Hallstatt Textile 123

By Tove Brianesdohter

Introduction

Hallstatt Textile 123 was so well preserved for its age that I instantly started asking questions that I needed answered. What was its use? Why was it so well preserved for its age? Why is there a Hallstatt period? Where was this textile found? What is it made of? How was it made? Where was it made? What was it dyed with? How were they able to replicate this pattern over and over? What is the size of this textile? The list goes on and on. I was able to answer some of these questions, but others will need to wait. Throughout you will see my random thoughts and comments sprinkled in *italics*, I hope you don't mind.

Earliest Hallstatt Salt Mine Records

It's interesting to me that the earliest recorded record of salt mining was 1305. Prehistoric artifacts had repeatedly been found by miners of the Middle Ages to know that mining has taken place for hundreds of years before that first record. But no records exist. In 1734, the body of a mummified man was found in the salt mines. It was reported that some of his clothing and shoes still clung to him and could be identified. Unfortunately, historical preservations were not taken into consideration at that time, and they buried him in the cemetery in Hallstatt. They mentioned a possibility of him not being alone due to the strange stench coming from that same area of the mummy, but no other records indicate more was ever found. At some point later, the mummified man was reviewed and thought to be from the 8-5th century BC placing him in the Iron Age.

Can you imagine excavating for salt and coming across human remains? It must have been both creepy and fascinating at the same point.

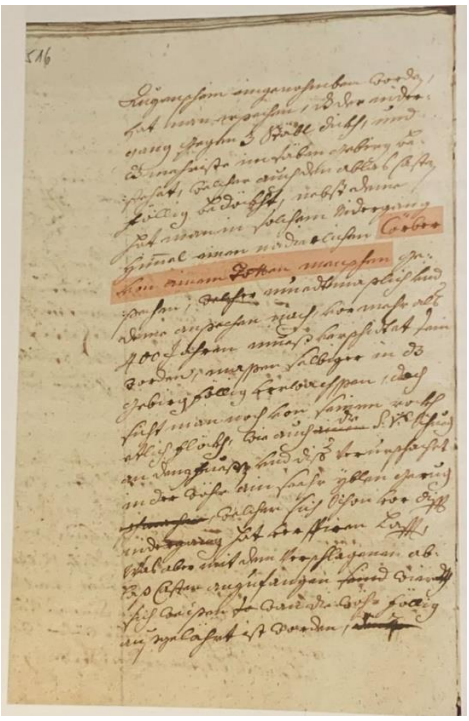


Figure 1 The man in the salt was mentioned in several documents. A report on the find is kept in the Upper Austrian Provincial Archives.

Hallstatt Preservation

In 1846, Johann Georg Ramsauer started the foundation for preserving artifacts, including textiles, found in Hallstatt. He was a mine operator and director for the excavations at the Hallstatt cemetery from 1846-1863. Ramsauer understood the importance of his work and contacted museums in Linz and Vienna for help. He documented and described his grave finds, which were exceptional for that time. During his research he would come across bronze objects with a green patina. With his knowledge of the salt mines, he also knew there were "green parts" in the mine and concluded that there must be bronze objects there too. In August 1849, he performed an experiment in the core dilution plant area of the mine, this is the same location Hallstatt textile 123 was found in 1990, and set up a fine jet of water directed at the wall to slowly dissolve the salt. It worked and artifacts were uncovered that had been encased in salt and the number of textile finds increased rapidly. The pioneer of research on the salt mine textiles was Hans-Jurgen Hundt. Textiles that were found before 1984 were examined by him leading him to publish several articles of technical data on them. Data such as thread count, yarn diameter, weave structure, seam, and hem information to name a few of the details. This interest in textile research has been continued by Katharina von Kurzynski who also worked on textiles from the Durrnberg salt mine in Austria. Because of the number of Late Bronze Age and Early Iron Age, 800-400 BC, artifacts found in the burials and salt mine it inspired researchers to name this period "Hallstatt Period". To date there are over 1500 graves that have been found and more than 700 single fragments of textiles preserved and possible to study.

Figure 2 Johann Georg Ramsauer

Many of the prehistoric mining sites have been discovered on accident while modern mining was taking place. To date they have found 88 salt mine locations from the Bronze and Iron ages. Intensive efforts are made with each discovery to keep the few remaining Bronze and Iron age areas accessible since the natural pressure of the mountain and growth of the salt crystals work against them and some tunnels have fell into disrepair and close as a result.

