



Friederike Hertel and Karina Grömer

Project reassessment of iconic textiles at the Halle Museum: New dates and fibre analysis for Ditfurt, Latdorf and Unterteutschenthal

Early textiles at Halle Museum and their importance in archaeological research

In the second half of the 19th and the first half of the 20th century, some important Stone and Bronze Age textiles were found which have since been stored at the Halle Museum an der Saale in Germany. In 1959, Karl Schlabow published those finds with methods and technical tools based on the best knowledge at the time. Archival material stored at the museum explains that he also aimed to use microscopes to undertake “micro-investigations” on the finds from Unterteutschenthal (Schlabow 1956).

Since then, the finds were of importance for our understanding of early textile culture in this area. The artefacts from Kreienkopp near Ditfurt and Spitzes Hoch near Latdorf were interpreted as being among

the oldest wool finds in Germany and the textiles from Unterteutschenthal are thought to be important Early Bronze Age finds. Throughout the 20th century, they served as the missing link between the textiles from the lakeside findspots around the Alps, especially in Switzerland, and the well-known textiles from the oak coffin graves in Denmark from the Early Bronze Age. In recent decades, the availability of radiocarbon 14 (C14) dating and scanning electron microscopy (SEM) for fibre analysis brought new opportunities to early textile research that were not available to Schlabow. This prompted Halle Museum an der Saale to start a project to re-assess these important finds. Some interesting new results concerning the date and raw materials of the finds from Ditfurt, Latdorf and Unterteutschenthal are available.

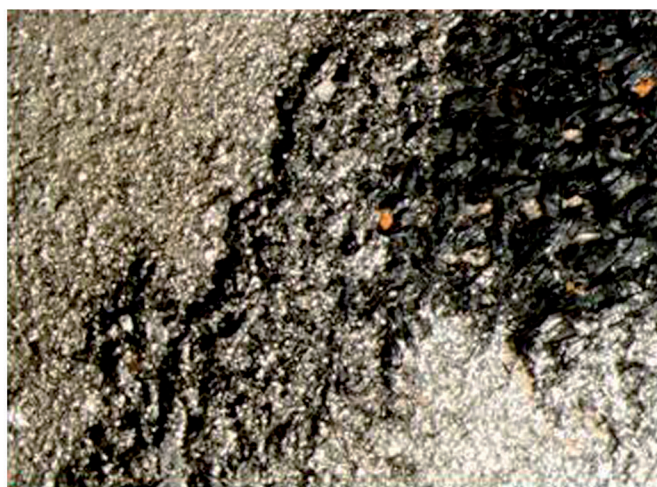


Fig. 1: Neolithic textile from Latdorf, now at Halle Museum, with detail of the silver-painted plate (Images: Friederike Hertel, LDA)

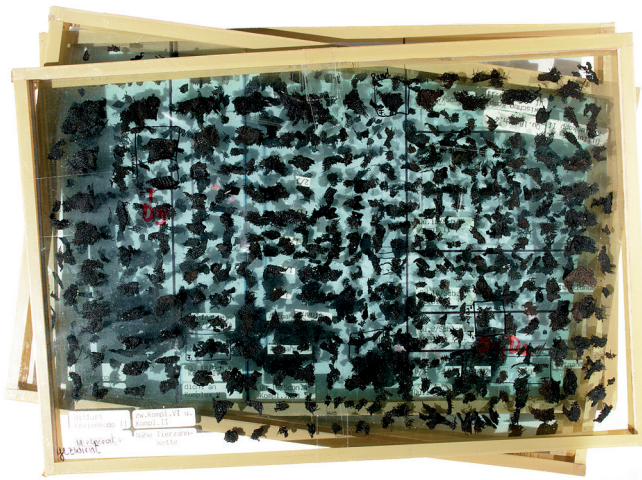


Fig. 2: Textile finds (Ditfurt-90) from the excavation season at the Kreienkopp tumulus II in 1990 (Image: Friederike Hertel, LDA)

Neolithic “wool” textiles from Latdorf and Ditfurt

Three textile complexes from Latdorf and Ditfurt were found in the large Bernburger Culture tumuli. This was a late Neolithic culture located in today’s Sachsen-Anhalt and Thuringian basin between 3200 and 2800 BCE.

The textiles from Latdorf (inventory number HK-Nr. 57:97) were excavated in 1880 by Friedrich Klopffleisch (then professor for prehistory at the University of Jena) at the tumuli site of Spitzes Hoch. The artefacts recovered in this excavation were divided between the Halle Museum and Museum Schloß Bernburg. The textile finds have never been exhibited, but the Museum Bernburg has plans to include these early textile finds into renewed displays in future.

After the excavation at the beginning of the 20th century, the charred textile fragments from Latdorf underwent conservation treatment, which included gluing them to cardboard to preserve and hold the charred items together. A cellulose nitrate (possibly *Zaponlack*) was also used. The area of the cardboard not covered by the textiles was painted with a silver colouring (using Aluminiumbronze pigment) in a careless way which partly overpainted the textiles (fig. 1), as previously documented by Schlabow (1959, 102). In addition, some smaller fragments were pressed between two glass plates, which was a technique in the conservation of archaeological textiles in the mid-20th century (Grömer & Reschreiter 2013, fig. 11).

