

Karina Grömer, Silvia Ungerechts and Hans Reschreiter

## Knowledge sharing: a newly found 2,700-year-old tablet-woven band from Hallstatt, Austria

### Introduction

Currently, more than 70 fabrics with twined structures consistent with tablet weaving are known from the first millennium BCE in central Europe (Saunderson 2020). Some have been woven as separate decorative bands, others as starting borders on larger fabrics. The colourful bands found in the Hallstatt and Dürrnberg salt mines in Austria are well known (Grömer et al. 2013; Grömer and Stöllner 2011). More than 20 tablet-woven items have been excavated in total from both sites. The new artefact presented here comes from the salt mine at Hallstatt.

Tablet-woven bands are also known from grave contexts, where they are usually mineralised and only rarely has any information on colour been available. The most prominent ensemble of tablet-woven artefacts is Eberdingen-Hochdorf (Banck-Burgess 1999; Ræder Knudsen 1999) with more than 20 different tablet-woven fabrics in various positions, e.g. providing a decorative border on one of the tapestries hung on the wall of the chamber and on the gorgeous large cloth hung over the cauldron. Other examples are known from graves in Hohmichele or Glauberg in Germany (Banck-Burgess 1999; Peek 2018), in Altrier, Luxembourg (Rast-Eicher; Vanden Berghe 2015), Apremont and Mardie in France (in Banck-Burgess 1999). Tablet-weaving comes from several sites in Italy, such as the finds in Sante Paloma and Sasso di Furbara (Gleba 2014) as well as Verucchio (Ræder Knudsen 2012). Some of the tablet-woven bands also reveal patterns, such as identifiable significant changes in structure. Some tablet-woven fabrics may have been monochrome with a strict linear cord design.

The discussion and presentation of the newly found

tablet-woven band from Hallstatt may inspire weavers, makers, and creators to share their ideas on this ancient handicraft, and how the structure and design of this band was made in addition to their own creative works with tablet weaving using the motifs.

### Citizen science in textile archaeology at the Natural History Museum Vienna

Some elements of a citizen science approach such as including the broader public in reproducing and understanding archaeological artefacts has long roots in textile archaeology. As long ago as the early NESAT conferences in the 1980s (for example, Bender Jørgensen and Tidow 1982), active cooperation between handweavers and archaeologists was welcome and resulted in fruitful discussions. The World Wide Web has added impetus here, as information on archaeological artefacts is more easily available and enthusiasts for ancient handicrafts can be reached across the globe. Formal citizen science projects in historical textile techniques such as *Knitting in Early Modern Europe* (KEME) (Malcolm-Davies and Mearns 2018) or *Spiral Textiles: Ancient Textiles – Modern Hands* have involved people in scientific processes and the recreation of artefacts, thus gaining a better understanding of the details of their production. For the Hallstatt textiles, the dynamics of interactions between the scientists providing information and the worldwide community of handweavers, makers, reenactors, and artists have been studied (Grömer 2017). It was interesting to see what people are actually doing with the knowledge about artefacts and their production techniques and even how they sometimes integrate recreated objects into their daily lives or make businesses out of them.

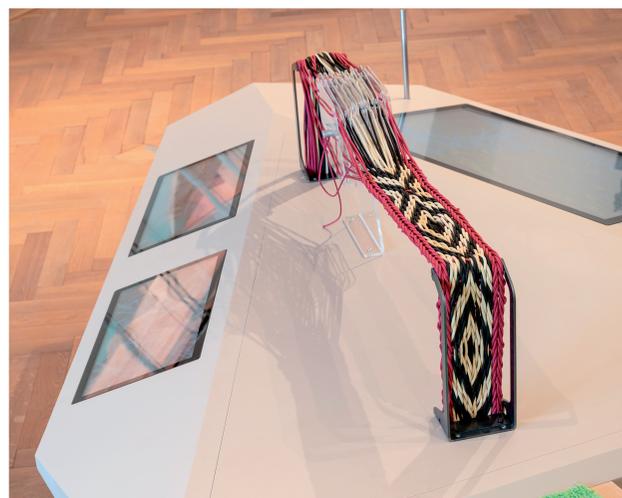


Fig. 1: Natural History Museum Vienna, Citizen Science presentation on “Ancient Weaving” on Deck 50 (Image: Chr. Rittmannsberger, NHM Vienna)