Only three prehistoric salt mines are currently known in the world. Hallstatt, Durrenberg, and Chehrabad. Hallstatt is by far the oldest and longest-operating operating salt mine in the world. Durrenberg is also in Austria and has had a presence in prehistoric mining as well. Chehrabad is in northwest Iran. The thing that makes these mines unique to burials that have been discovered is that salt is a natural preservative thus preserving leather, fur, animal skin, wool, hair, grass, ropes, feathers, horn, and wood to remain long after soil would have reclaimed them. Very few special conditions like this exist in other forms but ice, deserts, hollowed out tree trunks, under water and bogs are a few other places natural preservation has taken place.

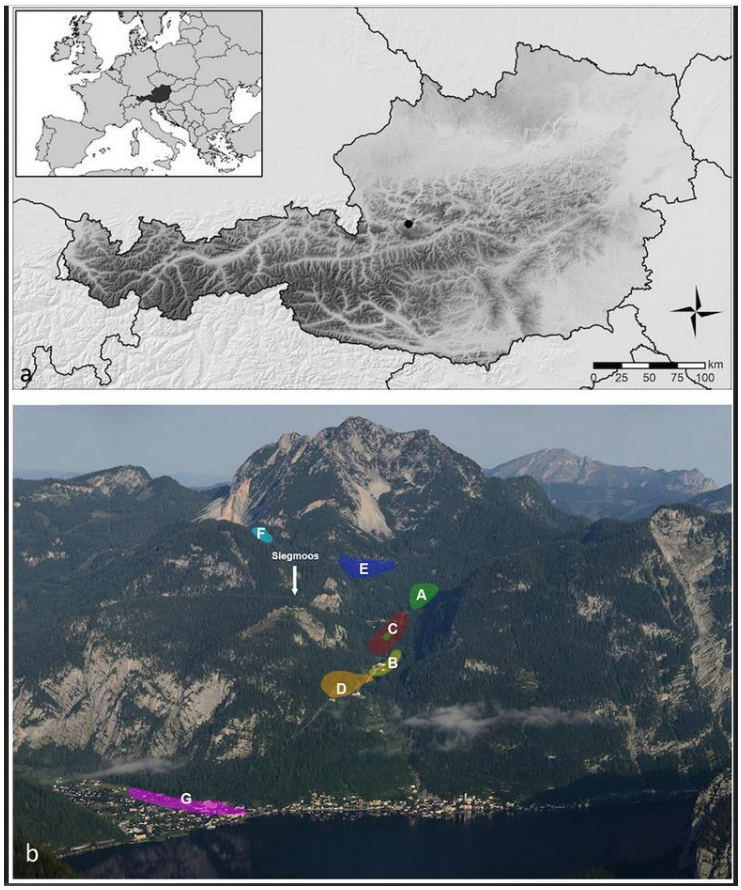
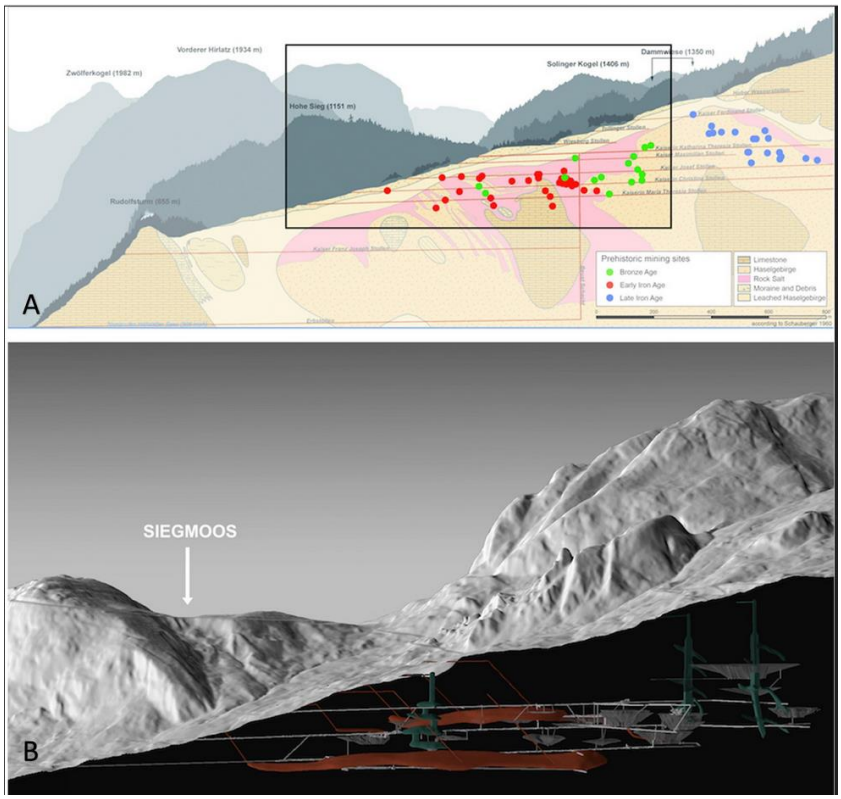