The Neolithic Ditfurt textiles that are well known in the academic community are those from the Kreienkopp I tumulus (Ditfurt-33: HK-Nr. 57:94). These were excavated by Karl Schirwitz in 1933 (Hertel & Schlenker 2018, 44-48). The finds were taken to different museums, as was common in the first half of

the 20th century. Some fragments are kept at the Halle Museum and other parts of the same textile are stored at Schlossmuseum in Quedlinburg pressed between glass plates to preserve them. One of the plates is kept in Quedlinburg and two are in Halle.

In addition to these well-known finds (Schlabow 1959), new excavations in 1990 brought to light further textile samples. The Kreienkopp II tumulus near Ditfurt was excavated by Detlef Müller in 1990 and mentioned in his excavation reports (Müller 1992a, 221-232 and 1992b, 21-32). The textiles were found in the western section of the burial chamber, along with charred seeds of various wild plants, such as *Cynoglossum officinale*, *Fallopia convolvulus*, *Amaranthaceae*, *Agrimonia L.* Some of these are medical and dye plants. The textiles may have served as a bag for storing the plants. In the same area, charred human bones were deposited, along with a large quantity of pottery (some undamaged), various antler tools, and dog and fox teeth used as a necklace. Animal bones from rodents, cows, pigs and fish were also found in a charred state. They had burnt on a pyre together with the corpse (Müller 1992b, 22). For the first preservation treatment in 1990, the textiles were cleaned with ethyl alcohol and stabilised with the polymer Scopacryl D 343. They were glued to glass plates for storage (fig. 2). Some of those newer finds are now included in the permanent exhibition of Halle Museum and published in detail in a catalogue (Hertel 2020). All textiles from Ditfurt were investigated during 2007 and 2008 as part of the preparation of the new permanent Neolithic exhibition at Halle Museum, including fibre analysis using environmental scanning electron microscopy (ESEM) in cooperation with the German National Criminal Investigations Bureau in Magdeburg.



Fig. 3: Details of the textile from Latdorf (Halle) with plied thread and ESEM image of the fibres (Images: left and middle Friederike Hertel; right Uwe Schwarzer, German National Criminal Investigations Bureau, Magdeburg)

Fibre analysis

Schlabow studied the charred textiles from Latdorf and Ditfurt when they were still glued to cardboard and with limited analytical methods (Schlabow 1959). He assumed that the raw materials are sheep's wool. Recent SEM analysis now shows the fibres to be of plant origin. Those from Latdorf were assessed using transmitting light microscopy (TLM) and SEM. The characteristic nodules (fig. 3, right), which distinguish plant fibre material from animal hair fibres with scales, are clearly visible using SEM.

Similarly, analysis of the Ditfurt material with SEM successfully identified characteristics of plant fibres (fig. 4, right), without being able to specify whether they are the plant fibres from flax or hemp. Comparison with similar contemporary finds suggests flax is likely. The results of those analyses were published together with a reassessment of the contexts and the research history (Schlenker & Hertel 2018).

Reassessment of technical data

All the textiles found in the tumuli of the Bernburg Culture at Latdorf and Ditfurt are fragmented and charred but their weave structure, quality and technical details are comparable. Thanks to the latest conservation work, reanalysis of the technical details

was possible and additional information about the construction of the threads was undertaken.

Several charred fragments from Spitzes Hoch at Latdorf are fine tabby textiles which may belong together, as they show the similar characteristics such as comparable thread counts and thread qualities. The textile is characterised as an open weave (fig. 4, left). In some fragments, a densely woven starting border is also visible (fig. 5, left). In this border, the thread count is 10 threads per cm as is that of the warp in the main weave with 28 threads per cm in the weft. The textile is balanced with the same kind of thread from a plant fibre been used for the warp and the weft. In some parts of the textile, the characteristics of spliced thread are visible, such as changes in the intensity of plying (fig. 5, right). The technical details of the weave are given as an average because there is some variety in the thread diameter and thread counts. The warp comprises 0.3 mm S-plyed (spliced) thread with a thread count of 10 threads per cm. The weft is 0.35 mm S-plyed (spliced) thread with a thread count of 14 threads per cm. The threads are mostly tightly twisted but also have some sections which are loosely twisted, which is typical of spliced material (fig. 5, right). The single threads used are very loosely z-twisted and about 0.15 mm in diameter.



