on both hands (L2 a,b,c,d, R2 a,b,c,d).

R1 goes with the index finger over one, under two and over one of the loops on L2, grasping the loop on L2d (the little finger loop); the loops on R2 are moved one finger downward to free the index finger R2a.

R2 goes with the index finger over two and under one loop on the same hand and takes the loop from L2d; the loops on L2 are moved one finger downward to free the index finger L2a.

L2 goes with the index finger over one, under two and over one loop on R1 and takes the loop from L1d; the loops on L1 are moved one finger downward to free the index finger L1a.

L1 goes with the index finger over two and under one loop on the same hand and takes the loop from R1d; the loops on R1 are moved one finger downward to free the index finger R1a.

In contrast, braiding the band using free ends (Fig. 7) can be done by one person on their own. One hand holds eight, the other hand seven pairs of threads (ends). The hand with eight ends takes the outermost end over two, under two, over two and under one end; the end then moves to the other hand.

Tests of the two different methods for braiding bands

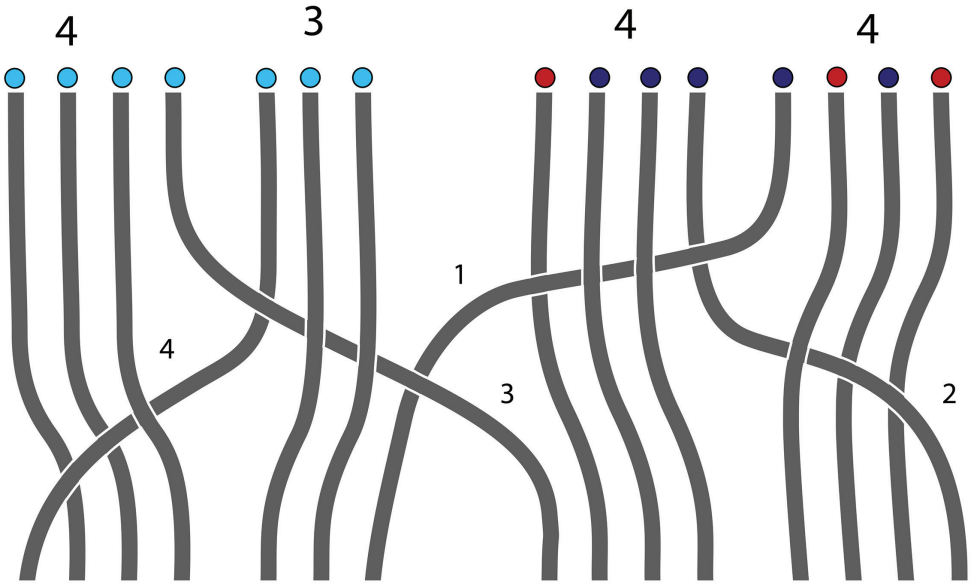

Fig. 7. Schematic drawing for free-end braiding of HallTex 301 (Drawing: Joy Boutrup).

like those at Hallstatt have shown that there is almost no discernible difference for a short piece of braid done with loop-braiding or with free-end braiding. However, the fact that the pairs that make up the ends always run parallel speaks in favour of the loop braiding-method as they would more easily cross if made with free ends. The way the ends turn at the edge of the braid also suggest this method, as does the fact that when using the free-end method the pattern becomes more open in the middle than in the original bands.

Braiding in European prehistory

A wide range of textile production methods – including braiding techniques usually employed for mats and basketry – are known from the Stone Age (*e.g.* Medard 2010, 95-101). Braided borders on woven textiles are also known from Bronze Age Central Europe (*e.g.* Hallstatt or Mitterberg: Grömer 2015, Fig. 67), as well as northern Europe (Broholm and Hald 1940, 73-78). These tightly-plaited borders are a means of reinforcing a fabric edge.