Figure 3 Archaeological zones on the Hallstatt salt mountain:

A: below ground - Bronze Age mine workings (Northern Group); B: above ground - Bronze Age log basin zone (meat curing); C: below ground - early Iron Age mine workings (Eastern group, red) and Bronze Age mine workings Christian-von-Tuschwerk area (green); D: above ground - Iron Age cemetery; E: late Iron Age mine workings (Western Group); F, above ground - late Iron Age settlement and G, above - ground Roman settlement and cemetery and location of the Siegmoos bog.



What is it about salt?

Salt is a natural preservative. It dries out single-celled bacteria that prevents the decomposition process. The high pressure in the mountain naturally closes the man-made tunnels after a time encapsulating the artifacts in what's call "heathens rock". This hermetically sealed salt rock is airtight and no oxidative degradation process can take place. The high humidity of the mountain prevents the fibers from drying out. This combination is what has kept the textiles and other artifacts found so well preserved. The textiles found in the salt mine were still elastic and supple.

I sure could use some salt preservative of myself somedays.

Trade theories

There are theories that people of Hallstatt focused mainly on the production of salt, which was traded to others for everyday goods, including textiles, they needed to live and work. Research on how mining is done has shown evidence that the entire mining process had to be highly organized, and most of the Hallstatt population had to be involved in some way with the mining of salt. Miners would have specialized in their work and there was a strict division of labor as a result. Some miners specialized in breaking up the salt, others were specialized in removing the salt from the mine and so on. This process left little time for manufacturing other everyday products. The land around Hallstatt also provides clues that trade must have occurred due to the steep slopes of the mountain and little area where flax fields could have been, or sheep husbandry performed. Some resources mentioned that perhaps the fine textiles that have been found in the salt mines were made in the Upper Austrian Alpine foothills where resources were available and traded to the miners.

Textile Production

You may want a beverage of choice and a snack because this section is a long one full of information on textile production. Preparation, spinning, whorls and size did matter (lol), weaving/tablet weaving, dyeing, and tailoring.

Textile production was very time consuming. Several sources give the same estimates on time to produce a textile during the Iron Age.

- 1 hour to sort fleece
- 1 hour to tease the wool
- 5 hours to card the wool
- 80 hours to spin and twist into yarn
- 5 hours to wash and dry the yarn
- 25 hours to weave
- Total of 117 hours used to produce 1 textile

There is no mention above for dyeing the yarn so adding that into the mix would also add time. This doesn't consider the time it takes to find the plants to use for dyeing and in making the weights or tools needed to weave the yarn. Think of a regular work week for a full-time person. Working 5 days a week at 8 hours a day is 40 hours. This means it would take almost 2.5 weeks to create one textile. It still does not take into consideration sewing a garment together or trim that was woven onto the garment. *It can be mind blowing to think about.*

Hallstatt textile 123 was made from wool and horsehair. Wool was found to be preferred during the Hallstatt Period but no reasons why have been found to explain. Were the temperatures colder? Was there an abundance of sheep compared to flax fields? Did the popularity change during this time like fashion does? Horsehair was used as the weft to give the band strength and help it keep its shape without curling up while wearing it. Horses had been a domesticated animal in Central Europe since at least 4000 BC. Horsehair also helped in keeping the width the same throughout the textile while still allowing some stretch lengthwise to happen.

