ASPECTS OF THE DESIGN, PRODUCTION AND USE OF TEXTILES AND CLOTHING FROM THE BRONZE AGE TO THE EARLY MODERN ERA

NESAT XII.

The North European Symposium for Archaeological Textiles
21st – 24th May 2014 in Hallstatt, Austria

Edited by

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Hallstatt and an Iron Age textile from the salt mine
(© Natural History Museum Vienna, photo: A. Rausch and K. Grömer)

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NESAT XII Preface

The North European Symposium for Archaeological Textiles (NESAT) was founded by Lise Bender Jørgensen and Klaus Tidow in 1981 as an interdisciplinary discussion forum for research into archaeological textiles. A symposium takes place every three years and is held in different North European centres associated in some significant manner with archaeology and/or textile production. Since the symposia were opened to a wider public at NESAT X in Copenhagen in 2009, the former small, intimate conferences have emerged as important international occasions for engaging with specialists from a broad range of disciplines to discuss recent research into a many aspects of archaeological textiles, which is a rapidly expanding area of scholarship. At the NESAT XII conference in Hallstatt more that 220 participants were registered, coming from more than 25 countries, from Europe and all over the world including USA, Japan, New Zealand and Israel.

The NESAT XII symposium was organized by the Natural History Museum Vienna from 21st to 24th May 2014 in Hallstatt, Austria. The venue of the 12th Symposium was chosen for several reasons. First, the rich archaeological treasures from the Hallstatt cemetery and the salt mine, and also the fascinating alpine village as a tourist hotspot. Since December of 1997 the region of Hallstatt has been honoured with a position on the UNESCO World Heritage list. This was primarily due to significant archaeological and speleological sites, and rare fauna and flora. The special significance of Hallstatt is based on its archaeological heritage: the salt mines of Hallstatt, exploited continuously for 3500 years and leading to cultural continuity dating back to the Middle Bronze Age, has resulted in the richness of the grave finds, after which an entire era has been named Hallstatt period. The glacier area of the Dachstein and the karst formations with the internationally known caves are of particular speleological interest. The lush flora and fauna are not typical and the unusual mountain landscape with the fjord-like lakes contribute very significantly to their importance. For visitors, of special interest are the Hallstatt Museum, which was newly opened in 2002, the world famous ossuary of the Catholic church and the salt mines.

The conference volume contains 35 scientific papers, grouped into seven sections. Firstly Austrian textile research, which has grown dynamically in recent years, is introduced. Next follows prehistoric textile finds from Europe, such as recent analysis of the earliest wool finds or early Scandinavian textile design showing that the potential new information to be gained from re-examination of textiles recovered many decades ago is considerable. The largest corpus of articles deals with textiles covering a time span from the early medieval until the early modern period, their detailed archaeological research and art historical context. Five papers focus on tools and textile production using object-based research as well as experimental archaeology and investigation of written sources. The section, Specific Analyses, embraces interdisciplinary research such as dyestuff analysis, isotopic tracing and a new drawing system for archaeological textile finds from graves, which demonstrate the increasing number of new techniques employed in this realm of textile scholarship.

We have to thank many individuals and institutions for contributing so generously to the 12th NESAT conference in Hallstatt. The Prehistoric Department of the Natural History Museum Vienna, who had the honour to host the conference, has a long tradition of cooperation in Hallstatt, especially with the Salinen Austria and Salzwelten GmbH. They offered generous funding of the ongoing research at Hallstatt as well as donating to the conference in many respects. The Hallstatt Museum and municipality of Hallstatt have to be named as well for their help and contribution to the smooth running of the conference at the Culture- and Congress House Hallstatt. We are also grateful to the MuseumsPartner for their support of the event. Our sincerest thanks go to the Natural History Museum for financial support, especially for the publication. In addition, we are extremely grateful to the team at the publishing house Archaeolingua for the efficient production of the volume.

Karina Grömer and Frances Pritchard
May 2015

Chapter 1:
Textile Research in Austria

1 | Textile Research in Austria – an Overview

KARINA GRÖMER

Abstract: Research on textiles from archaeological excavations is carried out in Austria mainly at museums and universities. The materials analyzed range in a time span from the Bronze Age till the Early Modern times; they derive from graves, mines, as well as from prehistoric settlements and medieval castles. Methods applied are textile analysis, fibre analysis with SEM, dyestuff analysis with HPLC and various others.
At the Natural History Museum Vienna textile research focuses on prehistoric, Roman and early medieval graves, but especially on the textiles from the salt mines in Hallstatt. This wide range of archaeological material leads to different research questions, which have been explored in various international research projects within the last ten years. Each project has different objectives, approaches and research questions. In this paper two case studies of approaches will be discussed.

Keywords: Austria, research history, theoretical approach, Natural History Museum, interpretation of textiles

1. Research History

In the past, archaeological textiles have been noted in Austria very sparsely – usually they were analysed by scientists from countries with a longer tradition of research on archaeological textiles, like LISE BENDER JØRGENSEN (2005), HANS-JÜRGEN HUNDT (e.g. 1960, 1977; 1987; 2002) or KATHARINA V. KURZYNSKI (1996; 1998; 2003) – to name the most important. They analysed textiles from prehistoric salt mines and Iron Age and early medieval graves. Since the year 2000, textile research increased dramatically. Austrian scholars from different institutions were interested both in original textile finds, as well as in textile tools. Nowadays, research on textiles deriving from archaeological excavations is carried out in Austria by universities such as the University Innsbruck (Homepage Innsbruck) and the University of Applied Arts Vienna[1]. There, scholars as well as students do research on textiles from prehistoric and early medieval graves, prehistoric copper and salt mines, as well as from prehistoric settlements and medieval castles. Depending on the conditions of the material, if still organic or in a mineralized state, the fibres were analysed using light microscopy or Scanning Electron Microscope. Some of the finds also allow dyestuff analysis with HPLC as well as other types of investigation.

Textile research carried out at the Prehistoric Department of the Natural History Museum Vienna is based on the textiles from the salt mine Hallstatt. But also fabrics from prehistoric, Roman and early medieval graves are studied. This was done with the help of international and interdisciplinary cooperation; three major research projects can be named for the last ten years (DressID, CinBA, HallTexFWF[2]).

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[1] Research projects on conservation of Hallstatt textiles (GENGLER 2005, and dyestuffs: e.g. HOFMANN-DE KEIJZER *et al.* 2013).

[2] 2010–2013: EU-Project CinBA – Creativity and Craft Production in Bronze Age Europe, project leader: Joanna Sofaer, University of Southampton, UK (*www.cinba.net*). 2008–2011: HallTex FWF: Dyeing techniques of the prehistoric textiles from the salt mine of Hallstatt, project leader: Regina Hofmann-de Keijzer, Universität für Angewandte Kunst, Institut für Kunst und Technologie/Archäometrie Wien. 2007–2012: EU-Project DressID Clothing and Identitiy – New Perspectives on Roman Textiles, project leader: Michael Tellenbach, Curt-Engelhorn-Stiftung für die Reiss Engelhorn-Museen Mannheim (*www.dressid.eu*).

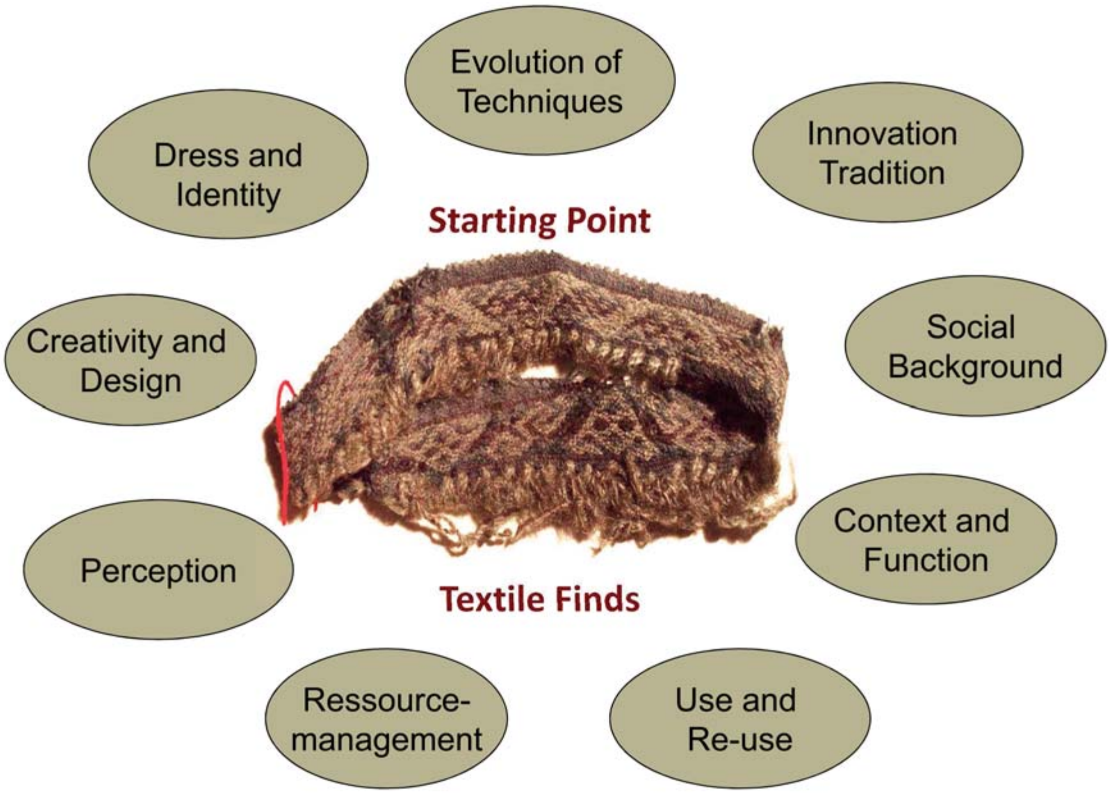

Fig. 1.1: Research topics of the Natural History Museum Vienna corresponding to textiles (graph: K. Grömer).

The most important research questions carried out by the staff of the NHM are (*Fig. 1.1*):
- Development of textile techniques; inventions, innovations and traditions within the 2nd and 1st millennia BC: weaving and patterning techniques, dyeing, wool processing, sewing techniques
- Technological, social and economic background of textile innovations in Central European prehistory
- Context and function of textiles in prehistory: clothing, soft furnishings, utilitarian textiles, grave goods, textiles as tools
- Resource management, use – re-use – "recycling"
- Dress and identity: social value of clothing and textiles from the Bronze Age to the Medieval period, representation and appearance
- Creativity and design; appearance of textile surfaces and patterns

In the following section, two case studies about some of those topics and theories will be presented – to point to the varied approaches we are taking to the textile finds.

2. Innovations and Traditions – change over time

Artefacts from Austrian sites provide some key finds for the study of the evolution of textile techniques, of innovations and traditions within the 2nd and 1st millennia BC in Central Europe. Especially the textile finds from Hallstatt are a clue for our understanding of textile craft in Central Europe. However, as important are the textiles from other sites in Austria and neighbouring countries as well as tools.

Detailed research on the chaîne opératoire was made, about what production steps are necessary to make a textile, what tools and resources have to be used (Grömer 2015, Fig. 15): beginning with fibre preparation and spinning – covering various weaving and patterning techniques, and including the post-making like dyeing or sewing.

It is our approach to study the early beginnings of the diverse textile techniques, trying to locate them in time and geographical region. In this case it is of interest how techniques like spinning, weaving and patterning were developed, and at what time special treatments were invented.

There is also a need for a theoretical background – to understand why there is a progress in textile techniques; why people did not restrain themselves; why inventions and innovations were made. Here we can make use of theories from psychology and neuro-sciences. The American psychologist ABRAHAM MASLOW (1954) analysed human motivation in his theory "Hierarchy of Needs" (*Fig. 1.2*). His theory is disputed (e.g. WAHBA – BRIDWELL 1976), because Maslow sees the needs in a strict hierarchy. However,

Fig. 1.2: Visualisation of Abraham Maslow's Hierarchy of Needs, embedded in prehistoric textiles from Hallstatt (© Natural History Museum Vienna, graph: K. Grömer).

in this paper his main ideas about human needs and motivation are used and discussed. Here the needs are more or less seen as equally standing beside each other.

Maslow points out, that there are physiological and basic needs of life (physiological needs: like food, clothing, a place to live...), and safety needs (security of body, of health, of resources, of property…) which have to be served. The social components (belongingness and love needs) as well as esteem needs are also essential: to affiliate with others, to be accepted, to gain approval and recognition. But also cognitive needs, to know, to understand, to explore, creativity and problem solving are important needs of humans. Aesthetic needs manifest in symmetry, order, elaboration, balance and form. At least, self-actualization needs are an important task of human behaviour, also religion is included here. All of those needs can be found in all cultures and throughout all periods.

All inventions and innovations of mankind can be correlated to those principles. Concerning textiles we can see that they of course serve the physiological basic needs, which are physical requirements for human survival: to keep warm, to protect against weather conditions. If this would be enough, there would be no reason for further development. All of the basic techniques to produce textiles for clothing and other requirements were known since the Stone Age – including spinning and weaving. The invention of complicated techniques for patterns and fine qualities serves much more than a basic practicability of physiological needs. Innovations in textile craft are also a product of esteem, cognitive and aesthetic needs and even self-actualization.

After the basic inventions of the Stone Age, concerning woven textiles there is an innovative period in Bronze Age, in which the main textile culture was still based on simple tabbies. However, we discern an inventive power in Bronze Age – Research Projects on dyestuffs on textiles from Hallstatt proved that dyeing with woad goes back to the Middle Bronze Age (Hofmann *et al.* 2013, 145–147, Fig. 49e, HallTex 211). The first patterns also appear in the Bronze Age: the earliest colour-striped textile in Central Europe dates back to 2000 BC and derives from a grave of a very rich woman from Franzhausen in Austria (Grömer 2012, 30, Fig. 1.1). Tablet weaving also can be traced back to the Middle Bronze Age. A recent find from the salt mine Hallstatt (Grömer et al. 2013, 312–313, HallTex 288) could be identified as the earliest evidence for a tablet-woven band with colour pattern – in this case stripes. Spin or shadow patterns are very distinctive types of patterning. They are typical for the Hallstatt Period (800–400 BC), but they were invented before that. The earliest evidence for spin patterning comes from the Mitterberg near Hochkönig (Grömer 2012, 30–31, Fig. 1.2) – a copper mine and dates back to c. 1600 BC. Different loom types were in use in the Bronze Age, an advanced type of the warp-weighted loom was developed in this period, equipped with more than one shaft – so it was possible to weave twill. Early twill textiles can be identified from Hallstatt, Malanser and Sublaines (Hundt 1988), covering a time-span from 1500–900 BC. There even is a development in respect of fibre preparation and sheep types (Rast-Eicher – Bender Jørgensen 2013).

The early striped fabrics highlight the more or less monochrome textile world of the Bronze Age. But from 800 BC onwards, textiles in Central Europe acquire more and more decoration. As we are able to overview the textile finds from Central Europe, there is a "boom" in the Hallstatt Period. It is the Early Iron Age, where we can recognize a fully developed textile art with different colours, patterns and textile qualities. We can find this not only in aristocratic graves like Eberdingen-Hochdorf (Banck-Burgess 2012), which is a very specialized context, but also in other contemporary graves (Banck-Burgess 1999, catalogue; Bender Jørgensen 2005; Rast-Eicher 2008; Gleba 2008; Grömer 2012, 44–45; 2014, 192–206) and the salt mine Hallstatt. There was a flourishing creativity between 800–400 BC to play with the possibilities of twill weaving in amazing qualities and design.

But why is there such a textile culture, expressing wealth, quality and creativity? What technological, social and economic background of textile innovations did exist in Central European Hallstatt Period that all this could flourish?

From historical and ethnographical studies we know, that there are specific societies, which are very dynamic, where innovations are welcome and can develop. Today's people of Central Europe for example, are members of such a society. On the other hand there are very conservative societies. They do not allow innovations, technical as well as social – extreme examples are the Amish People in Pennsylvania, USA (Kraybill – Johnson-Weiner – Nolt 2013; Amish 1).

To set these ideas in context with prehistory and textile production: from around 700 BC, trends towards concentrations of political power became more marked in Central Europe, this can be seen in a series of aristocratic seats and princely graves in the territory of the Hallstatt Culture (see Cunliffe 1994, 343–351; Vandkilde 2007 166–177). Large settlements with a central function began to appear, which may deserve to be called towns, such as the Heuneburg at the Danube in Germany. Similarly, giant monumental burials such as Eberdingen-Hochdorf or Glauberg might well be perceived as the last tribute paid to a head of society by members of the ruling family. The archaeological manifestation of a "prestige good economy" embraces imported commodities associated with wine drinking, Greek vessels as well as gold, ivory or silver objects. All this is linked to the political and economic potential inherent in this system. Especially in the Hallstatt Period there must have been a social environment, which stimulated creativity and variety. It must have been a very dynamic period, not only concerning textiles, but also in terms of other techniques like bronze casting or pottery making. These techniques reached high standards in the Early Iron Age. With regard to contemporary textiles we see a high degree of complexity. Simultaneously to the basic need of having clothing in Hallstatt Period, the social and esteem needs as well as the aesthetic needs (after Maslow 1954) are expressed via the use of high quality textiles, patterns and imported dyestuffs.

3. Context and Function, Ressource-management – how things are used

The theoretical framework is based on the works of cultural anthropologists Andre Leroi Gourhan's concept of "chaîne operatoire" (1993) and Igor Kopytoff's "Cultural biography of objects" (1986). The chaîne opératoire helps us to understand the production of an object, as well as its use, re-use and disposal; and views it in its social and historical context. In textile research, the theoretical background of this concept is usually applied to investigate the steps of production; how something was made from raw material to the product. In this case the focus also lies on the latter steps which represent decisions made by Bronze Age and Iron Age people, i.e. how the finished product was handled in terms of use, re-use and disposal. This is specified by the concept of the "Cultural Biography of Objects", which highlights the life-history of individual objects in relation to human beings and human behaviour, especially use-wear, repair, context etc.

Austrian finds – together with those of other sites in Europe, allow us to get a systematic view on different purposes which textiles had. Usually textiles are thought primary to have been used for garments, but we can also detect soft furnishings, utilitarian textiles, grave goods, textiles as tools and we even have hints for re-use and recycling (*Fig. 1.3*). Here we like to offer some comments on the identification of garments, as well as on textiles from burial contexts and specific use and re-use of textiles in salt mines.

It is very easy to identify garments in bog finds and oak coffin graves in Scandinavia, especially those found directly on a body. In Central Europe, complete garments are scarce. There are the so-called "leggings" and socks from Rieserferner glacier (Bazzanella *et al.* 2005) – foot wear made of wool twill and abandoned in the Alps at the border between modern Italy and Austria.

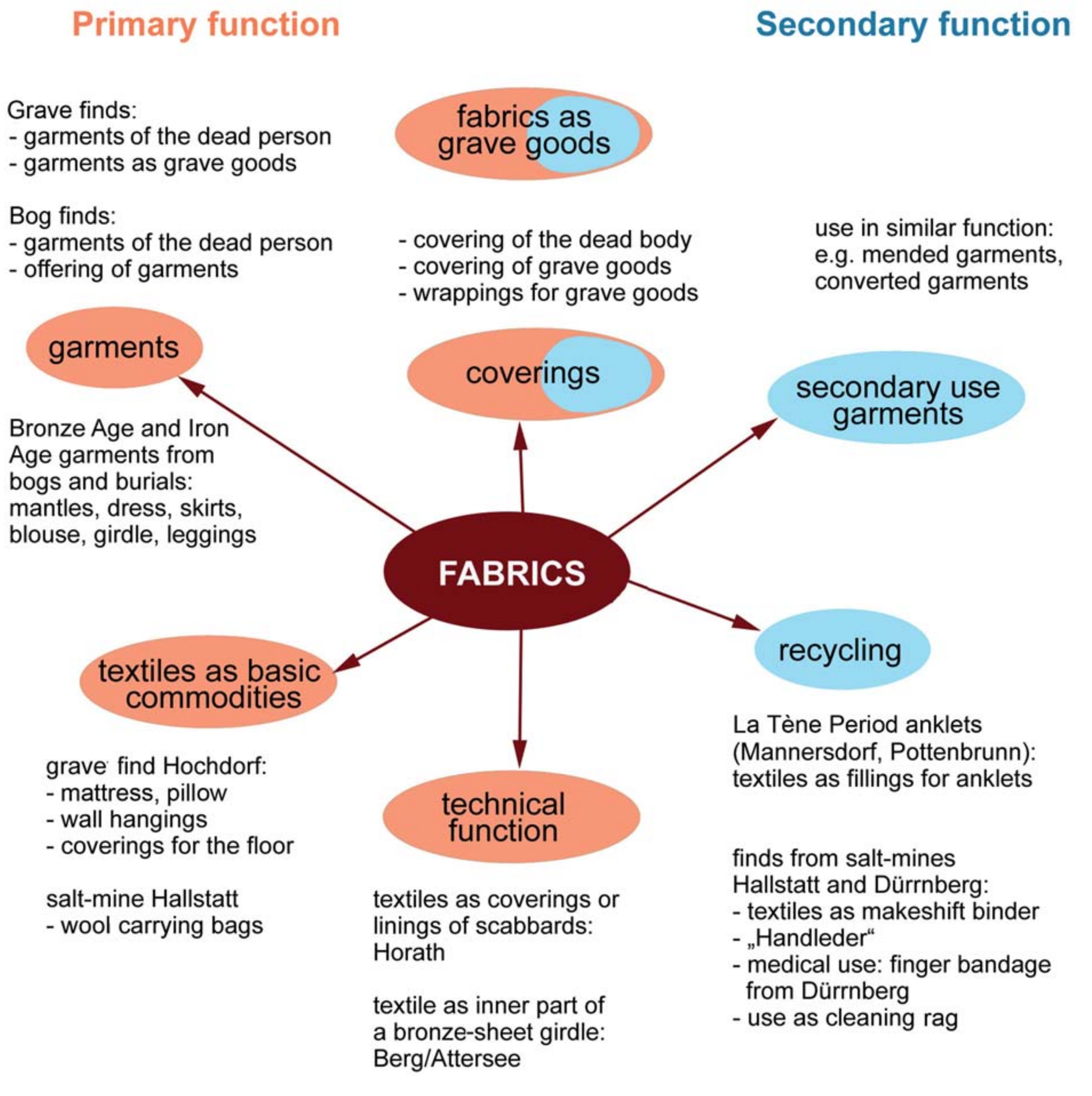

Fig. 1.3: Function of textiles in prehistory (graph: K. Grömer).

Textiles in inhumation graves attached to specific parts of metal dress fittings (e.g. the inner side of belt plates or fibulae) can be interpreted as remnants of garments as well. They provide hints for the quality of garments, revealed in the technical data of the fabrics. From Austria, cloth remains were analyzed from graves covering a time-span from 2200 BC–1000 AD. The focus of the research laid on the Roman period, within the project DressID (GRÖMER 2014). In this case, the textiles can be discussed in terms of the qualities of different garments (mantles, tunics, veils), gender and age.

Another context is offered by the salt mines at Hallstatt (GRÖMER – RÖSEL-MAUTENDORFER – RESCHREITER 2013) and Dürrnberg (STÖLLNER 2005), where we found more than 1000 textiles covering a time-span from 1500–300 BC. They survived as more or less small fragments in the mining waste and usually we have no idea what they were used for. In prehistoric times, they could have been parts of clothes, wall hangings, textiles to sit on, carrying bags and so on. How can we know, if a specific item was used as a garment in former times? There are some tablet-woven bands (Hallstatt: Grömer *et al.* 2013, HallTex 123; Dürrnberg: Grömer – Stöllner 2011), which can be identified as formerly sewn onto a sleeve of a tunic. In other cases this is not as clear, but from the salt mine at Hallstatt (Grömer – Rösel-Mautendorfer – Reschreiter 2013, 126–128; HallTex 32, 34, 40 and 292), we know some examples of textiles of different types (coarse tabby, fine twills with spin pattern, medium fine twill), in which body lice (*pediculus humanus corporis*) or nits were found, usually in rolled hems. Human body lice have the human person as their natural habitat (Buxton 1947, 5–23); in their natural state, body lice have evolved to attach their eggs to clothes. To live, lice must feed on blood; if separated from their hosts, lice die at room temperature. To follow our interpretation, those textiles with human body lice should have been clothes before their discard in the mine.

With luck, human body lice can even be found in graves. Those finds are useful to answer specific research questions: The Roman period (4th century AD) grave from Göttweig (Grömer 2014, 232, Tab. 20) may serve as an example: it is a grave of a child, equipped with a pot, necklace and bracelets of bronze, iron and bone (*Fig. 1.4*). On the inner side of the bronze bracelet a fine tabby was found, maybe it belonged to a long-sleeved tunic with the bracelet worn over it. It is significant that on the textile a louse could be identified. This is good evidence that this garment was worn by the child in everyday life as well. It was not just a funeral dress.

Grave finds allow deep insights into the practice and even beliefs of prehistoric people, however, without written sources, they are difficult to interpret. In Central Europe textiles were commonly used for several funeral rites. The Iron Age rite of wrapping of grave goods was analyzed by Johanna Banck-Burgess (1999; 2002, 139–148). Her theories based on the find of Hochdorf suggest that the textiles, being an integral part of the burial ceremony, cover the burial gifts and withdraw them from visibility and as such transfer them to a different semantic level.

Fig. 1.4: Göttweig, Roman period child's grave, textile with body louse (photos: A. Schumacher; SEM picture: S. Mitschke).

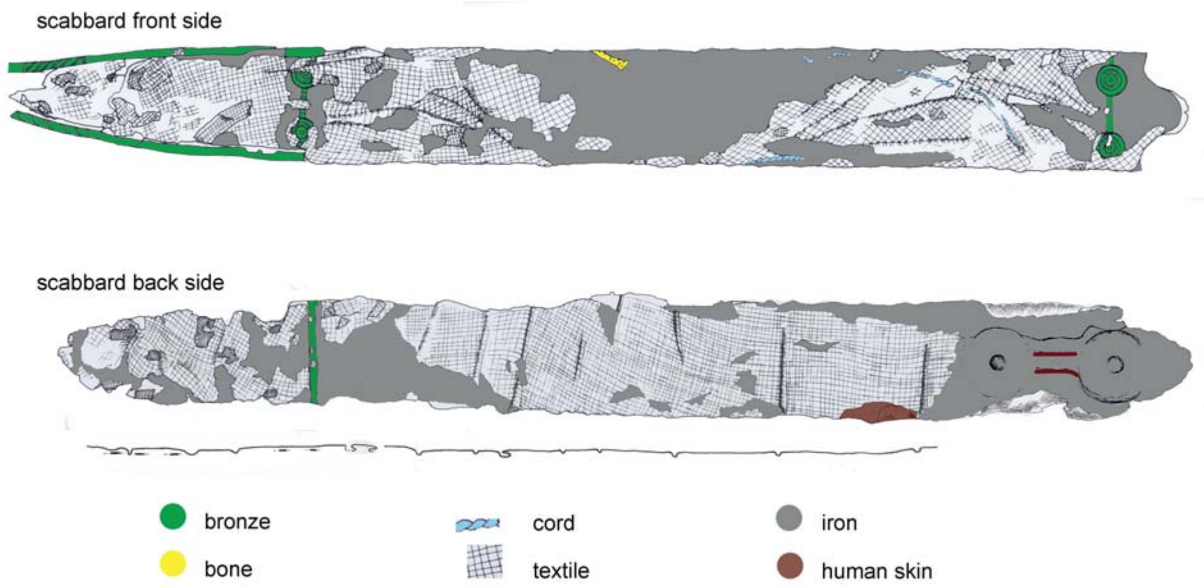

Fig. 1.5: Gemeinlebarn, celtic scabbard with textile wrapping (drawing: K. Grömer).

From Austria, there are some new finds, displaying this kind of rite. Recently, a Celtic warrior was excavated at Gemeinlebarn (Preinfalk – Preinfalk 2014), next to his right hand a sword in a scabbard was found with a well preserved textile wrapping. It is a big sheet of medium fine linen, covering the scabbard (*Fig. 1.5*).

Besides the glimpse into religion and cults in the Iron Age – especially offered by the textiles used as wrappings in a funerary context – we can see object biographies.

In Hallstatt there was a salt mining centre, where from Bronze Age onwards (about 1600 BC) and especially in the Iron Age, salt was taken out of the mountain. Various textiles have been found, embedded in the salt. Some of the Bronze Age textiles also served as tools for salt mining (Grömer – Rösel-Mautendorfer – Reschreiter 2013, 121–125). During excavations, a "filling station" was identified, a location of a shaft leading from the gallery, where the salt was broken, to the surface. The textiles from this context are very coarse with reinforced edges. They are interpreted as carrying sacks or hauling textiles, into which salt was filled and brought out of the mine.

The context and the appearance of the salt mine textiles from Hallstatt and Dürrnberg also provide us with interesting ideas about resource management and recycling (*Fig. 1.6*). Sometimes we find fabrics torn into stripes and or with a knot (Hallstatt: Grömer, Rösel-Mautendorfer – Reschreiter 2013; Dürrnberg: Stöllner 2005). We think that maybe the textiles also were collected outside the mine and brought in to serve special purposes. Maybe they were used to bundle something or as makeshift binding material. A well known example for such a purpose is an old find from Dürrnberg – a patterned band wrapped around a broken tool handle. Sometimes we can detect "recycling" – making something new from a worn-out textile. HallTex 97 from Hallstatt saltmine may serve as an example (*Fig. 1.6*). This was formerly a part of a garment, there is a fine seam, stitched in dark brown thread. But after wear and tear it was re-sewn with a coarse yellow thread, turning the textile into something else. Now it looks very like some leather items, which we call *"Handleder"* serving as a protection for the hand when handling tools and ropes in the mine.

The last described item is a good example for chaîne operatoire and the cultural biography of an object, as it tells about the production, use and re-use in a specific context. The production of textiles was very time-consuming. Marks of repair and mending tell us that the "resource textile" was valuable.

Fig. 1.6: Hallstatt Early Iron Age textiles with marks of re-use: torn into strips, with knots and secondary seams (© Natural History Museum Vienna).

4. Final words

In Austria, analyses of textiles from archaeological excavations are increasingly the focus of scientific research. Using modern methodology and various theoretical frameworks, new approaches and research questions are studied by the Natural History Museum Vienna. Two of the topics (Innovations and Traditions – change over time; Context and Function, Resource-management – how things are used) shortly have been summarized here. Broader conclusions and discussions of the other research questions mentioned in the introduction have been published elsewhere (Grömer *et al.* 2013; Grömer 2014; 2015).

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2 | Mining for Textiles – Textiles for Mining
Preliminary Report on Textiles from Gold Mining Sites in Austria

BEATRIX NUTZ

Abstract: Surveys at former gold mining sites at altitudes above 2.400 m a.s.l. in Carinthia and Salzburg yielded numerous finds of timber, leather (mainly shoe fragments) and textiles. At the sites – being covered with glacial ice – organic materials have been preserved and now resurface due to global warming. The retrieved textile and leather fragments can be dated to the 15th to 17th centuries, the main operating times of the mines. The woven, knitted and felted fabrics belong to fragments of clothing, for example two knitted caps dating to the 16th century and the fragment of a pleated shirt, or are parts of hauling bags and other mining equipment. Based on the analyses of the finds this paper discusses the use of textiles in high alpine mining areas.

Keywords: Alps, gold mining, textiles, mining equipment, hauling bags, knitted caps

1. Gold mining sites in Carinthia and Salzburg and their textile finds

Surveys in the former gold mining sites (*Fig. 2.1*) of the "Hinteres Freudental" and the "Goldzeche" at the Zirmsee in the upper Great Zirknitz and Kleinfleiss valley (Carinthia) as well as in the "Schmiede-Wintergasse" in the Rauris valley (Salzburg) yielded numerous finds of organic material including wood, leather (mainly shoe fragments) and textiles. The retrieved textile and leather fragments can be dated approximately to the 15th to 17th centuries. The current age estimation is based on the operation time of the mines and the onset of the so-called Little Ice Age, a period of relatively cool climate beginning in the 15th century and lasting to the 19th century. During its peak in the middle of the 17th century and up to the mid–19th century glacial advance made mining at great heights very difficult, if not impossible, thus putting a stop to mining activities at high altitudes. At the sites – being covered either with glacial ice or snow patches – organic materials such as textiles and leather have been preserved and now resurface due to global warming[1]. Thus, these findings offer a very rare, if not unique, opportunity to investigate equipment and clothing of early modern miners.

The woven, knitted and felted fabrics are fragments of clothing, for example two knitted caps dating to the early 16th century and a fragment of a pleated shirt. Others are parts of hauling bags and other mining equipment. At none of the sites has archaeological excavation taken place so far and all finds were either picked up from the surface or were dug out at repeated short visits by archaeologists, mineralogists or laymen interested in mining history, without further documentation of the features (except for a few photographs)[2]. Also, due to minimal funding no radiocarbon dating and no fibre or dye analyses have been done to date. The analysis basically consisted of a visual examination and the use of a Dino-Lite Pro HR microscope. Only the linen shirt has received professional conservation carried out by Hanna Grabner. All other textiles have only been subjected to cursory cleaning.

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1 Glacial archaeology (also: ice patch or snow patch archaeology) has become increasingly important over the last couple of decades (Dixon – Manley – Lee 2005).

2 Rapidly changing weather conditions do not allow an extended stay and in colder years the sites are not free of ice. Therefore this "mining for textiles" can only take place as opportunities (ice free, good weather) arise.

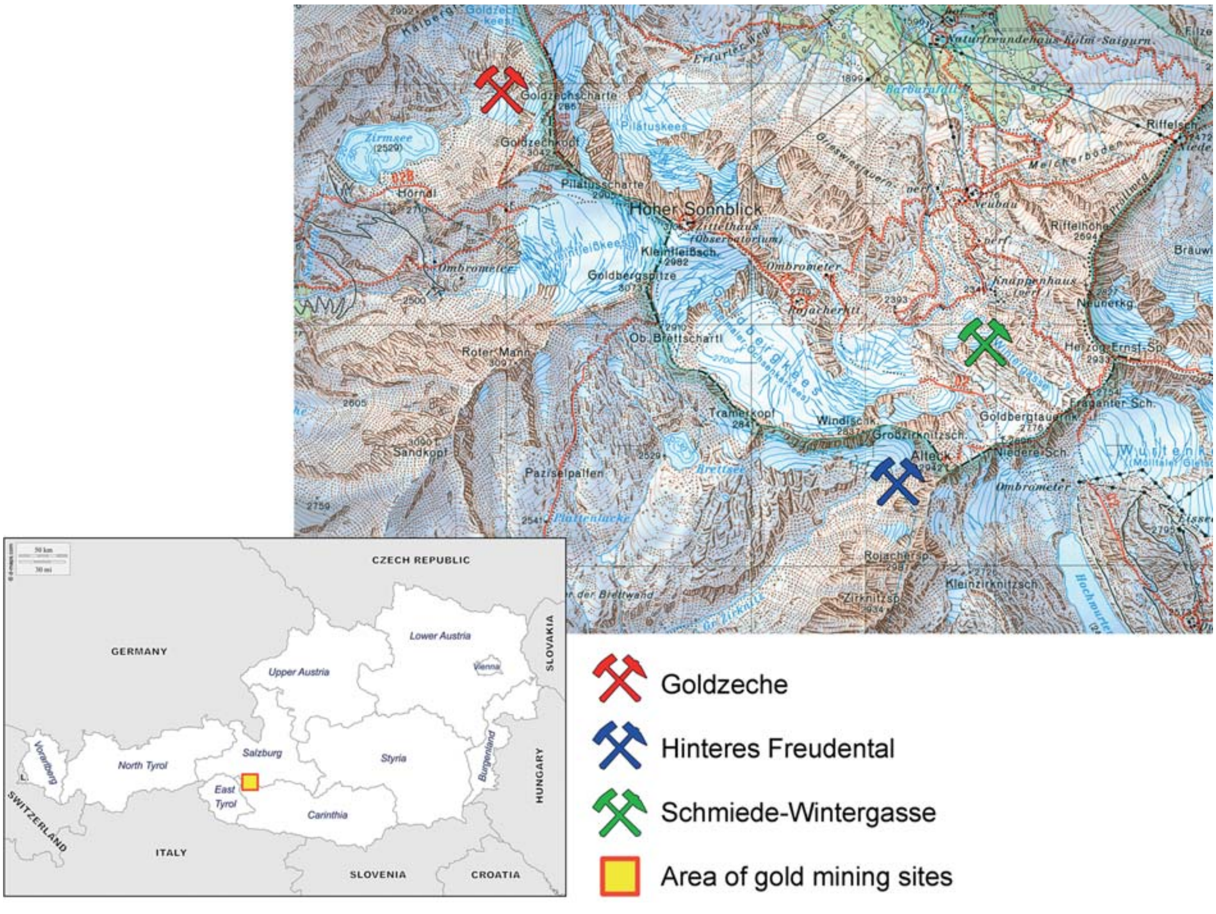

Fig. 2.1: The mining sites Goldzeche, Hinteres Freudental and Schmiede-Wintergasse. Detail of ÖK 1 : 25.000, page 154, Rauris (graph: B. Nutz).

1.1 The site "Hinteres Freudental" at an altitude of 2.721 m a.s.l.

The finds from this site come from an area surrounding a mine entrance, since a corresponding wooden construction was visible. Unfortunately, the site was disturbed by a recent rockslide now making the area inaccessible. From this mining site 101 woven textile fragments, five felt pieces and one knitted fragment have been salvaged to date.

1.2 The "Goldzeche" at an altitude of 2.737 m a.s.l.

The gold mine "Goldzeche" in the Sonnblick group close to the glacier was one of the most famous and richest mines for gold and silver ores. Early written records date back to the middle of the 15th century and mining activity was done on and off up to 1876 when the mine was finally abandoned after an avalanche damaged the site (KÄRNTNER LANDESAUSSTELLUNGSBÜRO 1995, 84). First owned by the family Putz (Austria-Forum), then the Stampfers (SALZMANN 2007), the mine came to be owned by the Jenner of Vergutz (CORNET 1939) who were very successful in the 18th century.

The site "Obere Goldzeche" (= Upper Gold Mine) includes the remnants of the former miner´s house (parts of the foundation wall are still visible). The house was built-on to the adit[3] in order to provide easy access to the mine without exposing the miners to the harsh weather. Mining took place mainly during the winter months when the hauling bags, several tied together to form "trains", could be easily slid downhill on the snowy slopes. Except for one of the felt caps, all textiles recovered were found inside or in the vicinity of the ruins of the house. The felt cap with the inventory number GZ 0001 was found stuck in a crevice inside the mine right behind the adit[4].

Number of textile finds to date: 144 woven fabrics, two knitted fragments and one knitted cap, four felt caps/hats, 19 felt fragments and one fragment consisting of two layers of woven fabric and one layer of leather patches sewn together with leather thongs.

1.3 "Schmiede-Wintergasse" at an altitude of c. 2.400 m a.s.l.

The "Schmiede-Wintergasse" (= Smithy-Winter Alley) is, as the name implies, the area of a former smithy situated in a gully where snow patches remain all year round (Paar – Günther – Gruber 2006, 73, Fig. 33). As with the other two sites no documentation of any features took place.

Number of textile finds to date: 98 woven textile fragments, 17 pieces of felt and one knitted cap consisting of two larger and three smaller fragments.

2. The textile finds

2.1 Woven fabrics

The woven fabrics can be roughly divided into two groups: coarse fabrics being fragments of hauling bags or maybe blankets and finer fabrics used for garments.

2.1.1 Hauling bags or blankets

Hauling bags full of ore (on their underside protected against friction by pigskin with bristles) were strung together in long trains and slid downhill in serpentines in a prepared channel (*Sackzugrinne*) in the snow (*Fig. 2.2*). On the first bag of each train sat a pitman who used his brake stick (*Leitstecken*) to direct the heavy transport. Sometimes a dog ran at the end of the train and after the bags were emptied the dog carried them back uphill. Sometimes the bags were carried back up the mountain by the miners themselves. Such scenes can be seen in a book illustration of the Khevenhüller chronicle (Dinklage – Kornauth 1980, 117–119) and in oil paintings from the 18th century. Both oil paintings depict the "Goldzeche", once in 1740 (*Fig. 2.2*) and again in 1746[5] (*Fig. 2.3*). The votive image of 1746 shows an avalanche tragedy, in which ascending miners and hauling-bag pullers (*Sackzieher*) were buried. A hauling bag train channel (*Sackzugrinne*) can be seen running down from the upper to the lower miner's house (*Fig. 2.3 left*). The miners wear everyday clothes, carry mallets, and on their backs rolled up ore bags in which a brake stick (*Leitstecken*) is placed (*Fig. 2.3 detail view right*).

The coarse wool fabrics are either woven in tabby with single yarns or in twill weave with plied yarns with no more than four threads per centimetre. Most certainly the fabrics in tabby with single yarns (WG 0012) were once used as hauling bags. Fabrics in chevron (FT 0003, GZ 0011 and

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3 An adit (from Latin *aditus,* entrance) is an entrance to an underground mine which is horizontal or nearly horizontal.

4 According to the oral report of the finder Helmut Prasnik.

5 Votive image in the small chapel of St. Anna in Ranach, Carinthia.

Fig. 2.2: Detail from an oil painting c. 1740. You can see the miner´s houses of the Upper and Lower Goldzeche (left) and two bag trains (right). This copy is housed in the Tauern Gold Museum in Großkirchheim (Carinthia), the original is in the Distretto minerario in Trent and another copy is found in the State Museum of Carinthia (photo: B. Nutz).

GZ 0012) and lozenge twill (GZ 0008), the twill weave accentuated by the use of two differently coloured threads, seem too elaborate for mere hauling bags and could also have been used for other purposes (for example, as blankets). But maybe coarse twill fabrics were inexpensive and readily available in the area so that it was not considered a waste to use them for bags. In addition, the plied yarns probably made for more tear-resistant fabrics needed especially for the transport of heavy, sharp-edged pieces of ore. Some fragments have sections of selvedges preserved and none show signs of cutting or sewing. However, as plant fibres such as flax are badly preserved, very brittle and in most cases completely decayed, linen sewing thread can only be found in rare cases and holes left in the fabric from sewing would not show in the coarse fabrics as they do in the finer fabrics used for clothing.

A find from the "Goldzeche" that could also be the underside of a hauling bag consists of two layers of finer wool fabrics and a layer of several leather patches. All layers are sewn together with leather thongs (GZ 0009). Although both fabrics are of the finer type usually used for garments with 8–9 threads/cm, the two layers could have achieved the same sturdiness as the coarse fabrics. In addition, the leather patches might have provided the necessary protection against friction when the bag was slid downhill.

Fig. 2.3: Votive image of 1746 in the chapel of St. Anna in Ranach, Carinthia, showing an avalanche tragedy (photo: B. Nutz).

2.1.2 Linen shirt (GZ 0007)

In contrast to the abundant wool fabrics obtained so far, only one single large piece of linen was found. This fact, as well as the fragile state of preservation of the piece and the general fragility of the few remnants of linen sewing threads, leads to the assumption that the conditions for the preservation of plant fibres at the sites are extremely poor. Therefore not only the size (a maximum of 56x70 cm) of this textile is remarkable but also that it can be easily identified as a shirt fragment.

A very similar, albeit smaller, boy-sized[6], shirt dating to the second half of the 16th century was found in in a vault beneath the dormitory of the monastery of Alpirsbach, Germany. As this shirt was completely preserved it was possible to reconstruct the pattern (Fingerlin 2001, 753, Fig. 733 and pp. 799–800). The same pattern in a larger scale suited for an adult can be applied to the shirt from the Goldzeche. A shirt dating to the 16th/17th centuries from Tyrol Castle in Italy, also found beneath floor boards and patched multiple times, has a narrower collar of a height of 2.3 cm but an almost identical collar size of 44 cm and a shoulder length (due to a slightly different cut) of 13 cm (Tomedi 1998). Both shirts were closed with hooks and eyes.

2.1.3 Wool garments

Most of the textiles are probably parts of clothing, although due to their fragmented state the type of garment can no longer be determined. The fabrics are made in tabby or twill and most are fulled and/or napped on one side[7]. Some show seams, hems or even eyelets, but the linen sewing thread has almost always decayed leaving only tiny holes in the cloth. Due to the decay of the sewing thread, pieces that were once sewn together have come apart and no longer form a unit. In addition, a couple of pieces were apparently reused as sections appear to have been cut off, maybe to serve as repair patches on other garments. Such an oval-shaped repair patch was used on a larger blue fabric (FT 0002). The oval patch

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6 Collar size: 32 cm, collar height: 4 cm, shoulder length 12 cm.

7 This results in Loden, a fabric where loosely woven cloth undergoes a lengthy process of shrinking, eventually acquiring the texture of felt and becoming quite dense. It is then brushed with a fuller's teasel and the nap is clipped.

with a length of 13.5 cm covered an equally oval hole with a length of 11.2 cm. Under the Dino-Lite microscope the sewing thread can still be seen in some places around the edge of the patch. It seems as if, after having been repaired itself, the larger cloth served as a supply for repairs for other garments. While two edges still maintain their seams, other edges are cut and frayed. This makes it very difficult to discern the former cut and pattern and to determine to what type of garment it belonged.

Besides the two blue textile pieces another eleven fragments and some smaller scraps of the same fabric were block lifted at the Freudental site together with six larger pieces (and again some scraps) of beige-brown wool fabric (FT 0001), the largest with a size of 130x40 cm. It is possible that they all once belonged to the same garment, maybe as two differently coloured layers (outer layer and lining). The brown fabric is napped on one side and woven in balanced plain weave with s- and z-spun single yarn (thread diameter: 0.4 mm; 12 threads/cm). In places where the sewing thread is preserved it is an S-plied two-ply-yarn with a thread diameter of 0.5 mm. Both running stitch and whip stitch were used.

Textile pieces preserved intact are small gussets, which also do not reveal the garments they belonged to (WG 0004 and WG 0005) and even textile fragments that reveal their function do not give away the shape of the complete garment. A strip of cloth with a row of paired eyelets (WG 0006) was meant for fastening, but to fasten what?

The general gist is that most textile finds in mining areas are more likely to be part of miners' clothing and therefore cannot summarily be ascribed to mining equipment.

In his publication on the copper mining area, Blindis-Tögisch in East Tyrol,[8] Richard Pittioni labelled all textile finds (excluding the felts) as fragments of hauling bags (*Erzziehsäcke*) (Pittioni 1986, 16). Fortunately Pittioni published all textile finds on a 1:1 scale, thus enabling rough measurements of thread diameters and thread counts even without access to the finds themselves. The fabrics from Blindis-Tögisch are in most cases in open tabby weave[9] with thread diameters up to 1 mm and thread counts of 5–6 threads/cm. It is disputable whether they were sturdy enough to haul heavy ore. Given the open weave and that the textiles were found in the ore sorting waste dump and not near a miner´s house, it is unlikely that they belonged to clothing. Maybe they were used in ore dressing. Spread out in buddles (in German: *Schlammherd or Waschbühne*)[10] the fabrics could have been used to remove the concentrated ore by bundling the corners of the cloth and hoisting it out of the trough. The open weave would then function similar to a sieve draining off the excess water. Several consecutive buddling dishes at the "Waschgang" in Carinthia are depicted on an oil painting from 1740 (Kärntner Landesausstellungsbüro 1995, 83).

With respect to the three sites in Carinthia and Salzburg it leaves us with the question why there are so many fragments of dress fabrics compared to coarse bags. For the site in Salzburg the answer is easy. The site is in the neighbourhood of a smithy, where the metal tools required for mining were forged or repaired with no need for hauling bags. The two find spots in Carinthia are areas surrounding adits and miners' houses where many people would be around wearing clothes that were in need of repair or were discarded if not repairable. Hauling bags are more likely to be damaged on the way downhill during the transport of the ore. If damaged beyond repair, the miners would certainly not bother to drag them back up the mountain to the mines and miners' houses but leave the tatters along the route or in the valley.

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8 Late medieval to early modern times copper mines at an altitude of about 2.400 m a.s.l.

9 The spaces between the warp and weft threads are in the 1 mm range.

10 An apparatus (such as an inclined trough or platform) on which crushed ore is concentrated by running water which washes out the lighter and less valuable portions. From: Merriam-Webster (link). Also called buddling dish, slime [concentrating] table, slime washer, miners (flat) frame, framing table, sludge mill. See: Schmidt 1981, 51, 606 and 676).

2.2 Knitted textiles

2.2.1 Knitted fragments of undetermined function

Only five textiles from all three sites are knitted, two caps knitted in plain stitch and three fragments of undetermined function, knitted in stocking stitch. Among the latter is a small (max. width: 15 cm, max. height: 13 cm), slightly triangular, dark brown piece with three stitches per centimetre from the Goldzeche and a rectangular light brown piece (max. width: 30 cm, max. height: 20 cm) with only two stitches per centimetre from the Freudental. The third, very small, fragment is probably a part of the triangular piece from the Goldzeche.

2.2.2 Knitted caps[11]

The partial remains of two knitted caps found in the Austrian mines are similar to other examples in European museum collections in terms of the materials used and the methods of manufacture. The crown diameters and head circumferences suggest that they were meant for adult men. Both were knitted in the round on four or five needles using plain (not purl) stitches.

Approximately three-quarters of the Goldzeche example (GZ 0002), including the crown centre, give a fair impression of the original cap. The estimated crown diameter is 9½ inches (24.13 cm). It was probably flat with a single brim of about ¾ inch (1.9 cm) wide running the full circumference of the cap, which is estimated at 29¾ inches (75.56 cm). The stitch counts are 6 per inch (2.36 per cm) for the crown and 7 per inch (2.75 per cm) for the brim and the rows counts are 9 per inch (3.54 per cm) and 9½ per inch (3.74 per cm) respectively. The cap's current dark brown colour suggests it was originally knitted with z-spun 2-ply undyed woollen yarn which was later dyed black. The unusual feature of this cap is the band of decorative stitching running around the circumference at the turn and underside of the brim. Holes and remnants of what appears to have been sewing thread in the fabric where the brim and the crown meet suggest that a ribbon or cord has been attached to the cap as additional decoration. A similar feature is probably depicted on a floor tile dated 1536–1565 at the Museum of London (line drawing after MOL A25388). The cap also shows signs of mending.