Fig. 4: Details of the textile (Ditfurt 33) with plied thread and ESEM image of the fibres (Images: left and middle Friederike Hertel, LDA; right Uwe Schwarzer, German National Criminal Investigations Bureau, Magdeburg)



Fig. 5: Starting border on the textile from Latdorf (Bernburg) with details of the threads in an open weave (right) and dense weave (Images: Friederike Hertel, LDA)

Several textile fragments excavated in the Kreienkopp I tumulus at Ditfurt in 1933 (now catalogued as Ditfurt-33) may also belong together. The charred tabby fragments are made in an open weave and have dense starting borders with 13 threads per cm in one thread system and 30 threads per cm in the other (fig. 6, left). The plant fibre threads may well have been made by splicing like the Latdorf textiles. The cloth is likewise more or less balanced (fig. 2 and fig. 4). The warp comprises 0.3 mm S-plyed (spliced) thread with a thread count of 14 threads per cm. The weft is 0.3 mm S-plyed (spliced) thread with a thread count of 14-16 threads per cm. The spliced threads are usually firmly twisted, but also have some sections which are loosely twisted, which is typical of spliced material. The single threads are very loosely z-twisted and about 0.13 mm in diameter.

The newer excavations at the Kreienkopp II tumulus in 1990 at Ditfurt revealed more charred textile fragments (now catalogued as Ditfurt-90). The

textiles from the second tumulus are comparable in all characteristics to the finds from 1933. Fine, open-weave tabby fragments of plant fibre were found, with further similar characteristics such as the starting border and a balanced appearance. The starting border in the new textiles has a thread count of 12 threads per cm in one system and 24 threads per cm in the other. The warp in the main weave is 0.3 mm to 0.4 mm diameter S-plyed (spliced) thread, with a thread count of 12 to 14 threads per cm. The weft is 0.3 mm to 0.4 mm diameter S-plyed (spliced) thread, with a thread count of 20 threads per cm. The threads are spliced with loosely z-twisted single threads of 0.2 mm diameter. Among the fragments from Kreienkopp II, fringes were also found. Some of the fringes are 5 to 6 S-plyed threads twisted together, forming 1.7 mm diameter fringe threads (fig. 6, right) fringes consist of 3 S-plyed threads twisted together forming in 0.9 mm diameter fringe threads.

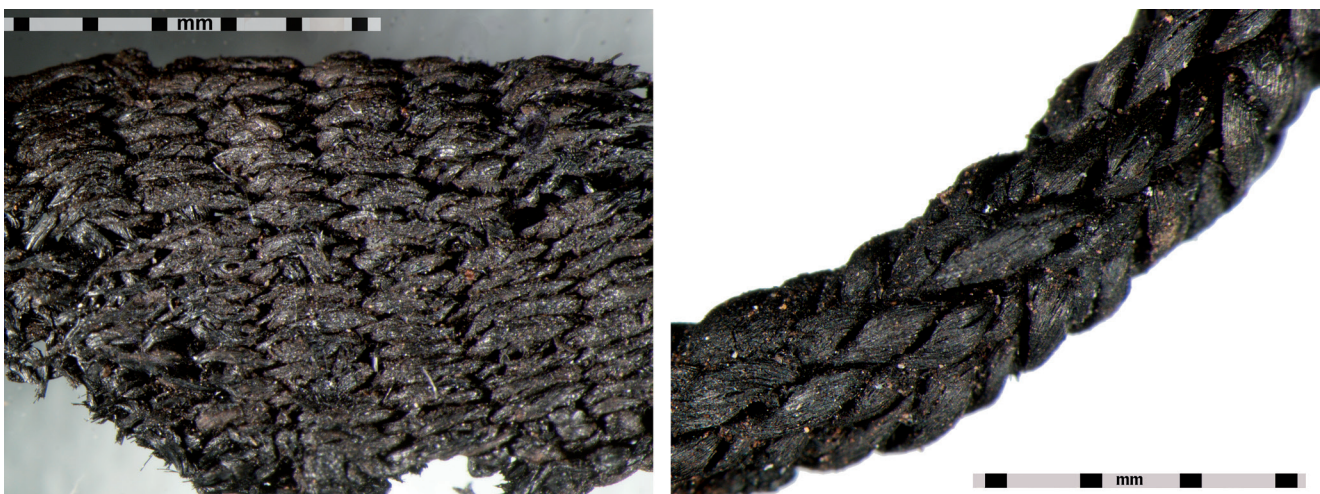


Fig. 6: Starting border on the Ditfurt-90 textile (left) and detail of a fringe (Images: Friederike Hertel, LDA)



Fig. 7: Unterteutschenthal textile HK: 5882,1 (Schlabow 1959, Woven fragment 1). Storage in the 1950s with remarks by Schlabow (left); after conservation treatment in 2000 (Images: Friederike Hertel, LDA)