The Natural History Museum Vienna set up a space to share and co-create information called “Deck 50” where people were invited to become involved in scientific research (fig. 1). One of the installations is on “Ancient Weaving”. It includes an enlarged tablet-weaving loom, monitors with background information, and a range of interactive tools as a good example of how Iron Age designs and techniques inspire people. Citizen scientists are invited to take an active part in research on tablet-woven bands by joining “(craft) knowledge of the global crowd” at a physical weaving sit-in or through posts on the internet (via Pinterest and Instagram #tabletweavehallstatt). In this way, some research questions can be solved, such as how certain textiles may have been produced, how

much time was required for them, and the degree of difficulty of certain pieces compared to other designs. Ultimately, all of this adds valuable information about the importance of textile handicrafts for economic, technical, and social history. In the case of the new tablet-woven band, ideas on the interpretation of the patterns are welcome: are they symbolic content or trial-and-error effects in creative design?

### The context of the band: Hallstatt salt mine

The Hallstatt salt mine offers a significant insight into the world of life and work in the Bronze and Iron Ages in Central Europe. Three themes in the interdisciplinary research on Hallstatt are 1) the work processes in the salt mine, 2) the interaction between

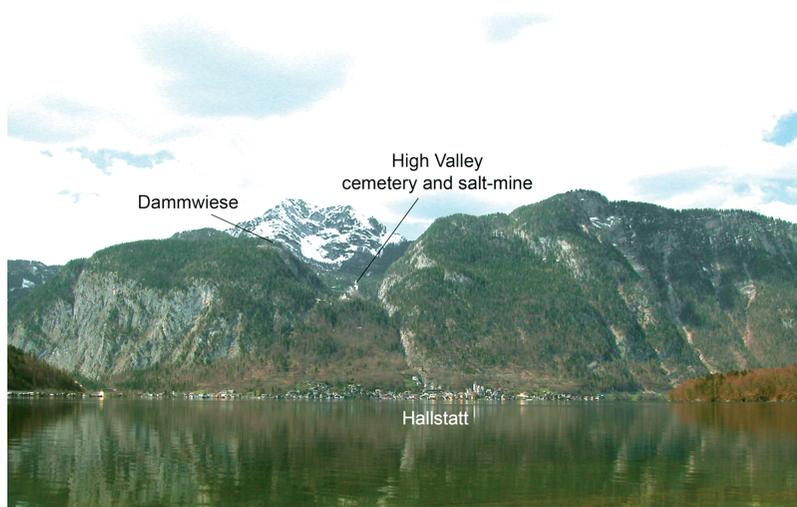


Fig. 2: Find context for the tablet-woven band (inventory number 126520): Hallstatt salt mine – Kilbwerk site and shaft renovation work (Images: D. Brandner, NHM Vienna)



Fig. 3: Tablet-woven band (inventory number PA NHM Vienna 126520) from Hallstatt/Kilbwerk site, excavated in 2019, front and reverse (Image: A. Schumacher, NHM Vienna)

the people and the landscape around it (Kowarik 2020; Reschreiter 2018), and 3) detailed studies of various material groups such as the textiles (Grömer et al. 2013).

Archaeological excavations have been carried out in the mine by the Department of Prehistory at the Natural History Museum Vienna since the 1960s and are still active in some parts of the salt mine. During the excavation season winter 2018/2019, a new tablet-woven band was discovered at the Kilbwerk site during renovation of the mining shafts to ensure the permanent protection of the most important sites in the mine (fig. 2). The Kilbwerk site represents part of a huge early Iron Age mining chamber with a length of approximately 300 m, a width up to 30 m, and a known height of 20 m (Barth and Reschreiter 2019, 36). The prehistoric mining at the Kilbwerk site was active from the period between the middle of the eighth and seventh centuries BCE. It was then interrupted by a huge landslide and some miners were buried during it. One of them was discovered by chance in the year 1734 during mining work at Kilbwerk and became famous as the “man in salt” (Barth 1989; Reschreiter 2020).

The textiles from the Hallstatt salt mine are well known (Grömer et al. 2013) and have repeatedly been the subject of detailed scientific work; for example, on conservation (Gengler 2005; Morelli 2005), dye analysis (Hofmann-de Keijzer et al. 2013), sewing technology (Rösel-Mautendorfer 2011), and experimental archaeology (Grömer 2005; Hartl et al. 2015; Rösel-Mautendorfer et al. 2012). So far, more than 600 individual textile pieces have been discovered since the first finds in 1846. Due to the annual excavations, this inventory is constantly increasing. Some textiles derive from the Bronze Age, but they are mostly from the early Iron Age areas of the salt mine and therefore the textiles in total cover a timespan of approximately 1400 BCE to 400 BCE.