There are two remaining sections of the Schmiede-Wintergasse example (WG 0001), which give a partial impression of the original cap. The estimated crown diameter is 9¾ inches (24.76 cm). Two sections of the brim and the crown (including an almost complete centre) suggest that this was a split-brimmed cap worn with one brim overlapping the other above the wearer's ears. Both brim sections are about 1¼ inches (3.17 cm) wide. The head circumference is estimated at 32¾ inches (83.18 cm). The stitch counts are 7 per inch (2.75 per cm) for the crown and 5 per inch (2.95 per cm) for the brim and the rows counts are 9 per inch (3.54 per cm) and 10 per inch (3.93 per cm) respectively. Each brim is double-layered and has rounded ends at the overlaps. Its current red brown colour suggests it was originally knitted with z-spun 2-ply undyed woollen yarn which was later dyed red when the cap was complete.

2.3 Felts

The original function of most felt fragments is no longer determinable, although some of them seem to have been part of felt caps or hats that have been reused as padding, repair patches or insoles. A felt strip with a length of 25 cm, an average width of 7 cm and a thickness ranging from 16 to 17 mm might have been used as padding for a carrying strap.

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[11] Many thanks to Jane Malcolm-Davies and Hilary Davidson for the analyses of the knitted caps. The text relies partly on a description by Jane Malcolm-Davies. For more information on knitted caps see Malcolm-Davies – Davidson, in this volume.

2.3.1 Felt caps or hats

An almost completely preserved felt cap and two felt hats were found at the “Goldzeche”. A fourth felt cap was located on an ice patch in the vicinity of the mine. It is not certain whether this cap can be associated with the mining industry, or if it was lost by a shepherd or mountaineer. On the inside, the brand of the hat maker, a heart shaped from (laurel?) leaves enclosing the initials S. A., has been burned-in twice.

The felt cap number GZ 0004 with earflaps or cheekpieces (the one on the right side is missing) shows a tabbed edge that has been partially cut off at the back probably because the tabs annoyed the wearer on the nape of the neck, although the tabs may have been cut into the edge of the cap not only for decorative purposes but in order to soften it and make the cap more comfortable to wear. The serrated brim of hat number GZ 0001 could have served the same purpose but was most likely not cut into the edge by the hat maker but at a later date by the owner. A similar felt hat, found on a flea market in Innsbruck, whose last known use dates to the second half of the 20th century, was presumably serrated to soften the very greasy and stiff edge acquired during many years of wear[12].

The most interesting felt artefacts found are not the complete hats, but a hat with a cut-off crown and the crown of another hat as they demonstrate secondary use. The hat (GZ 0016), with a brim circumference of 79 cm, was originally decorated with a hat string (now missing), whose imprint, as well as the holes left by the sewing thread fastening the string to the hat, can still be seen. After the hat string had been removed, a vertical cut, starting at the brim, was made up to approximately half the height of the crown and then all around the crown[13]. The cut off piece of this hat has not been found to date but a similar hat crown suggests its use[14]. Stitch holes all around the edge[15] of the round, domed felt piece (GZ 0015) points to it having been sewn onto another fabric, maybe as padding or repair patch. Its domed shape would make it well suited as an elbow or knee pad.

3. Conclusion

This preliminary study has shown that significant data on textile use at high altitude mining sites can be gained, even though access to the sites is limited to only a couple of days each year. It is possible to collect a more or less representative range of textiles by repeated visits to the mining area, providing insights into textile use in late medieval and early modern alpine mining areas. Hopefully, future funding will enable further research and will make it possible to undertake radiocarbon dating and dye analyses.

4. Catalogue of the objects shown in the figures (*Fig. 2.4–2.9*)

4.1 Freudental

FT 0002 (*Fig. 2.7*): Blue wool fabric of 53x39 cm with a matching oval-shaped patch 13.5x9 cm. 1/2 twill fulled and napped on one side (detail, right: fully preserved pile, left: pile partially worn showing the threads beneath). S- and z-spun single yarn, warp and weft not distinguishable, thread diameter 0.3–0.4 cm, 9–14 threads per cm. The preserved seams are sewn with overcast stitches.

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12 A badge from a carnival in Innsbruck dating to 1971 is pinned to the hat. Therefore the “teeth” could also have been cut into the brim for decorative purposes.

13 Probably with scissors, as the use of a knife would not have necessitated the vertical cut.

14 As the two felts vary in their thickness they do not belong to the same hat.

15 Inv.No. GZ 0015 – stitch holes highlighted by red arrows.

FT 0003 (*Fig. 2.5*): Selvedge. S-plied two-ply yarns in warp and weft. Light brown warp threads and dark brown weft threads, both with thread diameters up to 2.5 mm. 4 threads per cm warp and weft. 2/2 chevron twill. Size: 58x16 cm.

4.2 Goldzeche

GZ 0001 (*Fig. 2.9*): Felt hat with serrated brim, felt thickness: 3.2 mm.
GZ 0002 (*Fig. 2.8*): Single brimmed cap knitted with Z 2-ply-yarn, crown diameter: 9½ inches (24.13 cm); head circumference: 29¾ inches (75.56 cm); stitches in cap: 6 per inch (2.36 per cm); rows in cap: 9 per inch (3.54 per cm); brim width: ¾ inch (1.9 cm); stitches in brim: 7 per inch (2.75 per cm); rows in brim: 9½ per inch (3.74 per cm). Current colour: dark brown. Probable original colour: black.
GZ 0004 (*Fig. 2.9*): Felt cap with earflap or cheekpiece and tabbed edge, felt thickness 3 mm. Length of flap: 9.8 cm.
GZ 0007 (*Fig. 2.6*): Fragment of a shirt in tabby, with the band collar and the seams of the left shoulder and sleeve almost completely preserved. A repair patch from a slightly coarser plain woven fabric was sewn onto the area of the left shoulder. Z-spun single yarn in warp and weft, varying thread diameters ranging from 0.3–1 mm, warp threads generally thinner. 7 threads per cm warp, 9 threads per cm weft. Repair patch on left shoulder: 6 threads per cm warp, 9 threads per cm weft. Sewing thread: S-plied two-ply yarn, thread diameter 0.7 mm. Collar size 43 cm, collar height 5.5–6 cm, shoulder length 19 cm. Half fell seams with back and whip stitches, patch sewn onto the shirt with whip stitches. Running stitch on upper end of collar. On the right side of the collar stitches of the former fastening are visible. It can no longer be determined whether a button or metal hooks and eyes were sewn onto the shirt but comparisons with other finds suggest hook and eye.
GZ 0008 (*Fig. 2.4*): S-plied two-ply yarns in warp and weft. The warp threads show bluish colour, weft threads are a light brown, both with a thread diameter of about 1.5–2 mm. 4 threads per cm warp. 3 threads per cm weft. 2/2 lozenge twill. Size: 27x1 cm.
GZ 0009 (*Fig. 2.6*): One dark brown, almost black and one brown wool fragment. Both textiles: Z-spun yarn in warp and weft, tabby, approx. 8–9 threads per cm, napped on one side. The napping makes measuring thread diameters and thread count difficult. The textiles are sewn together, the napped sides facing each other. Irregular pieces of leather, animal species undetermined. All layers sewn together with leather thongs. Size: 37x28 cm.
GZ 0012 (*Fig. 2.5*): One large (GZ 0011: 56x43 cm) and one smaller fragment (GZ 0012: 18x10 cm) both with selvedge. S-plied two-ply yarns in warp and weft. Light brown warp threads and dark brown weft threads, both with thread diameters of approx. 2.2 mm. 4 threads per cm warp and weft. 2/2 chevron twill.
GZ 0015 (*Fig. 2.9*): Cut-off crown of brown felt hat? In secondary use probably as padding. Circumference: 37 cm. Felt thickness: 2-2.3 mm.
GZ 0016 (*Fig. 2.9*): Brown felt hat with cut crown. Brim circumference: 79 cm (graphic, A), head circumference: 56 cm, circumference of cut off piece: approx. 53 cm. Felt thickness: 2.8–3.8 mm. The hat was decorated with a hat string that is now missing, but whose imprint, as well as the holes left by the sewing thread fastening the string to the hat, can still be seen.

4.3 Schmiede-Wintergasse

WG 0001 (*Fig. 2.8*): Split-brimmed cap knitted with Z 2-ply yarn, est. crown diameter: 9¾ inches (24.76 cm); est. head circumference: 32¾ inches (83.18 cm); stitches in cap: 7 per inch (2.75 per cm); rows: 9

Fig. 2.4: Textiles from Goldzeche and Schmiede-Wintergasse, with technical details (photos: B. Nutz).

Hinteres Freudental, Inv.No. FT 0003

Inv.No. FT 0003
plied yarn, Dino-Lite 40x

Goldzeche, Inv.No. GZ 0011

Inv.No. GZ 0012

Inv.No. GZ 0012
plied yarn, Dino-Lite 55x

Fig. 2.5: Textiles from Hinteres Freudental and Goldzeche, with technical details (photos: B. Nutz).

Fig. 2.6: Wool textile and fragment of a shirt from Goldzeche, with technical details (photos: B. Nutz).

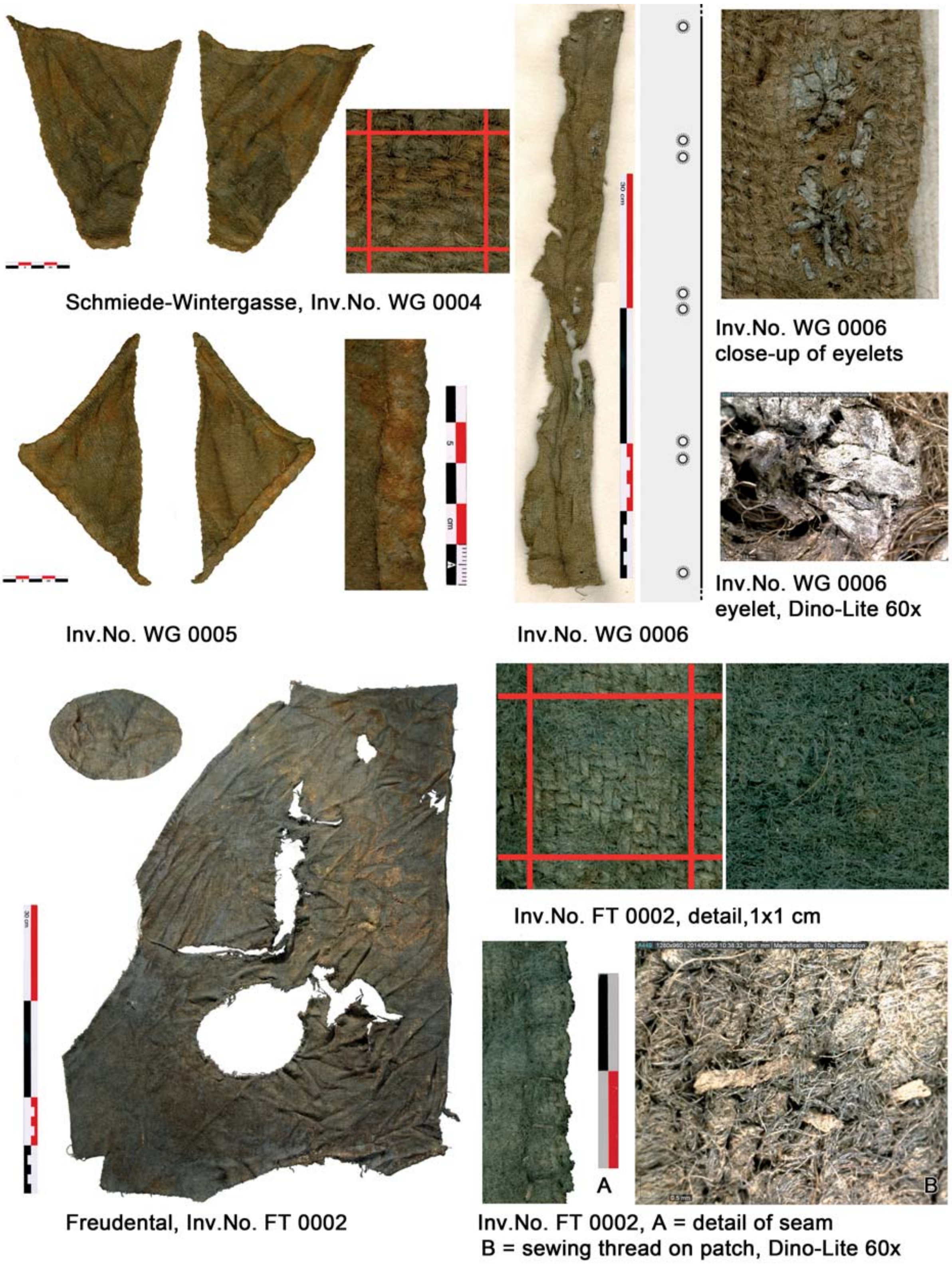

Fig. 2.7: Gussets from Schmiede-Wintergasse and blue textile from Freudental, with technical details (photos:B. Nutz).

Fig. 2.8: Knitted caps from Goldzeche and Schmiede-Wintergasse, with technical details (photos: B. Nutz).

Fig. 2.9: Felt cap and hats from Goldzeche, with technical details (photos: B. Nutz).

per inch (3.54 per cm); brim width: 1¼ inches (3.17 cm); stitches in brim: 5 per inch (2.95 per cm); rows in brim: 10 per inch (3.93 per cm). Current colour: red brown. Likely original colour: red.

WG 0004 and WG 0005 (*Fig. 2.7*): Two triangular gussets made from the same fabric napped on one side and fulled either intentionally or due to wear and frequent washing. The fulled surface has partially worn off but still causes difficulties determining the technical properties of the fabric. Z-spun yarn in warp and weft, thread diameter approx. 1 mm, twill weave, approx. 10–12 threads per cm. WG 0005 with seam on two sides. The seams are folded once and sewn with tight overcast stitches on the edge giving it a wavy look (Inv.No. WG 0005 – detail). Edges without folded seams were sewn in the same way also giving them a wavy appearance. Sizes: WG 0004 = 18x13 cm. WG 0005 = 19x9 cm.

WG 0006 (*Fig. 2.7*): Strip of fabric with a preserved length of 42 cm in tabby, napped on the inside. The right edge is folded once and shows a row of paired eyelets, three complete pairs and two single eyelets on the narrow ends with one eyelet missing each. Warp z- and weft s-spun single yarn, thread diameter 0.5–1 mm, 9–10 threads per cm. Some of the eyelets still show traces of now very brittle sewing thread.

WG 0012 (*Fig. 2.4*): The fabric is made from single z-spun yarns in warp and weft, the thinner warp threads have a thread diameter of approx. 1.3–1.7 mm. The diameter of the weft threads range from 2.5–5 mm. 3 threads per cm warp. 2 threads per cm weft. Woven in tabby. Size: 42x15 cm, 26x2 cm.

Acknowledgements

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3 | The Conservation of a Roman *Lorica Squamata* from the Barbarian Lands

JANET SCHRAMM – ANDREA FISCHER

Abstract: This paper presents the study and conservation of a Roman scale armour from the 2nd or 3rd century AD. The artefact consists of brass scales and two breastplates with the remains of the base fabric. The textile fragments are characterized by their large size and unique state of preservation. They are made of bast fibres, which are preserved due to the antibacterial effect of copper ions. For textile conservation a minimally invasive method was developed. The fabric was secured with single polyester threads, adhered to the metal surface of the scales with the acrylic resin Paraloid B72.

Keywords: Roman scale armour, copper alloy, textile, Stabiltex, cyclododecane, mounting

1. Introduction

A scale armour from the 2nd or 3rd century AD was unexpectedly found as a stray find within the vicinity of the Roman legionary camp of Carnuntum in *Baumgarten an der March*, Austria. The artefact consists of about 1,000 brass scales, brass and bronze bands, two breastplates and the remains of the base fabric. Due to its large size and unique state of textile preservation, this artefact is of great value for archaeological research. The uniqueness of the object is the combination of both metal and textile. The difficulty with conserving composite artefacts lies in the differing needs required by both material types. The conservation of the object was performed as part of a diploma thesis at the State Academy of Art and Design of Stuttgart, Germany in cooperation with the Museum of Natural History Vienna, Austria.

1.1 Provenance

The armour fragments were found as a stray find in the plough layer of a field in *Baumgarten an der March* in Lower Austria (*Fig. 3.1*). Baumgarten is located 30 kilometres north from the Roman legionary camp of Carnuntum. In Roman times, Baumgarten lay north of the Roman Limes, within the barbarian countries free from Roman occupation. For almost 500 years, Carnuntum was an important hub between Western and Eastern Europe, and the peoples North of the Danube and the Roman Empire itself (Jobst – Ditmar-Trauth 1992, 10). Due to the lack of an archaeological context, no further statements about the circumstances of the armour's discovery can be made.

1.2 Scale armours

Scale armours are body armours, which belong to the class of defensive weapons. In the Middle East their existence was confirmed as early as the 16th–15th century BC (Černenko 2006, 123). Throughout the Roman period the armour was used by all troops. After chain armour, scale armour was the second most common type of armour to be used (Robinson 1975, 27, 153).

Scale armours consist of individual pieces of iron or copper alloy sheets. The shape of each scale is rectangular with the exception of one side, which is rounded or peaked. Because of the similarity to fish scales the armour is often called *lorica* (armour) *squamata* (scaled) (Alfs 1941, 95; James 2004, 111). The scales are perforated on both longitudinal sides and at the upper narrow side. To connect the scales

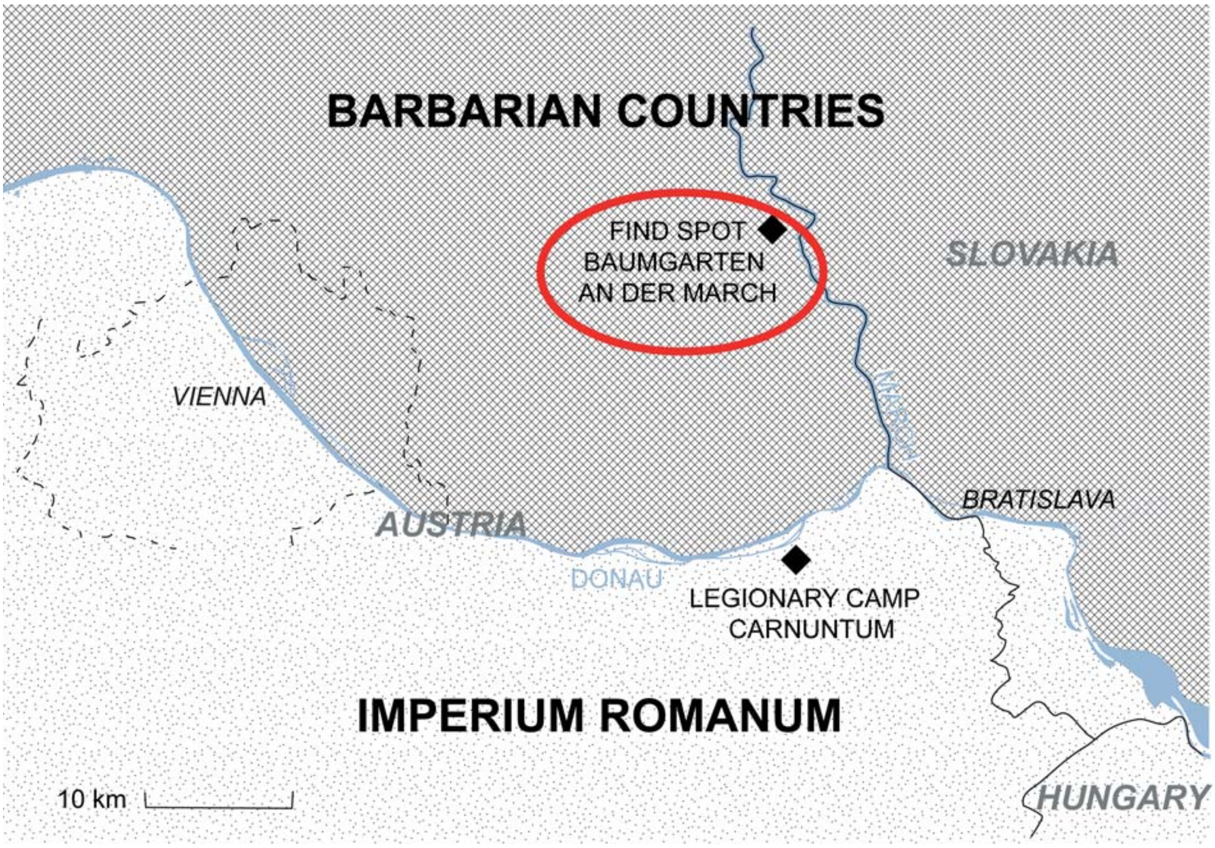

Fig. 3.1: Find spot, Baumgarten an der March, Austria (graph: J. Schramm).

with each other, they are lined up side by side until the holes overlap. A thin metal band or a wire, which is bent on the back, connects the scales to each other. In this way, rows of scales are constructed. The hole(s) on the narrow side of the scales serves as an attachment point onto the backing fabric.

The efficiency of the armour is given through the two components: a metal facing and a padded under layer. The overlapping arrangement of the scales spreads the force of an enemy strike onto a wider area (Sim – Kaminski 2012, 98–99). In Carnuntum it was proved that the padding was made from straw-filled linen pillows (Alfs 1941, 96).

2. The Object

The armour from Baumgarten was made with three types of brass scales (*Fig. 3.2*). The use of several types of scales for armoured equipment was not uncommon. Depending on the position where the scales were located they could vary in size and shape (Kory 2004, 357).

Type I scales have a rounded narrow side and five holes. The pair of holes on both longitudinal sides served to connect the scales to each other using a thin metal band. The fifth hole served as an attachment point onto a backing fabric.

Using two opposing running stitches, the scales were sewn with a thread on to the backing fabric (*Fig. 3.3*). Therefore, two threads passed through the fifth hole. The thread used was a twine, which was z-spun and S-twisted (1.2 mm yarn, angle of rotation: 45°). Some connection-knots were observed along the sewing thread. Probably the sewing thread was kept relatively short as, for sewing, a long thread was not practical.

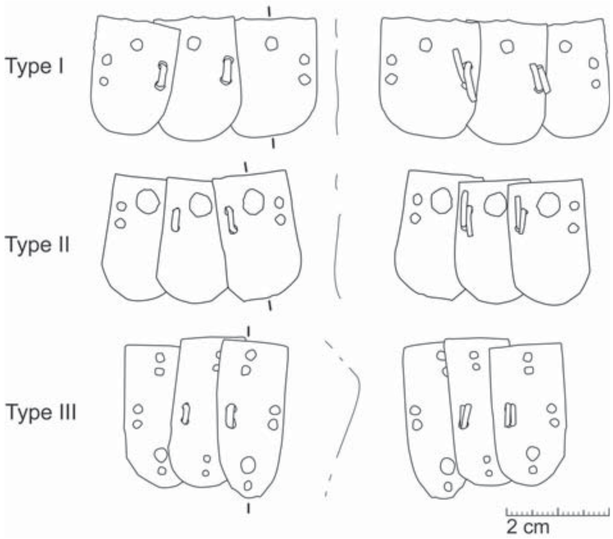

Fig. 3.2: The three different types of scales (graph: J. Schramm).

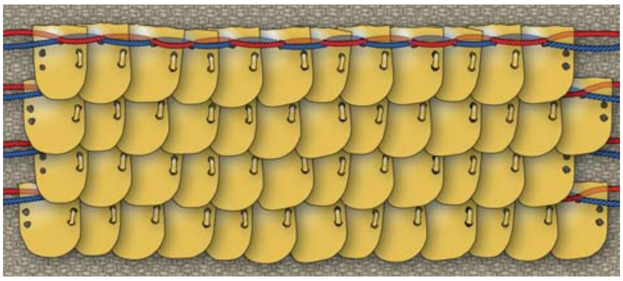

Fig. 3.3: Reconstruction of sewing method (graph: J. Schramm).

The base fabric of the armour, is a coarse basket weave (0.8 mm yarn, 10–12 yarns per cm, Z-twist, angle of rotation: 45°). The textile remains were still attached to the scales and could not be removed for the duration of the conservation. The largest textile fragments remaining measured about 16x10 cm and included six columns of scale rows. Next to those there were about 25 rows with various amounts of scales which were still attached to textile remains. The textile is indeed fragile, but it is preserved in its organic form and is still flexible.

Scales were attached to the base fabric starting with the bottom row. The following row covers about one third of the previous row. This protects the fragile seam. *Type I* scales probably belong to the collar region, thus some scales are still attached to the breastplate.

Besides the scales, two breastplates were found. Originally they were embellished with twisted tin-lead decorations. The ornaments, however, had already fallen off. A rotary knob secured with a cotter pin was used to open and close the breastplates (Humer 1999, 34). Breastplates were used primarily to minimize the neckline. With their rich ornamentation, they also had a decorative character. One of the plates shows a chased inscription, which probably gives the name of the soldier. Soldiers were responsible for their equipment and therefore marked their property. Despite a computer tomography of the inscription, it could not be completely decrypted.

Type II scales are slightly thinner than those of *Type I*. They also have a much larger central hole. A few traces of leather indicate that the assembly was probably carried out with leather strips. There are similar finds from Newstead, Straubing and Dura Europos, which show different kinds of connections using leather straps (Robinson 1975). The backing was made of leather or textile but, unfortunately, there were no remains left of it.

The smallest group of scales is *Type III*, with only 18 elongated items preserved. These fragments are constructed like a lamellar armour. They were used to connect the individual scale rows; therefore there was no need for a backing fabric. It is possible that these scales were used for the neck area or for sleeves.

3. Investigation

In order to gain a better understanding of manufacturing processes, material properties and the state of preservation, multiple material analyses were performed. According to the results an optimal conservation approach was developed. Only non-destructive or minimally invasive investigation methods were applied.

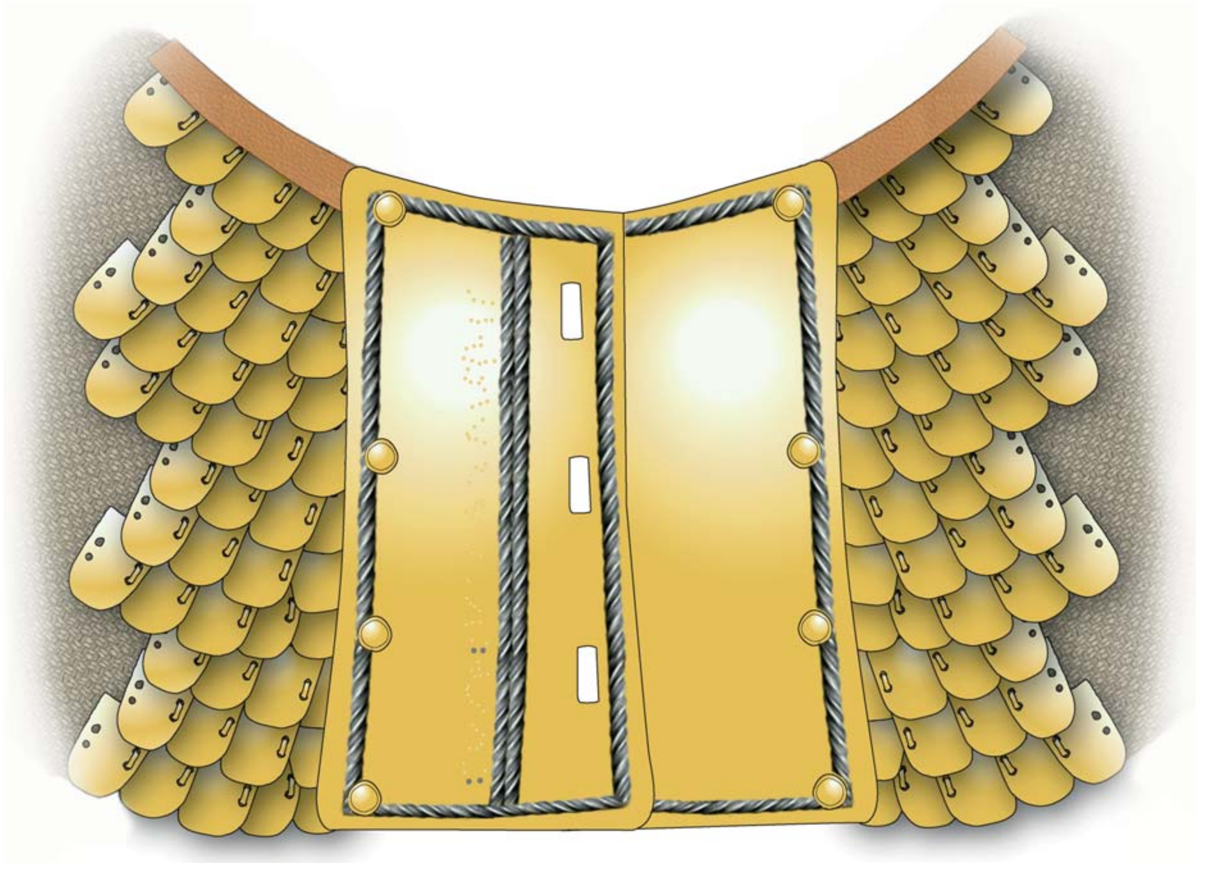

Fig. 3.4: Partial reconstruction of the collar area (graph: J. Schramm).

3.1 Investigation of the textile

The fibre analysis was based on the morphology of the fibre. It revealed that the textile was made of either flax or nettle. Due to the morphological similarity of those fibres, they could not be further differentiated[1]. The age of the fibres was determined to the 2nd or 3rd century AD using a radiocarbon dating[2].

3.2 Investigation of the metal

Quantitative metal analyses of the *Type I* and *II* scales and of the corresponding metal bands were performed. The results showed that the scales (*Type I* and *II*) consisted of a typical Roman brass alloy (CuZn15 / CuZn12Sn1.8Fe0.44). The analysis of the bands, however, showed that the bands of scale *Type I* had been made of brass (CuZn21Sn0.26Fe0.3) and that the bands of *Type II* had been made of bronze (CuSn12).

1 A fibre specification took place with the so-called *Herzog-Test*. The longitudinal view of the fibre appears under crossed polarizers with the additional use of the compensator Red I (λ-platelets); in a lying position (O-W) blue, and in a standing position (N-S) red and magenta. Thus, flax and nettle are both possibilities. An exact identification of the fibre might be possible due to the detection of calcium oxalate crystals using μ-X-ray diffraction (μ-XRD) (Bergfjord *et al.* 2010, 1634-b).

2 The radiocarbon dating was performed as part of the DressID-Project by Mark Van Strydonck at the KIK/IRPA Brussels: Lab. Nr. KIA-42756: 120–260 AD (95% probability); 135–200 AD (68% probability) (Grömer 2014, Fig. 107).

A dezincification of the metal was determined by metallography analyses. The investigation of corrosion products revealed the presence of copper chlorides exclusively on several *Type II* scales. Copper chlorides could be proved by both, µ-Raman spectroscopy and qualitative chloride proof (silver nitrate test).

4. Conservation treatment

4.1 Cleaning and securing the textile

For conservation, the artefact was transported to Stuttgart. Prior to transportation, the highly fragile fragments were secured using the volatile binder cyclododecan, which was applied melted.

After the cyclododecan had sublimated, the adhering soil was removed with a brush and a small vacuum cleaner. Using a disposable pipette as an attachment, vacuum cleaning could be limited to a very small area.

The challenge of this particular conservation treatment was that the textile remains were far too fragile to carry the weight of the numerous metal scales. Every movement endangered the textile fibres. A consolidation of the fabric was not considered, since this treatment has many disadvantages and cannot be reversed. A minimally invasive method had been developed which provided, in connection with an adequate mounting, sufficient stability and a support that is barely visible. Very fine single threads of polyester fibre[3] were used to connect the textile to the scales (*Fig. 3.5*). Thus the weight load could be spread over a large area. The threads were adhered with Paraloid B-72 on the metal surface in order to keep the textile in position. Since a very large number of threads were required for the support, this method was very time intensive.

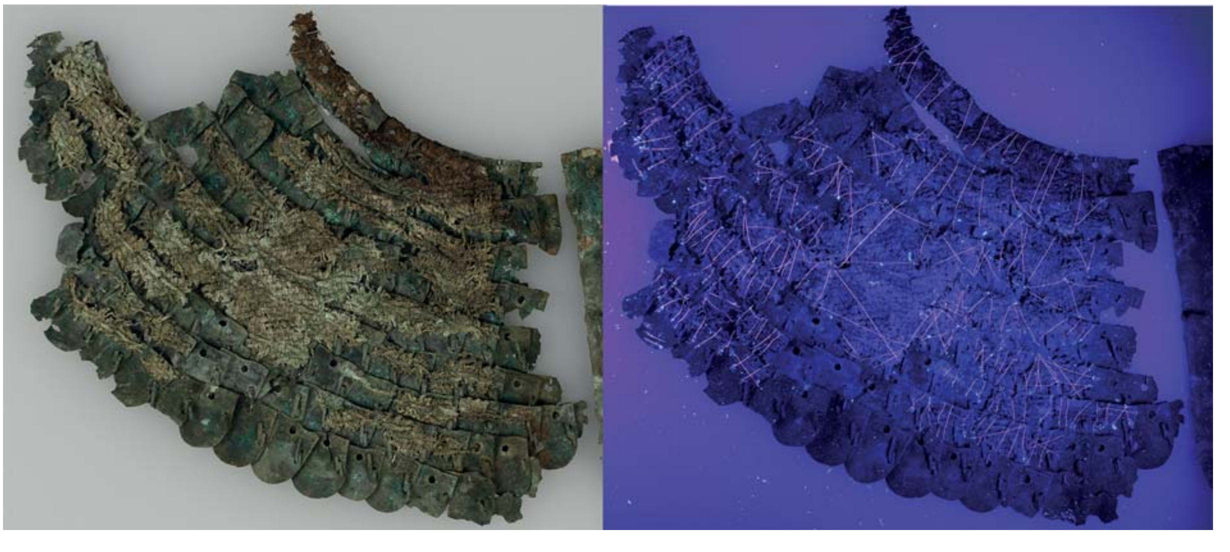

Fig. 3.5: Securing the textile (photos: J. Schramm).

[3] STABILTEX Khaki TR-PES 4/3: Polyester gauze as stabiltex / tetex is resistant to ageing and can be purchased in different colours (*www.plastok.co.uk*).

4.2 Conservation of the metal

The investigation of the metal revealed that the *Type I* scales, which were preserved together with the textile fragments, had no active corrosion. Several *Type II* scales were affected by chloride corrosion and were treated with the corrosion inhibitor 1H-benzotriazole (3% in ethanol). After the treatment, Paraloid B-72 was applied as a protective coating.

4.3 Mounting for exhibit and storage purposes

An adequate mount was the most important requirement for the preservation of the textile fragments. Since each handling is a potential risk to the artefact, the mounting must be suitable for both storage and for exhibition (*Fig. 3.6*).

Fig. 3.6: Final results showing the mounted plates (photo: J. Schramm).

Because the position of the fragments could not be retraced, the arrangement of the scales was carried out in a manner as neutral as possible. Therefore, the different types of scales were mounted on three different mats and undyed acrylic sheets (PMMA). The breastplate and about 200 *Type I* scales, which were still partly attached to the breastplate, were reassembled to an acrylic sheet. Because of the remarkable textile preservation, the fragments are shown from the reverse side. The impressive number of 250 scales (comprised of 5 rows) was mounted to a second acrylic sheet. The scales as arranged gives a partial impression of the front of the armour. To provide a view of the structure and manufacturing technique, a third acrylic sheet displayed all three types of scales from both the reverse and front sides.

The mounting of the acrylic sheets was performed mechanically with insect pins (V2A stainless steel, 0.4 mm). The mounting method does not affect the overall impression of the artefact as the pins are very fine. The methods used correspond to all conservation requirements and are easy to reverse.

5. Conclusion

Fragments of the scale armour from *Baumgarten an der March* form an important find for archaeological research. The extraordinary state of preservation of the backing fabric was the reason why some columns of scales have remained joined to each other. This fabric was made from flax or nettle fibres, woven in a coarse basket weave. During conservation, it was possible to distinguish three types of scales, which may represent different functions. Particularly the scales of *Type I* have been preserved together with the textile. Scales connected to the breastplate indicate that these scales were probably used for the chest and shoulder areas of the armour. Scales of *Type II* only show a few traces of leather possibly due to unfavourable preservation conditions. The exact position of *Type II* and *Type III* scales could not be determined.

A minimally invasive conservation method was developed to support the scale armour fragments with the adherent backing fabric. Thin polyester threads were adhered locally; a consolidation of the fabric was subsequently avoided. The required stability of all fragments was achieved by an adequate mounting, which is suitable for both exhibition and storage purposes. Due to this treatment, further investigations and conservation methods remain possible.

Acknowledgments

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4 | The Hidden Colours of Lengberg Castle, Austria

INA VANDEN BERGHE – BEATRIX NUTZ

Abstract: In the course of extensive reconstruction, starting in July 2008, at Lengberg Castle, East-Tyrol, archaeological investigations of several parts of the building were carried out. During the research a filled vault was detected below the floorboards of a room in the south wing of the castle on the 2nd floor. The fill consisted of dry material in different layers, among them organic material such as twigs and straw, but also worked wood, leather (mainly shoes) and textiles. 1048 textile fragments are coloured, mainly wool in various shades of blue, red and green but also purple and black. Some fragments of silk textiles display the colour yellow but also blue, red, purple and green. Coloured linen fragments are rare and limited mainly to blue sewing thread used for seams. Eleven textiles have now been analysed at the Institute for Cultural Heritage in Brussels.

Keywords: Lengberg Castle, medieval textiles, organic dyes

1. Context of the research

In the course of extensive reconstruction works in 2008 at Lengberg Castle (Municipality Nikolsdorf, East Tyrol, Austria) archaeological investigations on parts of the building were carried out under the direction of Harald Stadler (Institute for Archaeologies, University of Innsbruck). During the research a vault filled with dry materials deposited in different layers was uncovered in the south wing of the castle between the 1st and 2nd floor (*Fig. 4.1*). The fill consisted of building rubble at the very bottom (*Fig. 4.2*, layer 1) and organic material such as twigs and straw, but also worked wood, leather (mainly shoes) and textiles (*Fig. 4.2,* layer 2). The building history as well as investigations on construction techniques carried out by architectural historians of the Office for the Preservation of Historical Monuments Tyrol and the archaeological feature suggests a dating of the finds to the 15th century. This date is proved by radiocarbon-dating of five samples carried out at the ETH-Zurich.

Lengberg is first mentioned in a document from August 15th, 1190 AD in which a donation of Count Heinrich of Lechsgemünd to the monastery of Viktring in Carinthia was confirmed and Volcarth, Caloth

Fig. 4.1: Lengberg Castle, Nikolsdorf (East Tyrol) (photo: Beatrix Nutz, Inst. for Archaeologies, Univ. Innsbruck).

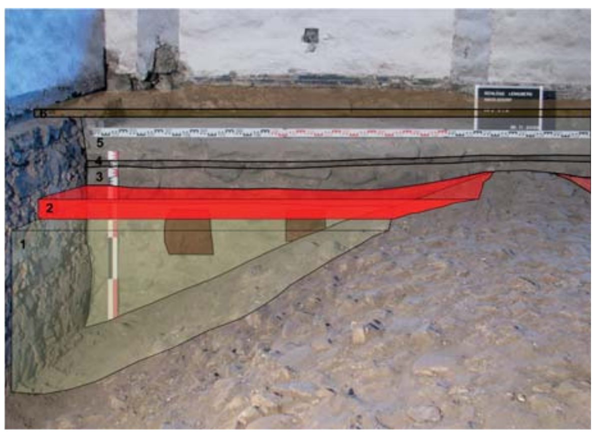

Fig. 4.2: The vault with the layer of organic material (red) (photo: Nick Graf, Innsbruck; graphic: Michael Schick, Inst. for Archaeologies, Univ. Innsbruck).

and Otto de Legenberch, ministerials to the House of Lechsgemünd, were named as witnesses. In 1207 Heinrich of Lechsgemünd sold the castle to Archbishop Eberhard of Salzburg. Until 1803 the castle was property of the archbishops of Salzburg, who assigned its administration to various peers.

Concerning the textile finds from Lengberg two administration periods deserve closer attention. In 1419 Andre and Peter Mosheimer received the castle for lifetime care, which then belonged to the family until 1453. Virgil of Graben (†1507 AD), one of the most powerful nobles of his time in the region of Upper Carinthia and East Tyrol, was assigned lifelong Lord of Lengberg in 1480 (Hörmann 2003). Virgil of Graben had the old castle "Veste Lengenberch" modernised by adding an additional floor. It was during this modification that the vault between the roof of the 1st floor and the floorboards of the new 2nd storey was filled with waste. This remodelling is mentioned by Paolo Santonino in his itinerary, who also gives us a short description of the castle and mentions the consecration of the castle chapel by Pietro Carlo, Bishop of Caorle (1472–1513), on October 13th, 1485 (Santonino 1947, 34–39). Taking into consideration that the reconstruction was probably finished by the time the chapel was consecrated, the majority of the finds (except for small pieces that later have fallen through gaps in the wooden floor) must predate October 1485. It is unlikely that the consecration took place while the construction was still under way, especially since in the 15th century the chapel and the vault with the finds were situated in the same wing of the castle, the chapel on the 1st floor and the room with the filled vault underneath on the 2nd. In addition, Paolo Santonino, while mentioning the "rebuilding" conducted by Vigil of Graben, wrote no word on still on-going reconstruction work.

2. Rediscovered (or retrieved) textiles

Approximately 2700 individual textile fragments, some originally probably belonging to the same item of clothing, range from almost completely preserved pieces of clothing and fragments of linen lining of garments with remnants of the former colourful woollen outer layer to finger-loop-braided laces, textile buttons and small cloth fragments whose original use is no longer determinable due to their degree of fragmentation. Evidence of tailoring is provided by an iron needle with linen thread still wrapped around the sewing tool, which was found among the filling material.

The majority of textile finds consists of larger and smaller fragments, mostly linen, many with seams and hems. Wool textiles are generally in worse condition and more fragmented due to moth damage. Several fragments provide evidence for a secondary use. They were torn into strips and used as binding material, as some pieces with knots suggest.

One thousand and forty-eight textile fragments are coloured. Most are woollens in various shades of blue, red and green but also purple and very dark – almost black – blue or brown. Some fragments of silk textiles are made of yellow threads along with blue, purple and green ones. Coloured linen fragments are rare and consist mainly of blue dyed pieces and blue plied thread used to sew seams and hems.

3. Study of the colours

Seven wool and four silk textile fragments have been selected for in-depth study of the dye content in order to provide supplementary information as to the provenance, function and value of these textile fragments. In total 18 coloured thread samples were analysed. Organic colorant identification with high performance liquid chromatography and photo diode array detection (HPLC-DAD) was performed on the acidic extracts after dye recovery for fifteen minutes in a mixture of water, methanol, acetone and 2.1 M oxalic acid (40/30/30/1, v/v/v/v) at 80/v. The dye composition identified after chromatographic analyses of the different coloured wool and silk textiles is listed respectively in *Tab. 4.1* and *4.2*. The actual colours on the textile fragments give the impression that multiple dye compounds still might be present. HPLC analyses of the extracts confirm this by the detection of a wide variety of colouring compounds, some of them very stable to light exposure though also other more vulnerable ones are found. The absence of light as well as the enclosed environment created by the vault would have helped the preservation of the dyes.

4. Dyes in the wool textiles from Lengberg (*Tab. 4.1*)

4.1 Textile 1: (n°01.06) a polychrome codpiece from a pair of trousers or joined hose

This codpiece has a main red woollen fabric in plain weave on the front side and a blue fabric, also in plain weave, on the reverse (*Fig. 4.3*). Both parts are sewn together. The red fabric was obtained by dyeing with the roots of a plant from the *Rubiaceae* family. Multiple antraquinone dye compounds

Tab. 4.1: Selected wool textiles from Lengberg castle. Dye composition and biological sources.

	Textile	**Sample colour: major & minor dye compounds** + (compounds in very small amounts)	**Main biological sources**
1	Codpiece from a pair of trousers (n°01.06)	**Red wool:** alizarin, purpurin, munjistin, xanthopurpurin, rubiadin, nordamnacanthal, (soluble redwood compound, ellagic acid) **Blue wool:** indigotin, indirubin, rubiadin	**Red:** madder, woad/indigo and traces of redwood and tannin **Blue:** woad/indigo
2	Red and green woollen fragments (n°751.01)	**Red wool:** alizarin, purpurin, xanthopurpurin, rubiadin (ellagic acid, soluble redwood compound) **Green wool:** indigotin, luteolin-7-O-glucoside and luteolin, genistein, apigenin glucoside	**Red:** madder and traces of redwood and tannin **Green:** dyer's broom and woad/indigo
3	Purple woollen fragment (n°674) – function unknown	**Purple wool:** alizarin, purpurin, indigotin, munjistin, xanthopurpurin, nordamnacanthal, (ellagic acid)	**Purple:** madder, woad/indigo and trace of tannin
4	Purple woollen fragment (n°T0049W) – function unknown	**Purple wool:** alizarin, purpurin, indigotin, xanthopurpurin, rubiadin, nordamnacanthal, (soluble redwood compound, ellagic acid)	**Purple:** madder, woad/indigo and traces of redwood and tannin
5	Red / purple woollen fragments (n°T0011L) – function unknown	**Purple wool:** purpurin, alizarin, indigotin, (ellagic acid) **Red wool:** alizarin, purpurin, xanthopurpurin	**Purple:** madder, woad/indigo and trace of tannin **Red:** madder
6	Black woollen textile (n°T0017W.01) – function unknown	**Black wool:** indigotin, ellagic acid and derivative, indirubin	**Black:** woad/indigo and tannin
7	Black woollen textile (n°T0053W) – function unknown	**Black wool:** indigotin, ellagic acid and derivative, indirubin, rubiadin, (alizarin)	**Black:** woad/indigo, tannin and trace of madder

Fig. 4.3: Front and reverse side of textile 1, a codpiece from a pair of trousers (n°01.06) (photo: Beatrix Nutz, Inst. for Archaeologies, Univ. Innsbruck).

have been found such as alizarin, purpurin and minor compounds munjistin, nordamnacanthal, xanthopurpurin and rubiadin (*Tab. 4.1)*. The actual dye content, especially considering the very low amount of rubiadin, suggests the use of cultivated madder (*Rubia tinctorum* L.) rather than a more local bedstraw species (*Galium* sp.). Apart from the dye compounds related to the roots dyeing, a trace was found of a marker compound of soluble redwood species as well as of ellagic acid referring to the presence of tannin. Until the 16th century, redwood was used from the trees *Caesalpinia sappan* L., of oriental origin, while after the discovery of the Americas, redwood derived from the trees *Caesalpinia brasiliensis* L. was shipped from the New World to Europe and Asia. According to ancient recipes, redwood was known to be used in a second bath after dyeing with madder. This combination gives radiance to the madder and imitates the bright red of kermes dyeing which made it a useful way to economise on the cost of dyeing (Cardon 2003, 216–225). Despite the fact that it was known that redwood had a poor fastness to light, municipal regulations often permitted its use in cloth dyeing (Hofenk de Graaff 2004). Redwood was mentioned as a source for red dyeing in the most ancient German recipes, there called *presilig*, found in the Innsbruck manuscript from 1330, kept in the Stams monastery in Tyrol (Ploss 1967, 100).

The blue fragment on the inner side of the trousers was dyed with woad (*Isatis tinctoria* L.), or an indigo species imported from the orient from *Indigofera* or *Polygonum* plants. Such indigoid dye sources might be determined from the detection of indigotin as the major dye compound together with a small amount of its isomere indirubin. Both indigo and woad plants produce these marker compounds. Also historically, both sources could be possible depending on where the fabric was made. Dyeing with woad was the usual way to produce blue in Western Europe. It was mentioned as the source for blue dyeing in the Innsbruck manuscript (Ploss 1967, 99), as well as in the *Trattato dell'Arte della Lana* from the 15th century Codex Riccardiano No. 2580, kept in the Riccardiana Library in Florence. The latter contains a detailed description of wool dyeing with woad by the help of '*madder water'* during the preparation of the woad vat. However, indigo might have been used as well, imported from the East by Italian merchants for their flourishing wool industry at this period (Brunello 1973, 152–158), although the use of indigo was limited in the rest of Europe until the18th century, especially by the countries which cultivated woad. The small amount of rubiadin detected in this blue thread could refer to the addition of madder roots during woad fermentation though considering the contact of the blue codpiece fragment with the red fabric, contamination of the latter cannot be excluded.

4.2 Textile 2: (n° 751.01) polychrome woollen fragment

Textile 2 is another woollen fragment with a red fabric on one side and a green one on the reverse. Both fragments are in plain weave and sewn together with a colourless thread (*Fig. 4.4)*. The red fragment is dyed with madder with again very small amounts of redwood and ellagic acid. The composition is very similar to the codpiece ~~of~~ from the pair of trousers (*Tab. 4.1*).

The green colour of the other fragment is the result of woad or indigo dyeing in combination with the yellow dye compounds from dyer's broom (*Genista tinctoria* L.). Such dyeing with the latter dye plant is concluded from the presence of the yellow flavonoid marker compounds luteolin-7-O-glucoside and apigenin-glucoside as well as the aglycones luteolin and genistein. Dyer's broom is one of the yellow dye sources well-known in medieval Europe (Brunello 1973, 158).

Fig. 4.4: Front and reverse side of textile 2, a red and green woollen fragment sewn together (n°751.01) (photo: Beatrix Nutz, Inst. for Archaeologies, Univ. Innsbruck).

4.3 Textile 3: (n° 674) a purple woollen fragment

Textile 3 is a bluish/purple, woollen fabric stitched to two layers of a colourless linen textile (lining) (*Fig. 4.5*) with two sewn eyelets. According to the dye composition (*Tab. 4.1*), the purple colour is obtained by a combination of red dyeing with the roots of cultivated madder (*Rubia tinctoria* L.) and woad/indigo dyeing. A small amount of ellagic acid detected in the same thread indicates the presence of tannin-rich material either applied for mordanting of the fibres though more likely deriving from the surroundings of the textile deposit.