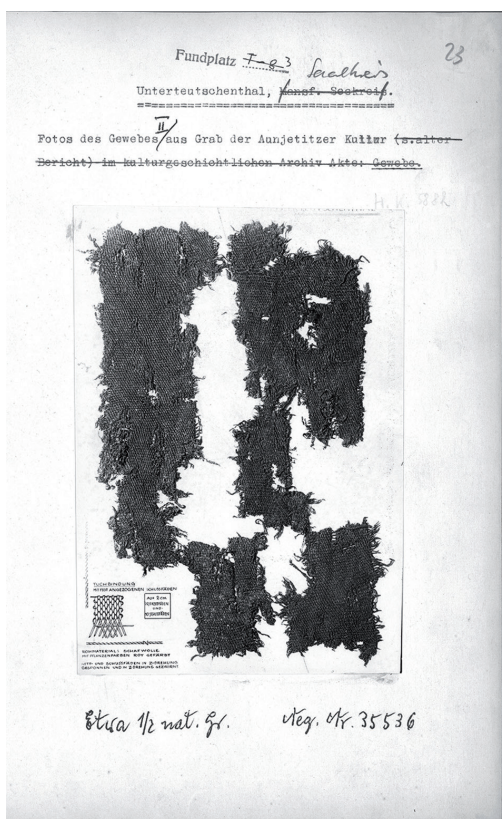


Fig. 8: Unterteutschenthal textile HK: 5882,2 (Schlabow 1959, Woven fragment 2). Storage in the 1950s with remarks by Schlabow (left); after conservation treatment in 2000 (Images: left Ortsakte LDA; right Friederike Hertel, LDA)

“Early Bronze Age” textiles from Unterteutschenthal

The textiles from Unterteutschenthal were found in tumulus II during the unsystematic excavations in 1887 by the local museum under the former director Oberst a. d. H. v. Borries (Hertel & Zich 2020). Since then, they have been stored at the Halle Museum. All textile fragments were preserved at that time by an impregnation but this was not documented. Nothing is now known about the substances used or the date of processing. However, Schlabow (1959, 119) reported: “After being conserved, the fragments [HK: 5882,2] were laid under glass on a 29 cm x 41 cm board”. The reason for the reinvestigation of the textiles from Unterteutschenthal (Hertel and Zich 2020) was investment in a new storage and conservation facility for the textile finds in the year 2000 (fig. 7 and fig. 8). This revealed a white-ish substance adhering to the textile surface, which can be seen very clearly under the microscope. It is likely that this is a cellulose nitrate, which suggests *Zaponlack* or another bonding varnish (*Geiseltallack*). The use of these treatments was common in the 20th century for a long time. However, these can easily be dissolved with acetone.

The “blended weave” (Schlabow 1959, Table 17; woven fragment 1) is now under inventory number HK: 5882,1. It had been previously placed between two glass plates and almost pressed flat in the 1950s (fig. 7, left). It has now mounted on a felt fabric and covered with a glass plate without direct contact. The “ribbed tabby” (Schlabow 1959, Tables 18-19; woven fragment 2) is now under inventory number HK: 5882,1 and has been likewise remounted.

C14 analysis

The textiles were briefly identified by Walter v. Stokar (1938, 105) as Early Bronze Age because the main contents of the tumulus date to the Únětice Culture. Schlabow did not question this dating in his detailed description of the textiles from Unterteutschenthal (Schlabow 1959, 118) and this has been repeated in further publications (Bender Jørgensen 1992, 51-52; Grömer 2016, 46, 97; Möller-Wiering 2012, 126, 130). Schlabow did not realise that Middle and Late Bronze Age artefacts were also found in the same tumulus (Hertel & Zich 2020) and that the placement of the textiles among the Early Bronze Age finds was not

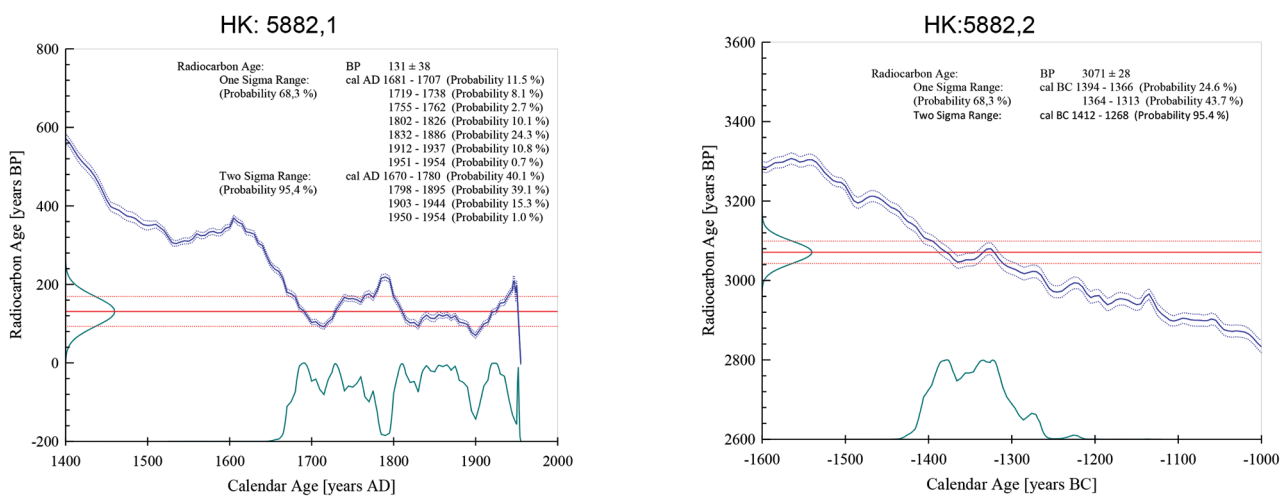


Fig. 9: Unterteutschenthal textile C14 dating carried out at Kiel University (2008)