### **The newly found tablet-woven band**

Information on the band was first published in German language and included an initial analysis (Grömer and Reschreiter 2020). The new tablet-woven band (inventory number PA NHM Vienna 126520) is 34 cm long and 0.8 cm wide. It was woven with 14 tablets and consists of a total of 56 threads in the colours blue, purple, red, and orange. The pattern section of the band is framed by three single-coloured stripes



Fig. 4: Detail of the threads (sheep wool warp and horse hair weft) in the tablet-woven band (inventory number PA NHM Vienna 126520) from Hallstatt (Image: A. Schumacher, NHM Vienna)

(from outside to inside: yellow/orange, blue, red). The pattern section is formed by the contrast of a darker background (in blue and purple) with light motifs in orange. The pattern of the band (fig. 3) consists of different variants in a triangular design. Larger areas can be described as interlocking triangles with inner stripes. There are also triangles filled with small or large diamonds, and what are interpreted as bridge-like motifs. In places, there is no distance between the individual motifs and, in others, there are large gaps, made by floating blue and purple threads.

The warp threads consist of Z-twisted plied yarn with a thread thickness of 0.7 mm to 0.8 mm. The fabric is made of sheep's wool in the warp direction. Horsehair (from the tail) was used as weft (fig. 4) to add strength and some stiffness to the band. The use of horse hair for the weft is also known from other bands that have been excavated at Hallstatt: the patterned belt fabric (inventory number HallTex 20) and two tablet-woven bands (inventory numbers HallTex 123 and 136) (Grömer et al. 2013, 55). A further comparable find (inventory number 4470) comes from Dürrnberg (Grömer and Stöllner 2011, Fig. 6).

### Experimental reconstruction and ethnographic comparisons with the weaving technique

The publication by Grömer and Reschreiter (2020, fig. 4) included an initial experimental reconstruction on the threading of the tablets used to create the new find (inventory number PA NHM Vienna 126520). Following this, specialist tablet weaver Silvia Ungerechts took the same approach to reconstruct all the patterned parts of it (fig. 5).

Comparing the weaving technique of this tablet-woven band with the other ones from Hallstatt shows that the new find is not a border in which each tablet is threaded with a single colour. Neither is it a broken twill like HallTex 123, nor was it done with only two

threads per tablet like HallTex152. The new band is unique in terms of threading and patterning: no pattern like this has been found at Iron Age sites according to current literature. It is not common for a band from the European Iron Age or Early Medieval period to be threaded with three colours in the pattern part in that specific order, namely purple – blue – purple – yellow/orange. The closest similarities in the threading of the tablets can be observed in the motifs on the belt of Queen Bathilde of France from the seventh century CE at Chelles (van Epen 2017, 8–10) but it is woven as floatwork. Warp threads of the band float above the woven ground forming its decorative element (Wollny 2017, 388–389).

Only in modern times are motifs with this threading and very similar weaving found. It is a technique called Sulawesi, named after an island in Indonesia where it is commonly used among the Sa'dan Toraja tribe. Bands woven in this way can be found, for example, in the Tropen Museum, Amsterdam, Netherlands (Collingwood 1996, 193, 200; Van Epen 1996, 17–20).

Comparing the Sulawesi technique with the new Hallstatt band, a lot of similarities can be detected: for example, the threading is identical. There is always a dominant pattern colour and two other colours in the background. In the case of the Hallstatt band, blue and purple form the background and the vibrant yellow is the pattern colour. There are slight differences in the weaving process. The tablets are always turned in one direction twice before changing the direction in the Sulawesi technique (Van Epen 1996, 17–39; Wollny



Fig. 5: Silvia Ungerechts reconstructing the band (Image: S. Ungerechts)

	Z	S	S	Z	Z	Z	Z	Z	Z	Z	Z	Z	S	
	A	B	C	1	2	3	4	5	6	7	8	D	E	F
<b>A</b>														
<b>B</b>														
<b>C</b>														
<b>D</b>														