Fig. 4.5: Textile 3, purple woollen fragment stitched to a colourless linen fabric (n°674) (photo: Beatrix Nutz, Inst. for Archaeologies, Univ. Innsbruck).

4.4 Textile 4: (n° T0049W) a purple woollen fragment

This is another purple coloured woollen textile fragment in plain weave (*Fig. 4.6*). The function is unknown. Despite the more reddish shade of this fragment compared to the one above (n° 674), also this shade resulted from the combination of a red dyeing with cultivated madder and woad/indigo dyeing. A minimal amount of the redwood compound and ellagic acid were found together in it.

Fig. 4.6: Textile 4, purple woollen fragments (T0049W)
(photo: Beatrix Nutz, Inst. for Archaeologies, Univ. Innsbruck).

4.5 Textile 5: (n° T0011L) a red and purple coloured woollen fragment

This ensemble is composed of a large uncoloured textile in plain weave with, on the reverse, a red and a purple fragment next to each other also in plain weave. They are stitched together by a colourless sewing thread (*Fig. 4.7*). The red fragment was dyed with madder (*Rubia tinctoria* L.) alone, while the purple fragment was dyed with a combination of madder and woad/indigo dyeing. Also here a trace of tannin was detected.

4.6 Textile 6: (n° T0017W.01) a black wool fragment

This fragment is a small piece of a black wool fabric in twill weave (*Fig. 4.8*). The function is unknown. The black shade was obtained by the use of tannin in combination with woad/indigo as could be deduced from the organic constituents present on the sample (*Tab. 4.1*). A common way to produce an intense black colour was to dye the textile first with tannin, then passing it in a second bath with iron. The problem with such a process was the corrosion of the wool. Despite this, it was allowed during the Middle Ages but only after the cloth was first woad dyed. Various recipes for black dyeing with galls are described in Plictho of Rossetti's of 1548. In many, a mixture of galls was used on a ground of woad or indigo to produce a good quality black (Hofenk de Graaff 2004, 289).

Fig. 4.7: Textile 5, red and purple woollen fragments stitched to a colourless linen fabric (n°T0011L) (photo: Beatrix Nutz, Inst. for Archaeologies, Univ. Innsbruck).

Fig. 4.8: Textile 6, black wool fragment (n°T0017W.01) (photo: Beatrix Nutz, Inst. for Archaeologies, Univ. Innsbruck).

4.7 Textile 7: (n° T0053W) a black woollen fragment

Textile 7 is another black woollen fragment with an eyelet (*Fig. 4.9*). The black was obtained by the combination of tannin and woad or indigo dyeing, similar to the previous textile (*Tab. 4.1*). The presence of the small amount of alizarin and rubiadin may indicate the addition of madder to the woad fermentation bath.

Fig. 4.9: Textile 7, black woollen fragment (n°T0053W) (photo: Beatrix Nutz, Inst. for Archaeologies, Univ. Innsbruck).

5. Dyes in the silk textiles from Lengberg (Tab. 4.2)

5.1 Textile 8: (n° 01.05) the bodice of a girl's dress

This textile forms a part of a bodice of a dress, with a red silk border sewn to the uncoloured linen lining of the bodice by means of a blue linen sewing thread (*Fig. 4.10*). The red border was dyed with an insect from the *Coccoideae* family, more precisely kermes (*Kermes vermilio* Planchon). Only the female insect gives this bright red substance. The main compound is kermesic acid (*Tab. 4.2*). Kermes is the most prestigious and expensive source of red dyeing in Europe in the Middle Ages. It was known in the whole medieval Occident. After the discovery of the Americas, it

Tab. 4.2: Selected silk textiles from Lengberg castle. Dye composition and biological sources.

	Textile	**Sample colour: major & minor dye compounds** + (compounds in very small amounts)	**Main biological sources**
8	Bodice of girl's dress (n°01.05)	**Red silk:** kermesic and ellagic acid **Blue linen sewing thread:** indigotin and indirubin	**Red:** kermes and tannin **Blue:** woad/indigo
9	Polychrome silk weave (n°682)	**Red silk:** alizarin, purpurin, xantho-purpurin, rubiadin, nordamnacanthal (soluble redwood compound) **Beige (yellow) silk:** no dyes **Blue silk:** indigotin, alizarin, indirubin, rubiadin **Green silk:** indigotin, luteolin-7-O-glucoside and luteolin, indirubin, rubiadin, alizarin,(apigenin glucoside)	**Red:** madder and redwood **Beige (yellow):** undyed **Blue:** woad/indigo and madder **Green:** woad/indigo, madder and luteolin-based yellow
10	Green silk fragment (n°247) – unknown function	**Green silk:** luteolin-7-O-glucoside and luteolin, indigotin and indirubin	**Green:** woad/indigo and luteolin-based yellow
11	Purple Tussah silk fragment (n°272.05) – unknown function	**Purple silk:** marker peak lichen	**Purple:** lichen (rock tripe, cudbear)

Fig. 4.10: Textile 8, bodice of a girl's dress (n°01.05)
(photo: Beatrix Nutz, Inst. for Archaeologies, Univ. Innsbruck).

was soon completely replaced by Mexican cochineal (*Dactylopius coccus* Costa), a species not only much cheaper but also with ten times more dye strength than kermes (CARDON 2003, 476–483). The use of kermes for the red border of this bodice emphasizes the high value assigned to this fabric as kermes was reserved for people of the highest social class. The high amount of ellagic acid in this analysis is the result of the use of tannin applied as a mordant and weighting agent on the silk. The blue linen sewing thread was dyed with woad or indigo. Plied, blue-dyed linen yarn used as sewing thread is also found on a linen textile from Tyrol Castle (South Tyrol) (NUTZ – TOMEDI 2015). With regard to the blue linen yarn, *coelsch garn, fil de Cologne, collen threde* or *kolcz* (yarn or thread from Cologne) comes to mind. Its finishing and colour fastness accounted for its quality and made it a well-known export item of Cologne (KUSKE 1956, 149). This type of thread is referred to in several written sources of the 14th and 15th centuries, for example in the chandler law of September 3, 1410, of the city of Lüneburg: ". . . ***blawen Collenschen twern****, rod Vlamesches czetergarn, gronen twern und ceter, snore, Vlamesches wullengarn, tappetgarn,* . . ." (. . . blue Cologne plied-yarn, red Flemish cotton yarn, green plied-yarn and cotton, rope, Flemish woollen yarn, tapestry yarn, . . .) (BODEMANN 1883, 138).

5.2 Textile 9: (n° 682) Polychrome silk weaving

The red ground of the polychrome silk (*Fig. 4.11*) was dyed with madder with the addition of some redwood (*Tab. 4.2*). No dyes were found in the actual beige-yellowish threads. Both blue and green threads were dyed with a woad/indigo vat together with madder. For the green, this was combined with a yellow dye plant with luteolin-7-O-glucoside as the main marker compound in the dye extract together with minor amounts of luteolin and apigenin-glucose. Such composition could be indicative for the use of sawwort (*Serratula tinctoria* L.) or chamomile (*Anthemis* sp.) or other luteolin based plant sources (SCHWEPPE 1993).

Fig. 4.11: Textile 9, polychrome silk weaving with blue and green motifs (n°682) (photo: Beatrix Nutz, Inst. for Archaeologies, Univ. Innsbruck).

5.3 Textile 10: (n° 247) green silk fragment

Textile 10 is a green mulberry silk fabric in plain weave of unknown function (*Fig. 4.12*). The green colour is the result of the mixture of blue and yellow dye compounds which indicates that the silk was dyed with woad and a luteolin based yellow dye source. The present dye composition suggests again the use of chamomile (*Anthemis* sp.), sawwort or another local luteolin-based plant.

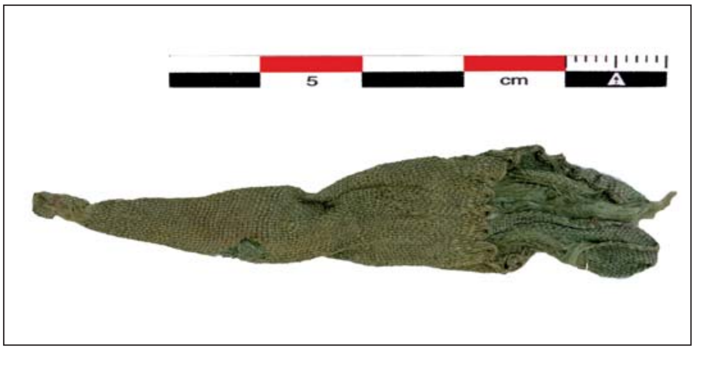

Fig. 4.12: Textile 10, green silk fragment (n°247) (photo: Beatrix Nutz, Inst. for Archaeologies, Univ. Innsbruck).

5.4 Textile 11: (n° 272.05) purple Tussah silk textile

This is a very fine, plain weave fabric with an open structure, made from Tussah silk (*Fig. 4.13*). The function of this fabric is unknown. HPLC analysis of this reddish purple revealed an organic substance, characterised by absorbance maxima between 516 and 540 nm wavelength. This is a marker compound for dyeing with lichens such as rock tripe (*Lasallia pustulata* L.) or cudbear (*Ochrolechia tartarea* L.).

No tannins were detected in the silk samples except for the red thread in the border of the girl's bodice, where the prominent amount of ellagic acid refers to the use of tannin both as an organic weighting agent and a mordant for the dyeing with kermes. The very small amounts of ellagic acid found in many of the woollen samples on the contrary, rather suggest contamination of the wool by tannin-rich surrounding material such as from the leather objects present in the vault spandrel or from wooden objects or construction timbers.

6. Summary

Archaeological investigations carried out in the course of extensive construction works at the Lengberg castle in Nikolsdorf (East Tyrol) revealed a vault spandrel in the south wing of the castle filled with organic material. Besides twigs and straw, worked wood and leather, no less than 2700 individual textile fragments were discovered in this layer among which were about 1000 coloured fragments. Eleven of them, seven wool and four silk fragments, have been selected for identification of the dyes. This resulted in the following observations.

Red dyeing of wool was done with the roots of cultivated madder (*Rubia tinctorium* L.), to which some redwood from *Caesalpinia sappan*

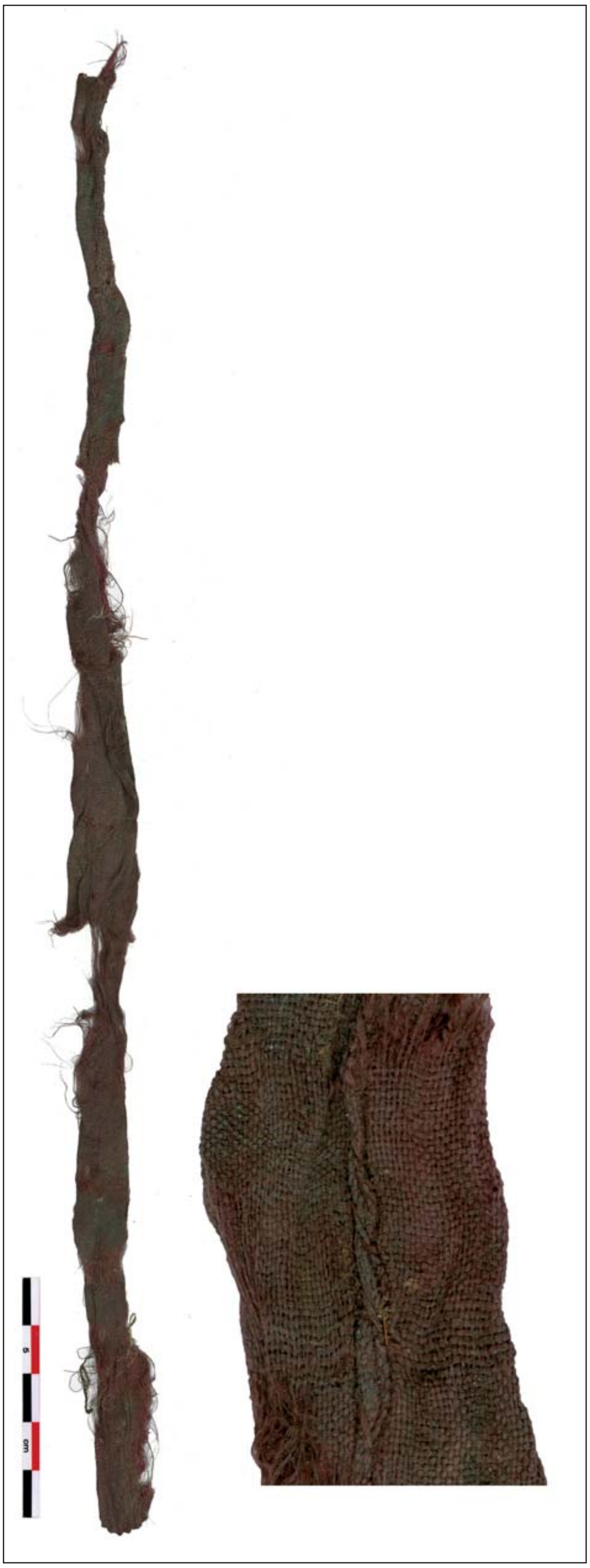

Fig. 4.13: Textile 11, purple Tussah silk textile (n°272.05), detail (photo: Beatrix Nutz, Inst. for Archaeologies, Univ. Innsbruck).

had been added twice, possibly to imitate the bright red shade of kermes. A purple colour was obtained by the combination of a blue woad (*Isatis tinctoria* L.) or indigo (*Polygonum* or *Indigofera* sp.) dyebath and dyeing with madder, while green shades were produced by the combination of woad or indigo dyeing with a separate yellow dyeing using dyer's broom (*Genista tinctoria* L.). Black wool was obtained by the use of tannins, possibly from galls, applied on a ground of woad/indigo, a common way to produce good quality black during the Middle Ages.

For red dyeing of silk, the precious scale insect kermes (*Kermes vermilio* Planchon) with tannin as mordant and weighting agent was found in one sample, while the other red was obtained with madder and some redwood, similar to that found in the red wool samples. The purple silk was obtained by the use of lichen dyes, probably rock tripe or cudbear. Blue silk was dyed with woad or indigo occasionally showing evidence of the use of madder as an additive for the fermentation process, while for green silk, the same blue vat dyeing process was applied combined with a yellow dyeing using a luteolin based dye source, possibly chamomile.

The biological dye sources identified in the actual selection of the textiles from the Lengberg castle are in complete agreement with the dating of the finds to the 15th century in Europe. Apart from redwood and eventually indigo, all other biological dye sources could have been of European or even local origin. Redwood and indigo were also available on the European market at that time, imported from the Orient by Italian merchants.

The most important find is the bodice of the girl's dress – find n° 01.05 – as the red silk border was dyed with the precious scale insect kermes which implies that this textile once must have been made for a person of high status.

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Chapter 2:
Prehistory: Neolithic, Bronze Age and Iron Age Materials

5 | Searching for the earliest wools in Europe

LISE BENDER JØRGENSEN – ANTOINETTE RAST-EICHER

Abstract: Which are the earliest wools in Europe, how can we identify and date them, and what do they tell us about the emergence of woolly sheep and wool as a raw material for textiles in prehistoric Europe? These questions involve methods of fibre identification, conservation and dating, terminologies of archaeological chronology and museum priorities. The paper explores and reassesses a series of claims for early wools from Europe in the context of the time when the finds and claims were made, and discusses how reassessments of their dating affect our knowledge about early wool and sheep husbandry in Europe.

Keywords: wool, fibre identification, Neolithic, Bronze Age, Wiepenkathen, W. von Stokar

At NESAT XI a project on Creativity in Craft Production in Middle and Late Bronze Age Europe (CinBA) involving several NESAT members was presented (BENDER JØRGENSEN – BERGERBRANT – RAST-EICHER 2013). During our work with the project's database (*http://cinba.net/outputs/databases/textiles*) we noted that radiocarbon dating had caused certain textiles considered as some of the earliest evidence of wool in Europe to *change* their dating, and that some previously undated or very roundly dated textiles had *acquired* dating. This raises questions on which are the earliest wools in Europe.

Throughout the history of archaeology, a number of textile finds have been claimed as early wools, only to be later refuted. The charred textile remains from Kreienkopp and Spitzes Hoch in Germany, both dated to the Funnel Beaker or *Trichterbecherkultur* of the Neolithic are good examples of this. First identified as wool, later re-examinations showed them to be flax (SCHLABOW after LORENTZEN 2013; BENDER JØRGENSEN 1992, 114; RØRDAM – LORENTZEN 2013). Charred flax and degraded wool cannot be identified with a light microscope, and the scanning electron microscope and other modern methods for the identification were not yet available.

The dating of textiles is another issue to be addressed. Before the emergence of modern dating methods, archaeological dates were relative, based on typological and comparative studies. In several cases, such dates are no longer are valid. We therefore need to query the dating of well-known finds. It is also necessary to look into established chronological frameworks and how they compare regionally, as they may well have been revised.

When did the Bronze Age begin, and what repercussions does it have for the study of early wool? In a paper on Bronze Age wools, Michael L. Ryder stated that no textile finds in Europe preceding the Bronze Age were made from wool (RYDER 1990). In a paper from 1986 on early Neolithic skeletons with textile remains from Bolkilde bog in Denmark, attention was drawn to the Wiepenkathen find as an early example of wool (BENNIKE – EBBESEN – BENDER JØRGENSEN 1986). But as no documentation was presented, Ryder could not accept this item as wool. His main argument was that all claims of wools from the Neolithic had proved to be vegetal fibres, and Ryder had obviously not seen the Wiepenkathen textile himself.

Here two questions are at issue: Is the Wiepenkathen textile Neolithic, and is it wool? It was found wedged under the wooden handle of a flint dagger. The dagger dates to find to the final phase of the Neolithic in southern Scandinavia (including the relevant part of northern Germany), 2350–1950 BC. It belongs to the Bell Beaker 'culture' of northwestern Europe and is partly contemporary with the Unetice culture (Reinecke Bz A1–A2), i.e. the Early Bronze Age (ROBERTS – UCKELMANN – BRANDHERM 2013).

Fig. 5.1: The dagger from Wiepenkathen (Kreis Stade, Germany) with textile remains under the wooden handle (photo: A. Rast-Eicher).

Fig. 5.2: Detail of Fig. 1, with visible wool threads (photo: A. Rast-Eicher).

Fig. 5.3: Detail of the textile from Unterteutschenthal (Saale, Germany), with thick wool threads in one system and very fine threads of plant fibre in the other (photo: A. Rast-Eicher).

This means that although the Wiepenkathen textile is Late Neolithic it is from a time that was already the Bronze Age in other parts of Europe.

The second question is whether it is indeed wool. The Wiepenkathen textile remains were examined by Walter von Stokar shortly after they were found (CASSAU 1935, 205–207). Von Stokar was a pharmacist who went on to study archaeology, and became a pioneer of archaeological science in Germany (SCHWAB 2007). He identified the textile as wool in one system, decomposed plant fibre in the other. His findings were first published in Adolf Cassau's paper on the Wiepenkathen dagger, and were also included in his *Spinnen und Weben bei den Germanen* (VON STOKAR 1938, 44, 103). Photos show that the dagger's wooden handle had been removed during its investigation (CASSAU 1935, Abb. 10–11). The textile was uncovered and fully visible, so von Stokar had excellent conditions for examining it. Afterwards, unfortunately, the handle was glued back on dagger and cloth, and only a few threads, soaked with glue, are now visible (BENDER JØRGENSEN 1992, Fig. 138). This makes it difficult to re-investigate as the glue prevents definite fibre identification. We have both examined the threads and are convinced they are indeed of wool. The composition of fine and a few very coarse fibres corresponds closely to Bronze Age wools (*Fig. 5.1* and *5.2*). Understandably, the museum in Stade is unwilling to allow the taking of a sample of the few remaining threads.

Another find that was examined by Walter von Stokar is from Unterteutschenthal in the Saale area of central Germany and dated to the early Bronze Age or Unetice culture (SCHLABOW 1959; VON STOKAR 1938, 44–45). Described as tabby with thick wool weft and thin, plant fibre warp it appears as a parallel to the textile from Wiepenkathen (*Fig. 5.3*). A close look at the records in the Landesmuseum in Halle shows however that the date and provenance is less clear. D. von Borries, Director of the Landesmuseum für Vorgeschichte in Halle, excavated three tumuli at Unterteutschenthal in

1887; the one in question, tumulus II, contained not one but multiple burials, most of them cremations. Burials of the Unetice culture were usually simple inhumation graves (Jockenhövel 2013, 725–726). The textile remains are listed under *locus* no. 287, fragments of burnt clay, along with a fragment of mortar-like substance, a fragment of reddish stone of burnt clay, some slag-like substance and fragments of human bones. The lance head and pottery referred to by von Stokar (1938, 105) as dating evidence cannot be related to the textile remains. The dating to the Early Bronze Age is therefore based on assumption rather than evidence. We visited the Landesmuseum in Halle autumn 2013, investigating the Unterteutschenthal texiles together with conservator Friederike Hertel, and are planning a paper discussing their dating and provenance in detail. We can, however, confirm the identification of the well-preserved weft-threads as wool.

While the early date of the Unterteutschenthal wool cannot be substantiated, other finds emerge as interesting candidates for the title of the earliest wool in Europe. One of them is a piece from Rylston in Yorkshire, the UK. It was found in an oak-log coffin, excavated in 1864 by cannon William Greenwell and was published in his book *British Barrows* in 1877. It is a well-known piece, listed by Audrey Henshall in her paper on *Textiles and weaving appliances in prehistoric Britain* (Henshall 1950). As the textile was the only grave good found enveloping the skeleton of the deceased, it has not been possible to date it further than possibly the early Bronze Age. Recently, however, a similar oak-log coffin from Gristhorpe, also in Yorkshire, has been dated by AMS radiocarbon as well as dendro-dating to between 2200 and 2020 cal BC (Melton *et al.* 2010). This suggests that the Rylston burial may be of similar date, and thus roughly contemporary with the Wiepenkathen wool. In 2013, a burial from Spinningdale in Scotland with remains of a sheepskin was briefly published in *Current Archaeology*. Radiocarbon dating of a bone and charcoal fragments suggests a date between 2051 and 1911 BC (Arabaolaza *et al.* 2013).

Further candidates can be found in central Europe and northern Italy. The most important ones are wool used as decoration on a flax textile from Molina di Ledro in the Trentino, Italy dated to between 2200–2100 BC (Bazzanella 2012), a textile from an Unetice burial at Tursko-Těšina in the Czech Republic, dated c. 2000 (Štolcová – Březinová, in print), and a wool textile fragment from the glacier of Lenk-Schnidejoch in Switzerland, dated to 1891–1634 cal BC (Rast-Eicher, in print). In all three cases recent work vouches for fibre identifications as well as the dates. It means we have a group of 5-6 finds that can be dated to the Early Bronze Age of Central Europe, Reinecke's Bronze A.

There is one more find that may belong to this group. A 'princely burial' from Kernonen en Plouvorn, Finistère in Brittany was excavated in 1966 by Jacques Briard. A tumulus 6 m high and a diameter of 50 m contained a stone cist with a conspicuous collection of artefacts, mostly deposited in three wooden boxes: 60 flint arrowheads, 12 amber beads, 4 bronze axes and 3 bronze daggers. Briard found minute textile remains on axe No 1 and dagger No 2. The former he describes as 'animal fibre, without doubt wool', the latter as 'without discussion plant fibre and not wool' (Briard 1970, 21–22, 26–28). He does not quote any specialist report nor supply documentation for fibre identification except for drawings of the two textiles (Briard 1970, figs. 7 1a (p. 21) and 9 (p. 26). Four radiocarbon dates carried out in 1969 deviated between 1960 BC and 1200 BC (Briard 1970, 43–44). Dagger No 2 closely resembles a dagger from Bush Barrow near Stonehenge in Britain, and supposedly is made by the same craftsman (Cunliffe 2001, 255). This would place the date between 1900 and 1700 BC (Roberts *et al.* 2013, 23). If the textile remains on the axe really is wool it belongs in the second 'wool wave', between 2000 and 1600.

In northern Europe, a small group of textiles dated to Montelius Period I, i.e. c. 1700–1500 BC, have been catalogued as wool: Mølgaarden and Briksbøl in southern Jutland (Bender Jørgensen 1986, catalogue numbers DK:I:1 (p. 185), DK:I:55 (p. 188); Ehlers 1998, 339) and Tensbüttel-Röst, Tinnum-Sylt and Schuby in Schleswig-Holstein (Ehlers 1998, catalogue numbers SH:7 (p. 383–384), SH:34 (p. 404–405), SH:62 (p. 443–444). During a recent visit to the Archaeological Landesmuseum in Schleswig, we had the opportunity of examining the three German finds. Two of them proved too badly preserved for us to ascertain the fibre type, but the Schuby piece could be confirmed as wool of the Bronze Age type. The south Scandinavian wools belonging to the later part of the Early Bronze Age, Reinecke's Bronze A2, add to our early wools and form a prelude to the following period with the rich finds of wool textiles and garments in the famous oak-log coffins.

At the end of the fourth millennium BC a larger sheep emerged in Central Europe and in the third millennium the slaughtering pattern changed to older animals, which can be interpreted as change from milk and meat pattern to wool pattern (Schibler 2008; Vretemark 2010).

At the current stage of research it appears as the third millennium BC was the time when wool emerged as a raw material for textiles in Europe. New finds and further research will certainly add to and revise this, but as we hope to have shown it is also useful to look at old finds and question their validity.

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6 | Folded, layered textiles from a Bronze Age pit pyre excavated from Over Barrow 2, Cambridgeshire, England

SUSANNA HARRIS

Abstract: The textiles from Over Barrow, Cambridgeshire, England present the opportunity to examine the burial practices at the end of the Early Bronze Age. They were excavated from a pit pyre cremation along with cremated bone, a bone needle/pin and two small sherds of a collared urn. Preserved in charred clumps of multiple layers, they have the potential to provide clues as to how the textiles were used in the cremation, for example, whether they were used as clothing, shrouds or for other purpose such as binding strips. These possibilities raise a number of questions as to the role of textiles in Bronze Age cremation burials in the early second millennium BC in Britain.

Keywords: textile, Bronze Age, cremation, wrapping, clothes, Britain

1. Over, Barrow 2

This paper presents textiles from an Early Bronze Age pit-pyre cremation beneath a round barrow in Over, Cambridgeshire, Britain. The textiles are unusual in that a number of them are preserved in thick multiple-layered clumps, some of which are over 1 cm thick. Due to these aspects, the textiles have the potential to provide clues as to how they were used in the cremation, for example, whether they were used as clothing, shrouds or for other purpose such as binding strips. For this reason, in addition to a technical and fibre analysis of the textiles, particular attention is paid to the way in which the textile clumps were folded and layered. The excavation is currently being written up; all excavation context and specialist analyses derive from Christopher Evans' unpublished report (Evans *et al.*, forthcoming).

1.1 Excavation context

A barrow in the area of Over, Cambridgeshire in the East of England was excavated between 1998–2001 as part of the annual training dig for the University of Cambridge, directed by Christopher Evans and Charly French. Over Barrow 2, from which the textiles originate, belongs to the southern group of barrows in the Over Narrows, an area of palaeo channels and islands on the River Great Ouse. The charred textiles were found in the primary burial, a cremation in the centre of the barrow dated to the first half of the second millennium BC, radiocarbon date 1887–1696 cal BC (OxA024639 3477±30BP). The Early / Middle Bronze Age horizon in Britain varies according to authors and criteria used. Published work by Evans dates the Early Bronze Age in Britain between 2000–1600 cal BC and the Middle Bronze Age between 1600–1200 cal BC (Evans *et al.* 2014, 245). On this basis the pit-pyre cremation dates to the later Early Bronze Age.

As revealed during excavation, the barrow was constructed in stages (*Fig. 6.1*). In the first stage a pit (Feature number F.515/519) approximately 1m in diameter was dug into the buried soil and underlying subsoil (*Fig. 6.2*). The pit sides are discoloured (orange, pink, purple and black) by heating, in the base of the pit there is a substantial deposit of cremated bone and charred wood. The charred textiles were found among the base deposit of cremated bone along with burnt animal bone, a bone needle/pin and two small sherds of a collared urn. Above the base deposit was heat-affected gravel and further cremated bone. Analysis of the bones by Natasha Dodwell suggests they belong to two adults (possibly female)

Fig. 6.1: Under excavation; Over Barrow 2, Cambridgeshire (© Cambridge Archaeological Unit).

and an infant. After the cremations a turf mound was built over the top of the pit, then expanded in a second stage of construction until it measured 22 m in diameter. In later phases further burials were added into the south-eastern part of the barrow and a ditch was dug around it.

Experiments were undertaken to understand the nature of such Early Bronze Age scorched cremation pits in Cambridgeshire (Dodwell 2012, 145–148). The results of the experiment suggests the fire was most likely the result of a pyre constructed above the pit (referred to by the excavators as a pit-pyre), while the spatial distribution and articulation of the skeletal remains suggests the bodies were tightly crouched (Dodwell 2012, 147–148).

Fig. 6.2: Central cremation pit with discoloured sides due to burning (© Cambridge Archaeological Unit).

1.2 The textiles: deposition, preservation and storage

All the textiles from the pit-type are charred. Due to their position in the pit accompanied by burnt bone and charred timber, it seems likely they were charred as a result of being part of the cremation fire. Cellulose fibres are highly flammable (Harris 2012, 106; Hencken Elsasser 2010, 58), and as part of the cremation pyre they would have added to the blaze. For this reason one may assume that all traces of textile would have disappeared. How then did the textiles survive the fire? Textiles are known to survive cremation, indeed small fragments of charred textiles have been recovered from other British Bronze Age cremations (Henshall 1950, 130–132; for example Petersen – Healy 1986, 99). The presence of layered clumps is more exceptional; maybe like paper books, dense piles of cloth resisted burning. In an open fire cremation, as opposed to an efficient modern furnace, areas of the body (and presumably other materials) which were touching the ground or fuel may not burn (Barber 1990, 380), also textiles may have fallen away from the heat of the fire and charred rather than burnt. As the pit-pyre burned, charred timbers and the body would have collapsed into the pit below, those falling outside the pit could have been raked in, cloth that fell into the pit early in the burning could have survived due to smothering (Evans pers.comm).

The textile clumps are stored at the British Museum (P+EE 2000,7-2.1/1-8), with the exception of one OVP00(TD) which is stored by Cambridge Archaeology Unit. In total there are eight textile clumps with multiple layers, some of which also have folds. The largest textile clump measures c.10x5 cm, with a thickness of 1cm (P+EE 2000,7-2.1/1). The thickest clump is 1.5 cm thick (P+EE 2000,7-2.1/2). In addition there are also approximately sixty loose textile fragments which were recovered from the pit-pyre cremation. Of the loose textile fragments, most are single layers but several have more than one layer.

2. Method of analysis

The textiles were examined using a 6X hand-held magnifier and a Dino Lite digital microscope. Following standard procedure (Walton-Eastwood 1988), they were observed for weave structure, spin direction, thread count, thread diameter and presence of borders, stitching and seams. To investigate the layers, the excavator initially commissioned x-rays to attempt to view the layers and folds, although these were not as successful as hoped. Instead a programme was proposed whereby the clumps were observed, described and where possible drawn in plan and profile view with special attention to layers and folds.

Two fibre samples from one textile (OVP00(TD)) were analysed by Margarita Gleba using Scanning Electron Microscope (Hitachi S 2300N) at the Institute of Archaeology, University College London. The fibre samples were observed under variable pressure (BSE), instrument settings 15.00 kV accelerating voltage, working at a distance of 10 mm. Observation for species identification are based on the morphological characteristics of the fibre including: diameter, longitudinal surface, cross sections and dislocations.

3. Results

First I present the results of the textile technology analysis (summarised in *Tab. 6.1*), fibre analysis, then for the layers and folds.

3.1 Technology

The Over textiles are woven in balanced plain weave (tabby), with the exception of two (P+EE 2000,7-2.1/8 (1) & (3)) which have a higher thread count in system 1. Balanced plain weave is typical of textile technology in Bronze Age Britain, as established by earlier authors (Bender Jørgensen 1992, 18–19; Henshall 1950, 133). Only one selvedge is visible in the Over textiles, it is woven in unbalanced plain

Tab. 6.1: Technological details of the textiles from Over Barrow 2.

Inventory number	Length mm	Width mm	Thickness mm	Weave structure	Spin system 1	Spin system 2	Spin angle System 1	Spin angle System 2	Thread diameter System 1, mm	Thread diameter System 2, mm	Thread ccunt System 1, per cm	Thread ccunt System 1, per cm	Borders	Layers
P+EE 2000,7-2.1/1	94	45	10	plain weave, tabby	2S	2S	loose to medium	loose to medium	0.6-0.8	0.6-0.8	14-16	14-16	-	8 or more layers
P+EE 2000,7-2.1/2	48	33	15	plain weave, tabby	2S	2S weak z spin			0.7-0.8	0.5-.07	12-13	12-13	-	9 layers visible
P+EE 2000,7-2.1/3	31	30	5	plain weave, tabby	2S	2S	loose	loose	0.7-0.8	0.7-0.8	13-14	13-15	-	layers, two overlapping folded clumps
P+EE 2000,7-2.1/4	30	26	7	plain weave, tabby	2S	2S	loose to medium	loose to medium	0.6-0.8	0.6-0.8	12-14	12-14	-	6 layers or more
P+EE 2000,7-2.1/5	45	23	15	plain weave, tabby	2S	2S	loose		0.5-0.7	0.5-0.7	12	12	-	at least 10 layers
P+EE 2000,7-2.1/6	38	24	5	plain weave, tabby	2S	2S	loose	loose	0.6-0.8	0.6-0.8	12-14	12-14	-	4 layers
P+EE 2000,7-2.1/7	40	13	5	plain weave, tabby	2S	2S	very loose	loose to medium	0.8-0.9	0.4	12	12	plain weave selvedge	layers visible in section
P+EE 2000,7-2.1/8 (1)	5	5		plain weave, unbalanced	2S	2S	loose	loose	0.2-0.3	0.2-0.3	18	12	-	see notes
P+EE 2000,7-2.1/8 (2)	18	5		plain weave, tabby	2S	2S	loose	loose	0.8-0.9	0.7-0.8	10-11	12	-	-
P+EE 2000,7-2.1/8 (3)	21	7		plain weave, unbalanced	2S	2S	loose	loose	0.3-0.4	0.2-0.4	16-18	12	-	-
OVP00(TD)				plain weave, tabby	2Sz	2Sz	loose	very loose & untwisting	0.5-0.6	0.5-0.6	14	12-14	-	layers

weave (P+EE 2000,7-2.1/7). The Over yarns are 2-ply, plied in an S direction (2S); a weak z-spin was discernible in two of them. Textile finds are still too scarce to claim any strong tradition in spin direction. However textile yarns from plant fibre plied in an S direction are recorded at other sites in Britain (Bender Jørgensen 1992, 19), as for example those at the comparably dated Site 3659 at Weasenham Lyngs, Norfolk (Petersen – Healy 1986, 99). This contrasts with wool textiles in Britain which seem to show a preference for simple yarns (i.e. single-spun) (Bender Jørgensen 1992, 19).

The full range of thread counts of the Over textiles is between 10–18 threads per cm, but most are characterised by thread counts from 12–15 threads per cm. Two of the textile fragments (P+EE 2000,7-2.1/8 (1) & (3)) have thread counts of c.12–18 threads per cm. The thread count of British textiles of this period range between 6–18 thread per cm, although most are around 10 threads per cm (Bender Jørgensen 1992, 18–19; Henshall 1950, 133, 158–2). The Over textiles are therefore at the finer end of this range. The yarn diameters range from 0.2–0.9 mm; most have a diameter of around 0.5–0.8 mm.

The fibre analysis was complicated by charring and heavy dirt encrustation. Of the two samples analysed, both have characteristic dislocations and polygonal cross sections (*Fig. 6.3*) indicating that the fibre is of plant origin. In terms of species, no clear identification was made and either flax (*Linum usitatissimum*) or nettle (*Urtica sp.*) remain possibilities. Further investigation is planned.

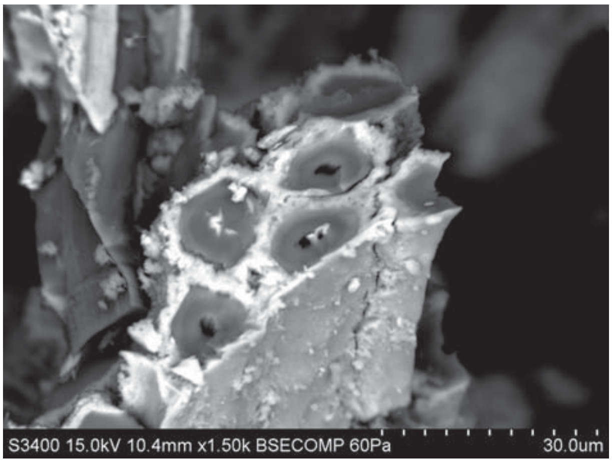

Fig. 6.3: SEM micrograph showing polygonal cross sections of plant fibres (© M. Gleba).

3.2 Layers and folds

Five of the layered textile clumps are described individually below, and are summarised together with all the textile remains in *Tab. 6.1.* The clumps are described in plan view (i.e. from the flat surface of the textile) and profile (i.e. thickness/layers). As the broken edges of the clumps demonstrate, they do not represent fully preserved textiles but were part of larger textiles. They may originally have been composed of more layers as some could have burnt off in the fire or fallen off during retrieval.

Two clumps (*Fig. 6.4a, 6.5d and 6.5e,* P&EE 2000 7-2.1/3 & P&EE 2000 7-2.1/6) both measure approximately 30x30 mm and are 5 mm thick. In plan view both clumps appear divided into two overlapping sections; it is not clear whether this is two overlapping folds or a thick seam. As no stitching is visible it seems most likely these are two overlapping folds. The sides and back of one are too encrusted with dirt to observe further details, the other has at least four layers in profile. The largest clump (*Fig. 6.4b and 6.5a*, P+EE 2000,7-2.1/1)

Fig. 6.4: a) top left; four textile clumps, lower two are P&EE 2000 7-2.1/3 & P&EE 2000 7-2.1/6 as illustrated in Fig. 6.5 d & e; b) top right P+EE 2000,7-2.1/1 as illustrated in Fig. 6.5 a; c) bottom left loose textile fragments (all textile images © Trustees of the British Museum); d) bottom right, studying the textile in the archive (© S. Harris).

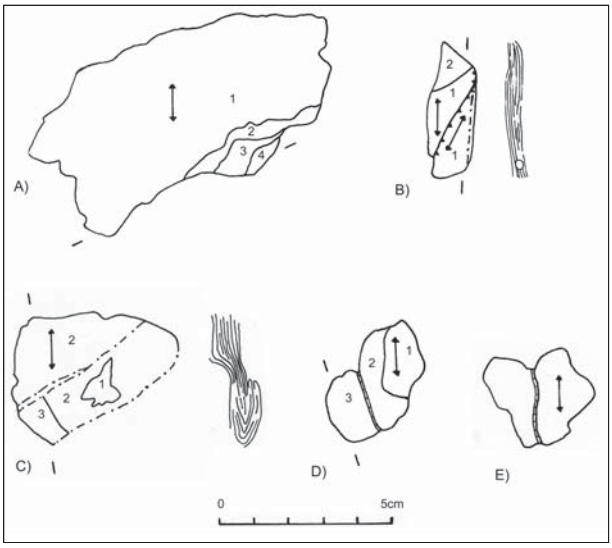

Fig. 6.5: Diagram of layered textiles clumps: a) P+EE 2000,7-2.1/1 four layers are visible in plan view and a further 4-5 layers are visible in profile.; b) P+EE 2000,7-2.1/7, a selvedge is visible on the upper surface of the clump. In profile there are at least seven layers; c) P+EE 2000,7-2.1/2, In plan view, three layers are visible and nine layers are visible in profile; d & e) P&EE 2000 7-2.1/3 & P&EE 2000 7-2.1/6, in plan view both clumps appear divided into two overlapping sections, possibly a fold. Key: doubled ended arrow = direction of thread system 1 for top layer; numbers = sequence of layers in plan view, section lines = area where profile layers counted; dot and dash line = fold; line with small triangles = selvedge, ladder line = fold or seam (graph: © S. Harris).

measures 94x45 mm and is 10 mm thick. Four layers are visible in plan view and a further 4–5 layers are visible in profile. Additional layers may be hidden due to the degraded nature of the sample. Therefore there are at least eight, possibly more layers. Another clump (*Fig. 6.5b,* P+EE 2000,7-2.1/7) measures 40x30 mm and is 5 mm thick. A selvedge is visible on the upper surface of the clump, it is folded back on itself. In profile there are at least seven layers. A further clump (*Fig. 6.5c*, P+EE 2000,7-2.1/2) measures 45x23 mm and 15 mm thick. In plan view, three layers are visible. The trace of a layer (marked 1) supports this notion that layers could have been burnt off. The main textile visible on the surface folds around itself, as can be seen more clearly in profile. A total of nine layers are visible in profile.

4. Comparanda: textiles in cremations

Charred textiles are known from cremations throughout Britain in the Bronze Age, for example at Winterborne Stoke 2 and 3, Wiltshire (Henshall 1950, 148–149). Most comparable in terms of date, site and geography is another multiple cremation burial under a round barrow: Site 3659 at Weasenham Lyngs, Norfolk which is 90 km from Over (Petersen – Healy 1986). Charcoal mixed with bone from the cremation is radiocarbon dated to 1791–1497 cal BC (BM-877 3339±56BP) (Petersen – Healy 1986, 73). The cremation contained charred tabby-weave textiles, Collared Urn sherds and cremated human bone identified by C.B. Denston as those of three or four people including a non-adult female and two female adults (Petersen – Healy 1986, 73, 100). The textiles analysis by Elisabeth Crowfoot (Petersen – Healy 1986, 99) identifies plain weave (tabby) fragments around 1cm squared, with S-ply yarn, thread counts 8 to 10 threads per cm. As they are charred they are presumably plant fibre; wool does not char. It is perhaps unsurprising that there were textiles in cremations as these may belong to clothing or bindings of the deceased. Due to their unusual clumping, can the Over textile clumps help address the question of the role of textiles in this cremation more specifically?

5. Discussion

Charred textiles are brittle and do not retain their flexibility. Therefore layers and folds must have formed before burning and have been placed in the fire in their layered state. There are many ways textiles could have been placed in a cremation. These can be separated into ‘pyre goods’, which are those things accompanying the deceased into the pyre such as clothing and offerings; and 'grave goods' which are placed with the cremated remains in the grave (Williams 2008, 243). To pyre goods we may add wrappers, bindings, offerings of the deceased's clothing or cloth wealth, a mattress or textile parts of the couch or bier. As the textiles from this cremation are charred they can be described as pyre goods. However, they may have been placed in the fire at any point during the cremation process. Cremation of a human body on an open fire takes many hours (Barber 1990, 380; McKinley 2008, 67) and the ceremonies accompanying this could have involved many stages. Which kinds of textile goods do the layered textiles from Over represent?

5.1 Clothing worn by the deceased

It is unlikely the clumps are the remains of the clothing worn by the deceased, because it seems improbable that layers of clothing worn on the body would be so tightly packed. An exception could be quilted or padded clothing. Such garments may be for warmth or protection, as for example the later linen corslets referred to in Greek texts and Italic/Etruscan art (Gleba 2012, 45–46). However, there is no clear evidence for stitching on the Over clumps to indicate quilting and, as far as I am aware, padded clothing is unknown in Bronze Age Europe.

5.2 Piles of cloth or clothing

Another possibility is that these clumps are the remains of piles of cloth that was stacked around the body, laid under the body as mattress or added as offerings of clothes or textiles. If this were the case we may consider these piles as deliberate destruction of wealth, gifts or the deceased's garments. Klaus Randsborg has suggested that textiles in the Scandinavian oak coffins represented wealth, in a similar way to metals (Randsborg 2011, 34–37). As an indirect comparison, in the Homeric literature, burning of stored clothes in the funeral pyre was a way to bring glory to the deceased (Mueller 2010, 13). Similar ideas should be borne in mind at Over.

5.3 Cloth to bind the body in a crouched position

A third possibility is that the cloth was used to wrap the bodies or body parts. As it seems likely that the bodies were cremated in a tightly crouched position (Dodwell 2012, 142), the textile could have served to bind the body into position. If this were the case, then they were wrapped in multiple layers, sometimes as many as ten deep; a process which could have required considerable quantities of textiles and may reflect the destruction of potentially valuable materials. To this we should add that cremation itself can be a labour and fuel intensive means of corpse disposal (Barber 1990, 380–381). The wrapping of the body also brings into question the treatment of the dead and issues such as the visibility and invisibility of the corpse (Banck-Burgess 2014, 152–153), in this case before cremation.

6. Conclusion

These possibilities raise a number of questions as to the role of textiles in Bronze Age cremation burials in the early second millennium BC in Britain, beyond their use as clothing or shrouds. Of the possible role of the Over textiles in cremation, their charred, layered state shows they went into the pyre in thick layers, small fragments of which escaped burning. Typical of textile technology in that they are made of plain weave, the Over textiles are nevertheless on the finer end of the scale in terms of the British

Bronze Age. It seems unlikely they were the clothes worn on the deceased's body. Instead they could have been stacked clothing or other textile offerings which were sufficiently densely piled to resist immediate burning. Similarly they could have been layers of wrapping to bind the body in its crouched position. In my opinion it seems most likely the dense layers were wrappings used to bind the corpse before cremation. However the evidence does not exclude the other possibilities. Either way textiles were labour intensive to make and may well have represented valuable materials consigned to the fire. The evidence from Over Barrow 2 leads us to consider the relationship between textile technology and the role of textiles in the ceremonies and social alliances surrounding the disposal of the dead in later Early Bronze Age societies.

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7 | Gewebe der Hallstattkultur aus Domasław in Niederschlesien

JERZY MAIK – ANNA RYBARCZYK

Abstract: Bei archäologischen Ausgrabungen wurde in Domasław bei Wrocław ein interessanter Komplex von Fundstellen (Siedlungen, ein Gräberfeld) der älteren Eisenzeit entdeckt. Die Arbeiten wurden vom Institut für Archäologie und Ethnologie der Polnischen Akademie der Wissenschaften, Filiale Wrocław, vor dem Bau des Wrocław-Autobahnrings durchgeführt. Schon die ersten Untersuchungen zeigten zahlreiche Einflüsse der Hallstattkultur und heute sind die Forscher von Domasław der Meinung, eine der am nördlichsten gelegenen Fundstellen der Hallstattkultur entdeckt zu haben – die einzige auf dem Gebiet Polens.

Unter den Funden gibt es auch einige Gewebeüberreste an Metallobjekten, die meistens vollständig von Metalloxiden durchdrungen sind sowie Gewebeabdrücke auf Ton. Die Textilien wurden in Leinwandbindung, Köperbindung 2/2 und vielleicht auch in Fischgrat- oder Spitzköperbindung 2/2 hergestellt. Da die Fundstücke in sehr schlechtem Zustand erhalten sind, bedarf es weiterer Untersuchungen, um die letztgenannten Köpervarianten eindeutig bestätigen zu können.

Die Bedeutung der Gewebe aus Domasław besteht nicht nur darin, dass sie als erste Textilien der Hallstattkultur in Polen gelten, vor allem, dass es unter ihnen auch Gewebe in Köperbindung 2/2 gibt, die in späteren Epochen, besonders in der 1. Hälfte des 1. Jahrtausends n. Chr., äußerst populär waren.

Keywords: Textilien, Früheisenzeit, Gräberfeld, Hallstattkultur, Domasław in Niederschlesien

1. Der archäologische Kontext

Eine der wichtigsten Errungenschaften der demokratischen Wende 1989 in Polen war die Erarbeitung und Umsetzung eines umfassenden Konzeptes zur Modernisierung des Landes. Ein wesentlicher Bestandteil dessen war der Bau moderner Autobahnen und Schnellstraßen. Auf der ganzen Länge der geplanten neuen Straßen wurden jedoch vorab archäologische Rettungsgrabungen durchgeführt, die viele bisherige Erkenntnisse über die Urgeschichte und über das Mittelalter in Polen stark veränderten. Es wurden mehrere Tausend archäologische Fundstellen erforscht, darunter auch jene in Domasław, Gemeinde Kobierzyce, Kreis Wrocław (Breslau) (*Abb. 7.1*).

Die Fundstelle liegt ca. 20 km südwestlich von Wrocław, im Gebiet von Równina Wrocławska (Breslauer Flachland). Archäologische Untersuchungen wurden in den Jahren 2005–2008 durch die Abteilung für Rettungsgrabungen, Institut für Archäologie und Ethnologie der Polnischen Akademie der Wissenschaften Breslau, unter der Leitung von Prof. Bogusław Gediga durchgeführt. Untersucht wurde ein Gebiet von über 15 ha und dabei wurden beinahe 14000 archäologische Objekte entdeckt, die einen Zeitraum von der Jungsteinzeit bis zur Römerzeit umspannen. Erforscht wurden unter anderem ein neolithisches Gräberfeld (4200–3800 v. Chr.), zwei Gräberfelder und dazugehörende Siedlungen aus der Frühbronzezeit (2300–1500 v. Chr.), ein großes Gräberfeld der Lausitzer Kultur von der Wende der Bronze- zur Eisenzeit (1300–700 v. Chr.), das auch in der frühen Eisenzeit gebraucht wurde, sowie eine Siedlung der Przeworsk Kultur (1. Jh. v. Chr.–2. Jh. n. Chr.) (Gediga 2013, 20–21; 2013a, 158–161).

2. Das Gräberfeld und die Einordnung des Bestandes

Der Fokus liebt in diesem Beitrag auf dem Gräberfeld der Hallstattkultur, aus dem Überreste von über ein Dutzend Geweben stammen. Es wurden dort ca. 900 Brandgräber, jedoch keine Skelettgräber gefunden.