Preparation of the wool tells us about the quality of the final textile. Analysis under the microscope gives us more information about the wool preparation. Irregular threads tend to mean a coarser yarn was produced. This could have been from lack of time given to preparing the wool or lack of tools available to create a finer wool that has more uniform and parallel fibers. Analysis of several Hallstatt textiles indicate both coarser yarn and finer yarn were around. Perhaps the use of the textile dictated whether coarse or fine yarn was needed. Or maybe the skill level of the spinner at the time?

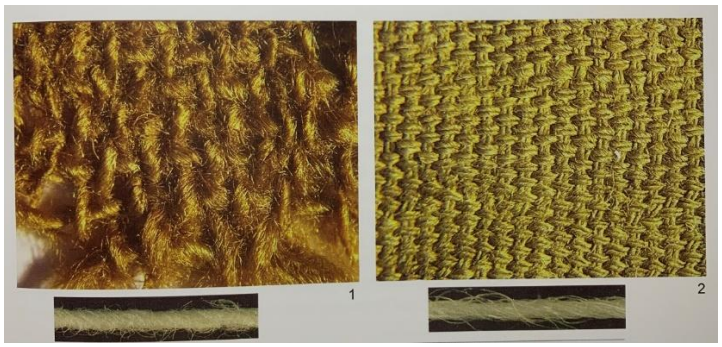
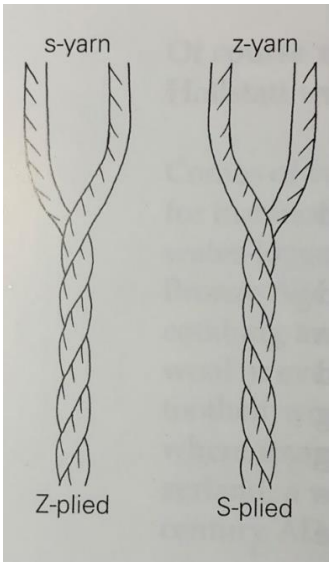


Figure 4 The weave on the left shows coarser yarn while the weave on the right shows a more parallel finer yarn

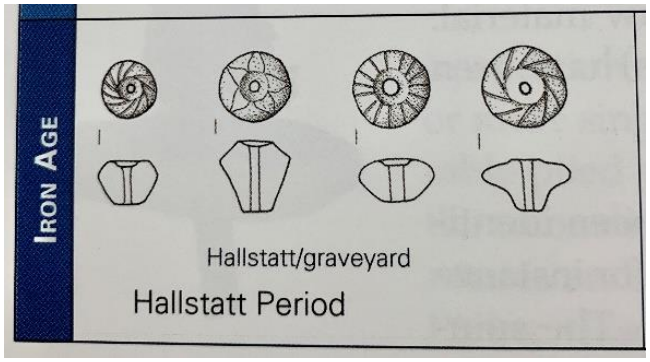
The spin pattern was another sophistication in the Iron Age and was popular in the Hallstatt areas. S and Z twisted yarns reflect light differently and a well-prepared parallel fiber can take on a subtle tone on tone pattern. Several textiles encompass this effect.

Few pieces of equipment have been found for the preparation of wool. Long tooth wool combs have been found as early as the Neolithic period so they did exist during the Hallstatt period and later in the La Tene period wooden boards with thorns have been found that would have been suitable for carding.

After the wool fiber was prepared it would have been spun into yarn. *In my experience spinning is a very meditative activity. It allows you to talk and socialize with others or become lost in your own thoughts.* A drop spindle would have been used to turn wool into yarn by twisting it into either a S or Z twist. Spindles were created from a wooden rod approximately 20-30 cm in length with a whorl, weight, impaled on the lower third of the rod. The weight of the whorl would have been a large factor in the thickness of the fiber being pulled and spun in a downwards rotation creatin yarn. If the wool fiber was spun in a S twist, then plying two yarns together would have been spun in a Z twist and vice versa.