Threading for weaving from up to down

Brettchengewebe Inv. Nr. PA/NHM Wien 126520

Pattern by Silvia Aisling Ungerechts

weaver	A	D
fabric	B	C

S&Z = Thread position

-  = turn the tablets away
-  = turn the tablets towards you

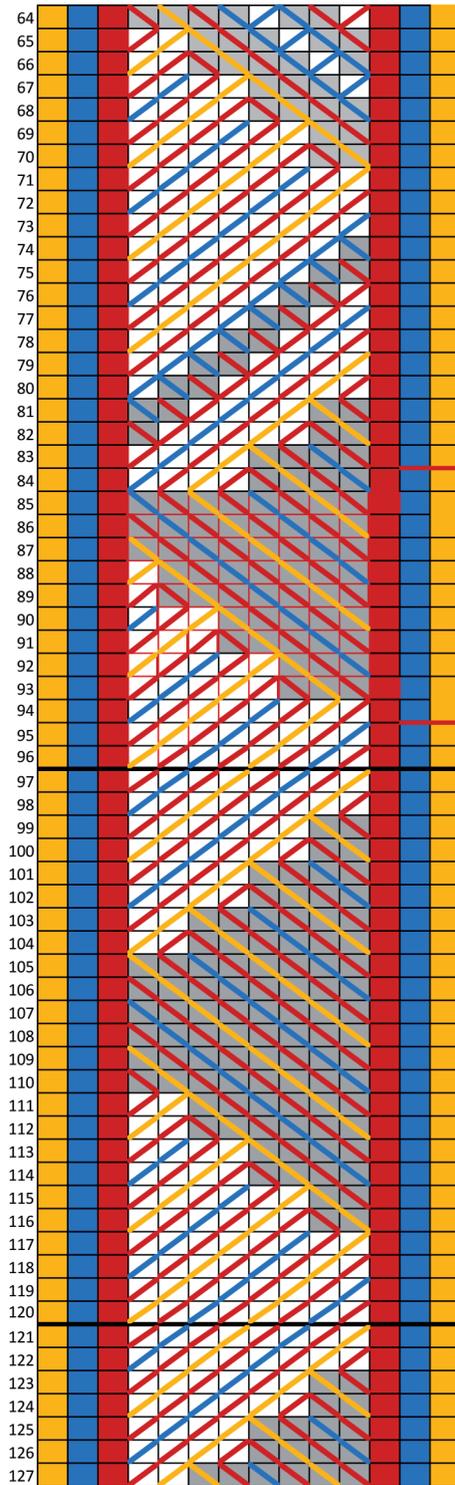
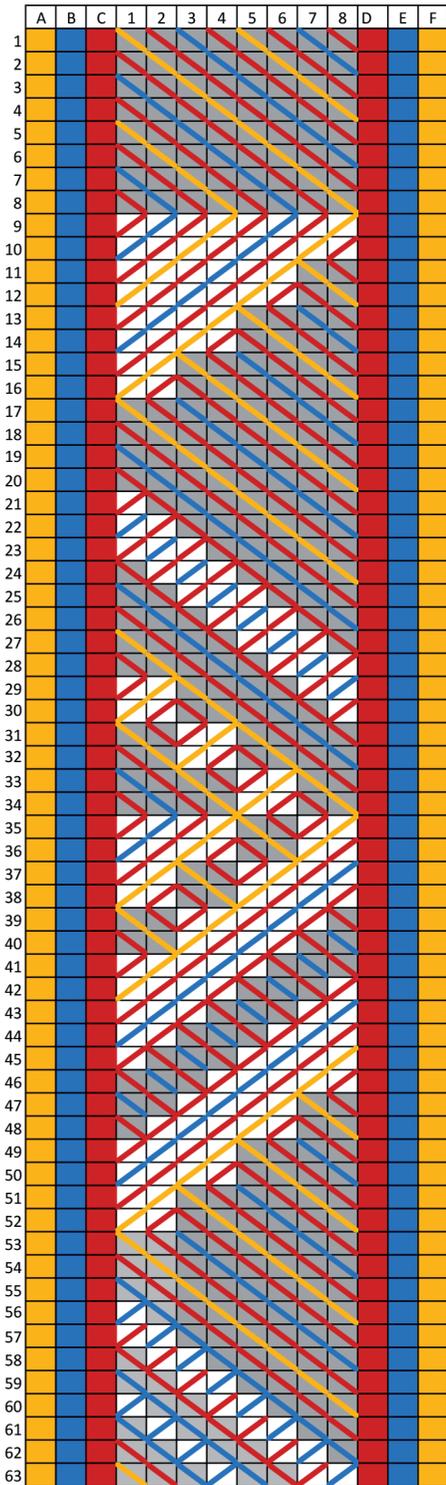


Fig. 6 (see next page)