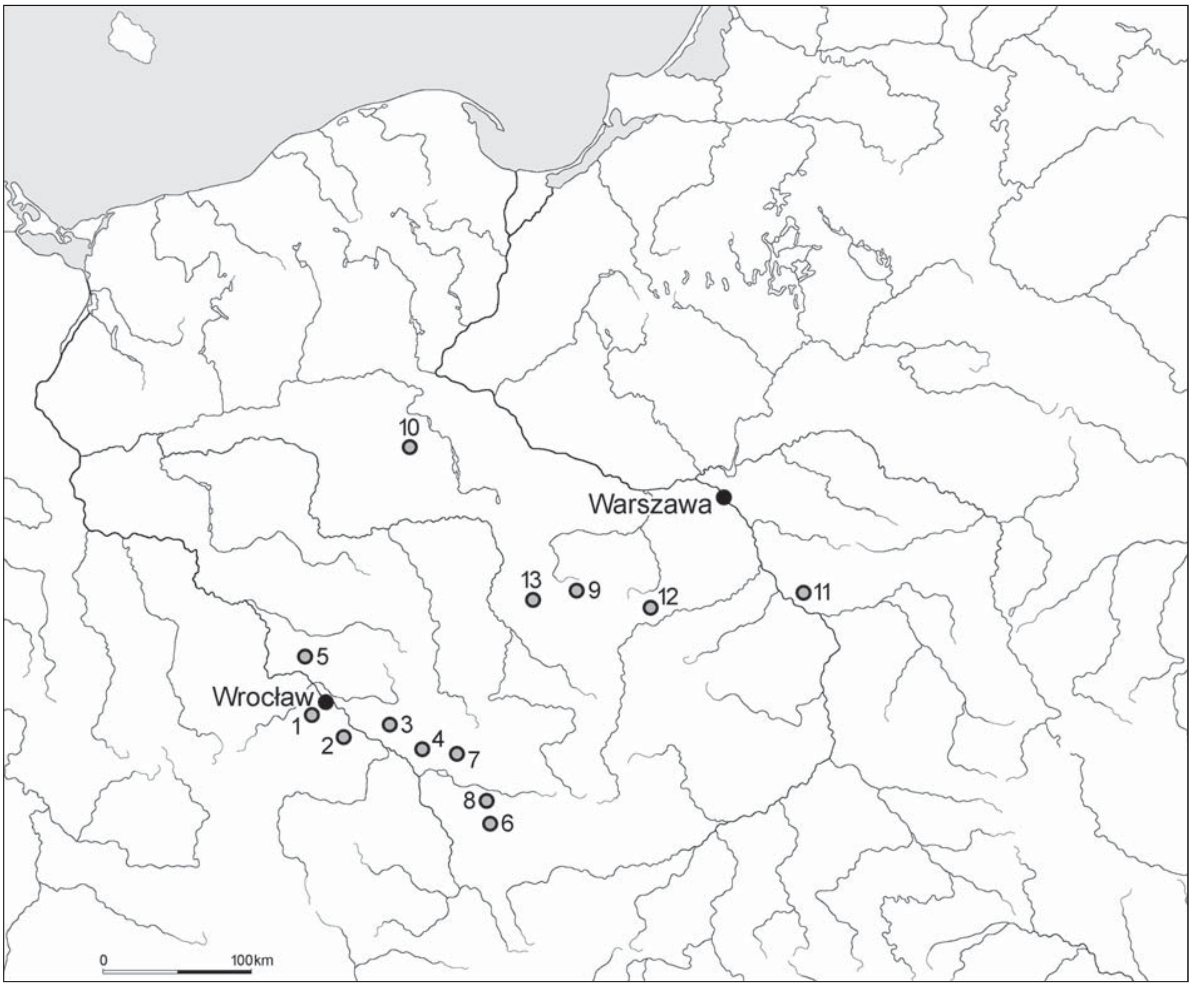

Abb. 7.1: Früheisenzeitliche archäologische Fundstelle in Polen mit Textilien. 1. Domasław, 2. Jankowice 3. Stare Kolnie, 4. Domaradz, 5. Wołów, 6. Łabędy-Przyszówka, 7. Lasowice Małe, 8. Świbie, 9. Łódź, 10. Biskupin, 11. Maciejowice, 12. Mąkolice, 13. Zakrzew (Zeichnung: E. Wtorkiewicz-Marosik).

Die Gräber, deren Konstruktion und Ausstattung von den Gräbern der Lausitzer Kultur abweichend sind, konzentrieren sich auf einem Gebiet und bilden eine deutlich separierte Gruppe. Es wurde dort ein Komplex reich ausgestatteter Gräber von komplizierter Konstruktion gefunden, darunter fast 300 Kammergräber. Sie wurden in Form von großen Gruben mit einem Durchmesser von 1 bis 4 m und einer Tiefe bis zu 2 m gebaut. Innerhalb der Gruben fanden sich hölzerne Konstruktionen mit vorwiegend rechteckigem Grundriss. Einige Gräber waren von ringförmigen Gräben mit einem Durchmesser von bis zu 15 m umgeben. Diese Grabanlagen bestätigen tiefgreifende kulturelle Veränderungen, die in der damaligen Gesellschaft stattgefunden haben.

Zur Ausstattung der reichen Gräber gehörten neben einer Urne (manchmal gab es sogar mehrere) auch zahlreiche Grabbeigaben – vor allem Keramik. Die Anzahl von Gefäßen, die ins Grab gelegt wurden, betrug teilweise über 50 Exemplare, dabei traten unter anderem qualitativ hochwertige Erzeugnisse der Hallstattkultur auf, zum Beispiel bemalte und graffitierte Gefäße. Eins der interessantesten Fundstücke ist wohl ein Wagenmodell – ein bemaltes Gefäß auf vier Rädern – das zweifellos eine kultische Bedeutung hatte. Der Fund wird als eine Spur der Einflüsse der Mittelmeer-Zivilisationen gedeutet. Neben der Keramik wurde auch eine Vielzahl von bronzenen und eisernen Metallgegenständen entdeckt.

Viele davon waren Importe aus dem Gebiet der Hallstattkultur von den Alpen und aus Norditalien. An Schmuckgegenständen fanden sich im Gräberfeld von Domasław goldene Ringe sowie Glas- und Bernsteinperlen.

Zwischen den reichen Gräbern mit komplizierter Konstruktion befanden sich auch einfache, arme Gräber, die nur mit ein paar Gefäßen und in wenigen Fällen auch mit Metallgegenständen ausgestattet wurden (Gediga 2010, 187–218; 2011a, 383–399).

Die verschiedenen Gegenstände, die für den alpinen Raum der Hallstattkultur charakteristisch sind, beweisen rege Kontakte zu den dortigen Gesellschaften. Die Differenzierung der Bestattungen weist auf eine bisher unbekannte soziale Schichtung und auf die Herausbildung einer Oberschicht hin – der Aristokratie. Dies bezeugt, dass aus dem Gebiet der Hallstattkultur neue Ideen einströmten und verwirklicht wurden. Es ist unbestritten, dass es zwischen dem Gebiet Schlesiens und dem alpinen Raum kulturelle Beziehungen gab. Es soll hier zur Diskussion gestellt werden, dass die Bewohner dieses Gebiets nicht nur Einflüsse der der Hallstattkultur aufnahmen, sondern vielmehr ein Teil dessen waren, was von Archäologen als nordöstliche Gruppe der Hallstattkultur bezeichnet wird (Gediga 2011, 83–116) (*Abb. 7.2*).

3. Die Textilfunde aus Domasław

Von den Geweben aus dem Gräberfeld der frühen Eisenzeit wurden 17 Proben untersucht, wobei in einer Probe keine Textilüberreste, sondern nur zufällige pflanzliche Fasern festgestellt wurden. Es wurden also 16 verschiedene Gewebe analysiert, wobei die meisten aus den reichen, mit Metallgegenständen

Abb. 7.2: Gebiet der Hallstattkultur mit Nord-Ost Gruppe und Domasław (nach B. Gediga).

ausgestatteten Brandkammergräbern stammen. Die Gewebe, meistens kleine Reste, überdauerten in direkter Nähe zu den eisernen Gegenständen. Das Eisenoxid wirkte auf die Textilien wie ein Konservierungsstoff, indem es ihre Fasern vollständig durchdrang. Die Rohstoffe der Gewebe konnten nicht festgestellt werden, jedoch soll hier aufgrund unserer jahrelangen Erfahrung mit archäologischen Textilien angenommen werden, dass sie aus Wolle gefertigt wurden. Dies ist aber nur eine subjektive Bewertung unsererseits.

Bei allen Geweben wurde das Garn in Z-Richtung gesponnen. Wir haben keinen einzigen Faden mit Z-Drall ermittelt, was darauf hindeuten kann, dass damalige Spinnerinnen mit ihren Spindeln kein S-gedrehtes Garn erzeugten.

Neun Gewebe (Nr. 1, 4–7, 10–11, 15–16) wurden in Leinwandbindung hergestellt, ein Gewebe (Nr. 8) in Ripsbindung, vier Gewebe in Köperbindung 2/2 (Nr. 2–3, 12–13) und ein Fundstück ist ein Brettchengewebe (Nr. 9). Es ist uns nicht gelungen, die Bindung des Gewebes Nr. 14 festzustellen, da seine Überreste zu klein waren.

Die leinwandbindigen Gewebe sind Erzeugnisse mittlerer Dichte, zwei sind fein. Nur bei dem gröberen Gewebe Nr. 11 liegt die Kett- und Schussdichte unter 10 Fäden pro cm (*Abb. 7.3*), die Dichte von Nr. 6–7, 10, 15 beträgt in der Kette und im Schuss von 10 bis 15 Fäden pro cm (*Abb. 7.4–7.5*), zwei weitere Gewebe (Nr. 4–5) haben 20 Fäden pro cm in der Kette und 12 Fäden pro cm im Schuss (*Abb. 7.6*). Für zwei Gewebe (Nr. 1, 16) konnten die Dichten nicht ausgezählt werden. Bei hohen Gewebedichten

Abb. 7.3: Domasław. Grobes Gewebe Nr. 11 in Leinwandbindung (Foto: J. Słomska).

Abb. 7.4: Domasław. Gewebe Nr. 10 mittlerer Dichte in Leinwandbindung (Foto: J. Słomska).

Abb. 7.5: Domasław. Gewebe Nr. 15 mittlerer Dichte in Leinwandbindung (Foto: J. Słomska).

Abb. 7.6: Domasław. Feines Gewebe Nr. 4 in Leinwandbindung (Foto: J. Słomska).

Abb. 7.7: Domasław. Gewebe in Ripsbindung (Foto: J. Słomska).

Abb. 7.8: Domasław. Sehr feines Gewebe Nr. 2 in Köperbindung 2/2 (Foto: J. Słomska).

ist die Garnstärke in der Kette und im Schuss nicht groß und beträgt meistens von 0,5 bis 1 mm, nur in einem Fall ist das Garn deutlich dünner mit ca. 0,3–0,4 mm (Nr. 2).

Bei dem dicken Gewebe in Ripsbindung (Nr. 8) ist die Kette aus zwei Fäden mit S/2z-Drall gezwirnt, der Schuss besteht aus z-Garn (*Abb. 7.7*). Bei der Ripsbindung wurde ein doppelter Schussfaden verwendet, um die Kett- und Schussdichte optisch anzugleichen.

Auf der anderen Seite des Bronzerings, an dem das feine, in Leinwandbindung gefertigte Gewebe Nr. 1 gefunden wurde, war auch ein sehr feines Gewebe in Köperbindung 2/2 (Nr. 2) erhalten (*Abb. 7.8*). Sein Zustand ist aber sehr schlecht, die stark korrodieren Fäden zerfallen bei jeder Berührung mit der Nadel. Die Dichte dieses Gewebes wurde zwar nicht ausgezählt, es handelt sich dabei um ein sehr feines Erzeugnis, was durch die Garnstärke in der Kette und im Schuss, die ca. 0,2–0,3 mm beträgt, bestätigt wird.

Auch bei anderen Geweben in Köperbindung 2/2 ist die Fadendichte hoch. Bei Nr. 13 beträgt sie 20/14 Fäden pro cm (*Abb. 7.9*), und bei den Geweben Nr. 3 und 12 liegt die Dichte bei 10 bis 15 Fäden pro cm (*Abb. 7.10–11*). Die Garnstärke dieser Gewebe beträgt von 0,5 bis 1 mm, und bei dem sehr dichten Gewebe liegt die Fadenstärke unter 0,5 mm.

Bei Textilfragment Nr. 9 handelt es sich wahrscheinlich um einen Rest eines Bandes, das

Abb. 7.9: Domasław. Sehr feines Gewebe Nr. 13 in Köperbindung 2/2 (Foto: J. Słomska).

Abb. 7.10: Domasław. Gewebe Nr. 3 mittlerer Dichte in Köperbindung 2/2 (Foto: J. Słomska).

Abb. 7.11: Domasław. Gewebe Nr. 12 mittlerer Dichte in Köperbindung 2/2 (Foto: J. Słomska).

mit Brettchen gewebt wurde (*Abb. 7.12*). Es ist zwar sehr schlecht erhalten, man konnte aber an zwei Stellen beobachten, dass in das Webfach, das durch Verdrehen der Brettchen gebildet wird, jeweils zwei Schussfäden eingezogen wurden. In der Kette und im Schuss wurden Fäden mit z-Drall gebraucht. Die Stärke der Kette beträgt 1,15 mm und des Schusses 0,7 mm.

Abb. 7.12: Domasław. Gewebe Nr. 9, Brettchenband (Foto: J. Słomska).

4. Früheisenzeitliche Textilien aus dem Gebiet Polens

Die kleine Gewebesammlung von Domasław hat eine besondere Bedeutung für die Kenntnis der ältesten Geschichte des Textilwesens auf dem Gebiet des heutigen Polens. Dies resultiert aus der Tatsache, dass Gewebe aus den vorrömischen Zeiten beinahe nur durch Abdrücke in Ton bekannt sind (Maik 2012, 295–297). Der Grund dafür liegt offenbar in den an Siedlungsorten herrschenden Bodenbedingungen, die für den Erhalt von Geweben äußerst ungünstig waren, sowie in der Sitte der Leichenverbrennung, die in der Bronze- und Früheisenzeit die bevorzugte Bestattungsart war. Am Beispiel der Textilfunde aus den Brandgräbern in Domasław kann man in Zukunft an anderen Gräberfeldern noch weitere ähnliche Funde erwarten.

Skelettgräber, in denen Gewebe relativ oft erhalten sind, treten in der Älteren Eisenzeit in Südpolen – in Schlesien – auf und gerade aus diesem Gebiet stammen die meisten Textilfunde (*Abb. 7.13*). Die ersten davon wurden von deutschen Archäologen in den 30er Jahren des 20. Jahrhunderts gefunden und von G. Sage und W. v. Stokar beschrieben (Sage 1934, 69–82; von Stokar 1938). Die Funde stammen aus solchen Gräberfeldern[1] wie: Jankowice, Kreis Oława (Jungwitz Kr. Ohlau), Stare Kolnie, Kreis Brzeg (Alt Köln, Kr. Brieg), Domaradz bei Opole (Dammratsch Kr. Oppeln), Wołów, Kreis Loco, (Wohlau-Ost, Kr. Wohlau), Łabędy-Przyszówka, Kreis Gliwice (Woldenau, Kr. Gleiwitz), Lasowice Małe, Kreis Olesno (Klein Lassowitz, Kr. Rosenberg). All diese Gewebe sind im Zweiten Weltkrieg verloren gegangen, sodass keine Möglichkeit mehr besteht, die Ergebnisse der damaligen Untersuchungen zu verifizieren. Die oben angeführten Gewebe wurden aus Leinen oder Wolle gefertigt, gelegentlich unter Beimischung von Tierhaaren. Die meisten wurden in Leinwandbindung aus z-Garn in Kette und Schuss gewebt, mit einer Garnstärke um 03–0,8 mm. Aus der Ortschaft Świbie, Kreis Gliwice (Schwieben, Kr. Gleiwitz) stammt zudem ein kleines Fragment eines Sprangs (ŁASZCZEWSKA 1966, 33–34, Abb. 10).

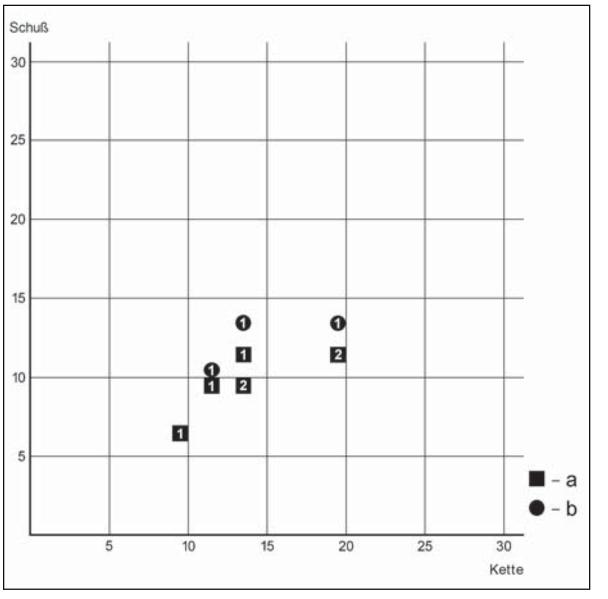

Abb. 7.13: Domasław. Diagramm der Gewebedichte. a. Leinwandbindung, b. Köperbindung 2/2 (Zeichnung: E. Wtorkiewicz-Marosik).

Die hallstattzeitlichen Gewebe bzw. ihre Abdrücke in Ton, die aus Gebieten außerhalb Schlesiens stammen, wurden ebenfalls in Leinwandbindung gefertigt. Als Beispiel können Textilien genannt werden, die auf in Łódź gefundenen Sicheln erhalten sind, oder Gewebeabdrücke im Lehmfußboden in Biskupin, Kreis Żnin in Kujawien, wo eine große, gut erhaltene befestigte Siedlung der Lausitzer Kultur entdeckt wurde (ŁASZCZEWSKA 1966, 34–35). Mehrere leinwandbindige Gewebeabdrücke sind Urnen aus dem Gräberfeld in Maciejowice, Kreis Siedlce in Masowien (MAIK 2014) bekannt. Neben der Leinwandbindung wurde auch die Variante Rips verwendet (z.B. Mąkolice, Kreis Piotrków Trybunalski) (MAIK 1995). Bekannt war auch das Brettchenweben, so wurde in Zakrzew, Kreis Sieradz, ein mit mindestens 21 Webbrettchen gefertigtes Band entdeckt (MAIK 2005, 227–228).

Charakteristisch für die Gewebe aus der Frühen Eisenzeit Polens ist z-Garn – so wie im Falle der Fundstücke von Domasław. Die Verfasser der alten Publikationen gaben meist weder Garnstärke noch Gewebedichte an. Nähere Angabe gibt es jedoch zu dem in Jankowice gefundenen leinwandbindigen Gewebe (Garnstärke ca. 0,5 mm, Dichte 9/7 Fäden pro cm) sowie von Łabędy (Garnstärke ca. 0,7 mm, keine Fadendichte angegeben).

5. Vergleiche mit den Textilien der Hallstattkultur und anderen zeitgleichen Kulturgruppen

Jene Gewebe von Domasław, die in Leinwandbindung 1/1 oder mit Webbrettchen gefertigt wurden, unterscheiden sich qualitativ nicht wesentlich von anderen, in Polen gefundenen Textilien aus der Früheisenzeit. Überraschend sind jedoch die Gewebe in Köperbindung 2/2, weil die ältesten derartigen Funde auf dem Gebiet Polens in die erste Hälfte des 1. Jahrtausends n. Chr. datiert werden. Entsprechende Analogien sind also woanders zu suchen.

[1] Da in den entsprechenden Publikationen die Funde unter den alte deutsche Ortsbezeichnungen veröffentlicht wurden, werden diese hier ebenfalls angeführt.

In diesem Zusammenhang ist es wesentlich, dass das Gräberfeld von Domasław wegen des ganzen dortigen Kulturkontextes der nordöstlichen Gruppe der Hallstattkultur zuzuordnen ist. Die Gewebe der Hallstattkultur sind gekennzeichnet durch eine große Vielfalt, wobei Köperbindung 2/2 besonders charakteristisch ist.

Zahlreiche Beispiele sind vor allem aus dem Salzbergwerk in Hallstatt bekannt. Sehr typisch ist dabei die Köperbindung 2/2 und deren andere Varianten (Fischgratbindung, Spitzgratbindung und Diamantbindung). Bei den Geweben aus Hallstatt tritt häufig z-Garn auf, es gibt häufig Spinnrichtungsmuster; die Garnstärke liegt gewöhnlich unter 0,5 mm, und in vielen Fällen beträgt sie 0,2–0,3 mm. Es gibt aber auch Fäden mit der Stärke von über 1 mm. Die Gewebedichte beträgt meistens 10–15 Fäden pro cm, obwohl es auch Textilfunde mit der Gewebedichte von über 40 Fäden pro cm gibt – diese Gewebe wurden aus dem dünnsten Garn, ca. 0,1–0,2 mm, gefertigt (Hundt 1959, 73–84; 1960, 130–132; 1961, 11–13; 1967, 39–45; 1987, 262–268, 272–276; Grömer 2012, 42–45; 2013, fig. 20).

Gewebe in Köperbindung 2/2 und 2/1 wurden auch in den hallstattzeitlichen Fundstellen in der Schweiz entdeckt – unter anderem in Langenthal, Ersingen und Subingen. Es gibt unter ihnen sowohl feine als auch dicke Textilien, hergestellt aus z- und s-Garn (Rast-Eicher 2012, 383–386).

In dem bekannten Fürstengrab von Eberdingen-Hochdorf, aus dem eine große Gewebesammlung stammt, treten ebenso vorwiegend Textilien in Köperbindung 2/2 auf. Ein Teil davon weist Muster auf, die durch Farbenwechsel und Änderung der Garndrehung entstanden waren (Banck-Burgess 2012, 139–150; Grömer 2010, 272–275).

Es sei noch hinzuzufügen, dass Gewebe in Köperbindung 2/2 auch in Regionen außerhalb des Verbreitungsgebietes der Hallstattkultur bekannt sind. Zu nennen ist vor allem Nord- und Mittelitalien, wo in der frühen Eisenzeit neben Geweben in Leinwandbindung viele Textilien in Köperbindung 2/1 und 2/2, darunter auch in Fischgratbindung 2/2 und Diamantbindung 2/2, gefunden wurden. Es sind unter anderem Verucchio, Sasso di Furbara, Vedretta di Ries, Tarquinia und San Basilio zu nennen. Bemerkenswert ist die Tatsache, dass das Garn dieser Gewebe sowohl in z- als auch in s-Drall vorkommt. Ein großer Teil der Textilien ist sehr fein, die Gewebedichten liegen unter 30 Fäden pro cm. Die feinsten davon wurden aus Garn mit der Stärke von ca. 0,1–0,3 mm gewebt (Gleba 2012, 223, 227–229; Stauffer 2012, 242–263; Stauffer – Raeder Knudsen 2013, 69–71).

Früheisenzeitliche Gewebe in Köperbindung 2/2 sind aus Norddeutschland bekannt (Bender Jørgensen 1992, 53–55), und auf der dänischen Insel Fünen wurden köperbindige Gewebe gefunden (Bender Jørgensen 1986, 15–28, 289–295; Mannering *et. al.* 2012, 97–110), die in die späte Bronzezeit datiert werden (entspricht der Früheisenzeit in Mitteleuropa). Diese wenigen Beispiele werden als Importe aus dem Gebiet der Hallstattkultur angesehen (Bender Jørgensen 1986, 25, 293).

Es scheint alles darauf hinzudeuten, dass die Gewebe in Köperbindung 2/2, aber auch das Gewebe in Ripsbindung und das Brettchenwebband von Domasław eine Verknüpfung mit der Hallstattkultur haben. Sie entsprechen ausgezeichnet sonstigen dortigen Funden und bestätigen die Zugehörigkeit des Domasławer Gräberfeldes aus der frühen Eisenzeit zur Hallstattkultur.

6. Funktion der Gewebe aus Domasław

Die untersuchten Textilfunde sind keine Überreste von Totenkleidung, weil sie keine Verbrennungsspuren aufweisen. Sie wurden neben verschiedenen Metallgegenständen, die als Grabbeigaben dienten, gefunden. Nach mündlichen Mitteilungen der Archäologen, die das Gräberfeld in Domasław erforschten, wurden kleine Überreste von nicht mehr erhaltenen Textilien auch an einigen Urnen entdeckt. Es ist daher wahrscheinlich, dass die Grabbeigaben und vielleicht auch die Urnen in die Gewebe eingewickelt waren.

Hierbei scheint eine Anknüpfung an Bräuche vorzuliegen, die auch im Gebiet der Hallstattkultur und der Etrusker gepflegt und verbreitet wurden. Im Gräberfeld in Hallstatt wurden Gegenstände, z.B. Schwerter gefunden, die in Gewebe eingeschlagen waren (Grömer 2010, 272–275). Grabbeigaben, die in Gewebe eingewickelt wurden, gab es auch im Grab von Eberdingen-Hochdorf (Banck-Burgess 2012a, 43–55). Auch die Etrusker wickelten Gegenstände aus Eisen in Gewebe ein. Die Totenaschen wurden zuerst in Stoffsäckchen und die Säckchen dann in Urnen gefüllt; auch die Urnen selbst wurden in Gewebe gehüllt (Aigner-Foresti 2010, 138–140; Gleba 2012, 232–233; von Hase 2013, 72).

Die Frage nach derartigen Totenriten bedarf weiterer Untersuchung. Zum einen sind die Urnen von Domasław erneut detailliert zu betrachten, um mögliche Spuren von Textilien entdecken zu können. Zum anderen ist zu verfolgen, wie sich Bestattungsbräuche vom Süden bis in den Norden Europas verbreiteten und einander durchdrangen, wobei dies in einem breiteren Kontext kultureller Veränderungen im früheisenzeitlichen Mitteleuropa zu erforschen und zu untersuchen ist.

7. Fazit

Wir wissen nicht, ob die Gewebe von Domasław ebenso wie die in Hallstatt gefundenen Textilien mit Mustern, durch Farbenwechsel gestaltet wurden. Es ist hier nochmals zu betonen, dass die Gewebe von Domasław, die in den Brandgräbern entdeckt wurden, sehr schlecht erhalten sind. Die kleine Gewebesammlung von Domasław hat jedoch eine wesentliche Bedeutung sowohl für die polnische Archäologie als auch für die Geschichte des Textilwesens. Sie bestätigt nämlich auf deutliche Art und Weise sowohl die Existenz der nordöstlichen Gruppe der Hallstattkultur in Niederschlesien der frühen Eisenzeit als auch die Tatsache, dass es im polnischen Gebiet schon vor der Römerzeit zu einer bedeutenden Entwicklung der Textiltechnik kam. Die textilen Funde von Domasław weisen auch auf die Übernahme diverser kultureller Bräuche hin, insbesondere Bestattungsbräuche, die in den Regionen südlich der Alpen üblich waren.

Übersetzung: Małgorzata Gawlik

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8 | Early Scandinavian Textile Design

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Abstract: Denmark possesses a unique collection of textiles and costumes dated to the Bronze and Early Iron Ages (1800 BC–AD 400). Since 2005 this material has been investigated at the Danish National Research Foundation's Centre for Textile Research at the National Museum of Denmark. Besides traditional textile technological analyses, fibre analysis has been used to explore the development and potential of raw materials for textile production and dye analysis to investigate the development of a new technology and to understand the visual appearance of early Scandinavian textile design. In this article the latest results from the ongoing research are presented with focus on similarities and differences between Bronze and Early Iron Age textile technology.

Keywords: Scandinavia, Bronze Age, Early Iron Age, textile technology, fibre, textile design, dye

1. Introduction

Since 2005 an interdisciplinary team of archaeologists, hand-weavers and researchers from the natural sciences have been working at the Danish National Research Foundation's Centre for Textile Research (CTR DNRF64) in Copenhagen, Denmark, with the large collection of Early Iron Age costumes recovered from the Danish peat bogs (Mannering *et al.* 2010; Gleba – Mannering 2012). This collection of costumes is extremely rare because the garments are mostly complete. In 2011 a study of textiles and costumes from the Danish Bronze Age oak coffin burial was also initiated (Nosch *et al.* 2013). Throughout the years several researchers have been looking at, analysing and publishing different parts and aspects of these impressive collections. The most famous works are the books by Margrethe Hald (Broholm – Hald 1939, 1940; Hald 1980; see also Bergerbrant 2007), but likewise important is the comprehensive registration of prehistoric textiles from graves made by Lise Bender Jørgensen in the 1980s (Bender Jørgensen 1986; 1992). Recently, some of these grave finds have also been examined by the CinBA research group (Bender Jørgensen *et al.* 2013). Altogether this research provides a unique opportunity to characterise and qualify the development of textile production throughout the early part of Scandinavian prehistory.

2. Early Scandinavian Textile Technology

Overall, Danish Early Bronze Age (1800–500 BC) textiles have a very distinct visual character, and even to the untrained eye they are fascinatingly uniform in their visual appearance. It is almost always possible to recognise Scandinavian Bronze Age textiles based on a few parameters: they are almost exclusively plain weaves, they have on average 3–5 threads per cm in both thread systems, the yarns are typically s-twisted or combined with z-twisted yarns, and the yarn is quite thick and unevenly spun (Nosch *et al.* 2013). Sewing and embroidery are often used on the costumes, both of which are highly developed techniques that follow different standards from the woven fabrics that they are found on (Fossøy 2013). For instance, yarns used for sewing are usually much finer than the ones used for the same woven textile. This means, that the coarse Bronze Age weaves were a deliberate choice, not because Bronze Age spinners were unable to produce fine yarns. Further, finishing treatments in combination with the rigid plain weave textile structure, gave the Scandinavian Bronze Age textiles a smooth and firm surface which in many cases also obscured the thread structure and even allowed the fabrics to be cut into shapes without fraying or being hemmed. In this way, many Bronze Age textiles are technologically and aesthetically embedded in a costume tradition which has significant similarities with the skin technology. Thus, it can be concluded that Bronze Age yarns and textiles were highly specialised and perfectly adapted to their purpose (*Fig. 8.1*).

In contrast, textiles from the succeeding Early Iron Age (500 BC–400 AD) are typically woven in plain 2/2 twill, which is a more flexible weave used to make denser and complex unbalanced weaves. In the Pre-Roman Iron Age (500 BC) textiles had on average 7–10 threads per cm in both thread systems. However, it is important to note that the spinning technology did not change significantly from Bronze to Early Iron Ages and the recorded Pre-Roman Iron Age yarns were still quite dense though often more evenly spun (Mannering 2011; Mannering *et al*. 2012). Textile weave structures were not very dominant in the Early Iron Age as twills were made with a balanced thread count and, as in the Bronze Age, the textiles had a high degree of felting and use of surface finishing treatments. Unlike the Bronze Age textiles, most evidence for sewing in Pre-Roman Iron Age textiles appears in connection with repairs or secondary use. These instances of sewing and repairs are often made in yarn of a different thickness, fibre and colour than in the ground weaves, which make them stand out and appear coarse. So far, there seems to be no obvious explanation for this feature, but perhaps sewing was not considered to be an important aspect of the Early Iron Age textile aesthetics.

3. Fibre Quality

Another important parameter which plays a decisive role in the look and feel of a textile is the fibre quality. Most Bronze Age textiles were made of sheep's wool, taken from a sheep breed that was moulting not sheared (Mannering *et al.* 2012; Rast-Eicher – Bender Jørgensen 2013; for the use of plant fibres see Bergfjord *et al*. 2012). Although the Early Bronze Age textiles give a coarse impression from simple visual inspection, they are in fact soft and light, and have a very good drape. The key to these properties are to be found in the fibre quality. According to the systematic fibre analyses performed at the National Museum of Denmark by Irene Skals, it can be concluded that there is little difference between the wool used for Bronze and Pre-Roman Iron Ages textiles, indicating that the same kind of sheep breeds existed and were used for a very long period in Scandinavia (Bender Jørgensen – Walton 1986; Mannering – Gleba, forthcoming; Rast-Eicher – Bender Jørgensen 2013; Ryder 1988; Walton 1988). The few differences that can actually be recorded in the fibre diameter distributions are most likely to be explained as a result of slightly different preparation and sorting processes. In the Pre-Roman Iron Age wool was still the dominant fibre used for textile production though the use of plant fibres seems to have gradually become more common (Gleba – Mannering 2010). Further, ongoing fibre analyses have shown that it is not until the Roman Iron Age (1–400 AD) that new and different wool types occur in Scandinavia. This development was probably also linked to the introduction of large iron wool shears and the technique of shearing (Henriksen 2009, 175–180). Initially this indicates that there was a limited range of sheep breeds available in the Scandinavian Late Bronze and Early Iron Ages, and most likely North European sheep breeds developed more or less independently from other European sheep breeds (Rast-Eicher – Bender Jørgensen 2013).

4. Design

A third important feature, which can be used to characterise textiles, is the aesthetic appearance or design of the textiles. Unlike later periods where "design" connotes innovation in costume

Fig. 8.1: In the burial mound from Borum Eshøj in East Jutland, Denmark dated to the 14th century BC, three people were found clothed in well-preserved costumes. A woman (left) was wearing a short blouse with a large piece of seamed cloth swathed around her waist and legs. A hair net, a sprang cap, and two woven belts also belonged to her wardrobe. An oval cape was draped over the old man (right). His lower body was wrapped in a rectangle of cloth like a modern kilt. This knee-length garment was fastened at the waist by a belt. The hat on his head was made of cloth with a surface imitating fur. The coffins were lined with cowhides (© National Museum of Denmark).

styles and even a producer/consumer relationship, design in early Scandinavian textiles stemmed from changes in technologies and production. In the Early Iron Age textile production is characterised by a distinct textile design using stripes and checks created by a combination of white and naturally pigmented yarn. On top of this patterning, plant dyes were used as a further way of colouring the textiles. During our analyses of the Danish bog textiles dye analyses of 180 samples from 45 different textiles coming from 26 different sites showed that the majority of these textiles contained traces of plant dyes (Vanden Berghe *et al.* 2009; 2010). The most common colour was yellow followed by blue and in rare occasions red. This new evidence documents that Early Iron Age textile producers mastered and used dyeing techniques in a very subtle way, and the use of naturally pigmented wools did not exclude the use of plant dyes (*Fig. 8.2*). Recently, we also have investigated whether plant dyeing techniques were also known and used in Bronze Age textile production, but unfortunately these analyses have not shown any traces of dyes in any of the analyzed textiles samples[1]. Based on this data it must be concluded that the dyeing technology was not an integral part of textile production in Scandinavia until the Early Iron Age, and that the overall visual appearance of Early Bronze Age textiles was typically monochrome using different naturally pigmented wool colours with occasional contrasts in white wool.

5. Conclusion

It can be concluded that the briefly sketched differences between Scandinavian Bronze Age and Early Iron Age textile production were based on different but equally strong craft traditions. Early Scandinavian textiles had distinct designs that were determined and dominated by the production technology and the raw materials available in the local area. Furthermore, uniform textile design observed in the Early Bronze Age points towards a craft that was strongly controlled and did not permit the same kind of individuality that is evident in Early Iron Age textile production. The uniformity to Bronze Age textiles even challenges the commonly accepted idea that most early Scandinavian textile production only took place in the individual farmsteads as part of the basic household production (Jensen 2013, 619), and suggests that the textile craft at this time was controlled by a small elite that controlled production, design, use and distribution of textiles. This suggestion is consistent with knowledge and distribution patterns based on other prestigious goods in the Bronze Age (Earle – Kristiansen 2011).

Further, there can be no doubt that Danish Bronze Age textiles from their very first appearance demonstrate a fully developed technology, with a costume design largely influenced by the much older skin craft. Especially in the Early Bronze Age, skin craft and textile craft had many common features and technological similarities. The overlap between these two crafts can be seen for instance in the textiles imitating fur like the piled male hats (*Fig. 8.3*) or the shaggy male cloaks (Broholm – Hald 1940). Though there are no skin costumes preserved from the Early Bronze Age in Denmark, except shoes, the textile costumes clearly demonstrate this technological link, which eventually disappeared in the Early Iron Age. In this period on the contrary, the textile and skin technologies were completely separated and have to be seen and understood as two different crafts with different standards and traditions. Nevertheless, this did not mean that skins and furs were no longer used for clothing, skin costumes remained an important article in the Early Iron Age costume tradition (Mannering 2011).

[1] All dye analyses were made by Ina Vanden Berghe of the Royal Institute for Cultural Heritage in Brussels.

Fig. 8.2: The Huldremose Woman was found in 1879 in a bog in East Jutland, Denmark. When she died (350–41 BC) she was placed in the bog dressed in two skin garments and three different textile items: a bluish wool skirt, a reddish wool scarf and a white linen inner garment. The two skin capes were worn on top of each other. A horn comb, a bluish wool hairband and a leather thong were sewn into the inner skin cape (© National Museum of Denmark).

Fig. 8.3: This hat was found in a burial mound from Muldbjerg in West Jutland. It measures 16 cm in height and 58.5 cm in circumference. It belonged to a man that was buried in his wool costume in the year 1365 BC. A dense pile layer made of extremely thin yarns gives the surface a curly appearance that probably imitates fur (© National Museum of Denmark).

By compiling detailed knowledge about textile technology with aesthetic appearances, fibre, colour and dyes from the Danish Bronze and Early Iron Ages collections it has become possible to produce a new picture of the development of the textile and skin crafts which can be incorporated in more general discussions of the organisation and development of prehistoric societies. More publications about Danish textile research will follow in the coming years, and can be found on *www.ctr.hum.ku.dk*.

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9 | Textile remains on Hallstatt bracelets in Alsace (France). Burial context of Soufflenheim-Obermattwald, Tumulus IX

FABIENNE MÉDARD – MURIEL ROTH-ZEHNER

Abstract: Excavated in 1999, the Hallstatt site of Soufflenheim-Obermattwald (France, Bas-Rhin) reveals eight burial mounds, including the tumulus IX which was completely leveled. Among the three tombs excavated under this building are two graves in which organic remains are particularly well preserved. In a central position, the first one contains a woman buried with rich materials and the second one contains a man who died later. Both individuals wear a heavy bronze bracelet on each arm; the four bracelets are covered by remarkable mineralized textiles. The analysis of these remains completes the database of Hallstatt textiles excavated in eastern France, as well as the knowledge of funerary practices in this period.

Keywords: Alsace, Hagnenau forest, Hallstatt burial, textiles, bracelets

1. Context of the site discovery

The Soufflenheim site (Alsace, Bas-Rhin) otherwise called "Obermattwald" (currently Golf international) is situated in the north eastern region of the Haguenau Forest (necropolis of "Kurzgeland"). The nine mounds were "rediscovered" in 1987 by François Sigrist and were mapped and recorded in 1989; several among them contained artefacts (ceramics, bronze fragments) dating to the Middle and Late Bronze Age (1500–800 BC) and the Hallstatt Period (800–480 BC).

Tumulus IX in Soufflenheim-Obermattwald was discovered following an archeological diagnostic examination of the proposed golf course (AFAN, Jacky Koch). The mound was completely hidden and not visible in the landscape. The excavation was conducted by Muriel Roth-Zehner (Antea-Archéologie) in 1999. It revealed the presence of three graves and two successive funeral circles. The northern part of the monument was destroyed by the construction of a road in 1992.

The first phase of the funeral circle consists of an uninterrupted pit (ext. diam. = 15.50 m; int. diam. = 14.70 m). The entrance to the circular enclosure is located on the south west part (l. = 3.50 m) that can be considered as the central grave of this mound. The second enclosure is behind the first circle and lies across of its alignment. On the part we could observe, the pit is continuous, its diameter is slightly superior to the preceding one (ext. diam. = 17.50 m; int. diam. = 16.20 m). A fence was installed, definitively sealing off the funerary space (*Fig. 9.1*).

Three adults, poorly preserved (probably female) were inhumed in the graves, all three adorned with bronze bracelets and earrings. The central grave also contained a collection of ceramics placed at the foot of the individual.

The stamped bracelets were discovered in pairs and were found on the forearms of each individual, a total of four were discovered in the graves 1 (inv. 4 and 5) and 2 (inv. 1 and 2). They are made of bronze and have a geometric pattern of type B as defined by R. Degen (1968) that appeared during the early Hallstatt Period (630–600 BC).

The entire surface of the bracelet is decorated with motifs forming a symmetrical pattern from one side to the central portion (incised groves and stamped round spot decorations). This type of bracelet is localized to the upper Rhine valley and more particularly on the right bank, between the Haguenau

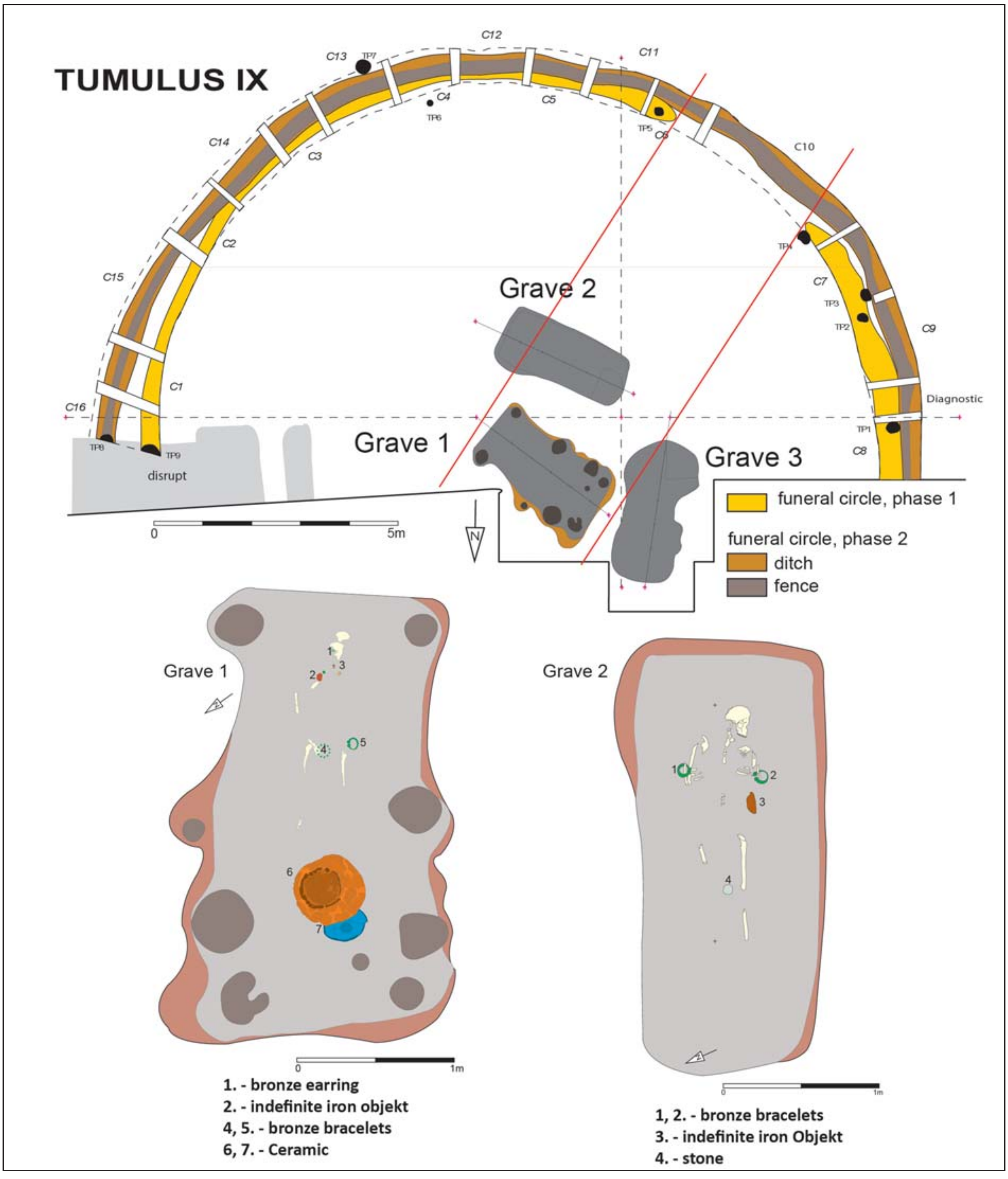

Fig. 9.1: Soufflenheim-Obermattwald (Bas-Rhin). Map of tumulus IX (map: ANTEA, according to DFS 2000, fig. 11, 18, 26).

Forest and Colmar. The concentration of these objects in northern Alsace allows us to identify its original production centre.

The study of the textile remains, conducted under the initiative of Antea-Archéologie, occurs as the result of the restoration of the objects by the Laboratoire d'Archéologie des Métaux (LAM) in Nancy-Jarville. The objective of the restoration was to preserve the textile remains covering the surface of the bracelets.

2. Organic remains

Among the graves in tumulus IX were two burial chambers each of which contained a corpse with two bronze bracelets that preserved traces of organic material (*Tab. 9.1)*.

Tab. 9.1: Soufflenheim-Obermattwald (Bas-Rhin), tumulus IX. List of objects with mineralized organic remains.

Tomb	Object	Type of object	Organic material
1	4	Stamped bracelet in bronze	Textile, skin
1	5	Stamped bracelet in bronze	Textile, skin
2	1	Stamped bracelet in bronze	Textile, skin
2	2	Stamped bracelet in bronze	Textile

The group of textile remains presents a similar state of degradation: the mineralized material is no longer supple; it has hardened and has a greenish colour characterized by the oxidation of copper alloys. They have completely taken on the shape, without deformation, of the supporting element to which they adhere. Convincing at first, the fabrics prove to be almost unreadable after careful examination, alternating between zones where the materials maintain a certain volume and others, more eroded, reduce the threads to lines encrusted in the corrosion. If the rhythm and the structure of these fabrics are clear, closer inspection hardly provides additional information.

Fig. 9.2: Soufflenheim-Obermattwald (Bas-Rhin). Tomb 1, object 5. Detail of the organic material conserved inside one of the two stamps (right) (photo: F. Médard, Anatex).

The four bracelets present large surfaces of fabric, essentially located on the large and rounded part. In any case, the textile does not extend beyond the limits of the obverse; on the three examples, no trace extends to the reverse although they are marked by the imprint of an organic material visible in the stamps and in the concave zone (grave 1, bracelets 4 and 5; grave 2, bracelet 1). The fabric appears as thin material, structured by rows in the same general direction. Within the rows, small traces of skin were found that we can suppose is that of the deceased considering the position of the bracelet (*Fig. 9.2*). These remains, based exclusively on the macroscopic observation, are approximately 1.8 x 1.5 cm in the interior of one of the stamps on bracelet 4 (grave 1); approximately 2.5 x 1.5 cm inside two stamps on bracelet 5 (grave 1); and approximately 13 x 6 cm on the majority of the concave area of bracelet 1 (grave 2).

3. Preserved fabrics on the bracelets in tomb 1

Typologically identical bracelets were discovered around the right forearm (bracelet 4) and left forearm (bracelet 5) of the deceased (*see Fig. 9.1, 9.3, Tab. 9.2*).

3.1 Description (*Tab. 9.2*)

Tab. 9.2: Soufflenheim-Obermattwald (Bas-Rhin). General information concerning bracelets 4 and 5 (grave 1).

Objects	Material	Dimensions (mm)	Observations
4: Bracelet with biconic stamps	Bronze	Width max: 74.2 mm Width min: 49.1 mm Thickness max: 38.8 mm Thickness min: 15.8 mm Mass: 177 g.	Object consolidated and cleaned Object whole Cloth remains on the obverse Dating: HA D1 a.
5: Bracelet with biconic stamps	Bronze	Width max: 72.8 mm Width min: 67.61 mm Thickness max: 39.1 mm Thickness min: 16.3 mm Mass: 170 g.	Object consolidated and cleaned Object whole Cloth remains on the obverse Dating: HA D1 a.

3.2 Analysis

In absence of telling technical features (selvedges, anomalies of the weave, etc.) the direction of the warp and weft are *a priori* indeterminable; the OY and OX will be used to differentiate the two directions of the weave.

Bracelet 4

The fabric conserved on the obverse of the bracelet is approximately 4.7 x 3 cm large.

Thread:	OY: plied yarn S2z; diameter: approx. 0.7 mm
	OX: single yarn, z; diameter: approx. 0.3 mm
Thread count:	OY: approx. 15 threads per cm
	OX: approx. 20 threads per cm
Weave:	2/2 twill

The direction of the thread twist is difficult to discern due to the alteration of the fabric's surface. In both cases, we can see S2Z plied threads in one direction (OY) and simple z threads in the other one (OX) (or inversely). The thicker threads create a raised pattern marked by diagonal lines in the same direction as the threads. The diameter is equally difficult to determine because of the corrosion. The weave appears to be a 2/2 twill, and if any intricate variants exist (i.e. complex twill), it is impossible to discern.

To sum up, the fabric consists of a 2/2 twill woven with single z-yarns in one direction and S2z plied yarns in the other. The choice of threads of varying thickness creates a diagonal visual effect throughout the weave.

Bracelet 5

The fabric is preserved on the obverse of the bracelet and measures approximately 6 x 3.5 cm. The differences of height suggest the presence of two layers. It is difficult to distinguish between the two despite detailed inspection with a binocular magnifying lens. The most important element is the underlying layer, adhered to the bronze, where the proximity of the bracelet has clearly fostered mineralization and the fabric has taken on a green tint. The overlying layer is represented by rare brown-coloured surfaces; the layer farther away from the metal is not as well-preserved and therefore little remains of this layer that can be identified.

Fig. 9.3: Soufflenheim-Obermattwald (Bas-Rhin). Grave 1, bracelets 4 and 5. Bracelet views (photos: F. Médard, Anatex).

Fabric – underlying layer

Threads:	OY: plied yarn ?, S ?; diameter: approx. 0.3–0.5 mm
	OX: single yarn, z; diameter: approx. 0.3–0.5 mm
Thread count:	OY: approx. 25 threads per cm
	OX: approx. 25 threads per cm
Weave:	twill (*Fig. 9.4*).

<u>*Fabric – overlying layer*</u>

Threads: OY: plied yarn, S (2z ?); diameter: approx. 0.3–0.5 mm
OX: single yarn, z; diameter: approx. 0.3–0.5 mm

Thread count: OY: approx. 20 threads per cm
OX: approx. 20 threads per cm

Weave: twill

The direction of the thread twist is difficult to discern due to the alteration of the fabric's surface. We observed what are essentially S threads (2z?) in OY and z-yarn in OX direction (or inversely). Measurements of the thread diameter are equally uncertain as corrosion has reduced the section of threads. If there is no doubt that the weave is constructed as a twill, we can only specify the individual elements. It is impossible to determine whether or not the fabric is a basic twill (2/2, 2/1, etc.), uniform or not, or complex twill (chevrons, diamond patterns, etc.) with the use of different torsions in each direction of the weave.