	Laboratory	Lab Nr.	C14 age	$\delta^{13}\text{C}(\text{‰})$	Cal1 sigma	Cal2 sigma	remark
HK:5882,1	Kiel	KIA35473	130±40 BP	-22.26 ± 0.10	cal AD 1681-1954	cal AD 1670-1954	see graph
"blended weave"	Mannheim	MAMS 19379	301±16 BP	-19.1	cal AD 1526-1643	cal AD 1521-1646	
HK:5882,2	Kiel	KIA34568	3070±30 BP	-23.14 ± 0.14	cal BC 1394-1313	cal BC 1412-1268	see graph
ribbed tabby	Mannheim	MAMS 19380	3040±19 BP	-22.5	cal BC 1375-1261	cal BC 1387-1227	

Table 1: Unterteutschenthal textile C14 dating results carried out in in Kiel (2008) and Mannheim (2014)

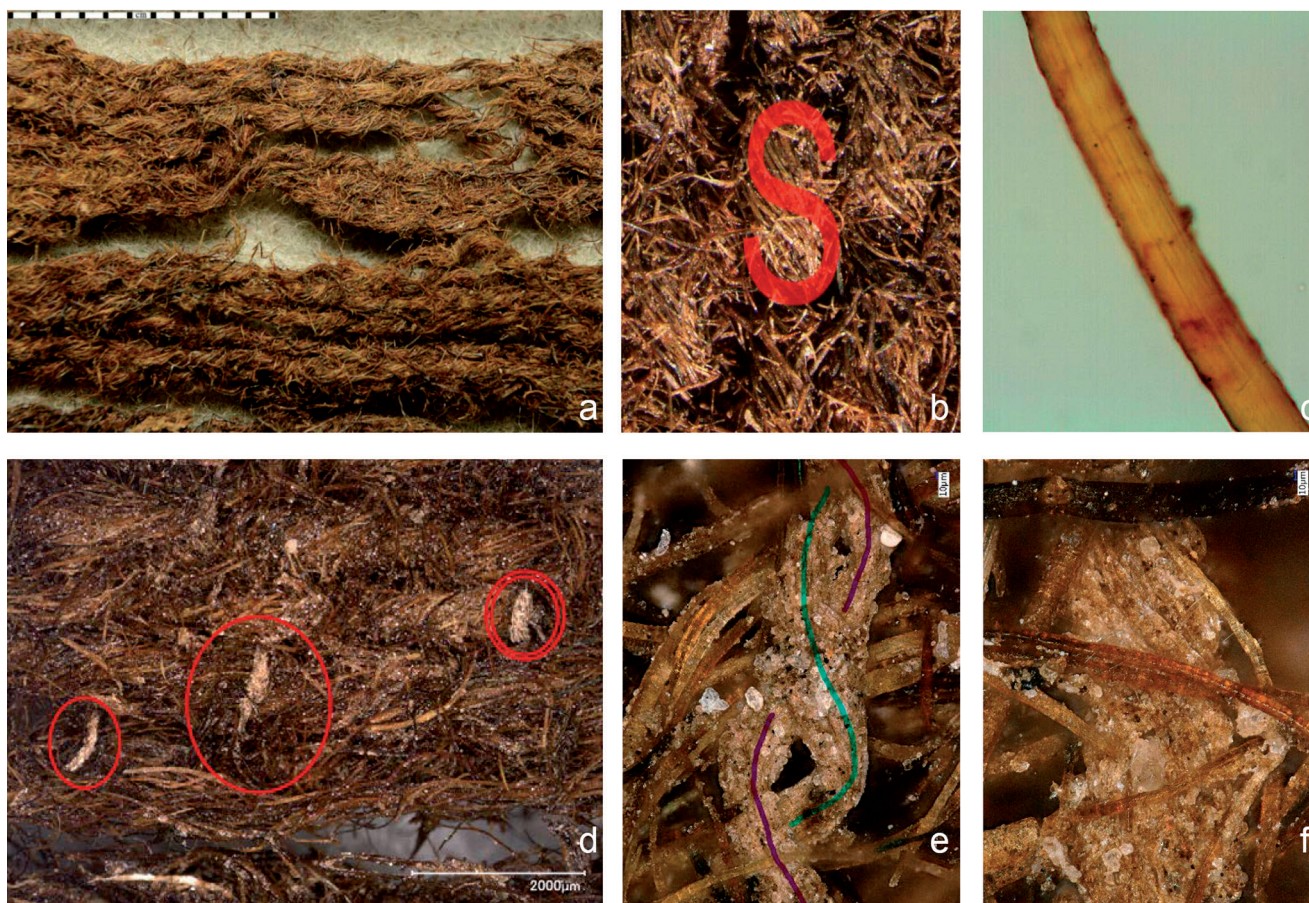


Fig. 10: Unterteutschenthal “Blended weave” textile HK: 5882,1: technical details. a) surface with disintegrated warp threads; b) twist direction weft; c) weft: light microscopy, sheep wool; d) areas with warp still intact; e) plied warp threads; f) horizontal weft wool fibres, vertical warp plant fibres (Images: Friederike Hertel, LDA)