Braiding with three or four ends was also used to create fringes to finish woven textiles after they were taken off the loom (*e.g.* Stone Age: Lüscherz: Médard 2010, Fig. 101d; Iron Age: cloaks of Hunteburg and Thorsberg: Schlabow 1976, fig. 71, 117, 120). However, as we have seen, plaiting was also used to produce narrow bands in parallel with different band-weaving techniques such as tabby rep and tablet weaving which is well-represented in Hallstatt. In contrast to the weaving techniques, plaited bands have no warp and weft, only one thread system. The threads run at an angle to the longitudinal edges. Separately-made plaited bands, but sewn on woven fabrics, could be identified on the so-called 'Rieserferner leggings' (Bazzanella *et al.* 2005, fig. 6). They were found together with woollen socks and remnants of leather shoes at the Vedretta di Ries glacier (Rieserferner Gletscher) on the border between Italy and Austria. The ensemble dates to the period from the 8th to the 6th centuries BC. The two pairs of leg warmers were sewn from bigger pieces of twill fabric. A rectangular piece of cloth was sewn to form a tube. On the left 'under-legging' a plaited ribbon was inserted vertically along one of the seams – maybe to make the tube more elastic. The lateral plaited ribbon was made of 12 double interlaced threads and is 1.5 cm wide. It is sewn together from two pieces, which differ in colour: one is of grey wool and the other of natural brown wool.

Comparative finds of finger-loop braided bands

In contrast to the method of braiding with loops, as known, for example, from medieval London (Boutrup 2010; Crowfoot *et al.* 2006, Fig. 107), there is only scant evidence for the braiding technique with loops described above, using both legs of one loop as one end. A description of how to make a band using this technique is preserved in the Tollemache Manuscript, dated to the 15th century, as presented above. Some other braided pieces from late medieval Germany and Sweden were also made using this technique;

furthermore, it is widely known in Greece and South America (J. Boutrup, unpublished observations).
Bands braided using a similar technique have survived in different contexts. Such a piece, flat and braided with double yarn, was used for instance for a reliquary at the cathedral treasury of Halberstadt in the 14th century AD (Stiftung Dom und Schlösser in Sachsen Anhalt, Reliquienbörse Nr. 57A; J. Boutrup unpublished research). The Royal Armoury in Stockholm also houses a horse harness that was made using this technique in 1673 in France (Livrustkammaren Stockholm, Object number 8876; J. Boutrup, 'New insight into loop braiding', Lecture *CIETA* conference, Brussels 2009). In the Danish National Archives, Copenhagen, a wedding contract from 1590 between Princess Anne of Denmark and King James VI of Scotland also has five seal strings made with this special type of loop braiding (J. Boutrup 2008, 14).

Conclusion
The braided bands from Hallstatt might have been made using the finger-loop braiding technique. It is often not possible to say with any certainty whether a braided band was made using free ends or a loop-braiding technique without tell-tale mistakes. Some details, such as the parallel position of the single threads making up an end, suggest the use of a loop-braiding technique. In some cases, loop-braiding can be clearly identified by characteristic mistakes, but this is more often the case in the loop-braiding techniques where loops are passed through each other. Whether made with single ends or with loops, the bands from Hallstatt are a fine indication of how much variety can be found in the production of textiles in the Iron Age, including braiding techniques. The long duration of their use – starting in the Iron Age at the latest and going at least until the 17th century (*e.g.* on the Faroe Islands: Hald 1975) – and their wide geographical spread not only within Europe, but even beyond, are truly remarkable. Loss of knowledge of craft techniques in our western European cultural context, brought on by industrialisation, can lead to misinterpretations of finds made using methods such as the loop-braiding technique presented here. Those misinterpretations include wrong assumptions about the age of textile finds. In the case of HallTex 301 and HallTex 306, a radiocarbon dating showed the true age of the textiles and helped us to gain better, more accurate knowledge of the achievements of textile producers in the Iron Age.

Acknowledgements
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