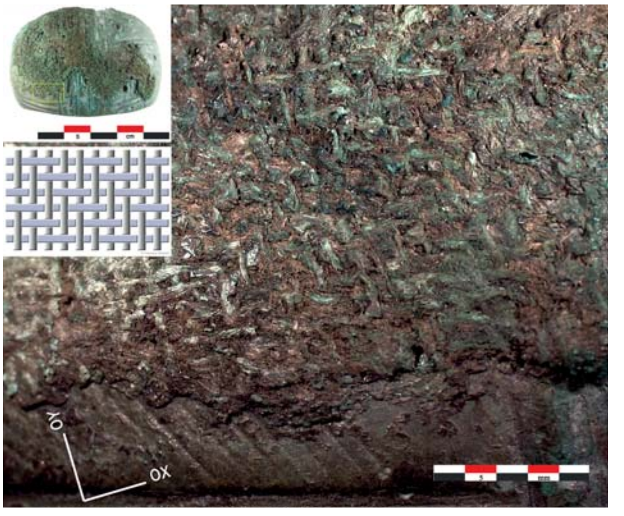

Fig. 9.4: Soufflenheim-Obermattwald (Bas-Rhin). Grave 1, object 5. Underlying layer of fabric. Top, left: location of the photographed zone and 2/2 twill pattern (likely hypothesis) (photos and drawing: F. Médard, Anatex).

4. Fabrics preserved on the bracelets in grave 2

Typologically identical bracelets were discovered on the right (bracelet 1) and left (bracelet 2) forearms of the deceased (see *Figs 9.1, 9.5*). We emphasize the slightly more significant dimensions of the bracelet worn on the left arm.

4.1 Description (*Fig. 9.5* and *Tab. 9.3*)

Tab. 9.3: Soufflenheim-Obermattwald (Bas-Rhin). General information concerning bracelets 1 and 2 (grave 2).

Objects	Material	Dimensions (mm)	Observations
1 : Bracelet with biconic stamps	Bronze	Width max: 80.3 mm Width min: 76.8 mm Thickness max: 57 mm Thickness min: 21.2 mm Mass: 178 g.	Object consolidated and cleaned Object whole Cloth remains on the obverse Dating: HA D1 a.
2 : Bracelet with biconic stamps	Bronze	Width max: 83.6 mm Width min: 81.2 mm Thickness max: 60.4 mm Thickness min: 22.2 mm Mass: 198 g.	Object consolidated and cleaned Object whole Cloth remains on the obverse Dating: HA D1 a.

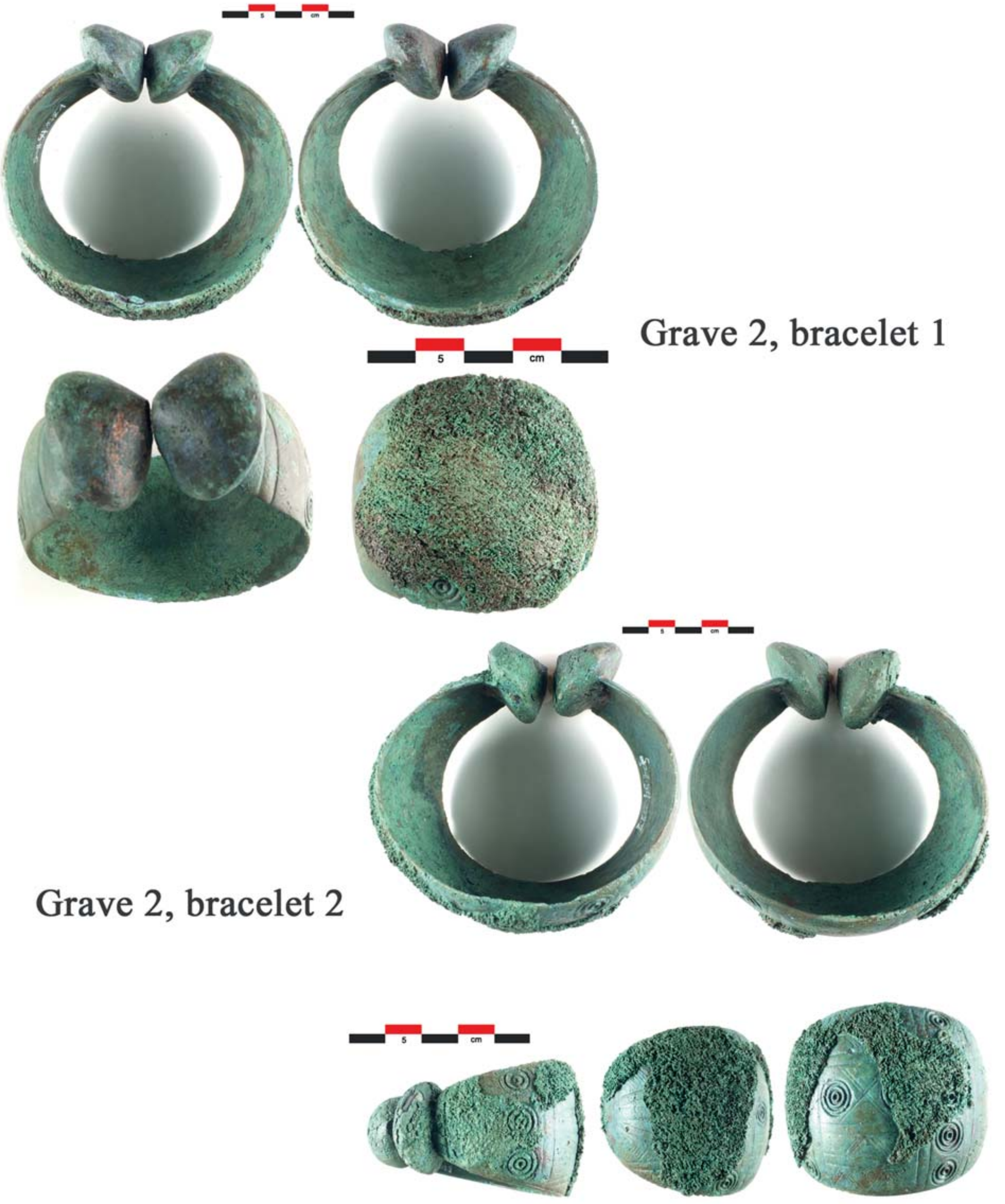

Fig. 9.5: Soufflenheim-Obermattwald (Bas-Rhin). Grave 2, bracelets 1 and 2. Bracelets views (photos: F. Médard, Anatex).

4.2 Analysis

As previously mentioned, the fabric has no selvedges or other analytic tools to discern warp and weft.

Bracelet 1

The area of the fabric is approximately 10 x 6 cm.
Thread: OY: plied yarn, S (2z ?); diameter: approx. 0.8–1 mm
OX: single yarn, z; diameter: approx. 0.8 (?) mm
Thread count: OY: approx. 10 threads per cm
OX: approx. 10 threads per cm
Weave: 2/2 twill (*Fig. 9.6*).

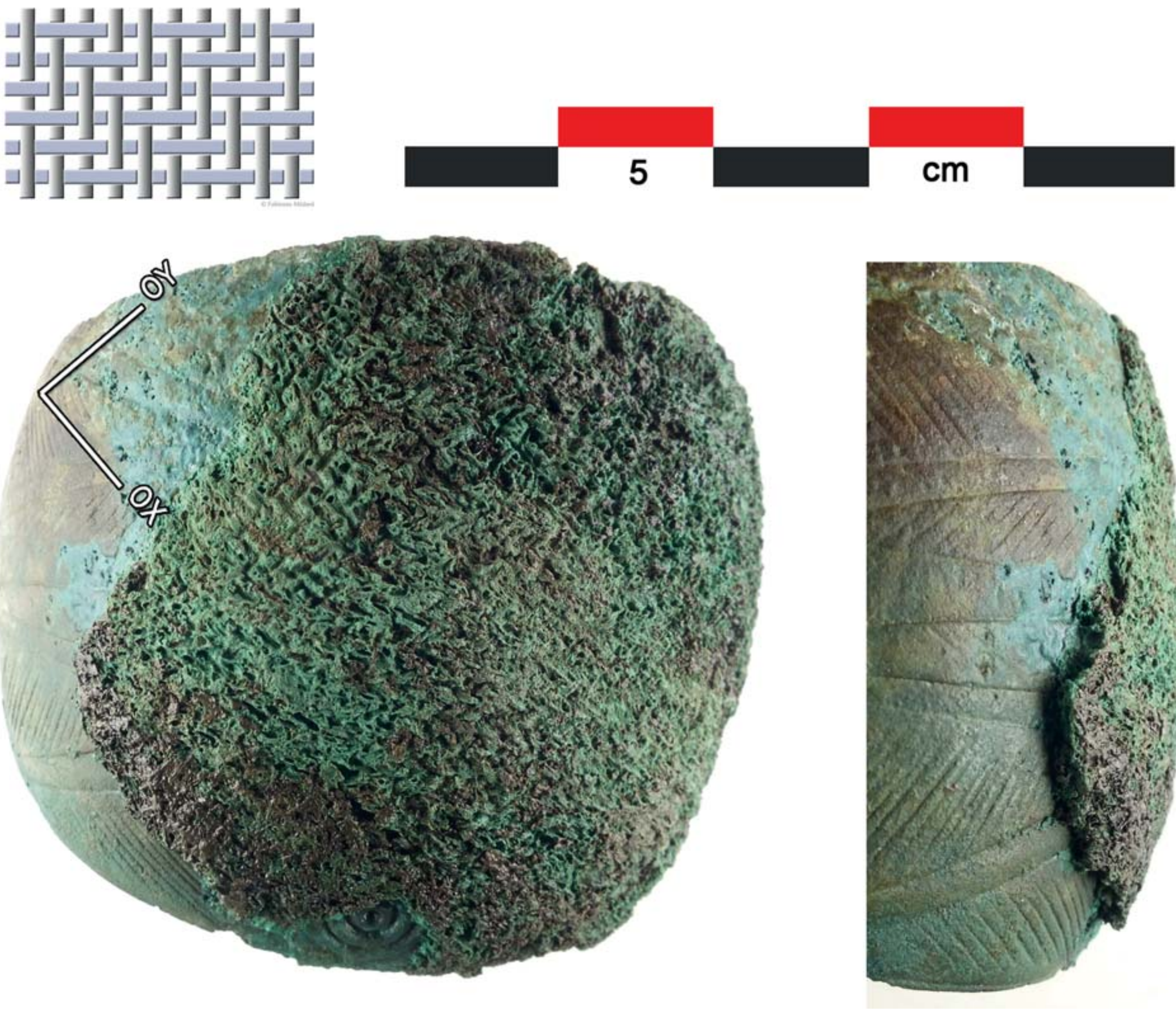

Fig. 9.6: Soufflenheim-Obermattwald (Bas-Rhin). Grave 2, object 1. View in plan and fabric thickness on the obverse of the bracelet. Scheme of the 2/2 twill weave (photos and drawing: F. Médard, Anatex).

The use of single yarn in the weave is evident but certain elements could be plied yarns without the possibility of verification. The direction of the twist is difficult to distinguish; it can be seen in negative and in small portions. The measurement of the diameter of the thread is done in a small zone where the volume is intact; the corroded elements are not reliable, because these sections are incomplete. The weave, only readable on the small surface where the threads' volume is preserved, attests to a 2/2 twill weave. This does not exclude the possibility of a more complex or irregular weave that a different mode of conservation would have allowed us to identify.

Bracelet 2

The preserved fabric is approximately 15 x 5.5 cm large.

Threads:	OY: plied yarn, S (2z ?); diameter: approx. 0.8–1 mm
	OX: single yarn, z diameter: approx. 0.8 (?) mm
Redution:	OY: approx. 10 threads per cm
	OX: approx.10 threads per cm
Weave:	2/2 twill

5. Identification of raw material

Several samples have been taken to confirm the diagnostics of the primary materials used for each individual textile.

The materials were examined under Scanning Electron Microscope by the CNRS/IS2M Laboratories (Institut de Science des Matériaux de Mulhouse, France). The textile fibres preserved as impressions are perfectly intact and attest to the use of wool for each fabric and in both directions of the weave (*Fig. 9.7*).

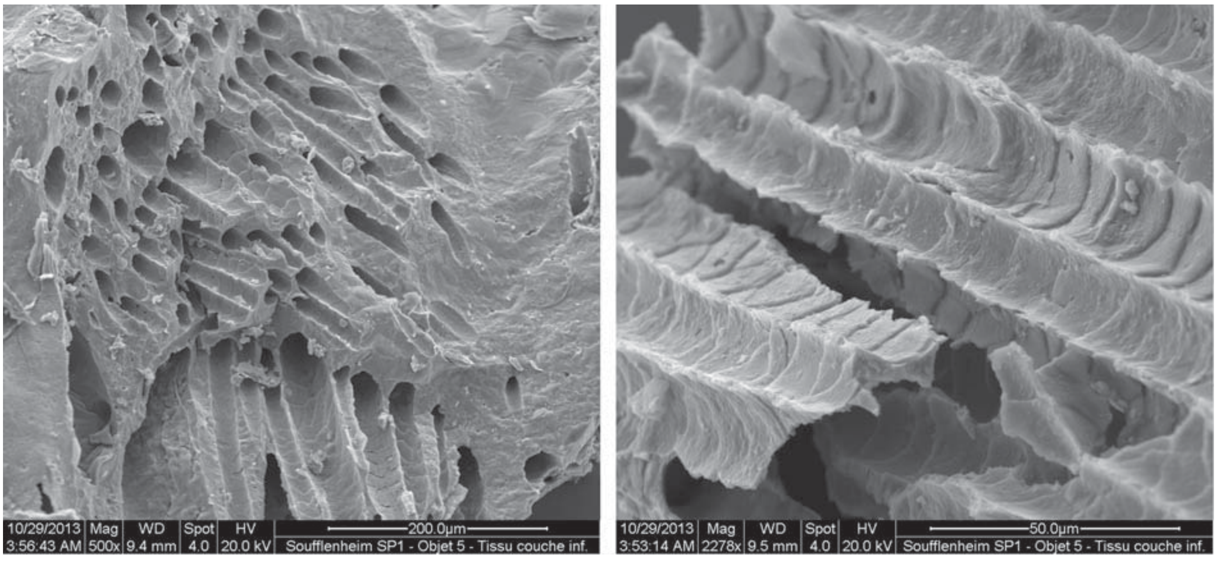

Fig. 9.7: Soufflenheim-Obermattwald (Bas-Rhin).
Grave 1, bracelet 5. Fabric sample from underlying layer.
Left: transversal and longitudinal views of the fibres forming the weft and warp of the fabric.
Right: Close-up of a longitudinal view
(photos: S. Knopf, CNRS-IS2M; F. Médard, Anatex).

6. Conclusion

6.1 Technical data *(Tab. 9.4)*

Destined for daily or funerary use, the fabrics from Soufflenheim enter into the framework of Iron Age textile production: fine threads of small diameter, often less than 0.5 mm, and the dominant use of twill weaves made with thread counts often higher than 15 threads per centimeter (Grömer 2012, 42–43). With single threads 0.3–0.5 mm in diameter and twisted threads of 0.8–1 mm, twill weaves with thread counts of approximately 15–20 threads per centimeter, the textiles analysed fit perfectly into the patterns currently observed. In addition, the combination of single and plied yarns in the same cloth is characteristic of the period, especially in the western part of Hallstatt Culture (see catalogue in: Banck-Burgess 1999). In the Hallstatt Period, textile creativity flourished (Grömer 2010, 223–239; Grömer *et al.* 2013, 38). Departing from the usual practice of using single yarn in one direction of the weave and not in the other one, the weavers tried to create an aesthetic effect that in the case of twill fabrics, emphasises the diagonal visual effect.

Tab. 9.4: Soufflenheim-Obermattwald (Bas-Rhin). Review of technical data related to textile remains.

Tomb - nº object	Object / material	Date	Localization of textile remains	Threads Ch.(OY)/ tr.(OX	Thread count Ch.(OY)/ tr.(OX)	Weave	Primary material	Functional hypothesis	Object in the tomb
Grave 1, object 4	Stamped bracelet / copper alloy	HA D1 a.	Fabric: present on the obverse Dimensions : 4.7 x 3 cm	plied/ simple; S2z /Z; 0.7/0.3 mm	15 threads/ 20 shots	2/2 twill base	wool/ wool	Blanket clothing ?	In place
Grave 1, object 5	Stamped bracelet / copper alloy	HA D1 a.	Fabric: present on the obverse underlying layer Dimensions: 6 x 3.5 cm	plied ?/ simples; S (2z?) /Z; 0.3–0,5/ 0.3–0.5 mm	25 thread/ 25 shots	twill base	wool/ wool	Blanket clothing ?	In place
Grave 1, object 5	Stamped bracelet / copper alloy	HA D1 a.	Fabric: present on the obverse overlying layer Dimensions: rare and sporadic	plied ?/ simple; S (2z?) /Z; 0.3–0.5/ 0.3–0,5 mm	20 threads/ 20 shots	twill base	wool/ wool	Blanket clothing ?	In place
Grave 2, object 1	Stamped bracelet / copper alloy	HA D1 a.	Fabric: present on the obverse Dimensions: 10 x 6 cm	plied ?/ simple; S (2z?) /Z; 0.8–1/ 0.8 (?) mm	10 thread/ 10 shots	2/2 twill	wool/ wool	Blanket clothing ?	In place
Grave 2, object 2	Stamped bracelet / copper alloy	HA D1 a.	Fabric: present on the obverse Dimensions: 15 x 5.5 cm	plied ?/ simple; Z/S; 0.8–1/ 0.8 (?) mm	10 thread/ 10 shots	2/2 twill	wool/ wool	Blanket clothing ?	In place

6.2 Taphonomy

Our knowledge of protohistoric funerary practices has often relied on the evaluation of objects, on the quality of metalworking, and on typological changes linked to artefacts disposed in the graves. However, the evolution of archaeological analytical methods has considerably advanced our understanding. Textile research is among the investigative approaches that have notably modified the evaluation of inhumation rituals in prehistory (Banck-Burgess 2012, 141).

Numerous examples attest to the wrapping of objects in cloth in graves, including buckets and pitchers in bronze, e.g. from the royal graves in Glauberg (Germany) and St. Genevieve-des-Bois "La Ronce" (Loiret, France) (Milcent *et al.* 2000). Also jewellery and grooming materials were covered with textiles, such as a wrapped torque from La Tène period graves at Dürnberg (Austria) (Hundt 1987), or

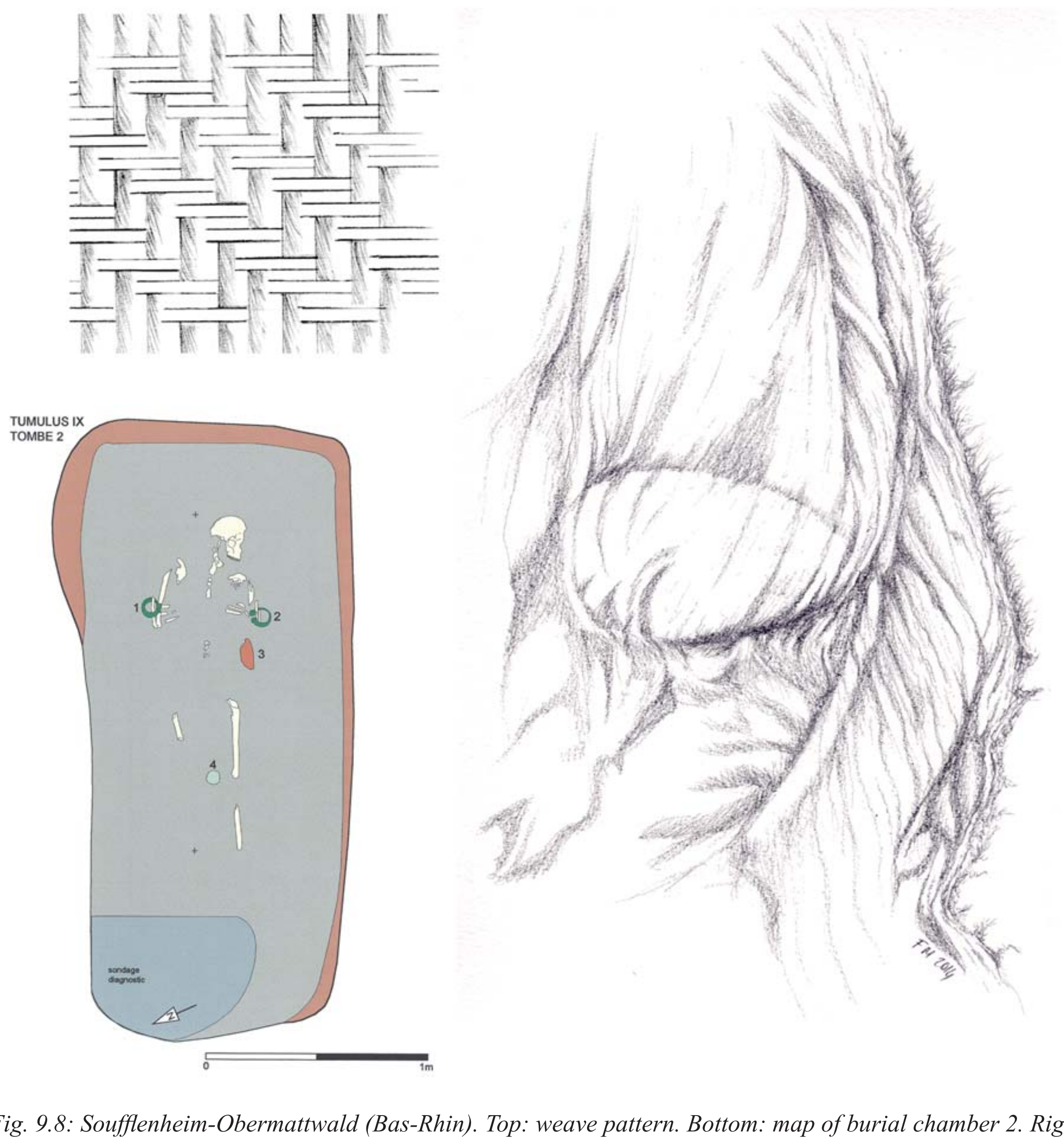

Fig. 9.8: Soufflenheim-Obermattwald (Bas-Rhin). Top: weave pattern. Bottom: map of burial chamber 2. Right: hypothesis of fabric placed on the body adhering to the underlying contours (drawings: F. Médard / Anatex).

the razor in Hochdorf (Germany). Other grave goods, e.g. swords from Appenwihr and from Sausheim (Haut-Rhin, France) (Plouin 1996), as well as furnishings and wagon elements were wrapped with cloth, e.g. the wagon in Hochdorf (Germany) (Banck-Burgess 1999; 2012) or finds from Apremont (Haute-Saône, France) (Masurel 1990; 1992). This practice widespread throughout prehistory over a vast geographical area around the Alps testifies to a remarkable cultural unity; the interpretation for this phenomenon remains fairly difficult to access.

What about the Soufflenheim bracelets? The taphonomic data tend to indicate that the fabric covered the bracelets without enveloping them and also showed that they mould the surfaces: either because they are both supple and heavy, or because they were pressed against these objects by an exterior element (e.g. earth, wood, …). This assessment allows several hypotheses: maybe the textile remains could be remains of a shroud, but this is less than satisfactory, as no constraint seems to have been exerted on the bodies. The theory of a garment covering the body could be valid, although the dissimulation of such finery is contradictory to their ostentatious nature. The final hypothesis could be that of a blanket placed on the body or rolled around it (*Fig. 9.8*). Several examples exist in the Bronze Age graves as well as in Hochdorf, where the inhumed body was wrapped in several layers of fabric (Banck-Burgess 2012).

It seems as if the intention was neither to protect the objects, nor the body. What symbolic significance could explain such a systematic and costly practice? It is difficult today to make distinct interpretations to these practices: it is remarkable that the quantity of the fabrics often is significant, but also their quality demonstrates how their role had become important in funerary cult. One must consider these textiles as a prestigious element together with jewels, wagons, weapons, etc. This practice slowly declines at the start of late Iron Age when textiles have rarely been recorded from burial chambers.

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10 | Altrier (LUX): A fresh look at the textiles

ANTOINETTE RAST-EICHER – INA VANDEN BERGHE

Abstract: The cremation grave of a man was found in 1971 in Altrier, Luxembourg, and is dated to the early La Tène period. It was placed as an urn in an oak coffin. Textiles were deposited in the top of an Etruscan *stamnos* used as an urn. The main textile consists of a 2/2 twill made of wool with plied warp and single weft. This textile was published in 1972 as wool, but afterwards identified as possibly one of the earliest silks in Europe. Two tablet-woven bands have been identified, and dye analysis revealed kermes and woad.

Keywords: Altrier, Iron Age, wool, tablet-weaving, dyes, kermes

1. History of research

In 1971, after an illegal extraction of sand, Gérard Thill, a former archaeologist and director of the Musée du Luxembourg, had to organize a rescue excavation of the Iron Age tumulus in Altrier (LUX). Unfortunately, the mechanical digger had hit the cremation grave deep in the tumulus. As a result, the records do not provide the original state of the objects and, aside from some drawings, no photographs were taken to document the situation (Thill 1972). According to the fibula type, the grave of Altrier dates to the early La Tène period (La Tène A), c. 430 BC.

The central cremation grave was 4.46 m deep in the tumulus in a wooden box (Quercus sp.), with the incinerated remains contained in an Etruscan *stamnos*. According to Jeannot Metzler, at that time a student and present at the excavation, some of the textiles were seen on the stamnos, with more inside it.[1] A bronze fibula (mask fibula) and a golden armring were found in the stamnos. The sword was angled towards the bronze vessel, and was fastened to the handle by a plaited leather band (*Fig. 10.1*).

After the excavation, the textiles were sent to Mainz (RGZM, H.-J. Hundt); there, they were separated into single layers, put into boxes on cardboard layers, and sent back to Luxemburg after 1990. Since then, nothing further has happened with this material. H.-J. Hundt never published the textiles. Nevertheless, he first assumed that one of the textiles could have been made from silk. This remark to a British colleague was later taken up in publication, referring to this textile as one of the examples of prehistoric silks in Europe (Bender Jørgensen 2013). This misapprehension was probably due to the fact that the fibres are noticeably parallel (especially in the warp, see *Fig. 10.4*), and are not well-preserved, and scales of the fibres nearly not visible by light microscopy.

A new project was initiated by the Centre National de Recherche Archéologique in Luxemburg in 2012, by the archaeologist in charge of the Iron Age, Catherine Gaeng. Antoinette Rast-Eicher (ArcheoTex) analysed the textiles, and Ina Vanden Berghe (KIK/KIRPA) the dyes. In total, 17 boxes have been found with textiles from this grave; one had to be eliminated as it is an early medieval textile.[2] Further analyses are planned, thus the present study should be regarded as a preliminary report of the textiles and dyes.

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[1] J. Metzler, pers. comm. 2013.

[2] Diamond twill, dating confirmed by C-14 (box AR4).

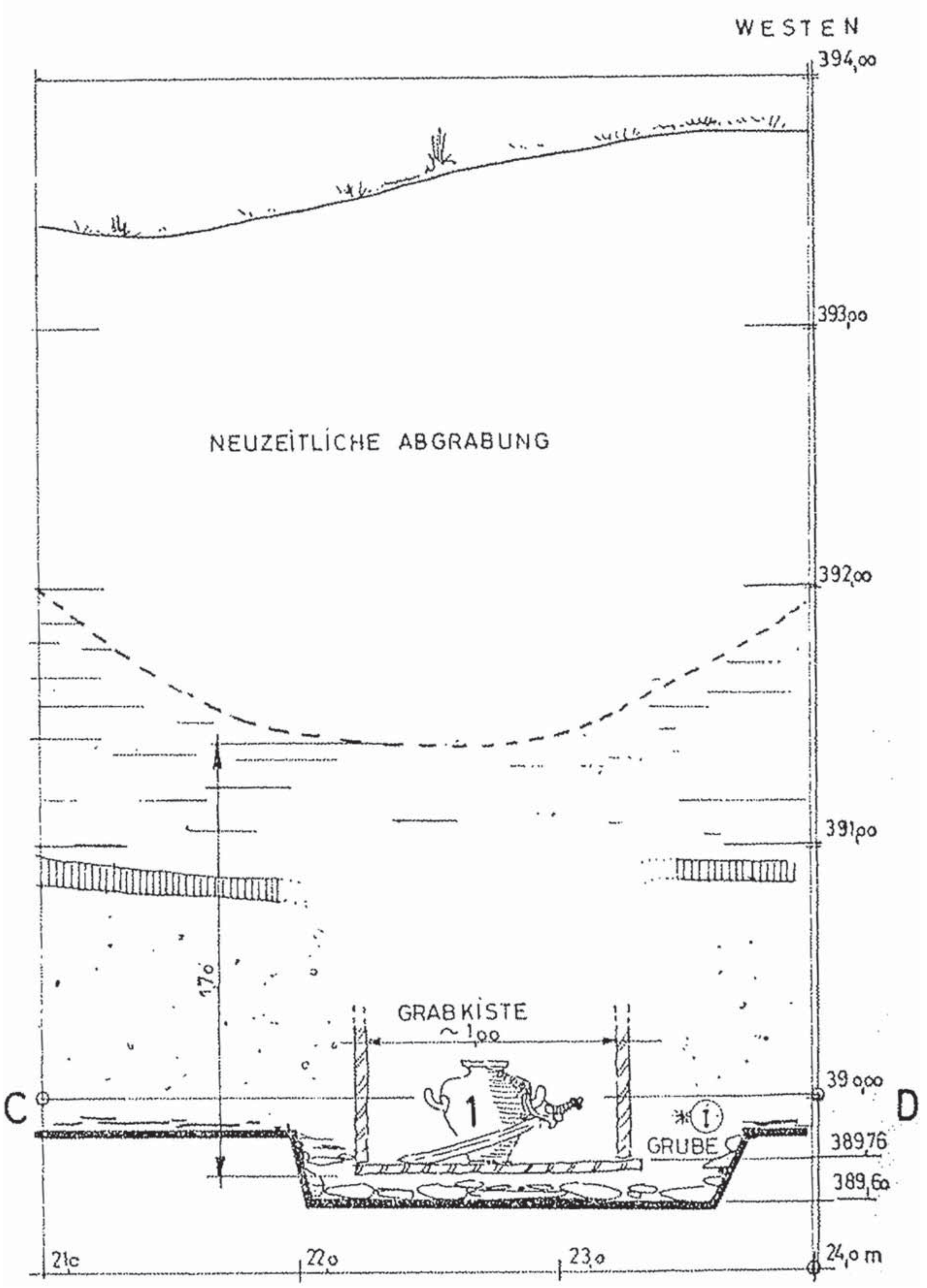

Fig. 10.1: The tumulus of Altrier (after THILL 1972, Fig. 2).

2. Results of the dye analysis (Ina Vanden Berghe)

Dye analysis has been done by HPLC-DAD using strong acidic extraction coupled with a second treatment with ethyl acetate (Vanden Berghe *et al.* 2009). Two dye compounds were found in the textiles: kermesic acid from the insect dye *Kermes vermilio* Planchon and indigotin, which at that time derived from woad (*Isatis tinctoria* L.). Kermes had to be imported from the Mediterranean, while woad was locally available (Cardon 2003). Kermesic acid is a mordant dye, hence easy to dye on mordanted wool or silk, while indigotin is a vat dye, which required a more complicated procedure for dye processing.

Textile 1 is probably a monochrome dyed textile. The other two textiles are at least two-coloured.

Textile 1 seems to be piece-dyed with kermes as this dye source was found in warp and weft threads as well as in the dark sewing threads. Textile 2, the tablet-woven border sewn to textile 1, has red, kermes-dyed twisted decorative threads and a blue woad-dyed soumak thread. Further samples will reveal whether the two threads used in one tablet were specially selected in different colours. In textile 3 the colours are still visible, with red kermes-dyed and blue woad-dyed warp threads.

3. The Textiles

Three textile types could be identified (*Tab. 10.1*).

Tab. 10.1: Textiles found in Altrier

Textile	Textile	Hundt	2013	Dyes (Vanden Berghe)
1	Textile with seams -> garment	*2/2 twill*	Sz/z, 2/2 twill	brown plied yarn (AR5): kermes brown single yarn (AR5): kermes black sewing yarn (AR14): kermes
2	tablet woven band sewn to textile 1 soumak thread	*2/1 twill or "Zwirnköper"* *embroidery*	Sz/Sz, 2-hole tablet-weaving, soumak decoration	brown plied yarn (AR1-1): kermes black soumak yarn (AR1-1): woad
3	tablet woven band -> girdle?	*"Schwarz-rot gemustertes Gewebe"*	Sz/Sz, 3-hole tablet-weaving,	brown plied warp (AR18): kermes black plied warp (AR18): woad

3.1 Textile 1

Textile 1 is a plain 2/2 twill made of wool which looks brown (*Fig. 10.2*). This textile had obviously fallen into the stamnos, as some fragments were stuck to burnt human bone remains. The warp threads are very fine plied yarns, while the wefts are single yarns. Textile 1 has many seams; the sewing thread is a dark plied yarn.

SEM analysis of the warp threads has shown tips and roots of the wool fibres, which point to plucked wool (*Fig. 10.3*). Furthermore, the fibres of the plied yarn stick together, and a substance is visible on their surface (*Fig. 10.4*). These warp threads have been sized/greased, for example with lanolin. This method has also been observed in modern times in northern Europe (Broholm–Hald 1940, 119). Another possibility is that it could be fish glue, but this seems quite unlikely in Altrier. The observations from the SEM data reveal the *chaîne opératoire* for the textile production: plucking of the wool, sorting,

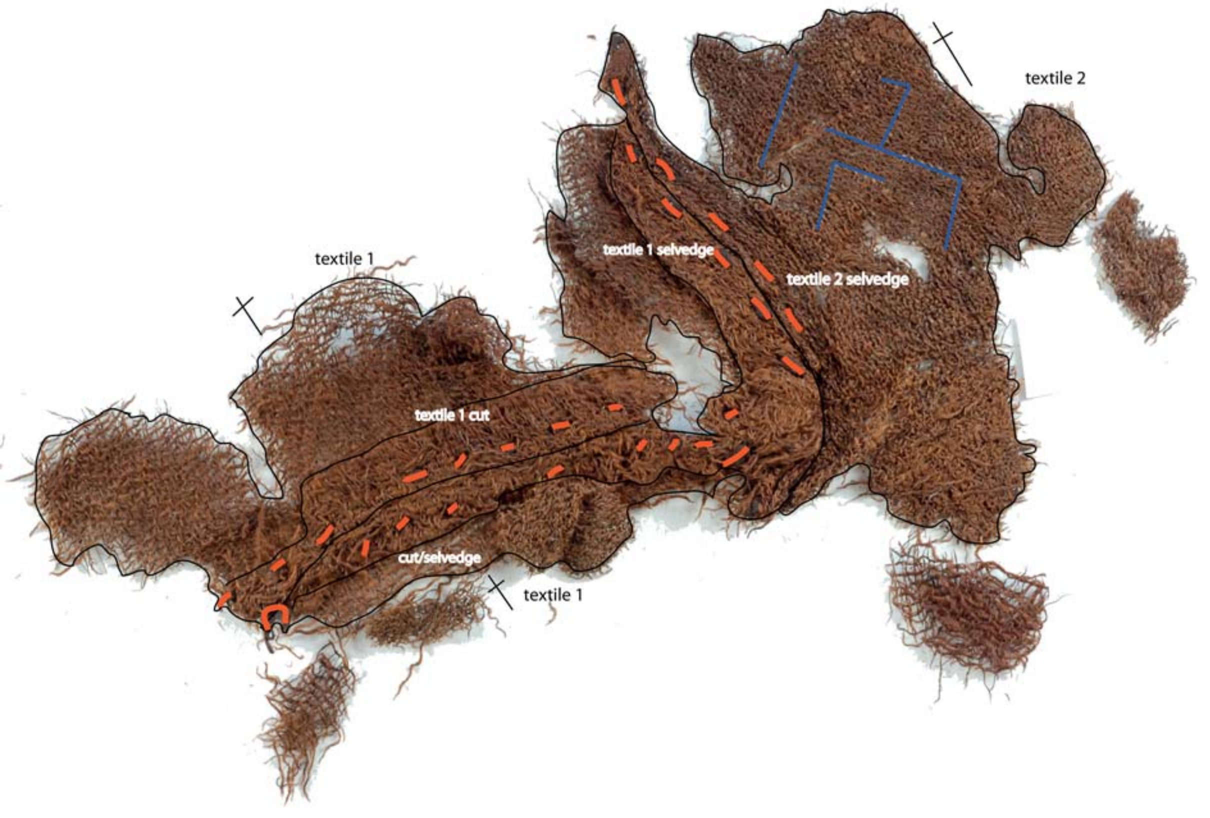

Fig. 10.2: Textile 1, 2/2 twill dyed red with kermes and with seams; on the right, textiles 1 and 2, sewn together (photo and drawing: A. Rast-Eicher).

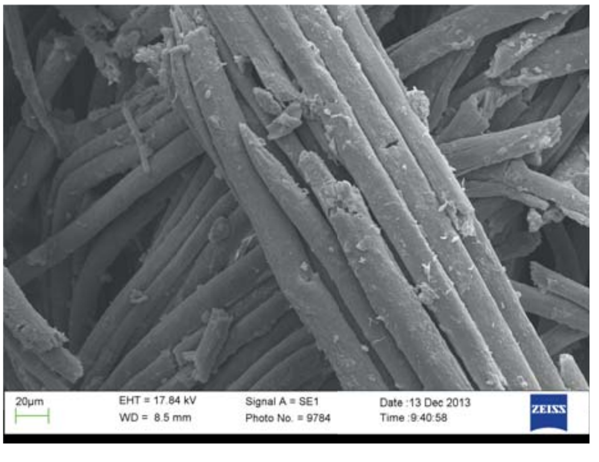

Fig. 10.3: Textile 1, detail of a yarn showing tips and roots (SEM photo: A. Rast-Eicher).

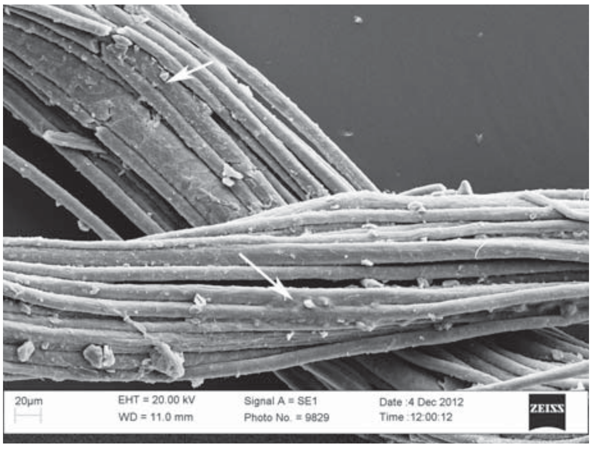

Fig. 10.4: Warp thread with glue/size showing the fibres stuck together (SEM photo: A. Rast-Eicher).

washing, dyeing of the fleece, sizing/greasing, spinning, weaving. Or as a variant: plucking, sorting, washing, spinning, dyeing of the thread, sizing/greasing, weaving.

This textile can be interpreted as a garment based on the seams and the different direction of the warp indicated by the warp of the added tablet-woven bands (textile 2). In at least one case three parts come together, just like a sleeve added to two body sections. Furthermore, in one fragment, a little

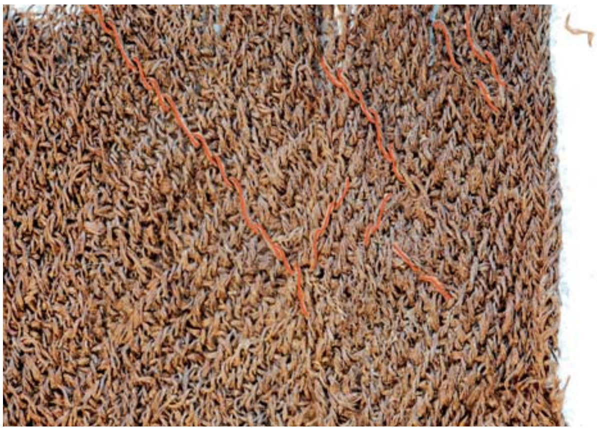

Fig. 10.5: Textile 2, tablet woven band in 2-hole technique and soumak thread (enhanced) (photo: A. Rast-Eicher).

bronze ring was sewn into the hem, which could point to a fastener. It is not a decoration as it is embedded deep in the hem.

3.2 Textile 2

Textile 2 is a tablet-woven band, woven with 4-hole tablet-weaving for the selvages (ZZS or ZSZ) and 2-hole tablet-weaving in the central part in 2/1 twill (*Fig. 10.5*). The differences in the selvage suggest that there was probably more than one band decorating the garment (textile 1). The full width of the band has not been preserved, but consists of a minimum of 74 tablets. Colours are not visible, and the threads appear brown. This band has been stitched to textile 1, not in the loop method described by Lise Ræder Knudsen (Ræder Knudsen 1998) but by sewing directly into the selvage. A decoration in soumak (or 'flying thread') runs over the surface and creates further lines. The soumak thread was dyed with woad, while evidence of kermes dyeing was found in the brown plied warp threads. With a second series of dye analyses we hope to be able to say whether the two threads used for weaving in the central part were divided into blue/red or if some threads were also white.

3.3 Textile 3

The third textile is another tablet-woven band, a narrow band, with a readily visible red swastika on a blue background (*Fig. 10.6*). The blue background is dyed with woad. The motif is made of one colour only, with vertical threads. The width is not quite complete, with the preserved width 3.7 cm. This band was not sewn to another textile, and some fragments were still rolled. Like textile 2, the selvages are made in 4-hole technique (SSS), but here the central part is woven in 3-hole tablet-weaving. This technique makes the weave denser, and the front and the reverse are not the same. The decoration, a swastika, is woven in red; the wool is dyed with kermes. Due to the 3-hole technique and the division of two blue- and one red thread per tablet, the red threads are sometimes longer (Collingwood 1982, 128–129). This band could be interpreted as a girdle, as it has been rolled and not sewn onto either of the other two textiles.

4. Comparisons

Technically, the textiles from Altrier are close to the ones from Eberdingen-Hochdorf in Germany (Banck-Burgess 1999). The Sz-plied yarns in the warp, the tablet-woven bands in 2-hole technique and the kermes dye are the main similarities. This spinning technique is well known among central European textiles of the Hallstatt period (Banck-Burgess 1999; Rast-Eicher 2008). The Altrier examples date about one hundred years later, but in technical terms they are still close to the weaving traditions of the Hallstatt period – and geographically not very far away. The plied and sized warp threads make it very probable that white wools with long fibres for very fine single yarns were not available. The wool measurements of the Altrier textiles reveal carefully selected fine wools, with underwool that is not as fine as Bronze Age underwools, but which is also different from Iron Age wools with a typical bi-modal histogram due to mixed fibre types. South of the Alps, threads from that period are not made with plied yarns (Gleba 2008).

Fig. 10.6: Textile 3, blue and red tablet woven band in 3-hole technique (photo: A. Rast-Eicher).

Kermes dye is very rare in Europe. Aside from textiles from Eberdingen-Hochdorf, Iron Age textiles dyed with kermes have been found in Sainte-Germaine-des-Bois, Les Ronces (F), a cremation in a stamnos dated to the same period as the one in Altrier (MILCENT –MOULHÉRAT 2000, 307; 314). Tablet-woven bands made in 3-hole technique are rare. One comparison, a wristband found in the salt-mine of Dürrnberg bei Hallein (A), is dated to La Tène B and is therefore slightly later than the Altrier piece (GRÖMER–STÖLLNER 2009). The latter is similar in technique, but not in terms of the motif.

5. Summary

Three textiles have been found on and in the stamnos used as the burial urn in the early La Tène tumulus of Altrier (LUX). One is a plain 2/2 twill dyed red with kermes, the other two are tablet-woven bands made in different techniques. The possible garment (an upper garment?) consists of a main textile, a monochrome red twill, decorated with a tablet-woven band (textile 2), and a tablet-woven girdle. The high quality of the textile and the special dye imported from the Mediterranean is indicative of high status, suggesting that the deceased held an important place among the local elite.

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11 | Sewing, Design and Creativity: Aspects of Tailoring in the Bronze Age

HELGA RÖSEL-MAUTENDORFER

Abstract: Clothes are not only made to protect against the cold, sun, or rain, but also to have an impact on the wearer, provide information and create moods. They are experienced both sensually by the person wearing them and visually by the audience and since clothing can also be used to alter body shapes, it becomes an object of art. When worn on the human body, clothing serves as a medium of non-verbal communication and as such can be used to demonstrate cultural, social and individual identities. Strategies for communication via dress exist in all parts of the world, and these systems vary not only geographically but also through time. The task of tailoring as a profession is to create garments which cover both these personal and social demands. This paper is based on observations and considerations that were made during the reconstruction of Bronze Age garments by using experimental archaeology methods.

Keywords: tailoring, Bronze Age garments, non-verbal communication, sewing

1. Introduction

The cultural anthropology of textiles recognises the connection between body and dress and their interrelationship (Mentges 2005, 11–54; 2004, 74). Clothing has many diverse connections to the human body. In the first instance it is the human body that brings clothing into being through the application of physical labour. For example, the production of a narrow band, such as the Bronze Age repp band from Mitterberg/Austria (Grömer 2012, 30), requires several stages of production. The Mitterberg repp band was made from wool with plied yarns 0.3–0.4 mm in diameter and 29/7 threads per cm. The alternation of S- and Z-plied yarns in the warp generates a spin pattern. For this narrow band, the craft person had to sort the wool, loosen and comb the fibres, spin s- and z-twisted yarns, plying these yarns together, then weave the cloth. Many garments need to be sewn and tailored and, if a textile requires colour, it had to undergo a process of dyeing (Grömer 2010, 46–47; Rösel-Mautendorfer – Grömer – Kania 2012, 194–199). Through this intensive interaction with the material, the object and maker have a close relationship to the craft and finished product.

Textiles worn on the body generate haptic (tactile), bodily and visual experiences (Mentges 2005, 31–32). Apart from tactile sensations such as warmth, softness, firmness or scratchiness, there is also a practical aspect to consider, for example does a garment fit correctly, is it comfortable or does it restrict movement? Next to the visual impressions provided by colour, pattern and design, there is also a sense of self, apparent in the question “does it suit me?”.

Clothing not only provides protection against the rain, wind, sun, or cold conditions, it also serves as a medium of non-verbal communication (Sommer 2010, 242–243). This way clothes are able to demonstrate cultural, social and individual identities and may indicate gender, period and occasion. Clothes may be suitable for indoors or outdoors, private or public space, sacred or profane. As they are noticed by others, clothes transmit information and emotions, which in turn create a response in the viewer and in this way they can indicate the role of the wearer (Mentges 2005, 21–33). Since dress communication strategies exist in all parts of the world it is not surprising that these communication systems vary both regionally and temporally (Craik 2005, 301).

At a fundamental level clothing can be used deliberately to shape the body and through this transformation the body is turned into an object of art. Basic design concepts are available to change the visual appearance of the body. These concepts can be found in modern, historical and ethnographic clothing. They are covering (veiling), uncovering (revealing) and emphasizing (highlighting). Examples of these concepts are the white Christian wedding veil from the 4th century AD onwards (LOSCHEK 1994, 134), the black mourning veil in the 19th century (LOSCHEK 1994, 457), the chemise made out of lightweight, transparent muslin at the beginning of the 19th century (THIEL 1997, 293–294) and crinoline fashions which transformed the body silhouette (KODA 2001, 104–137). The Bronze Age garments discussed in this paper also incorporate such concepts into their design. For example, the man´s costume with the wrap-around and cloak uses the visual concept of covering (BROHOLM – HALD 1948, 72, fig. 49), while the corded skirt harnesses the concept of uncovering and highlighting the hips, which is similarly achieved by the long skirt (BROHOLM – HALD 1939, 101, fig. 91).

2. Tailoring

To master these clothing requirements necessitates different design strategies. The task of tailoring is to create garments for these personal and social demands. To fabricate clothing a tailor uses sewing, shaping (RÖSEL-MAUTENDORFER 2013, 99–117) and modelling techniques (GILEWASKA 2012). In archaeology sewing techniques are documented through the stitches on textile finds and through finds of sewing needles, as for example those found in Italy (GLEBA 2008, 157–158). Shaping techniques are documented by the cut of the fabric. This can be seen in the rounded edges of the Scandinavian Bronze Age male cloaks from Borum Eshøj, Muldbjerg and Trindhøj (BROHOLM – HALD 1948, 46–63) and Hallstatt-Textile 232 (GRÖMER – RÖSEL-MAUTENDORFER 2013, 289; RÖSEL-MAUTENDORFER 2011, 139–140).

There is no clear evidence of the tools used to cut fabric in the Bronze Age; common knives or flint blades were probably used. Modelling on the body is difficult to detect due to the lack of archaeological evidence. Nevertheless, for complex garments like the female blouses from Denmark (BROHOLM – HALD 1948, 11, 23–24, 33–34), it may be assumed that the pattern cut from the fabric was developed through a process of modelling. Modelling is apparent in draping techniques, where the garment was fixed with pins or belts instead of seams. Evidence of this form of clothes includes pins and belts in graves in Central Europe (GRÖMER – RÖSEL-MAUTENDORFER 2011, 2–11; WELS-WEYRAUCH 1978; 1994).

When crafting clothes by hand, the craftsperson needs to understand the qualities of particular stitches, seams and when to apply them. They need to understand the characteristics of fabrics, the body, how to transfer the proportions of the body to a sheet of fabric and how to build a three-dimensional object out of a two-dimensional material. Social rules dictate the specific types of clothing for different groups and occasions. The creativity of the tailor may be hindered by such demands but a degree of creativity remains within these constraints.