that definite. As part of the reassessment and new conservation of the finds, the original excavation protocols were checked and this cast some doubt on the dating of the finds. It was decided that C14 dating could be used to help resolve the issue.

Samples threads from the main part of each textile were taken. The textile fragments were analysed in November 2007 to February 2008 using C14 dating at the Christian Albrechts University in Kiel, Germany (at the Leibnitz Laboratory for Dating and Isotope Analysis; fig. 9). In March 2014, additional C14 analysis of the same textiles was carried out by the Curt Engelhorn Archaeometry Centre in Mannheim, Germany to test the initial results (table 1).

Against all expectations, the “blended weave” textile (HK: 5882,1) was dated to modern times (fig. 9, left). How these fragments are related to the tumulus must now be reassessed. It is quite possible that the “blended weave” fabric is an intrusion that was introduced during the excavation in 1887. The result of the C14 dating for the “ribbed tabby” textile (HK:

5882,2) suggests it is from between 1412 and 1268 BCE. The second dating came to a similar conclusion (table 1). The two independent C14 dates (2008 and 2014) have shown that the four fragments come from the Middle Bronze Age (1550 BCE to 1250 BCE), not, as was originally suspected, from the Early Bronze Age.

Reassessment of technical data and fibre analyses

Among the finds from Unterteutschenthal, the “blended weave” textile (HK: 5882,1) (Schlabow 1959, 119, woven fragment 1), is the most iconic: “It is the first example of two different raw materials, sheep wool and plant fibres, being woven together in the Bronze Age. They are interconnected in a tabby weave” (Schlabow 1959, 119).

Despite its new dating to the modern period, the textile (fig. 10) can be described as a weft-faced tabby. The warp threads consist of plant fibres which have almost or completely disintegrated and are therefore not well preserved (fig. 10a). Only sparse fragments of thin plied threads could be documented by the use of reflected