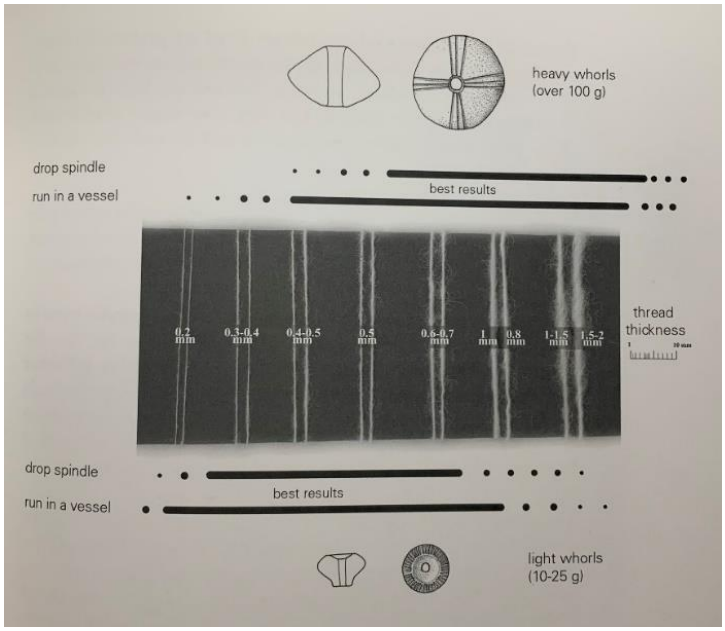


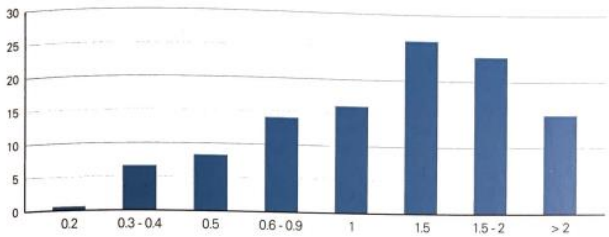
Spindle whorls are a very common artifact find. They are usually made of fired clay but in rare cases they have been made of bone and stone. While the shape of the whorls has changed over time their function has not. Weights of all ranges have been found and during the Hallstatt Period those weights were towards the light end of the spectrum. Small weights 5-20g have been found among the artifacts excavated in the Hallstatt area indicating a lighter whorl was preferred.



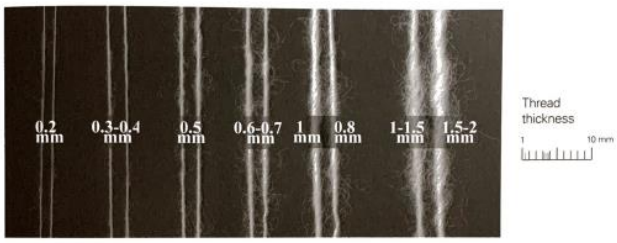
Experiments have been performed, by researchers, showing that large and heavy whorls put a lot of weight on the thread on which the spindle hangs. Attempts were made to spin a thinner wool thread of about 0.4 mm thickness using a large and heavy spindle whorl. The outcome caused the thread to tear. This happened especially when the wool used had shorter staple lengths. The lighter whorls like those from the cemetery of Hallstatt were suited for the production of fine wool yarn that was common in the Hallstatt Period.

The strength of the twist of the yarn is important as well. A tight twist produced a more stable yarn that could be used as the warp in weaving. This leads back to the quality of the preparation of the wool. Wool that had been combed to allow the wool fibers to run parallel would generate a tighter twist when spun.

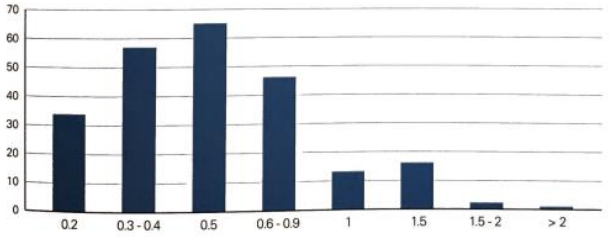




Bronze Age



Hallstatt Period

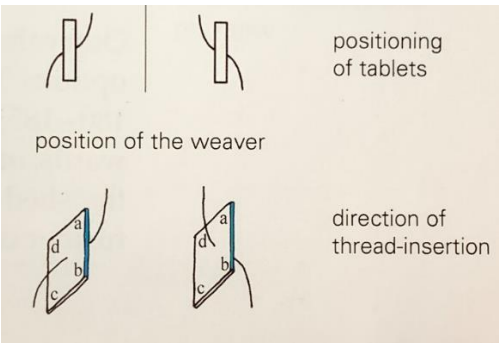


We know from artifacts found that there was a variety of weaving techniques available. Certain tools and methods were used in order to produce textiles for a specific use. The Hallstatt area is no exception. In fact, they wrote a book just about the textiles found in Hallstatt that provide detailed characteristics on each textile.