There are two basic principles of tailored clothing: the principle of the ‘second skin’ adapting the clothing to the body and the way it moves; or the principle of forming the body into a different shape and through this emphasizing specific body zones. In the first case, the main motivation is functionality, in the second the main motivation is the visual appearance in conjunction with the symbolic meaning of clothing as non-verbal communication.

In creating garments several tasks may be applied simultaneously: the construction of selected three-dimensional shapes, modelling of garments according to the human body, sewing as an element of construction and decoration or draping. Applying these methods when making costumes can enhance different zones of the body.

2.1 Case study 1: Functional Clothing

One aspect of clothing design is to consider the body and its flexibility. Here the main consideration is functionality and mobility. The garments should work like a second skin; this is most apparent in modern sportswear. The Iron Age trousers from Thorsberg were constructed this way. The choice of fabric, seams and pattern allow the wearer an enormous versatility of movement as can be seen in Katrin Kania´s reconstruction (2007, 277–290). In some instances the material is cut and later sewn together again in the same place without a noticeable difference in shape, this trick can be as seen on the loincloth of the Iceman "Ötzi". The reason for doing this was to achieve a better flexibility of the leather. The loincloth is built up of strips, which were sewn together along the long edge (Egg – Goedecker-Ciolek 2009, 80–82). Although the loincloth has the same contour as before this process, the seams achieve a better fit than the original unworked outline.

Fig. 11.1: Reconstruction of the man´s costume from Trindhøj (photo: H. Rösel-Mautendorfer).

We find a similar approach in Bronze Age garments. The man´s costume from Trindhøj consists of an oval cloak and a rectangular cloth, which was wrapped around the body (Broholm – Hald 1948, 44–45). The whole garment was cut from a single piece of cloth about measuring 165 cm by 245 cm. The cloak was cut in an oval shape measuring 243 cm by 126 cm and when worn on the body it finishes at the knee. There are two explanations for the design of the round-cut corners: one aesthetic, the other practical, as water does not accumulate in the corners but flows off more easily. The remaining piece of cloth was cut in half, turned around and then stitched together. The seam on the bias of the fabric has the advantage that the fabric becomes more flexible resulting in a better fit. With this, the pattern is adapted to the body and allows better mobility (*Fig. 11.1*).

2.2 Case study 2: Seams as an element of construction

Sewing enables a craftsperson to transform a two-dimensional flat material into a three-dimensional object. In this case the seam does not change the character of the material but builds up a whole new structure, which envelopes parts of the body. The Bronze Age leather cap found in the salt mine of Hallstatt is a good example (Barth 1986, 29–30; Popa 2008, 102). The cap is made from six triangular pieces and a narrow

Fig. 11.2: The woman´s blouse, reconstruction (photo: H. Rösel-Mautendorfer).

rectangular strip, it is similar to the woollen cap from Guldhoj in Denmark (Hald 1980). Another interesting garment construction is the Bronze Age woman's blouse from Skrydstrup (BORNHOLM – HALD 1948, 11, 24, 34). To make such a blouse (*Fig. 11.2*), a rectangular piece of cloth (measuring approximately 120 cm by 60 cm) is folded into three, parallel to the longer side. The fabric is then cut along the fold on either side, up to a quarter of the total length. Next, both flaps are folded inwards and stitched together to form the back of the blouse. The upper third is then folded down and stitched to this back section. The neckline is cut into the centre of the newly folded edge. Gussets are added at the sides to provide better manoeuvrability. Finally the blouse can be lengthened with strips of fabric sewn to the hemline. The outstanding element of this design is the fact that the sleeves are integrated within the main body of the garment and are not attached afterwards as is common today. Concerning three-dimensional imagination, this is more demanding than later shirt patterns and bears the question, why this complex cut pattern was used – maybe the reason for this was a different perception of the body at the time?

2.3 Case study 3: Seams as an element of decoration

Seams and embroidery can provide embellishment and draw attention to a particular area, making it special. This type of embroidery is known from the Bronze Age textiles from Molina di Ledro in Italy and from Irgenhausen in Switzerland (BAZZANELLA *et al.* 2003, 170–172, 227). In Denmark, the blouse from Skrydstrup has needlework on both sleeves and at the neck (BROHOLM – HALD 1939, 52–55). This embroidery was worked in different stiches and was carried out in two layers at the neck, resulting in a three-dimensional structure. Some textile fragments from the salt mines in Hallstatt also show ornamentation, as can be observed on the Hallstatt Textile #242, which has a dark brown thread stitched onto the light olive-brown fabric (GRÖMER – RÖSEL-MAUTENDORFER 2013, 299–301). Another example is Hallstatt Texile #216, a fragment of light brown tabby with a curved hem, which has a cord stitched onto it (GRÖMER – RÖSEL-MAUTENDORFER 2013, 274). Both fragments date in the Middle Bronze Age. Until now no surface embroidery has been found in Hallstatt, however, "dressed" clay figures from the Danube region dating into Middle Bronze Age are decorated with various ornaments (GRÖMER 2010, 332–334) and it is possible that similar ornamentation was applied to the garments in the form of embroidery.

2.4 Case study 4: Clothing to transform the shape of the body

Another aim in designing clothes is to change the proportions of the body by emphasizing particular body parts and thus communicate different messages by changing how a person is perceived by others. How this is achieved, differs from culture to culture. It is common to emphasise the neck and shoulders, with a long neck considered attractive in nearly all cultures as it implies strength, youth and health (KODA 2011, 16–49). There are different ways for the tailor to achieve this. At the end of the 16th century to the beginning of the 17th century ruffs were worn by men and women. During the 19th century in Europe the plunging neckline was characteristic for evening dresses (KODA 2011, 20, 33). Other examples would be the complete covering of the neck with beaded necklaces worn by the young women of the Samburu people in Kenya or the metal coils worn by the Padaung women of Burma (KODA 2011, 29–30). All these different types of costume serve to highlighting the neck.

In the Bronze Age a good example of accentuating the hip is the Nordic corded skirt. A skirt, measuring 38 cm long and 154 cm wide, consisting of cords was found in a grave of a young woman in Egtved; it was worn wrapped around the hips (BROHOLM – HALD 1939, 100, fig. 90; 1948, 36). The skirt length is similar to that represented on bronze figurines from Itzehoe, Faardal and an unknown site (BROHOLM – HALD 1939, 94–95), which portray women in acrobatic poses. These poses imply easy manoeuvrability and mobility. This contrast to the large fabric from Borum Eshoj, reconstructed as a long skirt (BROHOLM – HALD 1939, 101, fig. 91). It also serves to accentuate the hips, but its long length makes it appears more static and immobile than the short one. Nevertheless both garments emphasize the same part of the body – the hips.

Fig. 11.3: Reconstruction of a Bronze Age skirt with flat embroidery based on the statuette figure of Dupljaja (photo: 7reasons).

3. Conclusion

The Bronze Age garments from Denmark show many design aspects from a tailor´s point of view. There are functional garments that work like a second skin, garments which emphasise particular parts of the body through draping techniques and those decorated by means of embroidery. Principles of concealing and revealing are applied in both short and long garments, which may be related to the need for increased mobility. This shows the various ways in which Bronze Age garments could be designed within the social constraints of the community.

This creativity implies the ability to react in various ways to solve new tasks arising from a cognitive or an emotional need, achieved by applying intentional modifications of textiles using their specific properties. Bronze Age craftspeople demonstrated this in a number of ways, for example, by equipping the man's wrap-round with a diagonal seam to make it a more flexible garment. They must have had a good perception of the body to build three-dimensional objects out of plain cloth. One impressive application of this skill is illustrated by the Egtved woman´s blouse as the complex pattern demanded a fully developed spatial sense.

Creativity includes artistic and constructive design elements. These can be found in the interplay between body and dress by changing the body shape it changes its appearance for different occasions. Bronze Age examples include accentuating the hips with the short corded skirt and a long pleated skirt. Decorating garments with embroidery, ornamental seams and appliqués reveals a creative element – the blouse from Skrydstrup is a good example of the creative impulse in contrast to the plain blouses found at other sites.

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Chapter 3: Early Medieval Finds from Graves and Bogs

12 | Chinese silks in the Merovingian graves of Saint-Denis Basilica?

SOPHIE DESROSIERS

Abstract: A new examination of the textiles found in the Merovingian graves of Saint-Denis Basilica has revealed small dark fragments of eleven silks – plain and figured – dated from the end of the 5th century to the 7th century. Their characteristics are compared to those observed in better-preserved examples considered as woven in the Near East or Egypt, in Persia, and in China. Differences in warp proportion for the figured ones and in warp thread twist for all, the shiny appearance of two of them, the extremely fine texture of others, are subtle clues to hypothesize provenances and distinguish places of production, including China for a taffeta and a warp-faced compound twill or samit.

Keywords: early medieval silks, Saint-Denis Basilica, Merovingian graves, Arégonde

1. Introduction

During several campaigns between 1953 and 1980, Edouard Salin, and then Michel Fleury, excavated the 6th century crypt of Saint-Denis Basilica. The importance of the finds was highlighted by the identification of Queen Arégonde, thanks to the inscription on her ring. The material analysed by Albert France-Lanord was described in various articles and in a heavy monograph (Fleury – France-Lanord 1998).

Since 1999, the Saint-Denis material has become the subject of an interdisciplinary research programme led by Patrick Périn, director of the Musée d'archéologie nationale in Saint-Germain-en-Laye until 2012. Antoinette Rast-Eicher was charged with studying the textiles. She reanalysed all the fragments and reconstructed Arégonde's garments that had been misinterpreted by France-Lanord (Périn *et al.* 2008), and identified many luxury textiles, including silks of different types. Witold Nowik (Laboratoire des musées de France) analysed the dyes, and I researched the geographic origins of the silks. This is a difficult task because the fragments are heavily deteriorated; none shows trace of design. But I knew that, until the 8th century, broad regions of silk weaving, at least the Near East and Egypt, Sassanian Persia, and pre-Tang and Tang China, could be distinguished by comparing technical features corresponding to specific traditions (Desrosiers 2004, 14–20). Even if these are broad regions and we know little about some areas where textiles have not been preserved, for instance India (Heller 2006), some hypotheses can be advanced.

2. The graves and the silks: funerary contexts and textile types

Antoinette Rast-Eicher identified textile fragments entirely or partially woven with silk in eleven graves (*Tab. 12.1*)[1]. Nine graves are certainly Merovingian; they date from the end of the 5th to the 7th century. One is from late antiquity while another may be post-Merovingian. It is interesting to note that seven of the Merovingian deceased buried with silks were female.

The remains of twelve silks have been found: two plain taffeta, one figured taqueté, eight figured samits, and a ninth one that may be a samit or another textile with a similar weave (*Fig. 12.1*). *Taffeta* is the name given to plain weave woven with continuous threads. *Taqueté* is woven with 2 warps and a

1 For more details on the textile finds, see Rast-Eicher, in preparation.

Tab. 12.1: Saint-Denis graves with fragments entirely or partially woven with silk (data: A. Rast-Eicher).

Grave Nr	Burial date	Gender	Age	Garment with details	Textile type	Identified dyes or colours
4 Salin	5th c.	?	?	Tunic with gold woven band at neck opening	Taqueté	
63	end 5th–beginning 6th c.	Female	Adult?		Samit S, 1/1	Kermes, madder, indigo dyes
50	1st half 6th c.	Female	Adult	Veil?	Taffeta	
38	2nd quarter 6th c.	Female	Adult		Samit S, or warp-faced compound twill	
42	510–560	Female	Adult	Veil?	Samit S, 1/1	
47	Middle of the 6th c.	Female	Adult	Veil on the head, with gold thread	Samit S	
49	580–581	Queen Arégonde	Adult 61 +- 3 years old	Veil	Samit S, 1/1	Purple with traces of madder
				Sleeve cuff of the mantle	Samit Z, 2–3/1	
				Mantle (with leather belt embroidered with silk)	Weft-face tabby (silk wefts on plant fibre (?) warps)	Silk wefts: purple with traces of madder
				Front opening of the mantle	Woollen tablet woven band brocaded with silk	
41	6th c.	Female or male?	Adult	Veil or mantle	Samit S, 3 lats, 2–3/1	Red (madder), blue and yellow
13 Flury	6th–7th c.	Female		Veil	Samit S, 1/1	
13 Salin	2nd half 7th c.	Male	15-20 years old	On hair	Taffeta	
A6	Post-Merovingian?	Abbot?		Lined with tabby, on knees and back bones	Samit S, 1/1 embroidered with silk	Yellow ?

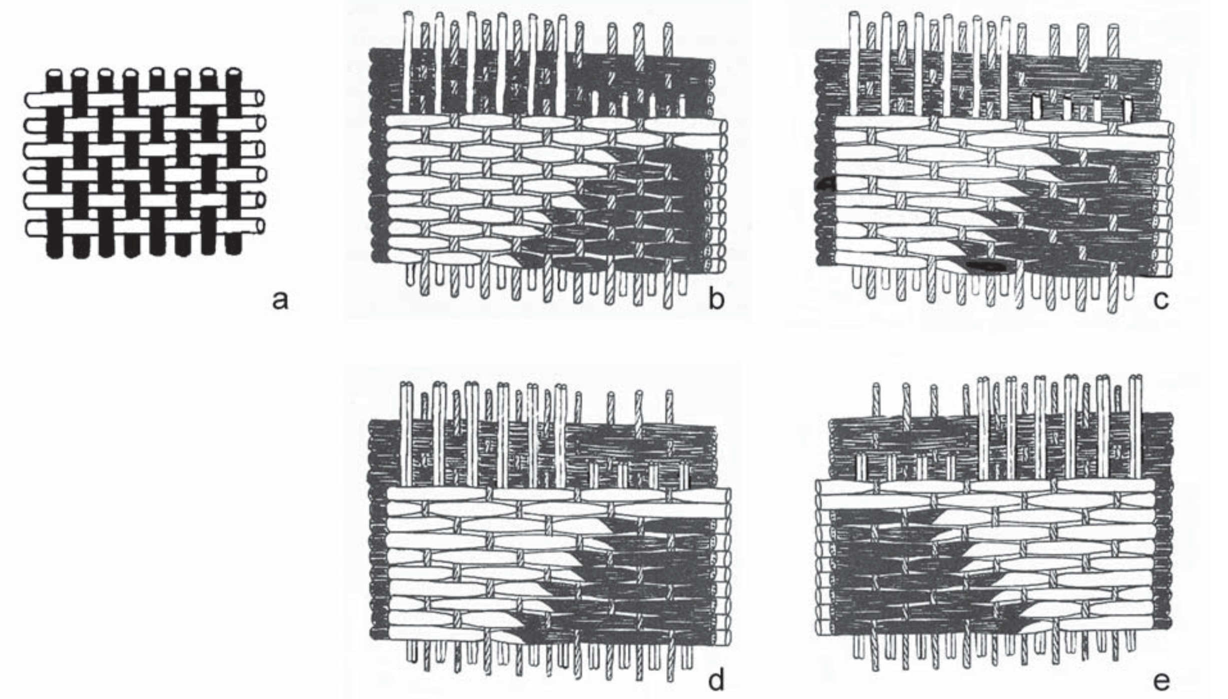

Fig. 12.1: Weaves. a) taffeta; b) taqueté 1/1; c) samit S, 1/1; d) samit S, 2/1; e) samit Z, 2/1

Tab. 12.2: The five categories of silks (wat: without apparent twist; data: A. Rast-Eicher).*

Grave Nr	Burial date	Garment	Textile type	Warp/weft threads	Binding warps /passées per cm	Dyes or colours
TAQUETE with a proportion of 1 main warp to 1 binding warp						
4 Salin	5th c.	Tunic	Taqueté	z/wat*	23/67	
SAMIT with a proportion of 1 main warp to 1 binding warp						
13 Flury	6th–7th c.	Veil	Samit S, 1/1	z/wat	38/63–76	
63	end 5th-beginning 6th c.		Samit S, 1/1	z/wat	30/60	Kermes, madder, indigo dyes
A6	Post-Merovingian?		Samit S, 1/1	z/wat	25–30/70	Yellow ?
42	510–560	Veil?	Samit S, 1/1	z/wat	25/50	
49	580–581	Veil	Samit S, 1/1	z/wat	20–23/53	Purple with traces of madder
SAMIT with a proportion of 2 or 3 main warps to 1 binding warp						
49	580–581	Cuff	Samit Z, 2–3/1	z/wat	20/53	
41	6th c.	Veil or mantle	Samit S, 3 lats, 2–3/1	z/wat	20/52	Red (madder), blue and yellow
SAMIT with grege warps or WARP-FACED COMPOUND TWILL						
38	2nd quarter 6th c.		Samit S, multiple/1 or warp-faced compound twill	grege/wat	50/115 115/50	
TAFFETA						
50	1st half 6th c.	Veil?	Taffeta	grege/grege	65/60	
13 Salin	2nd half 7th c.		Taffeta	z light/grege	45/24	

Fig. 12.2: Samit with red, blue and yellow wefts, S, 2-3/1 warp proportion (grave 41) (© A. Rast-Eicher)

minimum of 2 wefts, each group of threads playing a specific function. The binding warps (shaded on the design) bind in taffeta each *pass* (or group of wefts introduced successively), while the main warps (white on the design) separate the two wefts so that one appears on the front while the other is appears on the back. *Samits* succeeded taquetés by changing the weave of the binding warps from taffeta to twill.

Two other textiles woven partially with silk were identified: a weft-faced plain weave with a silk purple weft on a warp probably made of a plant fibre used for Arégonde's mantle, and a wool tablet-woven band brocaded with silk used along the mantle front opening. They were likely woven locally with imported silk threads or, for the mantle, in a larger Mediterranean region with easy access to silk threads dyed with shellfish purple.

Luxurious as they may have been, all are now reduced to small, dark fragments whose colours are hardly noticeable. Some violet shimmer is perceptible on fragments of Queen Arégonde's purple mantle, and one figured silk bears wefts with some red, green and yellow reflections giving an idea of its original range of colours (*Fig. 12.2*).

3. Synthetic presentation of the main technical markers

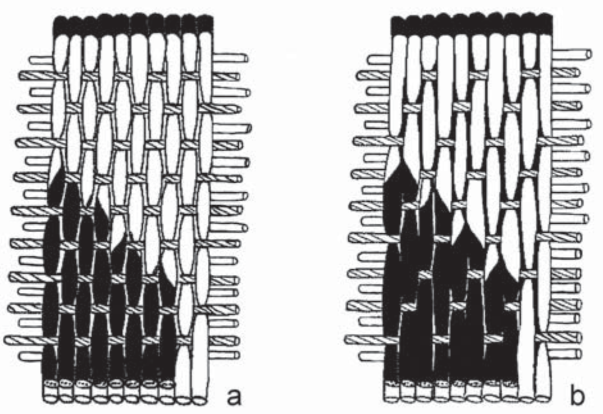

Fig. 12.3: Chinese warp-faced compound weaves: a) tabby; b) twill

Considering medieval silks, some technical features mark broad regional traditions. When textiles woven with *Bombyx mori* silk started to leave China for the West during the Han Dynasty (2nd century BC), they bore two important characters. Their threads usually have no twist or, for some figured silks, a light S twist (Wu Min 2006, 211) and considering their types, the most common were taffeta woven with *grege* (silk thread with gum and without twist), and the most luxurious, because of their polychrome effects, *were warp-faced compound tabby* created with grege or silk threads without apparent twist. Their weave is equivalent to a taqueté turned from 90° and I shall explain further why it is so (*Fig. 12.3a*). Examples of taffeta and warp-faced compound tabby, as well as other types of Chinese silks, travelled all the way to the Mediterranean as shown by fragments found in Palmyra (Schmidt-Colinet *et al.* 2000).

The Chinese figured silks soon inspired the Middle Eastern wool weavers who, accustomed to weaving decorated weft-faced fabrics as tapestry, imitated the weave by turning it 90°. This is how the taqueté appeared early in the 1st century CE as shown by wool fragments discovered on several archaeological sites in Egypt and the Near East, for instance Masada (Sheffer – Granger-Taylor 1994). The first silk example was found in Dura-Europos abandoned in 256 CE (Riboud 1975)[2]. Silk samits were woven in the Near East from at least the 4th century (Schrenk 2004, n°40, 61). This movement of imitation-creation was accompanied by a radical change concerning the silk threads that, in the West, have always a strong Z twist for the warps to resist the tension on the loom, and a light one for the wefts that make the designs on the surface shine better with the least twist possible. By the 6th century, Chinese weavers had adopted twill and weft-faced weaving; they wove both *warp-faced compound twill* (*Fig. 12.3b*) and weft-faced samit[3].

Concerning the samits woven between Persia and the Mediterranean, it has been noted, in the splendid Sassanian examples known so far, that their warp proportion is 2 or 3/1, while it is consistently 1/1 for the Mediterranean pieces (Desrosiers 2004, 14–20). Nevertheless, a small fragment of silk bordering a piece of felt found at Shahr-I Qūmis (Iran), dated 6th century, is a samit with a proportion of 1/1 (according to my own analysis in 2006)[4]. If it was woven in Persia, then the difference in warp proportion indicates local variations in quality and status more than geographical traditions. This is probably the case, as samits found in Xinjiang -with Z-twisted warps and designs strongly related to Persian examples-, show a 1/1 warp proportion at least in the 7th century (Riboud – Vial 1970, xxxiv; Zhao Feng 2006, 195–196).

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2 Its threads are in spun silk or *schappe*, a discontinuous silk spun like wool.

3 The process is here presented in a simplified way. For more details see Khun 2012, 27–29.

4 The fragment is not dated 1st century BC as indicated in Vogelsang-Eastwood (2006, fig. 6), but 6th century AD (Hansman – Stronach 1970) .

4. The categories of silks found in Saint-Denis graves: definition and comparisons

Fig. 12.4: Taqueté, 1/1 warp proportion (grave 4 Salin) (© A. Rast-Eicher).

The eleven silks about which Antoinette Rast-Eicher could extract sufficient data (remains in grave 47 are too deteriorated) can be divided in two groups according to their warp construction: those with strong Z twist woven outside China, and those with no twist or a light twist probably woven in China. The first group includes the late antique taqueté with a 1/1 warp proportion, five samits with the same warp proportion, and two samits with a 2-3/1 warp proportion (*Fig. 12.4–6*). The second group includes one samit with grege warps – possibly a 'warp-faced compound twill'–, and two taffeta (*Fig. 12.7–9*).

Fig. 12.5: Samit S, 1/1 warp proportion (Arégonde's veil; grave 49) (© A. Rast-Eicher).

Fig. 12.6: Samit Z, 2-3/1 warp proportion (Arégonde's cuff; grave 49) (© A. Rast-Eicher).

Fig. 12.7: Grave 38, threads grege and wat: a) samit; b) warp-faced compound twill (© A. Rast-Eicher).

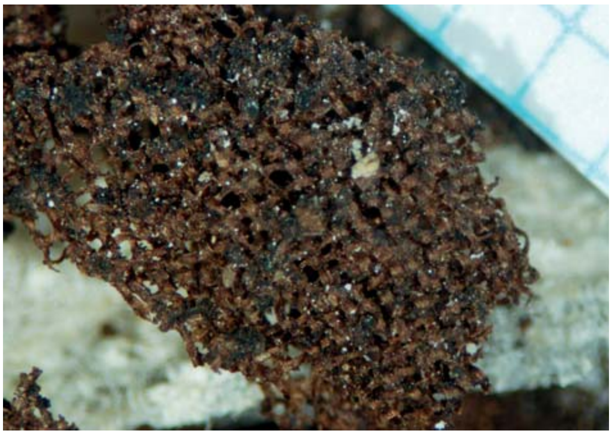

Fig. 12.8: Taffeta grege/grege (grave 50) (© A. Rast-Eicher).

Considering the examples published so far, the taqueté and the samits with a 1/1 warp proportion have thread densities fitting with those woven in the Near East or in Egypt. The taqueté is comparable to two 5th century examples found in Saint-Victor Abbey in Marseille and in the San Giuliano church in Rimini; both used for tunics (Boyer 1987; Stauffer 2000). The five samits have the same diagonal S and are quite fine (interestingly, the silk found in the post-Merovingian grave is similar to the others). An example with these characteristics has been found in a Merovingian grave in Louviers (late 5th–early 6th century) (*Fig. 12.10*), and another one appeared as a cross sewn on a garment in a 6th–early 7th century grave in Oberflacht (Rast-Eicher 2008; Streiter – Weiland 2003). The geometric design of the latter contrasts with the naturalistic expressions of other contemporaneous pieces believed to have been woven in the same area (Desrosiers 2004, 19; Schrenk 2004, n° 63; 2006). Nevertheless, if samits with a 1/1 warp proportion were woven also in Persia with the same thread counts, some pieces of this small Saint-Denis group could come from there.

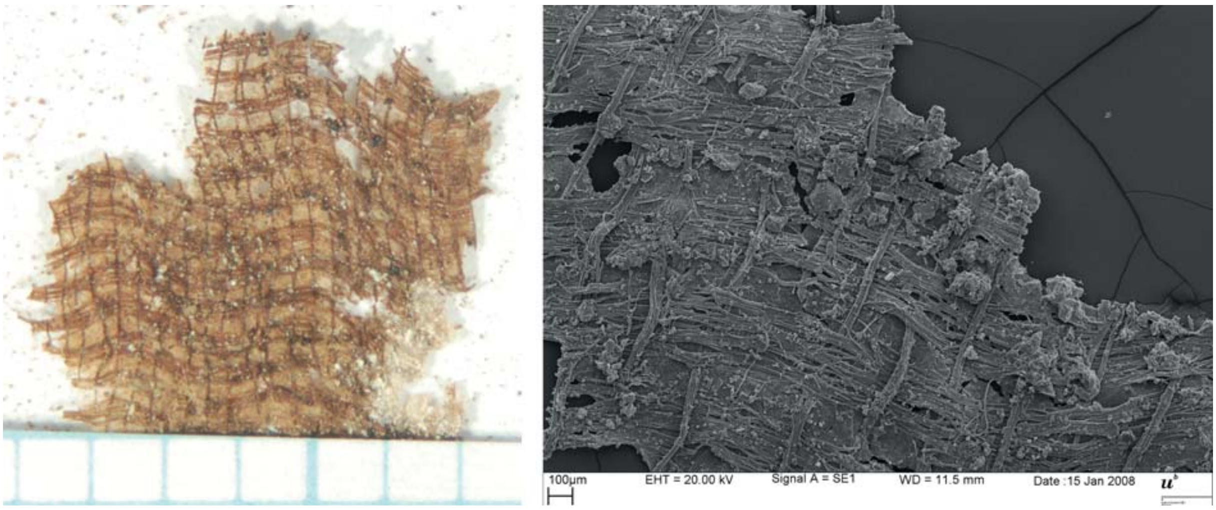

Fig. 12.9: Taffeta z light/grege: a) Binocular image; b) MEB image (grave 13 Salin) (© A. Rast-Eicher)

By contrast, there is no doubt that the last two samits with strongly twisted warps were woven in Persia and were of high quality. They have a shiny appearance like other pieces regarded as Sassanian, a specificity that might be related to the longer weft floats allowed by the higher warp proportion, and also to the quality of the silk. Both have the same thread counts. They differ in the direction of their twill – S for the veil or mantle of grave 41, Z for the cuff of Arégonde's mantle. A similar flexibility is observable on the samit with ducks in pearled roundels from the *Sancta sanctorum* in the Vatican whose twill direction is Z on its left part and S on the right (personal analysis in 2006; Volbach 1942, T108) and on the piece from Antinoé, with ibex, whose fragments have either a S or a Z twill direction (Durand 2013).

Fig. 12.10: Samit found in Louviers (Normandy) (photo: A. Rast-Eicher).

Fig. 12.11: Taffeta found in Unterhaching (Bavaria) (photo: B. Nowak-Böck).

The last figured piece, a samit or a warp-faced compound twill, has threads either without twist or without apparent twist, a feature that points to a Chinese production. Even if the fabric has shrunk while drying out, its extremely fine texture – combining 50 and 115 multiple threads per centimetre – points to the same conclusion (Riboud 1975; Zhao Feng 2012, 213). To my knowledge, no warp-patterned Chinese silk has been found in Europe. A warp-faced textile seems less probable than a weft-faced one or samit.

The light taffeta found in grave 50 can be interpreted also as a possible Chinese production as grege was used for both warp and weft, and its thread counts and appearance are very similar to all those found in Dunhuang (Riboud – Vial 1970, xxv-xxvii; Zhao Feng 2010). A comparable piece was found in Lauchheim (ca. 500 AD) (Banck 1998). With its light Z twist in the warp and its low weft count, the last fragment does not fit with a Chinese type, nor with the example with strong Z-twisted warps found in Unterhaching (*Fig. 12.11*) (Nowak-Böck – Von Looz 2010).

In conclusion, despite the deterioration of the material under study, it is possible to hypothesise about the Far East, Persian or Near East provenance of the silks from the Saint-Denis Merovingian graves. The deceased were certainly impressive when dressed in a flamboyant tunic, or covered with a veil eventually embroidered with silk or gold threads, especially queen Arégonde with her purple silk mantle decorated with cuffs made of a Sassanian samit of the highest quality.

Acknowledgments

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13 | Old Fragments of Women's Costumes from the Viking Age – New Method for Identification

HANA LUKEŠOVÁ

Abstract: A project for re-evaluating old textile finds from the Viking Age was undertaken at the University Museum of Bergen. In the past, textiles and metals that were found together were often separated, unfortunately without any detailed documentation. The main focus of the project was to find the original position of the textiles on the metals and to reconstruct the sequence of layers if possible. The working method involved a detailed study of the textile fragments and comparing the stains on the textiles with the metal objects. A portable XRF-spectrometer was used in this work. It was possible to retrace the lost context of many archaeological finds and to identify different types of garments.

Keywords: Archaeology, Viking Age, textile, XRF-spectrometry, costume, reconstruction

1. Introduction

The University museum of Bergen is an institution with a long history. It has collected archaeological objects since the second half of the 19th century. The textile fragments that will be discussed in this paper were found in West Norway. The majority was excavated at the end of the 19th century or in the first half of the 20th century. The finds have in fact had a "new" life with their own history since the time they were discovered. It is necessary to take into account their complete history including traces of the recent past that often have not been thought as being important.

The textile fragments were found in graves, mainly in association with metal objects. Many fragments arrived at the Museum as "dirt" on metal brooches. The first conservation reports about these objects date from the beginning of the 1970s. Most of the textile finds were separated from the metals at this time or before. Unfortunately, the process of separation took place without documenting any details. Looking for the lost context of archaeological finds that were excavated in the past is often the only way to regain missing information. It is the position of the textiles on the metal objects in particular, which could be a key to a partial costume reconstruction.

Although the textile fragments are small and often in a very bad condition they can still provide valuable information about the Viking Age costume in western Norway. The aim of the study was to regain information that has been lost in the recent past. Summarizing the content of the ensemble and making a statistical overview of the identified garment types was the next goal of the project. The plan was not to find a clue to a complete Viking Age women's costume because the study was based entirely on the preserved textile fragments, which are very small so a complete costume reconstruction was not possible. In addition, it is more than probable that numerous textile layers are missing.

2. Viking Age textiles from the University Museum of Bergen

The group of Viking Age textiles in the Late Iron Age Collection comprises 34 inventory numbers. Each number often includes more than one textile structure and many small textile fragments. Twenty finds come from female graves, four finds from male graves, three finds from double graves and seven finds from unreliable find contexts.[1]

It was possible to identify the remains of different garments in 25 finds. Two of them are remains of men's garments while the remaining 23 finds, belonged to women's garments.

Lise Bender Jørgensen studied the textile techniques of this group of fragments and published a thorough overview of the whole collection. She found clear evidence that broken lozenge twill, which she refers to as broken diamond twill and defines as so called "Birka type", was more common in western Norway than in eastern Norway (Bender Jørgensen 1986, 91). Several other archaeologists such as Charlotte Blindheim (1947), Inger Marie Holm Olsen (1976), Penelope Walton Rogers (1988), Karin Gjøl Hagen (1992) have also discussed some of the finds.

3. Method

Fig. 13.1: A fragment of very fine broken lozenge twill belonging to the textile find (B4864_g, h) from a double grave at Hyrt in Voss in Hordaland County (photo: S. Skare).

A first step to an identification of the garments was a detailed study of the textile fragments. The following aspects were considered: the textile structure, determination of warp direction if possible, the shape of a fragment, selvages, hems, seams, stains and specific pleats, imprints, abrasion wear, holes and others. The different details were studied using a stereomicroscope (*Fig. 13.1*).

In addition, metal brooches found in connection with the textiles were studied (*Fig. 13.2–3*). The main focus was given to remains of textiles used for fastening onto brooches. In many cases textile loops and different braids were wound around brooch-pins. The shape of the brooches and their material composition were also considered.

3.1 Garment categories

Different garment categories were established and defined first of all by their position relative to the typical Viking age oval brooches. It is commonly known that these brooches were used to fasten the straps of a suspended dress. The evidence is substantiated by remains of textile loops and fragments of an upper, folded hem fastened to brooch-pins, found in numerous Viking Age graves (Hägg 1970, 1971, 1974, 1982; Hedeager Madsen 1990; Kaland 1992; Speed – Walton Rogers 2003). Two categories, shift and tunic, were used for the

[1] The grave contexts were examined by Asbjørn Engevik jr.

Fig. 13.2: Two oval brooches (B8000_a) from Grødes in Hornindal in Sogn og Fjordane county. Double-shelled brooches made from copper alloy were gilded with gold and trimmed with silver bosses and chains (photo: S. Skare).

textile layers that were underneath a suspended dress. The term tunic was used in the cases when there was evidence of a shift (the undermost garment) and there was another layer of a different fabric between the shift and the suspended dress. The term "outer garments" was used for the layers that lay over the brooches, e.g. cloaks and shawls. The terms for different garments were used as means of distinguishing between different garment layers, which carried out a specific function rather than an exact garment definition.

3.2 Drawings and reconstruction of the original sequence of layers

It was necessary to handle the objects gently because of their fragility. The aim was to find a way of handling that would not affect their condition. The whole process was therefore carried out by sketches on transparent foils. This way of working allowed a mutual contact of the textile- and metal objects and their confrontation without any negative effects on their condition.

A computer programme for vector drawing was used to obtain an overview of achieved information during the reconstruction of some complicated finds. Hand drawings were scanned and converted into vector drawings. Different layers were distinguished by colour. Easy stratification, "switching off" particular layers, manipulation with the saturation of layers, rotation, reflection and other functions facilitated the reconstruction due to handling virtual objects.

Fig. 13.3: The inside of two oval brooches (B8000_d) showing the preserved brooch-pin made from iron with the remains of mineralized textile loops (photo: S. Skare).

3.3 X-ray fluorescence spectrometry

It was proved that X-ray fluorescence spectrometer can be used in the last step as a partial verification of the reconstruction of layers due to the different element composition of the outside and inside of oval brooches.

X-ray fluorescence (XRF) is a phenomenon widely used for elemental analysis (Glinsman 2005; Joyce 2011; Shackley 2011). The Thermo Scientific Niton XL3t Goldd was used to provide the tests. It was possible to measure the element composition of stains on the textiles and comparing it with the element composition of the metals that were found close to the textiles. The typical Viking Age oval brooches, which were used to hold a suspended dress, were commonly made of copper alloy. Especially the later types were often gilded with gold and decorated with bosses containing tin, lead, copper and other elements (Jansson 1985, 108). These bosses were often coated with a decorated silver sheet (Jansson 1985, 99 and 109). The brooch-pin was usually made from iron. Long lasting contact between metal objects and textiles is the reason why traces of metals from brooches can still be detected on the textile fragments even though they were wet treated in the past.

4. Case study

The find is from Hyrt in Voss in Hordaland County. The textile fragments were found in a double grave containing objects typical for both male and female graves.[2] The textile find contains: very fine dark blue broken lozenge twill, blue tabby, coarse 2/2 twill, fine tabby, fine twill and a small piece of yarn.

It was possible to identify a sequence of three types of weaves: broken lozenge twill, blue tabby, coarse 2/2 twill (Lukešová 2011, 158). A photograph of the stage before the separation helped to identify an oval fragment of coarse 2/2 twill. It is clear that the fragment was under the brooch and a pin did not pierce it. It completely covered the whole area of the brooch inside, which means that this fragment does not represent a suspended dress. The upper hem of a suspended dress usually ends approximately within the first third of an oval brooch. The fragment of 2/2 twill might thus be some kind of tunic. The blue tabby made from flax or nettle[3] probably belonged to a shift. Two upper and two lower loops on brooch II indicate that there were two strapped gowns. The top layer of fine diamond twill, which is to be observed on the old photograph as well, suggests some type of a cloak – an outer garment.

This find was a good starting point when testing the XRF method because the original position of the textile fragments on the metal brooch was clear in the photograph taken before the objects were separated. The aim was to see whether the element spectra of the oval brooch and the textile fragments matched. The area around the brooch fastening and a reddish stain on the coarse 2/2 twill were measured with the XRF handheld spectrometer (*Fig. 13.4*). It was possible to follow a clear link between the two objects. The brooch-pin contained a high amount of iron and the element spectrum from the textile fragment showed the same levels.

The outside of the brooch and the broken lozenge twill fragment were measured as well. The spectra indicate that there is less iron than on the inside of the brooch close to the brooch-pin. Copper predominates over zinc, lead and gold. Lead was probably used for the brooch bosses whereas gold was used for gilding. The element spectrum from the textile fragment matches the brooch; only gold is missing, which might have been caused by previous wet cleaning.

5. Preliminary results

There is evidence of 66 women's garments from 23 different finds. The suspended dress was the most common dress type, making up 50% of the total amount of identified garments. Shifts made up 14% of the identified garments while tunics were only 3%. 24% of the total amount of identified garments consists of the upper garments that lay over the brooches. The remaining 9% belongs to unidentified garments, which are referred as to women's clothing.

There was at least one suspended dress in 19 grave finds, 13 of which contained two strapped gowns and two contained as many as three strapped gowns fastened to one pair of oval brooches. Outer garments were also numerous in several grave finds.

5.1 Types of garments versus types of weave

All the fragments that were identified as a shift were tabbies, mainly made from plant material. The thread count is higher compared to the thread count of the outer garments.

[2] The grave context was examined by Asbjørn Engevik jr.

[3] Identified by using the Herzog test.

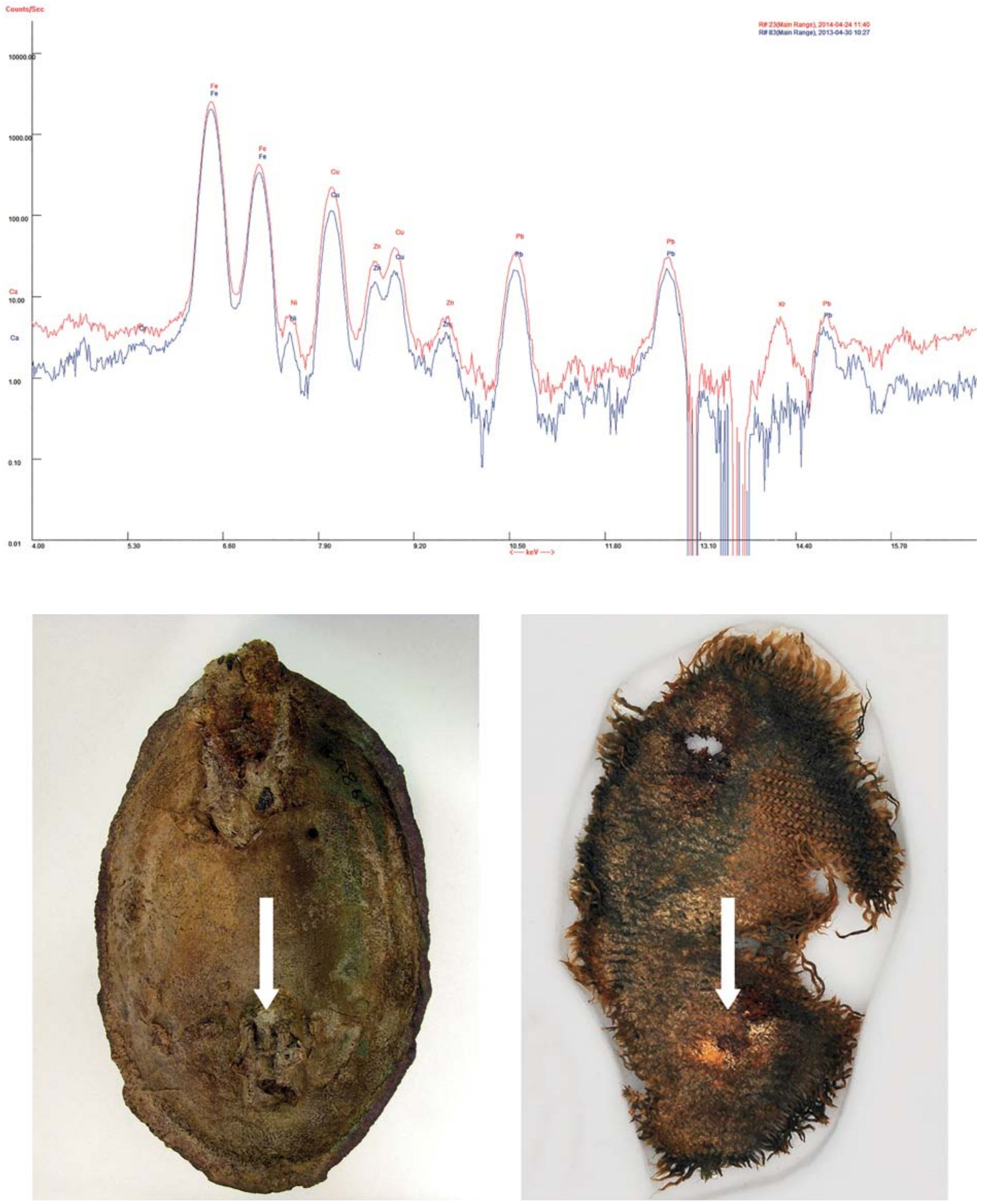

Fig. 13.4: XRF spectra of oval brooch I (B4864_i) and coarse 2/2 twill from the textile find (B4864_g, h). Blue spectrum: the inside of oval brooch I.; red spectrum: the red stain on the coarse 2/2 twill (graph: H. Lukešová; photo: S. Skare).

The fragments of the two identified tunics were made from rather coarse materials (both from animal hair). One tunic was made from 2/2 twill, the other was made from a coarse tabby. Both show remains of blue/blue-green colour.

34 garments were identified as some kind of dress fastened to oval brooches. The fabric type of most of the suspended dresses was fine broken lozenge twill which in many cases shows traces of blue. It is necessary to point out that the evidence of approximately half of the identified suspended dresses is substantiated on at least two preserved loops that were still attached to oval brooches. There are no remains of the dress itself.

2/2 twills dominate in the category of outer garments. Thirteen garments that lay over the oval brooches were made from rather coarse 2/2 twill. Only three outer garments were made from broken lozenge twill. Many outer garments show traces of blue as well. Some were probably made from a double-folded piece of fabric that was laid around the shoulders.

6. Discussion

The method seems to hold considerable potential. It was possible to retrace the lost context of many archaeological finds. However, it is still necessary to interpret the results as based on the reconstruction and to treat them with certain caution.

The use of the XRF-spectrometer is a promising method. However, it shows element composition only and does not give a clear answer as to what a particular metal object originally looked like. It cannot differentiate between the left and right oval brooch; it does not offer any clues in terms of reconstruction. It may support or exclude a hypothesis that has been put forward before a measurement. This method is worth using when there is a clear difference of the element composition of metal stains on textiles that are associated with metal objects or parts of metal objects (e.g. the element composition of the outside and inside of the brooch).

Using a digital x-ray photograph might help to show stains of corrosion products on textiles more clearly and it could be used for a precise focus when measuring. Another area for further research might be the behaviour of metal remains found on the archaeological textiles. How far from the metal object is the stain detectable? Corrosion products from metal objects on the textile fragments spread or stain in a different way according to the type of metal and burial environment.

7. Conclusion

It was possible to identify different types of garments despite the small size of the fragments. The evidence of garments was substantiated by a reconstructed sequence of layers and other specific details. The location of the preserved garment parts was possible due to oval brooches having an assigned place on Viking Age women's costume. All identified parts of the costumes came from the chest area. The following types of women's garments were identified: a shift, a tunic, a suspended dress and outer garments such as cloaks and shawls. What a complete Viking age women's costume looked like has been left open intentionally since the study is entirely based on the preserved textile objects.

Re-evaluating textile finds discovered in the past has been a challenging but rewarding project, which has regained important information about particular finds that had previously been overlooked.

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I would like to thank Sigrid Hillern H. Kaland, Prof. Emeritus Svein Indrelid and Prof. Knut Mikjel Rio who allowed me to work on this project. Thanks to Dr. Asbjørn Engevik, Prof. Ingvild Øye, Vedis Bjørndal and many other colleagues who motivated me and supported the project in many ways. Thanks also to Dr. Melanie Wrigglesworth, who helped with language correction.

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14 | Hunteburg Cloak A

SUSAN MÖLLER-WIERING

Abstract: The wool cloak Hunteburg A – dated to the 3rd century AD – is a 2/2 twill in z/s yarn with 12–13x6(–7) threads per cm. As it was made with tablet-woven borders on every side, it has been regarded as woven on the warp-weighted loom. However, the construction of the starting edge differs significantly from typical products of this type of loom. The use of a tubular warped loom and secondarily added tablet borders is suggested instead, simplifying the working process considerably. Comparative, contemporary pieces are "Prachtmantel I" from Thorsberg and cloak B from Hunteburg. Broad tablet-woven borders were prestigious objects. Therefore, the loss of the laterally tablet-woven borders from cloak A is interpreted here as a deliberate act, cutting them off for sale or exchange.

Keywords: Hunteburg cloaks, Roman Iron Age cloaks, tubular warped loom, tablet-woven borders

1. Find History

A considerable number of Roman Iron Age textiles have been recovered from bogs in northwestern Germany, most of which were published by Karl Schlabow (1976). Meanwhile, new results have been obtained for some of the most important finds. Amongst them is cloak A (*Fig. 14.1*) from Hunteburg (near Osnabrück in Lower Saxony).

In 1949, two male corpses lying side by side were discovered. Each was wrapped in a large wool blanket – i.e. cloaks A and B. As no other pieces of clothing were found, the corpses were described as naked (Schlabow 1976, 18). However, textiles made from plant fibres may have existed (see Frei *et al.* 2009). The find is 14C dated to 270 AD ± 50 years (van der Sanden 1996, 192).

2. Ground weave

The ground weave of cloak A is a simple 2/2 twill in z/s yarn, woven carefully and evenly. Yet, the weft does not always extend across the whole fabric,[1] seemingly as a means of achieving the even appearance. Counting the threads in a few spots in some distance from the edges gave 18–19x12–13 threads per 2 cm, compared to 25 x 13.5 threads per 2 cm given by Karl Schlabow (1976, 51). He mentions a diameter of c. 1 mm for the warp and c. 1.5 mm for the somewhat softer weft. The wool of both systems contains fibres of various thickness, though only very few are hairs with large diameters. All threads consist of – now – reddish fibres combined with a considerable amount of very dark fibres. Indications of any patterning have not been found.

3. Edge B – finishing edge

Edge B (*Fig. 14.2*) is preserved almost in its total length, although the outermost threads of the tablet weave are often missing. The border was woven with 14 tablets, with alternating orientated tablets (*Fig. 14.3*), as was usual for cloaks at the time. In two symmetrically located spots, the turning direction of the tablets was reversed. Within c. 2 cm, 5 sheds of the tablet weave were counted.

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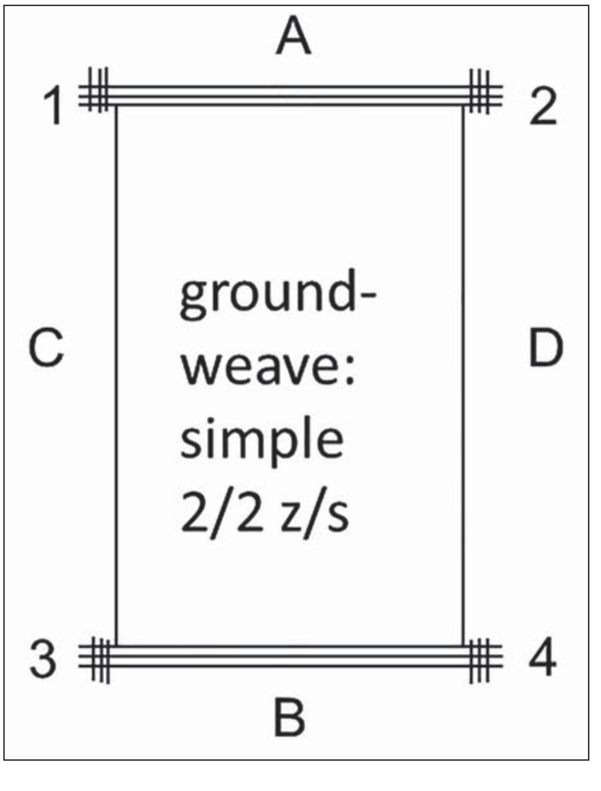
[1] Angelika Neuhausen, personal information, 6.11.2012.

Fig. 14.1: The cloak measures 2.73 x 1.77 m and is sewn onto a wool fabric, which was applied when it was first conserved (photo: S. Möller-Wiering).



The threads are clearly more homogeneous compared to the ground weave. The thread diameter is more uniform but larger; all in all, the fibres are straighter and darker, containing less reddish fibres. This indicates that originally it had a different colour to the ground weave.

Short z-twisted fringes make up the outermost edge (*Fig. 14.3*). Each of them consists of two warp threads of the ground weave. Each such pair of z-spun threads protrudes from a shed of the tablet-weave with a S-twist. After having formed a loop, the pair runs back into the tablet weave, into its next shed. Within the fringe, the twist results in a zSZ combination.

The fringes are slightly longer than 1 cm on average, with deviations of up to 3 mm. The surface has rubbed off as a result of wear and tear.

Fig. 14.2: Definition of the edges and corners (drawing: S. Möller-Wiering).

Many loops have disintegrated, although inside the protecting tablet weave, the yarns are well preserved. This confirms that the fringes were intended to be seen – indicating again different colours in the ground weave and tablet weave: beyond the tablet weave, the fringes would repeat and emphasize the colour(s) of the ground weave.