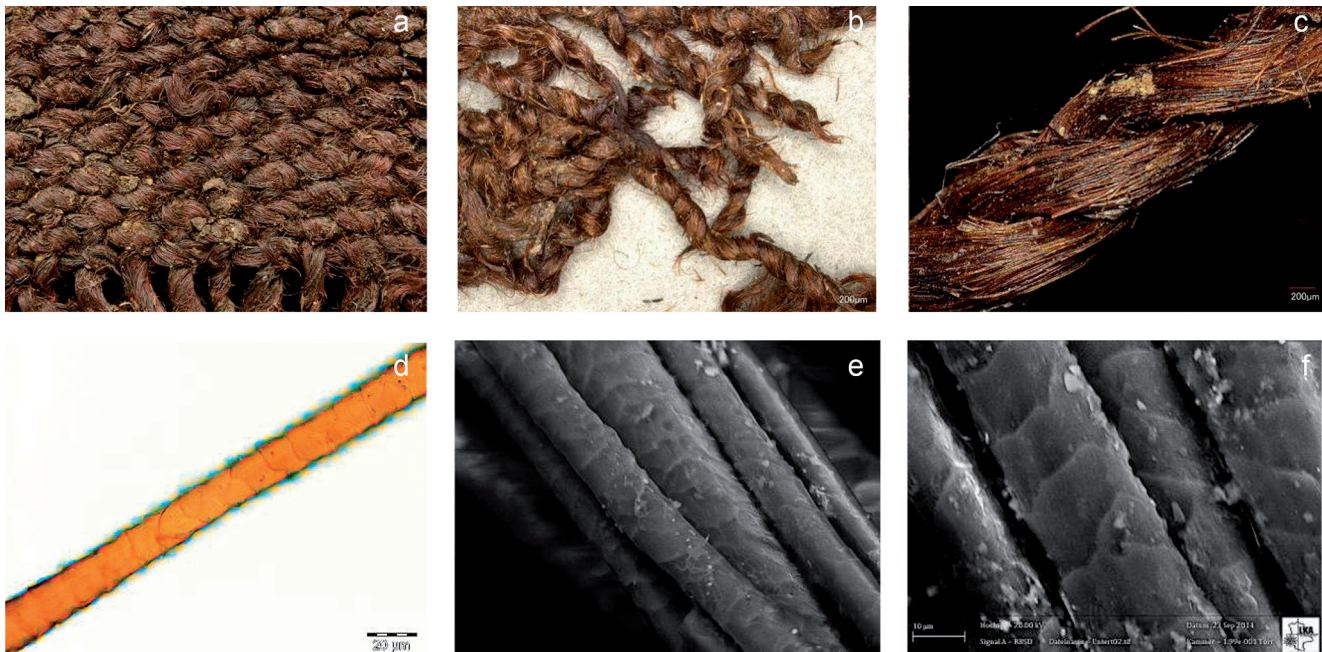


Fig. 11: Unterteutschenthal "Ribbed tabby" textile HK: 5882,2: technical details. a) ribbed structure; b) plied threads; c) more loosely plied thread; d) wool fibre, light microscopy; e-f) wool fibres, Scanning Electron Microscope (Images: a-d: Friederike Hertel, LDA, e-f: Uwe Schwarzer, German National Criminal Investigations Bureau, Magdeburg)

light microscopy at 400x and 700x with a high resolution (fig. 10d and fig. 10e). The fabric consists almost entirely of weft threads. These threads can be identified as sheep wool because the surface structure with scales is clearly visible (fig. 10c). Thread system 1 consists of 0.15 mm to 0.2 mm S-plyed (?) thread, with a thread count of 4 to 5 threads per cm. Thread system 2 comprises 0.4 mm to 0.6 mm s-single thread with a thread count of 10 threads per cm. In the original analysis, there is no difference recorded between the two thread systems and the thread diameter differs from that found during the new analysis (Schlabow 1959, 119).

The "ribbed tabby" textile (HK: 5882, 2) consists of four fragments and, on sight, it differs from textile 5882,1 (fig. 11). It is also very dense in one thread system which results in a ribbed appearance. No starting borders or selvages can be seen on the fragments, and the warp and weft directions cannot be distinguished. The fabric is dense and strong owing to the use of plied thread in both directions. Both thread systems consist of sheep wool. The characteristic scales are clearly visible under reflected light microscopy, TLM and SEM where the surfaces of the fibres have been ripped away.

Thread system 1 consists of 1.0 mm to 1.3 mm Z-plyed threads with a thread count of 10 to 11 threads per cm. Thread system 2 is 1.0 mm to 1.3 mm Z-plyed thread with a thread count of 5 to 6 threads per cm. The plied

threads are tightly twisted except for the 0.5 mm to 0.6 mm thick s-single threads which make up the Z-plyed thread which have a looser twist. For this textile, the new analysis differs only a little from the data given by Schlabow (1959, 119-120) where he does not note differences in the thread system.

Dyestuff analysis

The "ribbed tabby" (HK: 5882,2) has a reddish colour, which was described by Schlabow (1959, 119). The reddish colour can be seen more on one side than on the other. It is conceivable that the brownish and slightly brighter front was more exposed to the UV light of the sun than the other side (fig. 12). Nevertheless, the reddish shade suggested dye analysis would be informative. This was carried out by Annemarie Kramell at the Institute for Organic Chemistry at Martin Luther University in Halle Wittenberg (Hertel & Zich 2020). A sample of 4 mg was taken and analysed with a diode-array detector and mass spectroscopy (HPLC-DAD and LC-MS/MS; Kramell et al. 2014). There was no firm indication of dyestuffs. The reddish colour of the textile may have been caused by chemical processes in the soil such as humus or humic acid. By the time the dye analysis was undertaken, the modern date for textile HK:5882 had already been established by C14 analysis, and it was excluded from this testing.

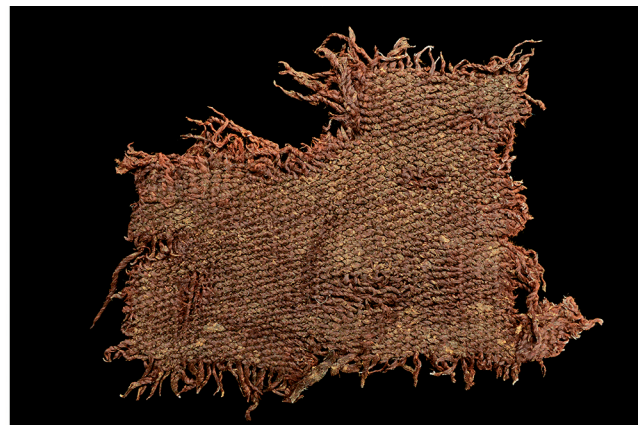
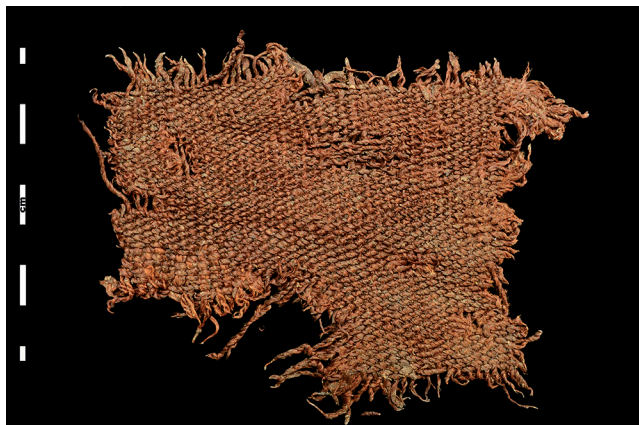