I've held this book for a short period of time. I consider it worth its weight in gold if I ever find one to purchase.

The process of weaving involves yarn being interlaced with each other at a 90-degree angle to each other. The pattern is formed in the way they are interlaced. The yarn that is held in place with loom weights is called the warp and the yarn that moves back and forth interlacing in the warp is called the weft. The weft does not need to be as strong as the warp does since it is not held under tension like the warp yarns would be.

Tablet weaving is another method of weaving where tablets/cards are turned to create the shed for the weft to pass. The cards used in the Hallstatt tablet woven bands so far have all used square tablets. Triangle tablets were also known in parts of the world at this time. Each corner of the card would have a hole for the yarn to be passed through and when the card was rotated a quarter turn it creates the pattern. The direction or side of the tablet card the yarn was passed through would determine if the twist direction of the warp was S or Z twisted. Cards have been found made from wood, bone and polished stone.



Ramses Belt was once thought to be the oldest tablet woven bands which dates 1200 BC but was refuted by Peter Collingworth in his rigorous studies. The earliest secure find of tablet weaving is from 1500-1200 BC from Schwarza, Germany and recently has been complemented by a tablet woven border patterns with blue warp stripes found in the Hallstatt salt mines from the same time.

While dye analysis has not been performed on Hallstatt 123 because of how valuable and unique this textile is, it has been done on other textiles from the same period of time. Experiments have also been performed using plants available during this time to draw some conclusions on what was possible. It's unfortunate that some colors, such as yellow, cannot be narrowed down as far as I had hoped. The only confirmation given was that it was indeed a plant containing flavonoids.

The blue-green and light blue-green dyed yarn it was most likely dyed with woad that had been in Hallstatt during the Iron Age and then dyed in any number of yellow flavonoid plants to give that green color.

The triangles and meandering pattern of Hallstatt 123 used 70 picks to have one complete pattern. This pattern is repeated on the entire band. How was this possible without error? Was the pattern memorized in some fashion? A rhyme or numerical sequence repeated over and over. Perhaps a song? To this day that is still a puzzle we are trying to piece today without success.

I can tell you from experience that this pattern is complex and would have needed to be memorized in some fashion. I needed to use lifelines in order to keep this pattern on track as there were a few times when I fell off track from the pattern and needed to find my way back to where the pattern was accurate and start over again. I cannot imagine completing this band from memory without tracking it in some fashion.

When Hallstatt 123 was found it also had a second part sewn to it. Along one edge of the band there was yellow twill scraps that were sewn to the band in two places with a few stitches. The band itself was sewn together to form a circular shape indicating that this piece was most likely the decorative end of a sleeve or pant leg.

Hallstatt 123 textile

The Hallstatt textile 123 was woven with 21 four-holed tablets for a total of 84 threads for the warp. The weft, as mentioned before, was horsehair. The analysis data found, indicated a 64 thread count. This didn't throw me off until I did the math on the pattern and found it indicated 84 threads were needed for the warp. I emailed Dr. Karina Gromer, vice-head of the Department of Prehistory at the Natural History Museum Vienna, to clarify the number of warp threads used. She did respond and confirmed there were indeed 84 threads and their count was by cm based on the overall width of the band being 1.3 cm or just over half an inch. All of the warp threads were plied and the diameters of the threads were 0.01-0.2 mm thickness. To put that into perspective, the yarn is a plied version of cobweb/lace weight thread. THAT'S FREAKING TINY! The twist direction of the thread was different between the warp colors used. The blue-green and brownish yarns have a Z twist. That means to untwist it you would rotate it in a counter clockwise manner. The light blue-green and yellowish yarns have a S twist. It would be untwisted in a clockwise motion. Look at the picture at the bottom of page 5 for a picture of the twists. The twist angle for all yarns were between 20-30 degrees with a 5–10-degree difference between them. This indicates a pretty consistent twist was applied to all yarns when they were spun and a pretty tight twist. The pattern of this band happens within cards 4-16 leaving the outside edges on both sides plain. So, not only are the individual threads tiny but the pattern is focused within 12 cards. The overall length of the band is 22 cm or just over 8.5 inches. The pattern as mentioned before has 70 picks to complete one full pattern of the triangle shape and meandering line. This would indicate that there were just over 6 repeated patterns in the overall band. Six times a perfect pattern would need to be produced just for this one piece. Not to mention this is just one cuff and as we all know arms and legs generally have two. It's truly mind-blowing thinking about the skills and labor put into this one textile that was produced 2400-2800 years ago. The band is also considered double-faced. Not in the way that you can see the pattern in reverse colors on the backside, although you can kind of see it, but in the fact that the pattern uses two light threads and 2 dark threads that double-face patterns are known to have.