Along the transition to the ground weave − or nexus, a term suggested by Lise RÆDER KNUDSEN (e.g. 2011) −, bundles of cut thread ends appear at regular distances (*Fig. 14.4* and *5*). They represent the very ends of the warp threads of the ground weave, after they have served as weft for the tablet weave. Here and there, a single warp thread is cut at the outer edge of the tablet weave (*Fig. 14.5*), balancing out minimal variations between ground weave and tablet weave.

Basically, this is a finishing border like those on other cloaks of the time (MÖLLER-WIERING 2011; RÆDER KNUDSEN 2011)[2]. Within 16.5–18 cm distance from the corners, some warp threads of the ground weave turn back to the nexus without being extended into loops, while others end as longer, now heavily worn fringes of up to 5 cm length without loops (*Fig. 14.6*).

At both corners 3 and 4, the tablet border of edge B continues across those of the edges of C and D. Thus, it was woven later. Its warp threads end in what are now thin fringes (*Fig. 14.7*).

Fig. 14.3: Reversal of turning direction in edge B (photo: S. Möller-Wiering).

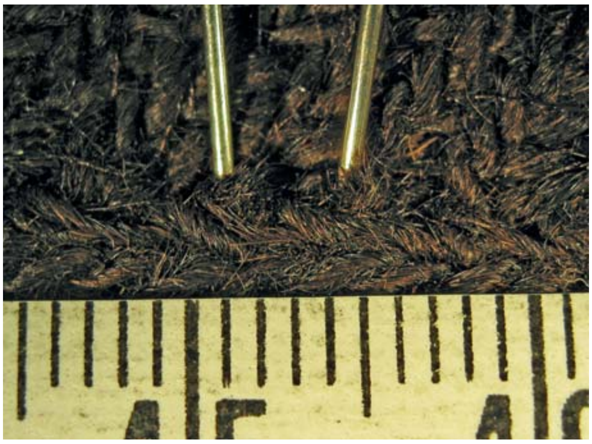


Fig. 14.4: Edge B, transition from ground weave (top) to tablet weave; cut end of thread (protruding from tablet weave) before each pin (photo: S. Möller-Wiering).

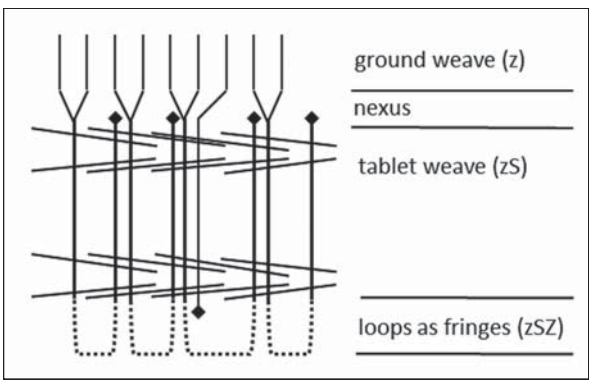


Fig. 14.5: Edge B, sketch (drawing: S. Möller-Wiering).

4. Edge A – starting edge

Since edge B was identified as a fairly typical finishing border of a Germanic cloak, the starting edge must be looked for in edge A. Already Karl Schlabow did so and postulated the use of a warp-weighted loom (SCHLABOW 1976, 50).

There are several parallels between both borders (*Fig. 14.8*):

– Similar width of the tablet weaves: 14 tablets in edge B, 16 tablets in edge A.
– Alternating orientation of neighbouring tablets.
– Type of fibres, although the dark appearance is less concise than in edge B.

2 Including further literature.

Fig. 14.6: Edge B, fringes of up to 5 cm length close to the corners (photo: S. Möller-Wiering).

Fig. 14.7: Corner 3; the tablet-woven (vertical) edge C is preserved only where it is integrated into edge B (horizontal) (photo: S. Möller-Wiering).

– Reverse direction of the tablets parallel to edge B (*Fig. 14.9*).
– Fringes of several cm in length protruding from the border within the first c. 16.5 cm from corner 2 (*Fig. 14.10*). Thus, one may assume a strip all along edge D (and probably along edge C as well) with long fringes and possibly a different colour or pattern contrasting to the main ground weave.
– Within this section of longer fringes as well as in the centre part, of which much has been lost −, there are cut threads at the nexus.
– The preserved centre parts show short, twisted, partly rubbed off fringes with loops; their length varies a little, the longest ones measuring c. 1.6 cm.

At this point, because of the great similarities between both edges, it seems questionable whether edge A really is the starting border of a fabric woven on a warp-weighted loom.

Fig. 14.8: Edge A, with tablet-weave, short fringes and cut thread ends (marked by pins) (photo: S. Möller-Wiering).

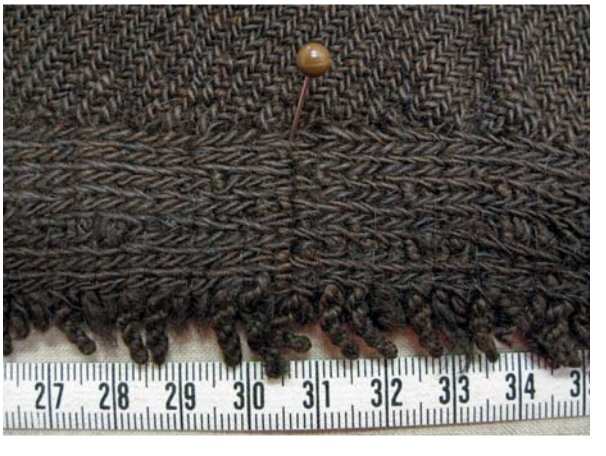


Fig. 14.9: Edge A, reversal of tablets (photo: S. Möller-Wiering).

Fig. 14.10: Corner 2, with longer fringes and the preservation of the tablet woven border of edge D (vertical) restricted to its section interwoven in edge A (photo: S. Möller-Wiering).

Fig. 14.11: Edge A, damaged section; the left green pin marks the length of the inner loops. The yellow pin marks two threads crossing at the nexus – probably a secondary displacement (photo: S. Möller-Wiering).

4.1. Further details of construction

A heavily damaged part of edge A provides further insight (*Fig. 14.11*), although the method of conservation hampers the observation of certain features.

Again, the warp threads of the ground weave form loops. These loops, however, do not reach beyond the tablet weave, but end after c. 1.5 cm within the tablet border (*Fig. 14.11*). In general, both elements (legs) of such a loop seem to lie side by side, not twisted around each other. Twined threads (3zS or 4zS) are inserted into the originally hidden loops. They form the short, twisted, looped fringes beyond the tablet-woven border. Not surprisingly, the tips of the outer loops have been disintegrated in this damaged part, thus loosing part of their twist (*Fig. 14.11* and *12*). The twined thread of the outer loops combines two (or three in at least one example) inner loops at a time (*Fig. 14.12, to the right*).

Fig. 14.8 shows edge A with six pins marking six cut thread ends within c. 3 cm. In the centre, one seemingly missing thread end may lie within the fabric. Various measurements give the following figures for 3 cm:

- c. 35 warp threads of the ground weave
- 17–18 loops hidden in the tablet-woven border
- c. 15 changes of shed in the tablet-weave
- c. 7 cut thread ends along the nexus, i.e. probably one in every second shed
- 7–8 short fringes (zSZ) along the outer edge (*Fig. 14.9*).

It may be concluded that the cut threads at the nexus belong to the short fringes rather than to the ground weave. The high number of cut ends represent a high number of short pieces of yarn integrated into the tablet weave – which is a strong indication of the use of different colours. Already Karl Schlabow (1976, 51) had suggested this. An hypothesis for the construction of edge A is given in *Fig. 14.13*. Alternating colours may also be expected amongst the longer fringes closer to the corners, since there too cut threads appear at the nexus.

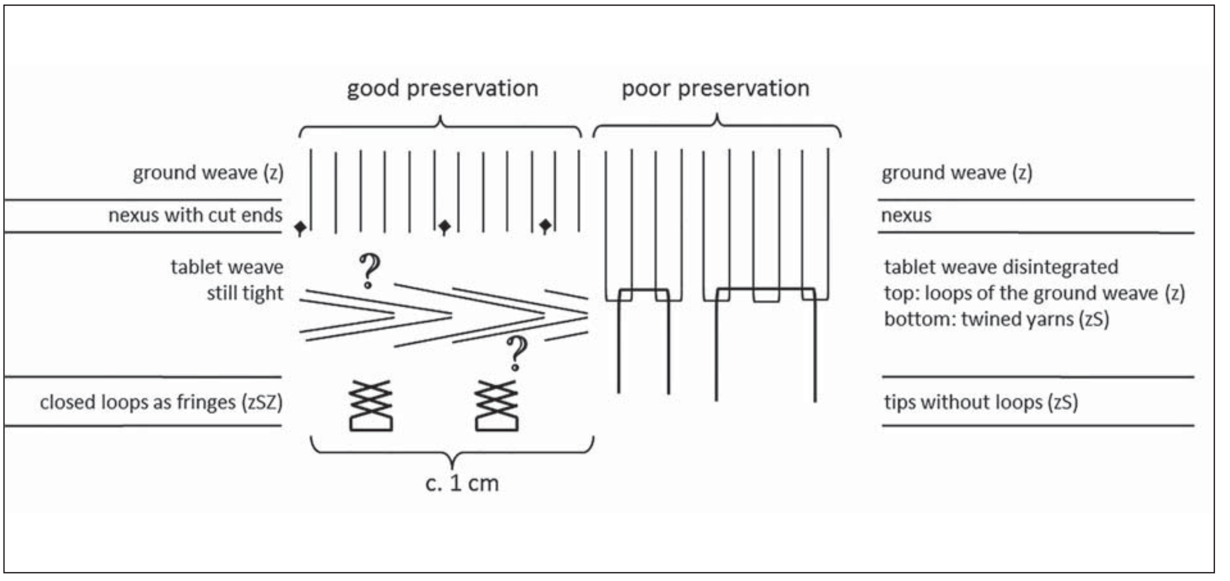


Fig. 14.12: Edge A, construction as far as visible (drawing: S. Möller-Wiering).

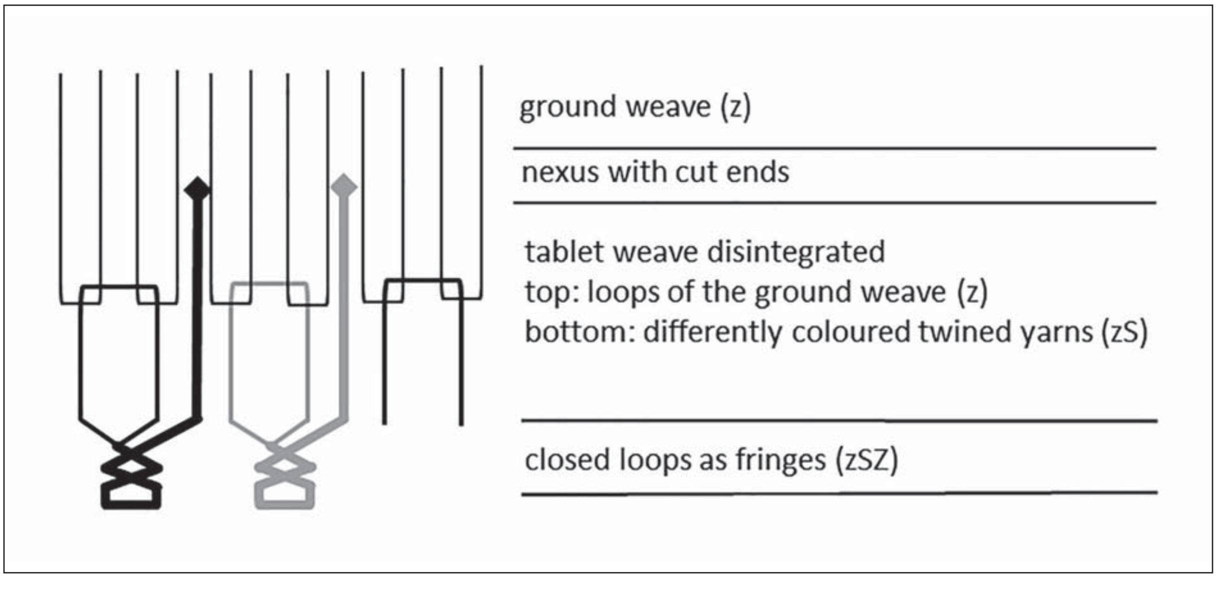


Fig. 14.13: Edge A, hypothesis of its construction (drawing: S. Möller-Wiering).

5. Edges C and D

The preserved corners demonstrate that originally, all four edges were decorated with tablet weaves. For the tablet weave along edge D, 12 tablets may be assumed. Again, the fibres are darker, smoother and more homogeneous in diameter compared to the ground weave.

At some point, though, edges C and D have disappeared. The then raw edges of the ground weave were folded and hemmed with 10.5–12 coarse stitches per 10 cm (*Fig. 14.14*). The wool z-spun, paired yarn resembles the warp threads though its colour is now a light reddish brown and the fibres are finer. Schlabow explains the loss of the lateral tablet borders by wear and tear. However, tablet weaves are extremely tight and robust. During time their surface may rub off as in the case of edges A and B, but it would be hard to destroy them completely.

It is more probable that they were cut off on purpose. Decorative tablet weaves were objects of prestige (Möller-Wiering 2011). Compared to other cloaks, the Hunteburg A fabric is of good quality, though not exceptional; this is demonstrated by the thread count, the even weave, the tablet borders of considerable width, including the sides and the use of various colours. One might speculate that despite its good quality, the original owner gave it away after some time. The cloak was then worn by other people for whom its function was more important than its prestige value. The still decorative borders were cut off and sold or exchanged for something more important.

Fig. 14.14: Edge C with hem (photo: S. Möller-Wiering).

6. Discussion of the manufacturing process

Postulating the production on the warp-weighted loom, one might consider three hypotheses of constructing edge A:

a) The ground weave was produced without the tablet-woven edging, which was woven to the fabric afterwards.
b) The making started with the inner part of the tablet border as a starting border for a warp weighted loom; the outer part was added later.
c) The inner as well as the outer part were woven simultaneously as a starting border; this is Schlabow's suggestion.

6.1. Hypothesis a): Starting edge originally without a tablet-woven border

One might think of a thick starting cord, a stick or slat around which the future warp threads might have been arranged. However, the latter may cause difficulties regarding the correct arrangement of the threads.

6.2. Hypothesis b): Starting edge with small tablet-woven border and later addition

Usually the two elements (legs) of each loop of the future warp lie in neighbouring sheds of the tablet weave. The turning points of the loops make up a horizontal line very close to the outermost warp of the tablet weave; there are no loops of any length to be combined later as described above. A solution might be to include a cord or stick along the outer rim which could be removed afterwards, producing the loops as needed.

Recently, another type of starting border has been described, in which both elements (legs) of any warp loop lie in the same shed of the tablet weave (MÖLLER-WIERING 2011; RÆDER KNUDSEN 2011). However, in this fabric, two or even three loops lie within one shed of the tablet weave. This might hamper the correct arrangement of the warp threads for weaving. Moreover, the many short, coloured yarn ends of the fringes, cut at the nexus, must have been pulled through the already existing part of the tablet weave. This would be extremely time-consuming − in contrast to other cloaks which reveal that adding tablet borders secondarily were a means of simplifying the working process.

6.3. Hypothesis c): Starting edge with broad tablet weave from the beginning

The two arguments just mentioned also apply here and argue against this hypothesis: the fact of two or three loops of the ground weave within one shed of the tablet weave and the highly time-consuming labour.

6.4. Alternatives

Although even other ways of creating such an edge may not be excluded, it can be stated that weaving this cloak on a warp-weighted loom is possible but unlikely. Looking for alternatives, one may think of a Roman device – Hunteburg is not far from the Roman border. But the loops along edge A argue against the vertical Roman loom. Any indications of a horizontal loom are missing for this area and period.

The simplest solution is the use of a tubular warped loom. Danish examples are mostly dated to the Early Iron Age (MANNERING *et al.* 2012, 114). Only recently, clear indications of this type of loom come from Thorsberg in northernmost Germany (MÖLLER-WIERING 2011; RÆDER KNUDSEN 2011). Particularly the so-called "*Prachtmantel* I" must be mentioned which is similar in date to the Hunteburg cloaks.

Textiles woven on tubular warped looms are characterised by loops along both narrow sides. The loops are short along the starting edge but of variable length at the end. In this case, along edge A, the loops were prolonged for a broader tablet weave. Along edge B, the loops were cut open and integrated into a tablet-woven finishing border.

7. Other research

According to KARL SCHLABOW (1976, 51–52), the cloak was woven on a warp-weighted loom with simultaneously woven tablet borders, applying a variation of the before mentioned hypothesis c. Recently, Lise Ræder Knudsen analysed the tablet weaves. Her results confirm the conclusions put forward here.[3]

Cloak B from Hunteburg was not included in this research, but is worth mentioning. It was also described by SCHLABOW (1976, 52–53) and a replica was woven by ERIKA ARNDT (2010). It is a simple twill in z/z yarn with 11 x 8 threads per cm and four elaborate tablet borders. Its similarities with cloak A include hidden loops combined with elongations along the starting edge. Arndt's way of preparing the starting edge was again a variation of hypothesis c. Based on the current research, the use of a tubular

[3] Personal communication, 17.5.2014.

warped loom might be more probable. Finally, it should be mentioned, that green and blue dyes were found in this cloak (Arndt 2010).

8. Conclusion

The construction of the starting edge differs significantly from typical products of the warp-weighted loom. The use of a tubular warped loom and secondarily added tablet borders is suggested instead, simplifying the working process considerably. Broad tablet-woven borders were prestigious objects. Therefore, the loss of the laterally tablet-woven borders of cloak A is interpreted here as an deliberate act, cutting them off for selling or interchanging.

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15 | Die Textilien aus dem Grab des Herrn von Morken – Neubearbeitung eines alten Fundmaterials

TRACY NIEPOLD

Abstract: Das reich ausgestattete, um 600 n. Chr. datierte Kammergrab des Herrn von Morken wurde während einer Notgrabung in den 1950er Jahren innerhalb eines Separatfriedhofs auf dem Kirchberg der Ortschaft Morken, Kreis Bergheim gefunden. Aus dem ungestörten Grab konnte eine umfangreiche Beigabenausstattung sowie Textilreste *in situ* geborgen werden, die sich in einer Bronzeschale erhalten hatten. Im Rahmen einer Neuuntersuchung wurde das gesamte textile Fundmaterial erfasst, umfangreich dokumentiert und herstellungs- sowie materialtechnisch analysiert. Mit diesen Ergebnissen konnten acht verschiedene, überwiegend sehr feine und teilweise bunt gemusterte Woll- und Leinengewebe rekonstruiert werden. Der von Karl Schlabow in den 1950er Jahren erbrachte Seidennachweis ließ sich auch mit Hilfe aufwändiger Faseranalysen nicht bestätigen. Die Anordnung im Grab sowie die teilweise rekonstruierbare Stratigrafie sprechen dafür, dass die Textilien dem Herrn von Morken ebenso wie die übrige Beigabenausstattung als Statussymbole beigegeben worden sind.

Keywords: Bronzeschale mit organischen Resten, Doppelgewebe, gemusterte Gewebe, textile Grabbeigaben

1. Einleitung

Bereits in den 1950er Jahren wurde die reiche Bestattung eines Mannes, des so genannten Herrn von Morken, unterhalb der Kirche St. Martin in der Ortschaft Morken nahe der Stadt Bedburg im Rheinland aufgefunden. Das Grab des Herrn von Morken nimmt in der bisherigen textilarchäologischen Forschung eine Sonderstellung ein, da sich nicht nur eine große Anzahl textiler Reste in dem Grab erhalten hatte, sondern darunter auch nach zeitgenössischen Untersuchungsergebnissen Seide nachgewiesen werden konnte. Damit ließ sich diese Bestattung in die Reihe nachweislich sozial hoch- und höchstgestellter Personen des Frühmittelalters eingliedern. Sowohl an den Ergebnissen der Material- als auch der Textilanalysen waren in der Vergangenheit jedoch bereits Zweifel aufgetreten (Bender-Jørgensen 1992, 240). Um die in den 1950er Jahren erzielten Analyseergebnisse und die daraus hervorgehende Bedeutungsinterpretation des Herrn von Morken durch neueste Untersuchungsmethoden zu bestätigen oder zu widerlegen, sollte das gesamte organische Fundmaterial erneut untersucht und im Rahmen des Forschungsprojektes "Demografische und soziale Phänomene der Merowingerzeit in den nördlichen Rheinlanden" (Nieveler, Druck in Vorbereitung) ausgewertet werden.

2. Grabungsbefund

Während der Ausgrabungen auf dem Kirchberg von Morken wurde den Bestattungen eines maximal 23 Gräber umfassenden, fränkischen Separatfriedhofs besondere Aufmerksamkeit zuteil, der in den Bauruinen einer römischen *villa rustica* errichtet worden war (Hinz 1969). Ausgehend vom Grab des Herrn von Morken (Grab 2), das auf Grund einer beigegebenen Münze um die Wende des 6. zum 7. Jahrhundert datiert werden kann, war hier ein Teil einer fränkischen Bevölkerungsgruppe fassbar, die vermutlich durch eine besondere soziale Stellung separiert von der übrigen Bevölkerungsgruppe auf einem eigens dafür angelegten Bestattungsplatz begraben worden war. Das zu dem Separatfriedhof zugehörige, 450 m in südwestlicher Richtung entfernt gelegene Ortsgräberfeld wurde 1983 entdeckt (GÖBEL 1990). Die dort aufgefundenen 478 Bestattungen konnten vollständig geborgen werden und stehen somit als Grundlage für vergleichende Untersuchungen zu den Funden aus dem Separatfriedhof zur Verfügung. Einige metallene Grabinventare konnten auch bereits auf textile Anhaftungen hin untersucht werden (NIEVELER – STAUFFER 2011).

Auf Grund von Bodenverfärbungen ließ sich während der Ausgrabungen eine 2,20x2,90 m große hölzerne Grabkammer rekonstruieren, in der der Holzsarg des Herrn von Morken aufgestellt war. Anthropologische Untersuchungen ergaben, dass es sich bei dem Bestatteten um einen wohl genährten, 40 bis 50 Jahre alten Mann handelte, der mit 1,80 m eine beachtliche Körpergröße aufwies. Aus der Grabkammer konnte eine vollständige Waffenausstattung geborgen werden sowie ein vergoldeter Spangenhelm, eine silbertauschierte Gürtelgarnitur, verschiedene Gerätschaften, Speisebeigaben und eine große Bronzeschale (BÖHNER 1959, 12–30).

Mit der Größe der Grablege und deren Ungestörtheit stellt das Grab des Herrn von Morken den wichtigsten Grabungsbefund des fränkischen Separatfriedhofs dar. Die aus Ortsnamenforschung und Quellenstudium zu vermutende Bedeutung des Gebietes um Morken sowie die weit über den europäischen Kontinent verortbare Provenienz der Grabbeigaben legen die Vermutung nahe, dass es sich bei dem Verstorbenen um einen lokalen Funktionsträger und/oder Verwalter eines Königgutes in Morken handelte (NIEVELER, Druck in Vorbereitung).

2.1 Die organischen Reste aus dem Grab – Forschungsgeschichte

In der Erdverfüllung der Bronzeschale hatten sich durch die konservierende Wirkung des Metalls größere Mengen organischer Reste erhalten, die grabungsnah von Karl Schlabow aus dem feuchten Erdreich freipräpariert und herstellungs- sowie materialtechnisch analysiert worden sind. So konnten insgesamt 13 größere Fragmente freigelegt werden, die jeweils einen komplexen Verbund aus unterschiedlichen organischen Schichten aufweisen. Alle Fragmente wurden in den 1950er Jahren mit einem Festigungsmittel getränkt und auf Kartonplatten geklebt. Am Schalenboden hatte sich außerdem eine große Anzahl an Bruchstücken der größeren Fragmentkomplexe erhalten, die seither ungefestigt aufbewahrt worden sind.

Schlabow identifizierte insgesamt sieben verschiedene Gewebearten sowie Fragmente eines federgefüllten Kissens und Reste eines pelzartigen Lederbeutels mit Leinenfutter (SCHLABOW 1969). Für drei der Gewebearten wurde Seide als verwendetes Fasermaterial bestimmt, für die übrigen die Verwendung von Woll- und Leinenfasern. Außerdem konnten Blütenblätter, Getreidespelzen sowie grünlich verfärbtes Erdreich identifiziert werden, was auf zusätzlich in der Bronzeschale vorhandene, botanische Reste hindeutete.[1]

2.2 Neuuntersuchung

Im Rahmen der Neuuntersuchung wurde das gesamte organische Fundmaterial begutachtet und Materialbestimmungen und Gewebeanalysen durchgeführt (NIEPOLD, Druck in Vorbereitung). Durch immer wiederkehrende, charakteristische Merkmale der verschiedenen Schichten innerhalb der Fragmentkomplexe konnte eine Zuordnung zu acht verschiedenen Gewebetypen erfolgen. Außerdem wurden Reste von den Kielen gerissener Vogelfedern dokumentiert. Der von Schlabow beschriebene Lederbeutel ließ sich nicht mehr eindeutig nachweisen. Nur noch zusammenhangslose Fragmente

[1] Die Erdverfärbungen werden nur im erhaltenen Manuskript der angegebenen Publikation erwähnt. K. Schlabow: Das Grab eines fränkischen Fürsten im Rheinland. Sammlung Schlabow, Stadtarchiv Neumünster.

eines Lederriemens, Fell- und weitere Lederreste waren zu erkennen. Von der einstigen Befüllung der Bronzeschale mit botanischen Bestandteilen konnten keine Spuren mehr beobachtet werden. Lediglich größere Holzfragmente hatten sich erhalten, die jedoch mit großer Wahrscheinlichkeit von der eingestürzten Grabkammer stammen.

Die Fasermaterialien der identifizierten Gewebetypen wurden mit Hilfe des Rasterelektronenmikroskops sowie durch Anfärbereaktionen unter dem Durchlichtmikroskop bestimmt. So war in allen Fällen eine Unterscheidung zwischen tierischen oder pflanzlichen Fasern möglich. Durch den hohen Abbaugrad der Fasern sowie die Überlagerung charakteristischer Faseroberflächen durch das in den 1950er Jahren aufgetragene Festigungsmittel ließ sich jedoch keine genauere Differenzierung innerhalb der Faserstoff liefernden Pflanzen bzw. Tierarten vornehmen. Für eine eindeutige Bestätigung oder Widerlegung der von Schlabow identifizierten Seide, wurden daher an einigen Proben Aminosäureanalysen durchgeführt.

3. Erhaltene Textilien

3.1 Leinwandbindige Gewebe

Bei **Gewebetyp 1**[2] handelt es sich um ein sehr schlecht erhaltenes leinwandbindiges Gewebe. Die aus Pflanzenfasern gefertigten Webgarne beider Fadensysteme scheinen s-gedreht zu sein, wobei dies nicht auf der gesamten Breite der erhaltenen Gewebefragmente sicher festgestellt werden kann. Eine webtechnische Musterung des Gewebes ist nicht zu erkennen, die Garne sind ungefärbt. Auf Grund des schlechten Erhaltungszustandes kann die Fadenstärke und -dichte beider Fadensysteme nicht mehr bestimmt werden.

Gewebetyp 8 ist ein ebenfalls leinwandbindiges Gewebe, das eine deutlich erkennbare Spinnmusterung aufweist. Ein Spinnrichtungswechsel der Wollgarne erfolgt in einem Fadensystem (Fadensystem 1) nach jeweils fünf Fäden, im anderen (Fadensystem 2) nach jeweils sechs Fäden. Kette und Schuss lassen sich nicht mehr eindeutig zuordnen. Die Fadenstärke der ungefärbten Garne beträgt 0,2–0,3 mm, die Fadendichte 18 bzw. 28 Fäden pro cm.

3.2 Köperbindige Gewebe

Gewebetyp 2 ist ein Diamantköpergewebe auf der Basis Köper 2/2, das ehemals aus blauen (Fadensystem 1) und naturweißen (Fadensystem 2) Garnen gewebt worden ist. Der Farbeindruck ist durch das aufgetragene Festigungsmittel heute stark verfälscht (*Abb. 15.1*). An einer davon unberührten Stelle konnte jedoch die originale Farbigkeit beobachtet werden. Die Webgarne sind aus Wolle gefertigt und weisen eine Fadenstärke von 0,5 mm auf. Kette und Schuss sind nicht mehr zu bestimmen. Im

Abb. 15.1: Fragmente von Gewebetyp 2, aufgenommen bei 20-facher Vergrößerung. Deutlich sichtbar ist die starke Verschwärzung der Fäden eines Fadensystems, die die ursprüngliche, blaue Färbung überdeckt (Foto: T. Niepold).

[2] Die Nummerierung der Textiltypen basiert auf der Identifizierungsabfolge während der Bearbeitung des Fundmaterials.

Fadensystem 1 sind die Fäden z-, im Fadensystem 2 s-gedreht. Die Fadendichte beträgt 32–34 bzw. 16–18 Fäden pro cm.

Gewebetyp 3 ist ein nur noch sehr schlecht erhaltenes Gewebe auf der Basis Köper 2/2. Eine eventuell zusätzlich vorhandene Webmusterung lässt sich nicht mehr bestimmen oder ausschließen. Kette und Schuss können nicht mehr zugeordnet werden. Die Webgarne beider Fadensysteme sind aus Wolle gefertigt, z- (Fadensystem 1) bzw. s-gedreht (Fadensystem 2) und waren ursprünglich sicherlich gefärbt (rötlich?). Sie weisen Fadenstärken von 0,5–0,6 mm auf; die Fadendichten betragen 10–15 bzw. 10 Fäden pro cm.

Gewebetyp 6 ist ein köperbindiges Gewebe, vermutlich auf der Basis Köper 2/2, dessen genaue Bindungsart sich jedoch auf Grund des äußerst fragmentarischen Erhaltungszustandes nicht mehr bestimmen lässt. Die Webgarne beider Fadensysteme sind aus Pflanzenfasern gefertigt, z-gedreht und ungefärbt. Kette und Schuss sind nicht mehr zuzuordnen. Beide Fadensysteme weisen mit 0,7–1 mm einen großen Fadendurchmesser bei Fadendichten von 8–10 (Fadensystem 1) und 10–15 Fäden pro cm (Fadensystem 2) auf.

3.3 Gemusterte Gewebe

Gewebetyp 4 ist ein gestreift gemustertes Doppelgewebe in Leinwandbindung, das durch zusätzliche Musterschüsse verziert ist. Die Kettfäden des Grundgewebes sind z-gedreht und aus Wolle gefertigt, wobei ein Spinnrichtungswechsel nicht gänzlich ausgeschlossen werden kann. Die Kettfäden erscheinen heute überwiegend stark verschwärzt, so dass eine möglicherweise vorhandene Färbung nicht mehr zu erkennen ist. Die Kettfadenstärke beträgt zwischen 0,2–0,3 mm, die Fadendichte liegt bei 30–40 Fäden pro cm. Die Schussfäden bestehen aus Wollfasern und sind s- und z-gedreht. Die s-gedrehten Fäden scheinen dabei ungefärbt, die z-gedrehten Fäden stark verschwärzt, so dass von zwei unterschiedlich gefärbten Schussfäden ausgegangen werden kann. Die Schussfadenstärke liegt zwischen 0,2–0,3 mm, die Fadendichte beträgt 30 Fäden pro cm. Die Musterschüsse bestehen aus z-gedrehten Wollfäden, die zu S-Zwirnen miteinander verdreht sind und mit Fadenstärken von 0,3–0,4 mm eine große Feinheit aufweisen. An einigen Stellen ist zu erkennen, dass die Zwirne rot und gelb gefärbt waren. Für die Erzeugung des Doppelgewebes arbeiten zwei Kettsysteme unabhängig voneinander, die die auf der Vorder- und Rückseite verlaufenden Schussfäden in Leinwandbindung abbinden (*Abb. 15.2*). Eine die beiden Seiten trennende Bindekette wird nicht verwendet. Auf Grund der unterschiedlichen Farbigkeit der beiden Schussfäden und den Wechsel nach jeweils sechs bis acht Durchschüssen auf Vorder- bzw. Rückseite wird eine gestreifte Musterfläche erzeugt. Erst

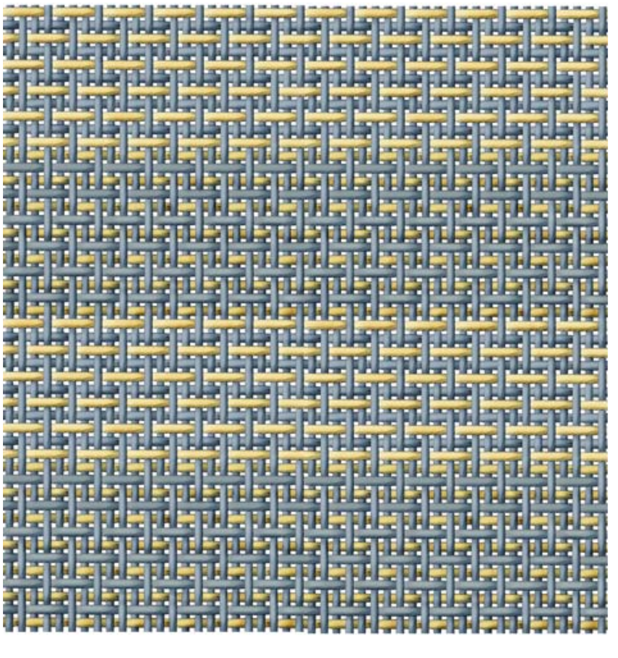

Abb. 15.2: Schematische Zeichnung der gestreift gemusterten Partie des Doppelgewebes. Durch das Fehlen einer Bindekette sowie einer fehlenden Verzahnung durch Unterschuss oder Unterkette entsteht ein Hohlgewebe. Eine flächige Verbindung der Gewebelagen wird durch den Warenwechsel hervorgerufen (Zeichnung: H. Voß, Bayerisches Landesamt für Denkmalpflege).

durch den Warenwechsel kommt es zu einer flächigen Verbindung des eigentlich hohlen Gewebes. Andere Bereiche dieses Gewebetyps sind zusätzlich mit den roten und gelben Zwirnen gemustert, wodurch ein komplexes Muster entstanden sein muss. Die Musterzwirne sind jedoch größtenteils stark abgebaut oder vollständig ausgefallen, so dass deren ursprünglicher Verlauf vor allem durch die an Ein- und Austrittstellen auseinander gedrängten Kettfäden deutlich wird (*Abb. 15.3*). Eine genaue Motivanordnung lässt sich jedoch nicht mehr rekonstruieren. Von den gestreiften Musterflächen dieses Gewebetyps haben sich Gewebekanten erhalten, an denen der geschilderte Fadenverlauf zu erkennen ist.

Abb. 15.3: Fragmente der zusätzlich gemusterten Gewebepartie von Gewebetyp 4, aufgenommen bei 30-facher Vergrößerung. Die Musterschüsse sind heute überwiegend abgebaut, so dass der ehemalige Fadenverlauf nur noch anhand der Ein- und Austrittstellen im Grundgewebe zu erkennen ist (Foto: T. Niepold).

Gewebetyp 5 ist ein mit Broschierschüssen gemustertes Gewebe mit leinwandbindigem Grund. Kett- und Schussfäden des Grundgewebes bestehen aus Pflanzenfasern und sind s-gedreht. Die Fadenstärken betragen 0,2–0,3 mm. Im Kettsystem ist eine Fadendichte von 30 Fäden pro cm zählbar. Die geringe Fragmentgröße erlaubt für das Schusssystem keine Bestimmung der Fadendichte. Die Broschierschüsse sind aus z-gedrehten Wollgarnen gefertigt und zu S-Zwirnen miteinander verdreht. Es sind zwei unterschiedliche Färbungen der Broschierschüsse zu erkennen. Die heute sichtbare rote Farbe entspricht vermutlich der ursprünglichen Farbigkeit, wohingegen die heute schwarz erscheinende Färbung vermutlich durch den Einfluss des Festigungsmittels hervorgerufen wurde. Mit großer Sicherheit haben sich die beiden Musterschüsse in ihrer Farbigkeit jedoch deutlich voneinander unterschieden. Zwischen jedem Eintrag eines Broschierschusses verläuft ein Grundschuss, was einen Mustereintrag während des Webprozesses nahelegt, eine Stickerei jedoch nicht gänzlich ausschließen kann. An den erhaltenen Gewebefragmenten sind aus kleinen Blöckchen zusammengesetzte Musterflächen zu erkennen. Ein größerer Musterzusammenhang ist jedoch nicht mehr rekonstruierbar (*Abb. 15.4*).

Abb. 15.4: Fragment von Gewebetyp 5, aufgenommen bei 20-facher Vergrößerung. In dem Ausschnitt ist eine durch die unterschiedlich gefärbten Broschierzwirne hervorgerufene, blöckchenartige Musterung des Gewebes zu erkennen (Foto: T. Niepold).

Gewebetyp 7 ist ein ebenfalls leinwandbindiges Gewebe, das durch zusätzlich eingebrachte Lancierschüsse gemustert ist. Das Grundgewebe besteht aus z-gedrehten und zu S-Zwirnen miteinander verdrehten Webgarnen aus ungefärbter Wolle mit 0,4 mm Zwirnstärke. Die Kettfadendichte beträgt 22 Fäden pro cm, die Schussfadendichte 20 Fäden pro cm. Die Lancierschüsse sind aus z-gedrehten und zu S-Zwirnen verdrehten Wollgarnen gefertigt und rot gefärbt (*Abb. 15.5*). In Musterflächen aus Dreierstreifen sind jeweils zwei Lancierschüsse gegenläufig eingetragen, wonach wiederum ein Eintrag des Grundschusses folgt. In welcher Weise die Lancierschüsse das gesamte Gewebe gemustert haben, lässt sich aus den erhaltenen Fragmenten nicht mehr rekonstruieren.

Wie aus der Beschreibung der identifizierten Gewebetypen hervorgeht, waren in keinem Fall Seidentextilien nachweisbar. Die von Schlabow als solche bestimmten Gewebe lassen sich den oben aufgeführten Untersuchungsergebnissen eindeutig zuordnen, so dass das Vorliegen von Seide im Grab des Herrn von Morken widerlegt werden muss. Einige weitere material- und herstellungstechnische Analyseergebnisse Schlabows mussten zudem korrigiert bzw. um neue Erkenntnisse ergänzt werden.

Abb. 15.5: Fragment von Gewebetyp 7, aufgenommen bei 30-facher Vergrößerung. Der Gewebegrund wurde mit gezwirnten Kett- und Schussfäden hergestellt (Foto: T. Niepold).

4. Auswertung

Auf Grund der langen Bodenlagerungszeit und der relativ starken Störung des Schaleninhaltes nach dem Einsturz der hölzernen Grabkammer lassen sich die nachvollziehbaren Schichtenabfolgen der Fragmentkomplexe nur noch bedingt in einen interpretierbaren Zusammenhang zueinander setzen. Eine allgemeingültige Schichtenabfolge ist nicht mehr zu rekonstruieren. Sicher ist jedoch, dass eine dickere Schicht der Federn direkt am Schalenboden lag und darauf Fragmente nahezu aller beschriebenen Gewebetypen haften (*Abb. 15.6*). Dieser Umstand sowie das Fehlen einer unterhalb der Federn befindlichen Gewebeschicht sprechen eindeutig gegen das Vorliegen eines federgefüllten Kissens, das Schlabow beschrieb. Lose eingestreute Federn, die vermutlich im Zusammenhang mit einem speziellen Bestattungsritus stehen, konnten vor allem von Hans-Jürgen Hundt in anderen Grabkontexten mit Organikerhaltung nachgewiesen werden (z. B. Hundt 1978, 62; 1996, 186).

Trotz der nur fragmentarisch nachvollziehbaren Stratigraphie lässt sich rekonstruieren, dass größere, zusammengefaltete Gewebebahnen in die Bronzeschale gelegt oder darüber gebreitet worden sind. Das vollständige Fehlen von Verarbeitungsspuren, wie Nähfäden, Einstichlöchern oder aber auch von Brettchengeweben, deutet zusätzlich daraufhin, dass hier ganze, unverarbeitete Gewebebahnen oder Abschnitte davon vorliegen könnten. Dieser Tatsache entsprechend scheinen damit Textilien fassbar zu sein, die als Beigaben in den Grabkontext gelangt sind.

Abb. 15.6: Fragmente der Federschicht, aufgenommen bei 20-facher Vergrößerung (Foto: T. Niepold).

Alle beschriebenen Gewebetypen weisen webtechnische Musterungen, besondere Gewebefeinheiten und/oder Färbungen auf, so dass hier wohl aufwändig herzustellende oder zu beschaffende Gewebearten vorliegen. Ebenso wie den übrigen Beigaben kann diesen Geweben sicherlich statussymbolhafter Charakter zugeschrieben werden. Dass es sich bei der in Morken nachvollziehbaren Deponierungsart offenbar um keine singuläre Erscheinung handelt, legen einzelne Vergleichsfunde aus den Gräberfeldern von Oberflacht, Lkr. Tuttlingen (Paulsen 1992, 105) und Alach, Stadt Erfurt (Farke 1990, 170) sowie aus dem Frauengrab unter dem Kölner Dom nahe (Doppelfeld 1960, 93, 106).

Doppelgewebe in Form von Taqueté- und Samitgeweben konnten in reichen merowingerzeitlichen Bestattungen bereits mehrfach nachgewiesen werden. Taquté-Gewebe haben sich beispielsweise in den Gräberfeldern von Trossingen, Lkr. Tuttlingen (Grab 58, Peek – Nowak-Böck 2010, 30–31) und (B) Berleegem, Prov. Ostflandern (Grab 111, Verhecken-Lammens *et al.* 2004, 57) erhalten. Samitgewebe konnten unter Anderem in (F) St. Denis, Paris (Grab 49, Rast-Eicher – Périn 2011, 72–73) sowie in den Gräberfeldern von Ergolding, Lkr. Landshut (Grab 244, Nowak-Böck – Bartel 2014, 81–82) oder Oberflacht (Grab 62, Streiter – Weiland 2003, 145–146) nachgewiesen werden. Für das mehrfach gemusterte Doppelgewebe aus dem Grab des Herrn von Morken fehlen hingegen bisher Vergleichsstücke. Dessen Zusammenhang mit den komplex gemusterten Seidengeweben aus nahöstlichen Webereien und seiner Bedeutung für die frühmittelalterliche, europäische Webtechnologie muss weiterhin nachgegangen werden.

Trotzdem das Vorhandensein verschiedener Seidengewebe im Grab des Herrn von Morken durch die Neuuntersuchung eindeutig widerlegt werden musste, stellen die nun festgestellten Gewebetypen die Bedeutung der Textilien für die textilarchäologische Forschung keinesfalls in Abrede. Das Grab lässt sich zwar nun nicht mehr in einer Reihe mit den reichsten Bestattungen der Merowingerzeit aufführen. Die Qualität und die jeweiligen Besonderheiten der Gewebebeigaben lassen sich jedoch gut mit dem Bild des in Morken bestatteten Mannes in Einklang bringen, das sich aus der antiquarischen Analyse der übrigen Grabbeigaben ergeben hat.

5. Summary

In the 1950s the rich burial of a man, the so called Herr von Morken, was found underneath St. Martin's church in the village of Morken in the Rhineland. Together with other grave goods, a bronze bowl was found in which several organic remains, especially textiles, were preserved. After new examination eight different types of textiles, fragments of a leather or fur bag and layers of loosely spread feathers were detected. Among the textiles, different types of tabby weave, twill weave, patterned weaves and also a double weave were identified. Even with special investigation methods like amino acid analyses, the presence of silk textiles mentioned by Karl Schlabow could not have been confirmed. Nevertheless, the textiles of the Herr von Morken are all of high quality and seem to be precious grave goods that were originally placed in the bowl.

6. Appendix

Die Untersuchung der organischen Reste aus dem Grab des Herrn von Morken wurde als Masterarbeit der Autorin an der Fachhochschule Köln, Institut für Konservierungs- und Restaurierungswissenschaft durchgeführt. Diese fand als Kooperation zwischen der Fachhochschule Köln und dem LVR-Landesmuseum Bonn im Rahmen des dortigen, durch den Landschaftsverband Rheinland finanzierten Forschungsprojektes "Demografische und soziale Phänomene der Merowingerzeit in den nördlichen Rheinlanden" statt.

Die holzanatomischen Untersuchungen wurden im September 2012 von Dr. Ursula Tegtmeier durchgeführt, Labor für Archäobotanik der Universität Köln. Die Aminosäureanalysen wurden im Dezember 2012 von Dr. Andrea Körner durchgeführt, Interactive Materials Research, DWI at RHTW Aachen University.

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16 | The Dätgen Trousers

GABRIELE ZINK – ANNE KWASPEN

Abstract: To compare the trousers of Dätgen with other excavated trousers from the first millennium AD, a new study of the pattern-cutting and the analyses of the material and weave was conducted. The reconstruction of the history of the conservation turned out to be necessary to understand the original seams. The study of the pattern cutting shows that the cut of the Dätgen trousers differs from the other wool trousers found in Northern Germany, which have a more developed cut. However, the cut of the trousers is similar to linen trousers from Egypt and Syria (6th–7th century AD). On the basis of a replica, the fit and the size of this exceptionally preserved garment was examined.

Keywords: Trousers, wool, pattern-cutting, 2/2 twill, tubular selvedge, tablet weaving

1. Introduction

The Dätgen trousers were found close to the village of Dätgen in the north of Germany. The aim of this research was to reconstruct the history of conservation treatments on these trousers, to analyse the materials, the techniques and the pattern cutting to compare these wool trousers from the 4th–6th century AD (Van der Plicht *et al.* 2004) from the collection of Schloss Gottorf with other trousers from the first millennium AD.

2. Features of trousers from the first millennium AD

Trousers are a garment that covers abdomen and legs by two connected trouser-legs.

A remarkable feature is that probably all early trousers[1] are made without side seams[2]. We may accept that their origin was a wrapped cloth and as a step towards creating trousers a vertical incision in the centre was necessary to form the two separated trouser-legs (*Fig. 16.1*). The crotch, the juncture between both legs, is decisive for the fit of a pair of trousers. To have a comfortable fit, the crotch must follow the rounding of the body (*Fig. 16.1*). The simplest way to form a crotch is the use of a separate diamond shaped piece or a derived form, folded on the diagonal before stitching it between the two trouser-legs, as can be seen on the Moscevaja Balka trousers (Ierusalimskaja 1996, 159) or the trousers from Turfan (Beck *et al*. 2014, 479).

The linen trousers found in Egypt (6th–7th century AD) have also a small insert to form a curved crotch in the front (*Fig. 16.2*). In the back the crotch is constructed in another way. A rectangular back piece, starting from the waist is stitched to the trouser-legs in such a way that it clearly forms the required rounding (*Fig. 16.2*) (Kwaspen 2013, 258).

The pairs of wool trousers from the collection of Schloss Gottorf, both pairs of Thorsberg and one of Damendorf, all date to earlier periods (1st–4th century AD), also show this back piece but they have

1 Hypothesis proved by the study of the pattern-cutting of trousers from following sites: Thorsberg (FS 3684 and FS 3685), Damendorf (KS 10924)) and Marx-Etzel, (Schlabow 1976); Noin Ula (Rudenko 1969); Turfan (Beck 2014); linen trousers from Egypt kept in the collections of Katoen Natie Antwerp, Musée du Louvre, Paris, Museum Kunst Palast, Düsseldorf and National Museum, Damascus (Kwaspen 2013).

2 Side seams are those on the outside legs of trousers.

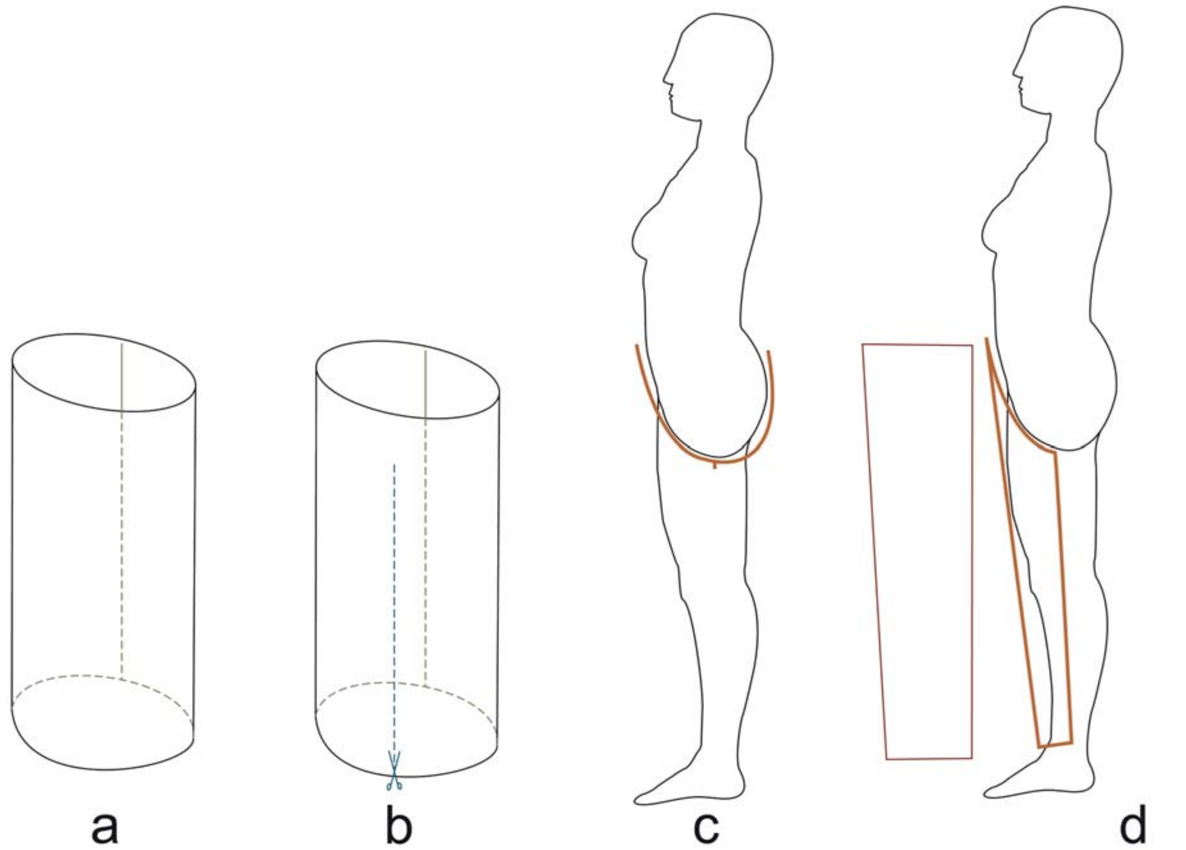

Fig. 16.1: a: wrapping of a cloth, b: incision on the front, c: cross-section of a human figure to show the rounding needed to be formed in between the legs, d: pieces that form a trouser-leg (© A. Kwaspen).

a much more advanced crotch in the front as it is formed by a curved seam (Schlabow 1976, 76–77; Farke 1994, 69–81). The most important result of a curved cut in the front is a tight fitting waist.