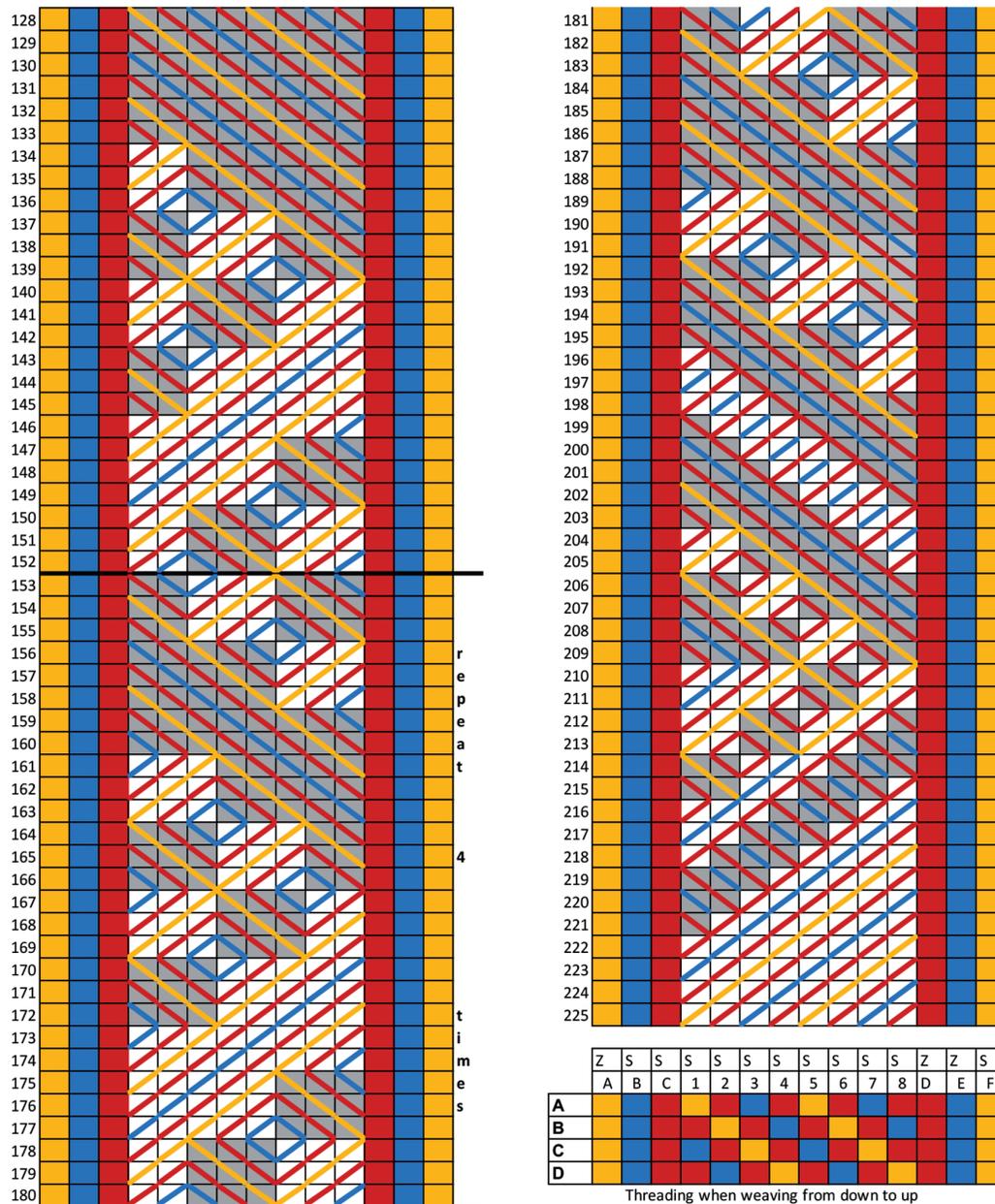


Fig. 6 (previous page and above): Weaving pattern of all sequences in the tablet-woven band (inventory number PA NHM Vienna 126520) from Hallstatt showing lines 1 to 127 on the left and lines 128 to 225 on the right (Image: S. Ungerechts).

2017, 354–387). It works as a type of double faced technique with two tablets treated as one double-faced tablet. The Hallstatt band also features single turns and the tablets are not set in pairs. The starting positions are also different to the modern way of weaving Sulawesi style. As there are no connections between Hallstatt and Indonesia, the similarity of the techniques is coincidental. Today, Sulawesi weaving is a popular modern technique as it is much easier to weave, for example, than 3/1 broken twill.

### Drawing the pattern of the new Hallstatt band (fig. 6)

Two sections which were woven using two different techniques have been identified in the band: the selvedge or border section and the patterned section. The selvedge section used three tablets each at the sides. These tablets were turned in only one direction over the entire length of 34 cm. This is common among decorated tablet-woven bands from the Iron Age onwards as it ensures a regular appearance and adds



Fig. 7: Reconstruction of the tablet-woven band with a horse hair weft (Image: S. Ungerechts)

strength to the selvedge. The threads of the two inner tablets are arranged parallel to each other, and those of the outer tablet in the opposite direction.