Fig. 12: Unterteutschenthal “Ribbed tabby” textile HK: 5882,2: reddish colour on face (slightly faded) and reverse (Images: Friederike Hertel, LDA)

Implications on research

Some of the earliest textile finds from central Germany are kept at Halle Museum: the Neolithic textiles from Latdorf and Ditfurt and the Bronze Age textiles from Unterteutschenthal. Thanks to their extensive and detailed publication by Schlabow (1959), the finds were referred to in several books about early textiles in Europe (Barber 1991, 176, 217; Grömer 2016, 46, 97; Möller-Wiering 2012, 126, 130) especially in relation to their dating and their technical details, which were not questioned. They have occupied an important role in our understanding of the introduction of sheep wool in Europe and other handcraft details.

The reassessment of the technical data and especially the fibre of the Latdorf and Ditfurt examples must now have an impact on our understanding of the development of textile technology in early Europe. Interpretations about how and when the use of wool reached central Germany and northwards from there may have to be reconsidered. Schlabow (1959) identified the fibres of both find complexes as sheep wool. Moreover, he specifies that it was good quality sheep wool which was carefully plucked without shearing taking only the long fibres and not the short underwool and kemp (Schlabow 1959, 115). This exciting information about Neolithic textile material was often cited. However, the renowned expert on the historical use of sheep wool, Dr Michael Ryder from Southampton, questioned the analysis of the raw material. He argued his doubts to Andrew Sherrat, who published them: “An important find in this context is the Spitzes Hoch tumulus at Latdorf near Bernburg in central Germany (DDR) ... However, Dr M.L. Ryder (in litt. April 1981) informs me, that he examined this supposedly Neolithic “wool” in

1964, and is of the opinion that flax; and carbonized flax-seeds occurred in the grave (Vogt 1937, 43). It seems most likely, therefore, that this late-fourth millennium sample is linen, like contemporary Swiss textiles” (Sherrat 1983, 93). The same doubts also were expressed by Elizabeth Barber (1991, 141-142) and Lise Bender Jørgensen (1992, 51-52; Bender Jørgensen & Rast-Eicher 2015). SEM analysis has now shown these doubts to be well-founded.

More technical details concerning both find sites are of importance here: The threads have not been made of spun single threads twisted together, but with splicing – a technique and term which was not known in Schlabow’s time. The use of spliced thread, twisted in the S-direction is typical for Neolithic flax textiles, especially those which were found in the lakeside settlements around the Alps (Leuzinger & Rast-Eicher 2011). In splicing (Barber 1991, 44-47; or Gleba & Harris 2018), the ends of pre-formed fibre bundles (strings or strips), stripped from the flax stalks, were spliced together, so that the ends of the ultimate fibres overlapped in bunches and at wide intervals. After this first step, two of these elements were then twisted or plied together. This fits well with our recent knowledge of how threads were produced in the Neolithic era. The techniques arise from a long tradition of working with plant material, especially tree bast (Rast-Eicher 2005).

The brief remarks of Stokar (1938) and the detailed descriptions of Schlabow (1957 and 1959) presented the important Unterteutschenthal finds for textile archaeology which stood for a long time. The dating of the textiles was regarded as firm because the associated finds were assigned to the Early Bronze Age. Consequently, this unique find from central Germany offering the earliest evidence of a blended

wool fabric has become firmly integrated into scientific publications (Bender Jørgensen 1992, 52; Grömer 2016, 46; Möller-Wiering 2012).

The new, unexpected C14 dating results of the Unterteutschenthal textiles will also have an important influence on textile research. The “blended weave” fragment (HK: 5882,1) was dated to modern times (between 1640 CE and 1955 CE) and must therefore be deleted from the history books of the Bronze Age. It was firmly established as one of the earliest European examples of a textile combining wool and plant materials (Barber 1991, 176). This must now be reviewed. There is now no evidence of an early blended weave in Bronze Age Europe. There is a small band from Chania, Minoan Period (first half of the second millennium BC) made of a flax warp and animal hair in the weft with supplementary threads in nettle fibre (Spantidaki & Moulherat 2012, 189, Fig. 7.3).

The other Unterteutschenthal textile (HK: 5882,2) is now dated to the Middle Bronze Age at end of the 14th century BCE. The new dating moves this textile from the Early to the Middle Bronze which demands a reconsideration of it and comparative materials. Still, it is the oldest surviving wool fabric in Saxony-Anhalt. Ans still, it can be interpreted as a link between the textiles from Bronze Age Hallstatt and the wool textiles from the Danish bog finds.

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Authors:

FHertel@lda.stk.sachsen-anhalt.de;

karina.groemer@nhm-wien.ac.at