Let the reconstruction begin

I initially dreamed big about seriously producing this band with the attempt of getting it to its exact size. Spinning the wool, dyeing the yarn, weaving the band and then I had a good laugh at my grandiose idea. To gain just the skill alone for producing cobweb plied yarn in the length and consistent twist needed to weave this band would take the rest of my lifetime to produce. So instead, I set out finding thread already in the world to eliminate that work for me. What I found was 16/2 unmercerized cotton from Maurice Brassard. Yes, I know its cotton and not period at all for this band but I wanted everyone to see

the actual size in person and not just imagine it. My next thought, was to use horsehair for the weft as I wove. I wove about 4.5 inches and scratched that idea as well. It was too much to keep up with on keeping the width of the band perfect, along with the pattern accuracy and not allow the horsehair to slip out the ends and form little loops. So, I started over in my planning once again and just used 16/2 cotton for the weft as well. Honestly, I really love the end result. I don't recall the number of times I cursed because I took a wrong turn somewhere and had to use my lifeline for help but it was a lot. I wish I had recorded more about how long it took me to actually weave the band but all I can tell from my pictures is that I must have printed off the pattern around December 16, 2021 and completed the band on December 26, 2021. It was just a couple days later, December 28, 2021 that I started work on the second all wool band. Nothing in the initial band was historically accurate except for the pattern itself. I also didn't have a true blue-green thread so I used what I had on hand. I used an inkle loom for both bands since I do not have experience yet at using any other fashion of loom for tablet weaving. The cards used were heavy cardboard and are my favorite.

The second band I created is 100% wool thread and 100% horsehair. My intent for this band was to use the same fibers in the original. I search for a cobweb weight thread that would be strong enough for the warp and never found it by the time I was ready to weave. Just a couple weeks ago I found some alpaca yarn that may do the trick but its still not what I truly want. The wool thread I did find was used for embroidery and finding the blue-green colored thread did not happen. The thread could have been processed more to create a smoother thread but it was strong enough to do the job for me which is what I really needed. I search Etsy and found that horsehair could be bought from there and not knowing the exact length or amount of horsehair I needed I decided on the small-medium length offered and medium quantity amount as well. Let me tell you that it does not take as much as one would think when creating a band this small. In creating this band, I decided I wanted a comparison in length so I wove the same number of picks in this band as I did in the first one made of cotton. I figured some kind of apples to apples would be nice to see. I did not end up with a finished piece on the first go and forgot my lifeline rule after just over 8.5 inches in or just after 3.5 patterns were complete. Ugh. Start over. Something I did learn with the second start of this band was to use beeswax to make the horsehair sticky enough that it would not try to pull out at each pass. I finished the second band on January 6, 2022 with a total of 13.75 inches in length to complete the same number of patterns as the cotton band. If I am honest with myself, I really like the cotton band so much more. Its clean and the pattern jumps out at you. Perhaps someday I will have enough time to weave this pattern again and make a belt from it. The colors would change to match those in what I wear most often and I will most likely use a larger thread to just give it some more width overall.

Fun fact. My email to Dr. Karina Gromer was not the first email conversation with her. Before I could get my hands on the Textiles from Hallstatt book I had contacted the museum with questions about the band. They suggested a couple books, which I bought, and put me in contact with Dr. Gromer so I could ask her directly. I also follow her on Instagram and had posted a couple pictures of this band there to which she commented on. For me researching this band I don't think it could have gotten any better than being able to communicate with her.

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