The patterned section does not have a single significant dominant motif as is the case with many other bands of the time (see discussion below). There are triangular and diamond motifs in several variations. The reconstruction of this band is relatively simple because the colours make it easy to read each thread. An experienced weaver needs only a sketch with two colours (here yellow and blue) to reweave the pattern.

Lines 84 to 94 (fig. 6) were not easy to reconstruct as there was most likely an error made in the original weaving. Alternatively (but not so likely), the blurred lines suggest the band was damaged. Therefore, the reconstruction of this part (lines 84–94) is only a guess. There are several other small variations in the band. It is not that a tablet is turned incorrectly or that the shed has not opened properly but that the weaving sequence varies in tiny details: for example, at lines 133–145. Here, for the specific pattern, three tablets should be turned forwards (away from the weaver),

three backwards, and two forwards. However, there are two tablets turned forwards, three backwards, and three forwards. These actions form the whole pattern sequence. Comparison of line 146 with lines 173 to 174 shows two turns instead of one at the turning of the line. In the next step, the weaver came back to the original motif. It is interesting to consider why those irregularities were not corrected. Maybe the wool could not be woven back without damaging the threads or there was no time to correct it. Maybe it was not even seen as a mistake at the time.

In total, the reconstruction of the 34 cm of the new Hallstatt tablet-woven band required more than 300 pattern lines. The instructions have been shortened to approximately 230 lines instead of approximately 340 lines by repeating them without considering the slightly different pattern sequences (by omitting some). In addition, three lines at the end have been altered to make it possible to weave through this pattern without bumpy transitions to get started again.

This description of the weaving sequence of the new Hallstatt band offers an invitation to re-weave it, try it out and recreate it today. It is useful to note the following tips. When weaving through the complete instructions, twisted threads build up behind the tablets because the turning sequences do not balance each other out. This can be avoided by reversing the weaving direction at the end of the pattern and then weaving the pattern backwards so that the threads will untwist. The pattern matches the original band when woven from bottom to top. The motifs are mirrored when weaving from top to bottom.

For the reconstruction of the band presented here (fig. 6 and fig. 7), industrially spun wool dyed with natural dyestuffs was used. So far, no dye analyses have been carried out on the original fabric and so for the experiments, dyes were selected that are already known from contemporary textiles from Hallstatt and other sites (Hofmann-de Keijzer 2016, Fig. 84): kermes, woad and camomile. Naturally pigmented black horsehair from an Icelandic horse was used for the weft.

For the result to be as fine as possible, the threads of the industrial wool for the reconstruction were Nm 28/2. The modern threads still have a width of 1 mm instead of the 0.8 mm in the original band. Even finer material would have been needed to achieve accurate dimensions. The reconstructed band is 41 cm in length instead of the original's 34 cm. The fineness of the original hints at the skills of iron age textile producers. The weaving itself is not as time-consuming as it might seem at first glance and it is possible to weave the whole pattern in a few hours.



## Discussion: Creativity, trial-and-error effect or symbolic content

What makes the new band from Hallstatt so interesting is the irregular pattern appearance, albeit the band was carried out skilfully (woven very evenly and the weft threads inserted evenly) and thus seemingly by an experienced person. Iron Age tablet-woven bands from central Europe were usually designed with a regular repeat forming recurring motif sequences. Colourful examples following that design principle (fig. 8) come from the Hallstatt site itself (Grömer et al. 2013) such as: HallTex 123 with filled triangles that alternate with meanders; HallTex 152 with a row of cross-filled diamonds; and HallTex 186 with opposing triangles. A band from Dürrnberg (inventory number 4470) has regular meanders on differently coloured backgrounds, which also follows the same design principle (Grömer and Stöllner 2011).

The principle of regular patterning can also be observed with structural patterns in the design of opposing triangles, as on the cloaks from Verucchio (Ræder Knudsen 2012; Stauffer 2002, 198–207). This grave find is thought to be monochrome, based on current knowledge. Geometric patterns with regular repetitions can also be identified among the tablet-woven items from Sasso di Furbara, Hohmichele and Altrier. Textile 3 from Altrier has a red swastika on a blue background across the whole piece (Rast-Eicher and Vanden Berghe 2015, 121). The regularly repeated motifs found in Eberdingen-Hochdorf (Banck-Burgess 1999) are based on different triangle, diamond, and swastika variants.

There is only one exception to this design rule of a strict pattern repeat (fig. 9) currently known: Kesseltuch 1 from Hochdorf (Kesseltuch 1, Group 1/object 1.42 and 1.45; Banck-Burgess 1999, 182–183, plate 27.2) has a total of five patterned sections. There are two wide ones which are separated or surrounded by narrow ones (with widths of three times 0.5 cm and twice 1.2 cm). In the wide pattern sections, there are horizontally subdivided geometric spaces containing swastikas enclosed by diamonds and zigzag lines. The narrower pattern sections have interesting variants, with various lines, zigzags and angled hooks in irregular sequences on the outside, and various diagonal structures on the inside in the narrow pattern section.

The irregularities in the design of the new band from Hallstatt demand some discussion. The band's overall appearance makes it very likely that a trained person was involved in its production. From a cultural-historical perspective, there are three potential explanations as to why the band looks like it does: are the irregularities due to individual creativity,



Dürrnberg textile 4470



Hallstatt textile 123



Hallstatt textile 186



Hallstatt textile 152

Fig. 8: Tablet-woven bands with regular motifs from Hallstatt and Dürrnberg, Iron Age (Images: Karina Grömer, NHM Vienna and Keltenmuseum Hallein)

evidence of trial-and-error in action, or do they carry some symbolic content?

Creativity and individuality in design is conventional nowadays and these can be demonstrated in the technique of tablet-weaving, which is used in creative education (Joliet-Van Den Berg 1975, 172–179). There are many tablet weavers' communities on the internet sharing their creativity and designs. Numerous pattern variations are possible in tablet-weaving with a stretched basic warp. These result from different turning sequences for all or parts of the pack of tablets. However, the strict design principles of repeated pattern sequences in the extant evidence suggest that such individualistic design was not very common (or desirable?) in prehistoric Europe.

Evidence of irregularities may not only be interpreted as creative design, it may have been deliberate

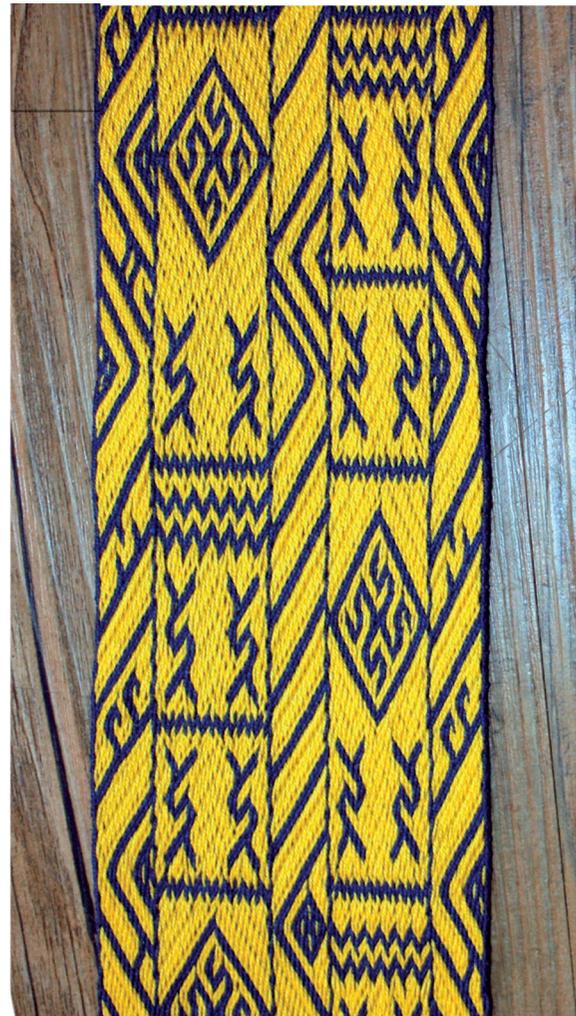
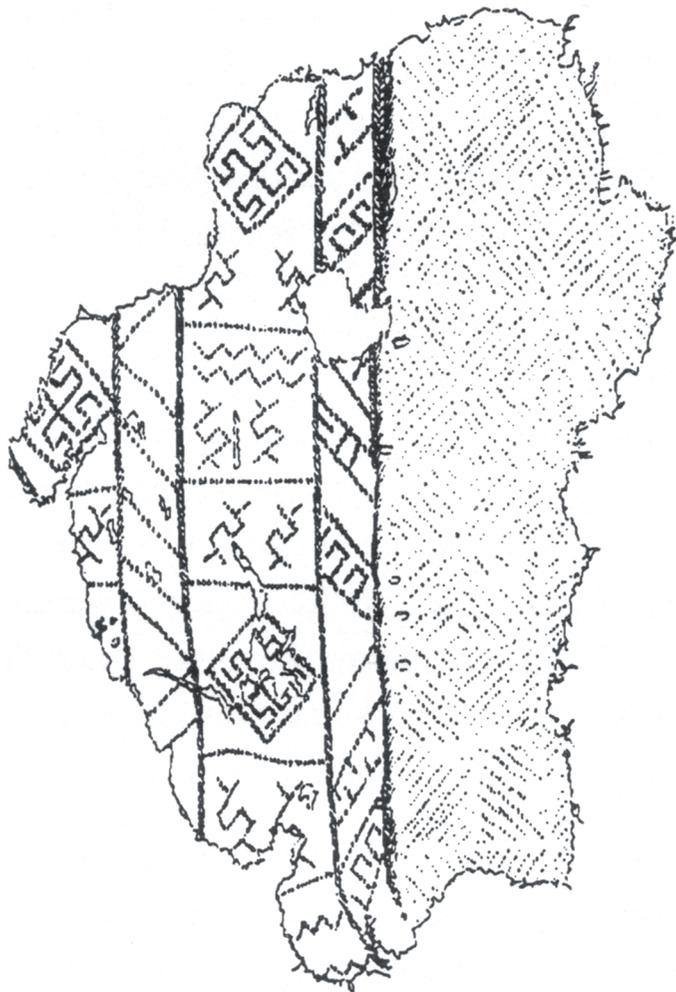


Fig. 9: Recreation of the Iron Age band from Hochdorf, Kesseltuch 1 with irregular pattern sequences by Sirko Galz (Image: A. Schumacher), NHM Vienna

experimentation. It is conceivable that the variations in the pattern came about when the weaver tried out something new. It might be evidence of trial-and-error or attempts at new motifs.

Another potential interpretation of the decoration in the new band (inventory number PA NHM Vienna 126520) is that it contains some symbolic content. The material culture of the Hallstatt period often has characteristic designs with mostly geometric patterns in regular repetitions: these appear on textiles (Grömer 2016, fig. 99), wooden objects (Reschreiter 2009), and pottery (Schappelwein 1999). Unlike the textile decoration, the patterns on the pottery often combine variants with different triangles, diamonds, lines, etc. (Preinfalk 2003). Triangles with points on the tops can sometimes be interpreted as abstract representations of people (Dobiat 1982). In recent years, some authors have been working on the

interpretation of what at first glance appear to be simple geometric patterns. Examples of abstracted depictions of ships and waterbirds have been identified (Flemming 1998).

Ethnographic comparisons from the Basel Museum clearly show that entire creation myths can be hidden in seemingly simple geometric “patterns” on ceramics or on woven mats (Kümin and Brust 2011, 100–102; Wessel 2011, 150–152). For Swedish traditional costumes, region- and group-specific colour combinations and patterns of braids and belts can be worked out (Porsbo 1999). Such it seems likely that the geometric motifs on the newly discovered tablet-woven band from Hallstatt are to be understood in their symbolic nature and the individual components as well as the number of their repetitions to carry a symbolic meaning. The fact that one of the most prominent Iron Age examples from the cauldron of Hochdorf, also shows a change

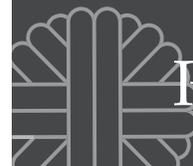


of repeat could support this theory. Finally, it has been shown that geometric motifs on Late Hallstatt bronze sheet metal belts can also be used to visualise and identify regional groups (Brandner 2014). However, a certain reading of these symbols and an interpretation of the content are not possible to date.

Likewise, it might be possible that the changing designs and motifs on the newly discovered band from Hallstatt, as well as the Kesseltuch 1 from Hochdorf, have a symbolic meaning that could be read by prehistoric people which are not clear today. These brief notes recording and interpreting the newly discovered band from Hallstatt are an invitation to tablet weavers, makers, and creators to share their ideas on an ancient handicraft. Please post them or any with creative recreations on Instagram under #tabletweavehallstatt.

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Authors:

[karina.groemer@nhm-wien.ac.at](mailto:karina.groemer@nhm-wien.ac.at)  
[aisling@gmx.net](mailto:aisling@gmx.net)  
[hans.reschreiter@nhm-wien.ac.at](mailto:hans.reschreiter@nhm-wien.ac.at)