Another striking feature of early trousers is the opening on the calf. This feature can be found on trousers with a rectangular back-piece. Fitting of several replicas has proved the necessity of these slits on the calves (Kwaspen 2013, 260). Creating trousers with only one pattern-piece for a trouser-leg in combination with a rectangular back-piece always results in trouser-legs which are very narrow from knees towards the hem. The circumference of a person's instep-heel and calf would be too large to get into the trousers. The solution of creating wider trouser-legs to get into the lower part of the trouser-leg would result in extremely wide trouser-legs on the hips and waist. Therefore a slit is left in most trousers, starting from the hollow of the knee. The linen trousers have ribbons attached to the hem for closing and binding the trousers around the ankle while for example the wool Thorsberg trousers (F.S. 3684) has several cords along the slits to close them. Trousers constructed with only three pattern-pieces as the Moscevaja Balka trousers have wider trouser-legs due to their cut and thus do not need slits.

3. Conservation History

The modern history of the Dätgen trousers starts in late May 1906 when Hinrich Rix and Hans Dose lifted this garment accidently during peat digging. In doing so the right leg was cut off but fortunately found afterwards by further excavations. The first sketch and description was probably done by Johanna

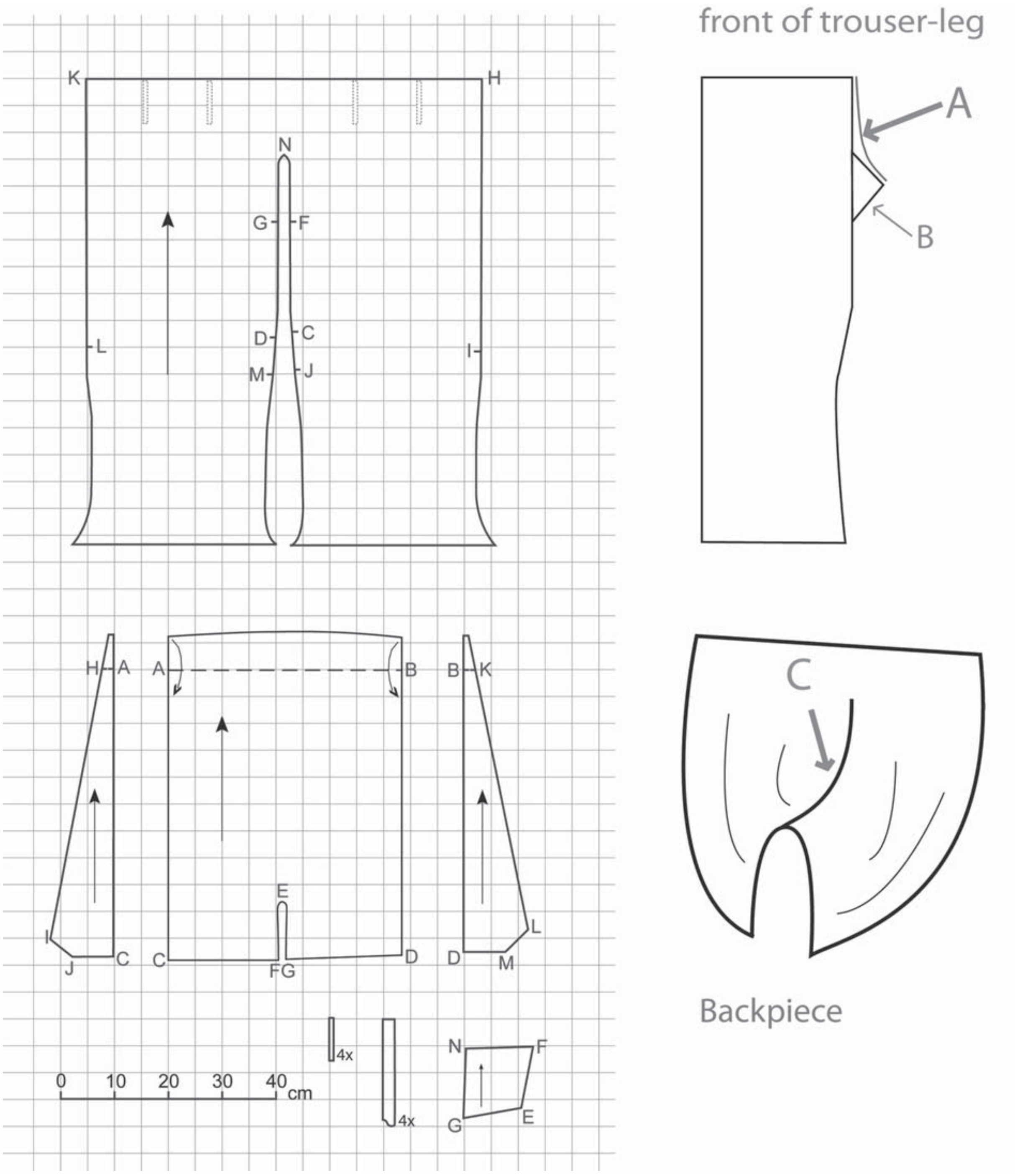

Fig. 16.2: Pattern-cutting the linen trousers (KTN 1733) of Katoen Natie, Antwerp, A: rounding formed by the diamond shaped insert on the front, B: diamond shaped insert, C: curved back-piece (© A. Kwaspen).

Mestorf, the former director of the "Museum für Altertumskunde" in Kiel, and shows the conserved object: the trousers and the cut off right leg fixed by cross stitches and couching stitches with z-plied threads from silk on a wool twill support fabric which copies the shape and the seams of the original (*Fig. 16.3*). This kind of conservation treatment was typical for most of the textiles of the museum´s

Fig. 16.3: The trousers in 2014. The white dotted lines on the right trouser-leg mark the cutting edges from lifting; left: front side, right: backside (© C. Janke, G. Zink).

collection and commissioned or perhaps practised by Mestorf herself. But the mounting of the trousers on the support fabric was not all done correctly according to the grain of the fabric. Also the centre front seam is fixed with a gap between left and right, tears are not closed, seam-allowances are fixed unfolded and the right leg is slightly twisted to the inner side of the thigh, which all affect the interpretation of the cut.

Based on his research Karl Schlabow, the former director of the "Textilmuseum Neumünster", published his technical analyses of the trousers in 1976 and states that the "pattern cutting is not a masterpiece" (SCHLABOW 1976, 78). There is no indication that he reworked the trousers. Gudrun Hildebrandt, a former textile conservator of Schloss Gottorf, was the first to reverse and undo the historic conservation stitches in the 1980s and identified a selvedge in the centre front seam for the right leg. Plied threads from white cellulosic material were probably used by her to follow the run of warp and weft. Very small stitches made by double red z-yarns were detected in small numbers close to tears on the abdomen. They are supposed to be conservation stitches, but of unknown origin.

4. Analysis of the Dätgen trousers

4.1 Materials and Weave

The Dätgen trousers are made of 2/2 wool twill, z-diagonal, 10–12 threads per cm in warp and 7–8 threads per cm in weft (*Fig. 16.4*). The use of a hard spun z-yarn, up to 1 mm thickness, in both systems results in an uneven fabric. According to Schlabow the dark brown colour is not the result of being buried

Fig. 16.4: The tablet woven finishing border with seven four-holed tablets, 1Z-1S-2Z-1S-2Z threading, and the right side of the 2/2 twill (© G. Zink).

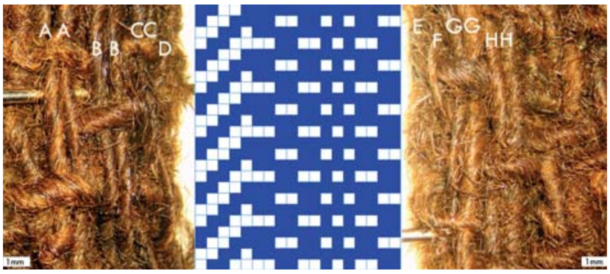

Fig. 16.5: The tubular selvedge on the slit of the hem of the left leg. The warps are marked by capital letters A to H: three double warp threads on the right side (AA, BB, CC), three single warp threads around the edge of the textile (D, E, F) and two double warp threads on the wrong side (GG, HH) (© A. Kwaspen, G. Zink).

in the bog but represents the natural colour of the wool. As dye analyses have not been carried out this hypothesis has to remain speculation.

The left edge of the back piece has a tablet-woven finishing border made with seven four-holed tablets with 1Z-1S-2Z-1S-2Z threading (*Fig. 16.4*). The wefts which continue into the ground weave as warp were cut on the back and simply twisted. Only one end knot was detected.

Schlabow mentioned a peculiar selvedge which he also detected on the cloak of Dätgen (Schlabow 1976, fig. 86a/b). He describes a special woven edge where the returning of the wefts forms a small tube (Schlabow 1976, 78). Actually this tubular selvedge is detected at two places on the front pieces of the trousers: at the top centre front edge of the right leg and on the front edge of the slit on the hem of the left trouser-leg. Three double warp threads (*Fig. 16.5: AA, BB, CC*) are grouped on the right side of the fabric, two double warp threads (*Fig 5: GG, HH*) are grouped on the wrong side of the fabric and in between – at the exact edge of the textile – three single warp threads (*Fig. 16.5: D, E, F*) form these tubular selvedges (Seiler Baldinger 1991).

4.2 The cut of the trousers

It is important to keep in mind that the cut of early trousers was known by heart and done by eye in contrast to modern tailoring where pieces are first produced on paper before cutting them out of fabric. We assume that in the first millennium the garment parts were directly cut from the fabric. Consequently, the right and left side pieces of garments are not usually mirror images of each other, but differ in size and form. This is clearly the case with the Dätgen trousers.

The Dätgen trousers are constructed from five pieces. The first drawing of their cut was published by Schlabow (1976, Fig. 188) and was later copied by Hald (1980, 333). However Schlabow's drawing, documents the pieces as they were altered during construction and in wear instead of taking account of the straight warp threads along the grain. It shows the trouser-leg pieces as two irregular shapes drawn as one piece. The new measurements, which take into account the grain of the cloth, clearly show that these trouser-legs are constructed from two simple rectangular pieces (*Fig. 16.6*). Both have more or less the same size.

The back piece, also a rectangle, is probably cut from the same fabric and has a tablet-woven finishing border on one side. This piece is turned 90°, so that the warp runs horizontal. The only irregular pieces are both inserts on the back. They are also a division of small rectangles. The upper half of the right insert is rectangular but the lower half tapers to a width of 4 cm. The top of the much smaller left insert is missing and the weave of the lower end is stretched. But the original rectangular shape is still

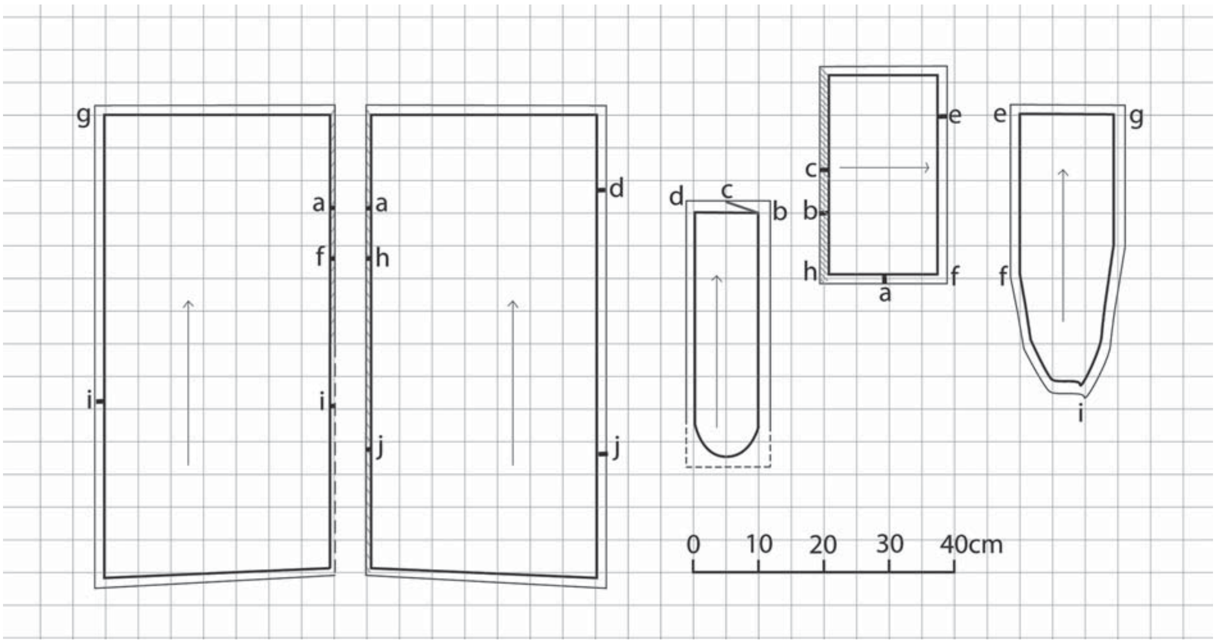

Fig. 16.6: The cut of the Dätgen trousers (© A. Kwaspen).

recognizable, only the lower 4 cm is tapered. For comparison with the pattern-cutting of other early trousers, the cut of the Dätgen trousers is most similar to the linen trousers from Egypt and Syria, with a large rectangle to form the trouser-legs, a small rectangle in the back and two side inserts (*Fig. 16.2*).

4.3 Construction of the trousers

The large rectangles forming the trouser-legs are placed with the selvedges towards each other. The direction of the twill differs since the wrong side of the fabric is used for the right leg (*Fig. 16.7*). As a first step in the construction, the upper 14 cm were sewn together. Currently the seam is open except the top corners, they are still fixed together with one stitch but it is not possible to determine the type of seam. On the right leg, the edge is formed by the tubular selvedge. The edge on the left leg is turned to the outside and flattened by whip stitches. Subsequently the two inserts are sewn on either side of the back piece where the back piece finishes 6 cm above the inserts. On the right side of the back piece the seam-allowance lies towards the insert. The lower part of this seam is a run and fell seam (*Fig. 16.9 A*) but at the upper part, the second row of stitches is missing so that it looks like a different type of seam (*Fig. 16.9 B*). The left seam of the back piece makes use of the tablet-woven finishing border. This edge is put flat on the seam-allowance of the left insert, and stitched with one row of running stitches and one row of whipped stitches (*Fig. 16.9 C*) on the lower part and only whipped stitches on the top. A strange bulge is created where the whipped stitches start. The top of the insert is missing and it probably is a repair where the back piece was stitched on to the new top edge of the insert forming this strange corner. Schlabow's statement "The seams are roughly done with plied wool yarn" cannot be confirmed. Most seams are done with two wool yarns which sometimes cross each other. On just two seams the use of a plied thread in a brighter colour was detected. The yarns for the repair appear to be the same as the yarns on the originally closed seams, so it is plausible that the repair was carried out in antiquity (*Fig. 16.8*).

Next the back parts (back piece and inserts) were sewn with a run-and-fell-seam on the trouser-legs, with the seam-allowances put towards the trouser-leg pieces, same as it was done done with the

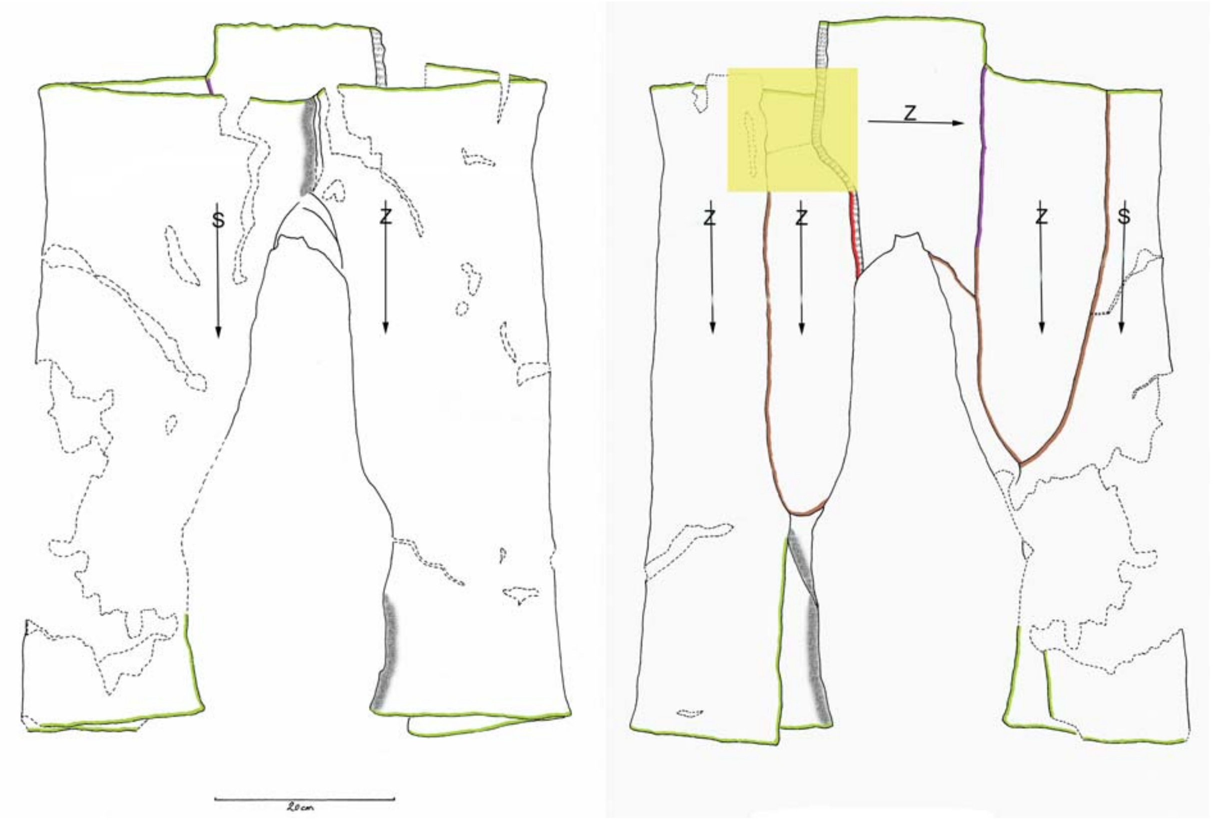

Fig. 16.7: Overview of construction (left: front side, right: backside). Brown: Fig. 16.9A, Purple: 16.9B, Red: 16.9C, Green: 16.9D, Grey: tubular selvedges, Yellow: damaged area with repair seam (Fig. 16.8) (© G. Zink).

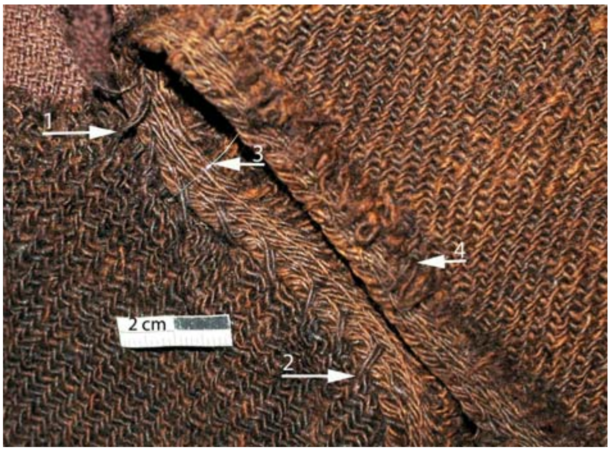

Fig. 16.8: The repair which connects the back piece (right) and the insert of the left trouser-leg (left): whipped stitches are made by two z-spun yarns (1 to 2). Details of the tablet-woven finishing border are the turning point (3) and the cut warp ends on the backside (4) (© G. Zink).

"in-between-legs"-seam. This one is closed as far as the bottom point of the inserts, where the seam-allowance again is placed towards the trouser-leg pieces.

The seams on the calves are left open and are finished with a whip-stitched rolled seam (*Fig. 16.9 D*). Some single thread loops and corresponding stitch holes are found along the edges of the slit of the left trouser-leg. Probably these are remains for closing the slits. Also all edges on waist and hems are finished with a rolled seam.

5. Replica

An accurate replica was made in wool fabric (twill 2/2, 12 threads per cm), to find out more about the fit and size of these trousers. In his book Schlabow cites the suggestion of Mestorf that

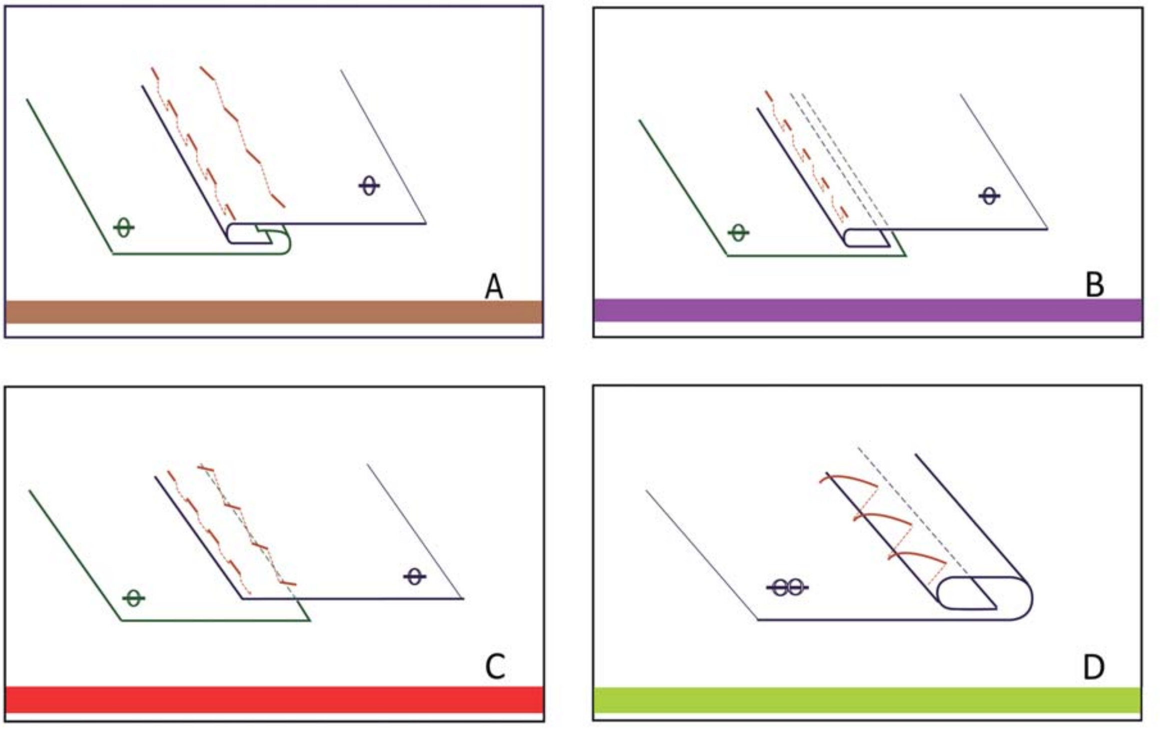

Fig. 16.9: Different types of seams used on the Dätgen trousers (© A. Kwaspen).

these trousers were women's trousers due to the fact that they are knee-breeches, but this assumption is not substantiated. Schlabow himself adds that the circumference of the waist (more than 1 m) indicates an adult wearer and that the decorative girdle which was found together with the trousers probably belonged to a woman.

It was decided to fit the replica onto different female models. Earlier experiments with trouser replicas showed that it is not the age or total height of the model but the in-between-legs length which is a good indicator. The trousers were fitted on models with an in-between-legs length of 82, 76, 73, 69 and 65 cm (*Fig. 16.10*). For most models the trousers ended on the calves, for the smallest model the trousers came almost to the ankles. The endpoint of the slits on model A was too high and on model E the endpoint was lower than the hollow of the knee.

A most striking feature is the short rise of the trousers. For all models the rise and, therefore, also the centre front height is extremely short. It is impractical for the tallest models to wear these trousers. Another finding is that the extra length of the back piece seems to have no function. Coming back to the linen examples, we see that on these trousers the extra length was used to create a tunnel for keeping a belt in place. On the Dätgen trousers no remains of stitches or stitch holes are found. Also most other early trousers have belt loops on the waist. The above comments may indicate that there is a long piece (with belt loops) missing at the waist. Experiments with a waistband stitched on the replica show that the rise is still too short for the tall models but results in much more comfortable fitting trousers for the smaller models. However no traces of any stitch holes were found to prove this, so this can only be noted as a hypothesis.

Fig. 16.10: Model A, C, E: fitting of the replica and fitting of the replica with an extra waistband (© A. Kwaspen).

6. Conclusions

The Dätgen trousers (4th–6th century AD) are one of four pairs of wool trousers that belong to the collection of Schloss Gottorf. The study of the pattern cutting proves that the cut of the Dätgen trousers differs from the three other trousers, which have a more developed cut. However, the cut of the trousers is similar to linen trousers from Egypt and Syria (6th–7th century AD).

The trousers have an extremely short rise. This fact and the lack of belt loops could point to a missing waistband. But experiments with replicas – even with an extra waistband – showed that the trousers fit a person with an in-between-legs length of approximately 70 cm best, which corresponds to the size of an average modern child of the age of 11 years.

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Chapter 4:
Medieval and Early Modern Textiles

17 | A Renaissance Woman's Silk Coif from a Copenhagen Moat

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Abstract: During metro excavations in Copenhagen in 2011–12, a Renaissance woman's silk coif was excavated. The three-piece coif is made of various layers, which have many hidden details that can offer clues about its appearance, use and repair. The specific traits can help to date the coif, but comparisons with historical sources are needed. Depictions of Danish townswomen from this period show an otherwise uniform style of headwear consisting of layers of linen (headcloth), very different from the coif excavated in Copenhagen. However, probate records of deceased townswomen from a number of Danish towns show a more nuanced use of headwear, in which local and international styles, traditional and fashionable styles were worn side by side. The international fashionable styles of headwear are usually associated with ladies of noble rank but were occasionally acquired by women of the lower classes. The silk coif is undoubtedly a fashionable type, and unique as it is the first woman's cap, possibly worn by a commoner, dating to this period found in Denmark.

Keywords: coif, Copenhagen, Renaissance, textile, fashion

1. Introduction

In 2011–2012, a new metro station was about to be built in the centre of Copenhagen at Rådhuspladsen, the City Hall Square. Before the actual construction of the station, archaeological excavations were carried out by Museum of Copenhagen, who excavated parts of the city's old rampart and moat[1]. The moat was situated along Vester Voldgade (Western Rampart Street), but in the late 1660s, due to many years of war, this old fortification was outdated and a new one built. The old moat was thus filled with rubbish from the whole city, such as kitchenware, metal objects and clothes, but also a lot of organic waste, which together with the wet conditions in the moat helped preserve more than 2000 textile fragments.

2. The coif

Among the many textile fragments is a fine silk coif (*Fig. 17.1*). It is a so-called three-piece coif, made from one centre piece and two side pieces of fabric. It originally had two straps, one on each side, but only one strap is preserved today on the right side of the coif. At the back it has eight pleats.

The coif apparently consists of five layers: the face fabric is of silk, possibly made in liseré technique with a floating weft yarn in a pattern of small ovals or hexagons (*Fig. 17.2*). It has 40/32 threads per cm and 0.1/0.4 mm thick threads of reeled silk. The textile has turned brownish as a result of burial in the slightly acid soil, but the threads were probably dyed in different colours, creating a pattern in colour as well as in the weave. No dye analyses have been made yet, so the original colours remain unknown. The second layer is a tabby-woven linen, which is very badly preserved, so that the thread count and thread thickness could not be recorded. A possible third layer is composed of thin cardboard, now completely decomposed. It is likely that this was the only original cardboard layer in the coif. The fourth layer is a silk taffeta lining of about 70/60 threads per cm and 0.1 mm thick threads. The fifth layer is also

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1 Excavation report, KBM 3827 Rådhuspladsen, Museum of Copenhagen.

Fig. 17.1: The silk coif seen from the right side, the back and the left side (photo: C. Rimstad).

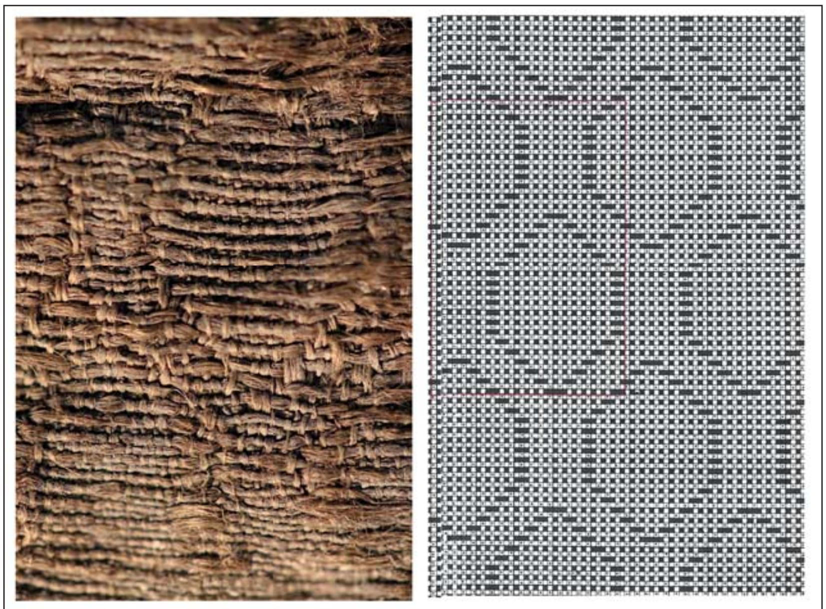

Fig. 17.2: The pattern of the face fabric (photo: C. Rimstad, pattern drawing: U. Mokdad).

cardboard and positioned along the middle part of the coif, with sewing stitches to keep it in place[2]. This made the coif look much stiffer than it is today. The linen and cardboard layers were only detected and preserved because the coif was gently cleaned after excavation and then freeze-dried.

The strap preserved on the right side of the coif is made from silk in half basket weave with 0.1 mm thick threads and about 70/60 threads per cm. It was folded in five pleats. Moreover, the coif had a fine linen bobbin lace, about 4.5 cm wide, on the front edge. This was discovered during conservation, as small linen threads from the lace were visible in the microscope and a faint imprint of the lace could be seen on the face fabric along the front section. Inside the coif, remains of silk stitches were found, probably used for fastening the bobbin lace. The microscope also showed that small remnants of copper corrosion on both sides of the coif came from two brass pins, which were originally used to fasten the coif.

2 The National Museum of Denmark's Conservation Department, report no. 10992100.

3. Interpretations and comparisons

The fine and delicate appearance of the coif suggest that it once belonged to quite a wealthy lady. However, several traits reveal that the coif was probably made from reused silk fabric or cut offs from tailoring. Firstly, the outer layer on this three-piece coif is actually made of four pieces of silk. The left side consists of two fragments, sewn together, and thus indicating that not enough silk was available to make one whole piece. The small fragment was probably deliberately attached where the bobbin lace could hide it, so no one would have noticed this construction. Secondly, the large fragment has been attached in the wrong direction, making the pattern differ from the rest of the coif. This feature has either not been very visible or perhaps not that important. Thirdly, the oddly situated cardboard layer inside the coif could have been added, when the original cardboard layer was no longer functioning. This indicates that the coif has been used over a long period of time.

The Danish costume collections, unfortunately, do not possess any similar coifs. A small silk coif[3], exhibited at the National Museum of Denmark, resembles the coif from the moat, with its pleats at the back, but the cut and silk pattern are completely different. A French silk coif in the collection of the Metropolitan Museum of Art, New York, also resembles the moat coif with a cut that is almost identical. It is has an uncertain dating to 1643–1715, which would fit well with the overall dates of the moat to 1660s. However, this coif lacks the pleats at the back and the bobbin lace is made of metal thread. In order to date the silk coif it is thus necessary to refer to other sources than the preserved ones.

4. The coif in perspective – headwear of Danish townswomen

Large Danish towns such as Copenhagen and the neighbouring towns of Malmoe, Elsinore and Elsinburg were inhabited by a very varied group of townspeople from common town dwellers to wealthy citizens.

Images of townswomen, such as epitaphs (funerary paintings) of the wealthier people of the city show a uniform style of headwear consisting of layers of linen, (head-cloths and/or linen coifs), very different from the coif excavated in Copenhagen. This style of headwear was originally just a local style worn by Danish townswomen, but with the Protestant reformation in 1536 it became part of the Danish protestant church dress (Dahl 2008). By the early 17th century it was no longer everyday dress but the civil dress of Danish bourgeois women and worn for formal and ceremonial occasions. The cut and shape of this headwear changed only slowly over the centuries it was worn, the overall style remaining the same. The excavated silk coif from the Copenhagen moat is clearly not of this type.

Probate records of Danish townspeople, on the other hand, show a much wider variety of headwear styles worn by townswomen at the time. The probate inventory was a business document in which economic values were assigned to listed items to facilitate division among heirs and assessment of estate duty. When a person died, their home would be sealed and everything of value systematically and carefully registered and taxed, and eventually divided between the heirs. Its prime purpose was to list and value all movables and immovables in the home; clothes and textiles were valuable items.

Besides the traditional linen coifs, headcloths and their fastenings, other styles of headwear such as coifs appear in this source as well. At first mainly in wealthy women's probate inventories but after 1620 most townswomen owned a good coloured coif beside their white coif of linen. Such coifs were, for instance, made from fine cloth, velvet or occasionally of silk like the excavated coif. Coloured coifs appear in blue, red, green, brown and yellow but the majority of listed coifs in the inventories were black (Dahl 2008–14).

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[3] Sct. Michael's Church, Slagelse. Inv. D926.

5. Coifs in fashion

Fig. 17.3: Portrait of Dorothea Skeel. Detail of epitaph of Danish knight Niels Skeel with family, Vinderslev church, dated 1564 (photo: C. L. Dahl).

The coif in the Renaissance was the obligatory headgear for noble ladies. Maidens (unmarried women of high rank) had the right to wear uncovered hair while the hair of married women had to be covered. The coifs had many different shapes, colours and qualities, not least because the coif marked not just marital status, but also social status. For this reason the coifs came in various qualities from extremely expensive to relatively modest.

Fashionable coifs at the time as those worn by wealthy noble women also influenced the styles of headwear worn by bourgeois women. In the 16th century a variety of silk, velvet and brocade coifs were worn, often adorned with lavish embroidery, studded with pearls gold and silver, costly ribbons and lace as well as jewellery. Such can be seen in the portrait of Dorothea, daughter of Danish knight Niels Skeel. The pattern and cut of the coif resembles the excavated coif, which, however, has no trace of exterior decoration such as pearls (*Fig. 17.3*).

The coifs of ladies from the upper stations of society could be extremely expensive. As an example, a Danish noble lady, Sophie Brahe, owned according to her account books in 1630 two precious pearl-studded coifs which together had a value of 850 rigsdaler – more than the expenses of running her entire estate for a year (Sophie Brahes Regnskabsbog, p. 43). A number of even more expensive pearl coifs appear in the trousseau of Queen Anne Catherine of Brandenberg, spouse of King Christian IV of Denmark-Norway. The trousseau from 1597 mentions a pearl-studded coif decorated with three large pieces of jewellery, two in the form of Saint George and one with diamond shields, and the entire coif decorated with diamonds, rubies, emeralds, large and small pearls. The coif was valued at 2000 daler. Another coif had large and small pearls, gold pieces, an oriental emerald, a diamond, a ruby, a sapphire and small rubies and was valued at 550 daler. All in all, the queen brought with her nine different pearl coifs and two frontispieces at a value of 7225 daler (Danish National Archive, Inventarium 1597; Dahl 2009, 57–58).

In 1576 sumptuary legislation had been passed prohibiting noble maidens from acquiring more than two precious pearl coifs for their wedding – such restrictions did not, of course, affect a queen consort (Corpus constitutionum Daniae, bd. II, 40). Not only the queen and the wealthiest ladies had pearl coifs, even burgher's wives could have them, although in more modest versions. Bodil Pedersdatter, wife of the mayor of Køge, south of Copenhagen, owned a pearl-studded coif that weighed 15 lod (Neubert 1992, 68).[4]

[4] 1 lod = 15.5 grams. 1 lod perler was, depending on the quality, valued at c. 5–15 daler, meaning the coif had a value of approximately 75–225 daler.

Fig. 17.4: Portrait of Anne Karlsdatter. Detail of epitaph of Anne Karlsdatter and her husbands, dated 1587. Ronneby Church (photo: C. L. Dahl).

Fig. 17.5: Carved female head. Detail of epitaph of Anne Karlsdatter and her husbands, dated 1587. Ronneby Church (photo: C. L. Dahl).

The headwear of townswomen was obviously more modest, only very few pearl-studded coifs are mentioned in the inventories of townswomen, for instance that of the wife of the mayor in Køge, but coifs of silk, brocade and velvet appear and occasionally decorated ones too are listed. Despite the appearance of festive wear in written accounts, images of townswomen wearing festive wear rather than civic dress are rare. An example is an epitaph of wife of an alderman from 1587, where she is shown wearing a pearl-studded coif, and a carved female head on the same epitaph wears a black coif (*Fig. 17.4* and *5*).

The style of the Copenhagen coif resembles the styles worn by noble women in the later part of the 16th century, a tight helmet-like coif with pleats at the back of the neck, also found in images of ladies' coifs of the period. The Copenhagen coif was probably outdated at the time of its disposal as it was worn out. It may have ended its days as a coif for daily wear but it was once a beautiful and elegant coif possibly worn for more festive occasions when it was new.

6. Preliminary conclusions

The silk coif was probably made of five layers, originally with two straps and decorated with bobbin lace. It was made from reused silk, scrap pieces or cut off remains from tailoring in a liseré silk fabric, which was most likely imported. Moreover, the inner cardboard layer indicates that the coif was highly appreciated and was used over a long period. Although the style of the coif resembles the style worn by noble women in the middle and later part of the 16th century, it probably belonged to a townswoman, as this type had gone out of fashion by the time it ended in the moat. However, it is of course difficult to determine whether the coif was a daily item of wear for a wealthy woman or the finest wear for a woman of lower social status. It could have been used for special occasions at first and later for everyday use, or it might have been made for everyday use from a previously elegant silk. The coif was discarded in the late 17th century, probably because it went out of fashion, as it was not otherwise worn out.

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18 | Silk liturgical garments from priests' graves, excavated in St. Nicolas parish church in Gniew

DAWID GRUPA

Abstract: Burials of Catholic priests are often characterised by slight differences to the norms obligatory for traditional burials. The priests' graves situated in a crypt and under the church floor are often positioned in the opposite direction to the rule, referring in this way the role of a priest as a shepherd of believers even after death. During excavation works conducted inside the parish church of St. Nicolas in Gniew, many burials containing fragments of silk grave garments were revealed, including remains of priests in a crypt with pieces of liturgical vestments. Two chasubles and stoles were selected for futher analysis. They were made from silk textiles together with ornamented mercery. The burials date between the 16th and 18th centuries.

Keywords: silk, ornament, clergy, parish church, liturgical vestments, burials

As early as the Middle Ages, the trade networks of towns located in the north of Poland were of crucial significance for European Hansa towns in respect of far reaching trade with the Byzantine Empire and the Middle East. One of the most precious commodities circulating between Western Europe and the Byzantine Empire was silk in both its raw and finished woven state, as a result of which many Polish trading centres gained substantial wealth. Due to the animal origin of silk and its unique properties, many textile collections have been preserved to our times and they are often exhibited in museums and churches. Silk textiles have also been recovered from archaeological excavations, which include sites in churches and Hanseatic towns.

Investigations in churches are delivering more and more information on burial ceremonies of lay and ecclesiastical grave equipment. In the course of archaeological excavations in the parish church of St. Nicolas in Gniew, many of the burials were found to contain traces of silk grave garments (*Fig. 18.1*), in particular from two burials of priests in the southern crypt, where parts of vestments were recognized. The clergy had been buried between 16th and 18th centuries. During the excavation, two chasubles and stoles made from silk textiles were identified, which preserved decorative haberdashery that matched particular parts of the vestments and ornamented the stoles. Smaller band fragments forming crosses were usually positioned at both ends of a stole.

Fig. 18.1: One of the sets of fabrics containing fragments of liturgical vestments (photo: D. Grupa).

The burials of Catholic priests were usually associated with traditional burial rites. Some of the graves situated under the church floor are oriented towards the east, reminding the congregation of the priest's role as a shepherd of believers even after his death. The parish congregation put their confessor into the grave dressed in a silk chasuble which usually had served him during his life. That was the case for both priests excavated in Gniew parish church. Fragments of the vestments were subjected to detailed laboratory analyses and research, while the remains of both priests' bodies underwent anthropological analyses at the Laboratory of Archaeological Artifacts Conservation of the Institute of Archaeology and the Anthropology Department of the Biology Faculty of NCU in Toruń.

In the past, the shape of vestments changed over time, just like trends in lay fashion. This can be observed in ecclesiastical burials and museum collections, although taking into account canon law, it took place much slower. The "fiddleback" form of a chasuble is the most usual and is a simplified form that was in use. It differs from the standard gothic chasuble, because it does not limit the movements of the priest during the liturgy. The predominance of very large chasubles of "gothic" type used before the Council of Trent 1545–1563, gave way to ones which were not so cumbersome and this tendency is mostly observed between 13th and 17th centuries. When the service was celebrated with a priest standing facing the altar, the decorative orphreys on the back of a chasuble were clearly visible. Changes in liturgy resulted also in vestments adjusting to new requirements.

The textiles at present are brown resulting from decomposition of the human remains and degradation of natural plant dyes used on the silks (Grupa 2007, 207–218; Rumiński 2008, 121–148; Szostak – Kot 2004, 165–170). Conservation treatments applied to the textiles aimed to strengthen them and obtain more elasticity, as well as to improve their physical appearance. Complex decorative bands with metal-coated threads prolonged the conservation process. In addition to conserving the vestments, some are being reconstructed for display, which will make them accessible to the public. Most of the chasubles recovered from archaeological excavations were in use for a long period of time and bear the imprint in the textiles of where decorative bands were positioned. It was also often observed that in both archaeological and various museum collections, repairs to vestments involved making extra embroideries which were intended to hide the damage, but this unfortunately resulted in further damage to the original textile. Analyses and comparative studies of these vestments will enable better conservation methods to be applied in the future.

Both vestments found in Gniew are treated as unique archaeological finds. The first chasuble, which is made of silk velvet, is preserved in a very bad condition (*Fig. 18.2*). Analyses show that it had been extensively used before it was deposited on the body in the grave. The textile surface was extremely rubbed and the pattern discernible only in the seams. The textiles forming the chasuble and stole were also destroyed as a result of the corrosion of the metal elements in the decorative haberdashery. Preserved fragments enabled the general garment sizes to be determined: the orphrey is 24 cm wide; the length of the cross arms respectively 26.5 cm and 27 cm; the length of the front of the chasuble is 98.5 cm and is shorter than the back, which is approximately 120 cm; and the arm width is approximately 15 cm.

The other chasuble is now bright brown and was made from silk damask (*Fig. 18.3*). The textile is patterned with plant ornament in a symmetrical repeat, consisting of acanthus leaves, vases and crowns surrounded by heart-shaped leaves[1]. It is in a bad condition but due to the preservation of side seams and the orphrey it is possible to reconstruct the original size of the vestment. It proved to be quite large: the orphrey is 25 cm wide and 121.5 cm long; it measures 93.5 cm at its widest; the back length is approximately 148 cm; and the arm width is approximately 12 cm.

Stoles deposited in both graves were also made from silk, but they differ from the textiles used for the chasubles. They do not appear to belong to the original sets of vestments and were specially added to emphasize the status of the priests. One of the stoles was made from dark silk velvet, that is now dark brown. It was placed together with a dark brown vestment, presumably similar in colour before it was deposited in the coffin. The ends of the stoles were finished with fringes, of which three lengths

[1] A similar pattern is described in Nahlik 1971, 41.

Fig. 18.2: Velvet chasuble after conservation (photo: D. Grupa).

Fig. 18.3: Application of the original textile on the new fabric (photo: D. Grupa).

Fig. 18.4: Reconstruction of the ornament on the basis of the original silk fabric (graph: M. Grupa).

are preserved at one end, creating a trapezoid of 16x18x13.5 cm. The opposite end possesses only fragments of tassels, 13.5 cm long. The total stole length is currently approximately 191 cm. Imprints of haberdashery in the form of crosses, 8x8 cm, are visible at the ends of the stole.

The present state of knowledge of vestments is based mainly on ecclesiastical records and donations to museum collections. However, the archaeological material adds to the political, geographical and social context, which changed over the centuries. In several cases it is impossible to identify the place of origin of the textiles for apart from trade in ready made goods, unfinished products and raw materials were also required for use in various textile workshops of Europe (*Fig. 18.4*). It is possible to suggest the origin of silk textiles, but the products of Italian or French manufacturers were very similar to one another. It also should be taken into consideration that plenty of copies were produced by migrant weavers, wandering from country to country, making the most of changing fashion trends and fiscal policy (*Fig. 18.5*).

Fig. 18.5: Close-up of the left side of damask fabric with traces of silicone adhesive (photo: D. Grupa).

Fig. 18.6: Close-up of a fragment of damask fabric under magnification (photo: D. Grupa).

According to canon law many vestments, should be made from silk. All the chasubles excavated in Gniew, Warsaw, Końskowola, Lubiń (GRUPA 1998, 277–288) and Lublin (DRĄŻKOWSKA – GRUPA 2002) were made from silk fabrics. Another fact is that they should be in prescribed colours: white, red, green, violet, pink and black. Unfortunately, the decomposition of plant dyes during deposition has deprived us of that information. Moreover, in modern times the rule was not so strictly observed. Therefore, Longin Żarnowiecki reminded people of the symbolic meaning of those six colours and their religious significance (ŻARNOWIECKI 1915, 126). The mediaeval period was marked by the use of silks bought from the market, but orphreys were embroidered with liturgical motifs, which included biblical scenes and symbols representing particular saints. As a result vestments can be more easily identified. In the Renaissance period there was a widespread impoverishment of church embroidery. Even the most expensive vestments lacked additional decoration with religious symbols (ŻARNOWIECKI 1915, 127), and instead they had ornate woven patterns – large flowers, bushes, arabesques, acanthus leaves, various geometrical-floral compositions and even architectural elements. In the Baroque period, this type of textile was used for upholstery and for clothing. The chasuble from Gniew, made of damask (*Fig. 18.6*)*,* was recognizable only on account of the orphrey. Initially it was identified as a grave gown.

Fig. 18.7: Reconstruction of the pattern (graph: M. Grupa).

The chasubles from archaeological excavations in Poland possess no signs of any embroidery so far. The back sections were often made from many small pieces, a good example of this is the vestment from Lublin. With one exception, the chasuble from Końskowola, no lining was recorded for any of them, and only in one case, the chasuble from Warsaw, a front section was identified.

As it can be observed, vestments that were worn out were put into graves as burial clothes. According to church regulations they had to be made from silk, but financial considerations were also taken into account. This is demonstrated by the burials of monks belonging to the Piarists Order from Szczuczyn, where woollen chasubles, which were prepared specially for burial purposes, were identified.

Comparing the archaeological vestments, it can be stated that they all belong to 'fiddleback' types, with the back longer than the front and various textiles were used for the ground fabric, orphreys and neck lining. They differed in pattern and colour, from what can be observed, even though they are now all shades of brown-yellow. Orphreys were made in bright colours and edges were trimmed with additional bands or laces. Similar textiles served for lining a stole and a maniple.

In the case of the burials of the two bishops Jan Trach Gniński († 1636 in Lubiń) and Michał de la Mars († 1726 in Lublin), there are no difficulties with dating the textiles as the dates of their deaths are known. However, similar information is not available for the burials in Warsaw and Końskowola. The silk from Warsaw was thick, with an elaborate pattern, while the textile from Końskowola was very thin and delicate and had a repeating stripe pattern (Grupa 2010, 93, fig. 10). Despite these differences, the textiles date to more or less the same period, i.e. the end of 17th century and first half of 18th century.

The vestments discussed in this article are part of larger project and were analyzed in order to determine manufacturing technique, type of twist and yarn composition (silk, semi silk, wool, linen), size of repeat and types of ornament (*Fig. 18.7*), the degree of textile destruction while in use and the amount of fibre degradation. More detailed discussion of the evidence will be included in a doctoral thesis, which is in preparation and covers finds of vestments from archaeological sites located in historic parish churches in Poland.

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19 | “Fossilized” Textiles

TÜNDE KASZAB-OLSCHEWSKI

Abstract: This article – as a preliminary report – deals with textile subjects which were used in the production of pipe-clay figures by craftsmen in the 15th century in the Rhine area. Many pipe-clay objects show after the firing textile shapes which are preserved in the clay. The remains enable some textile-details to be determined e.g. the weave density and type of binding. In order to understand the processes, I conducted a series of experiments with a colleague. Presented here is one figure from ´s-Hertogenbosch (NL).

Keywords: late Middle Ages, pipe-clay figures, textile traces, textiles as a work tool, Experiment, St. Catherine-figure

1. Introduction

Can textiles become fossils? I would say not really, because fossils arise from particular circumstances, when the body of an organism is not completely disintegrated after death, but parts of it are preserved in the original form or structure (LEHMANN 1996, 90–91). But there are many parallels to ichnofossils (trace fossils)! This article deals with textile subjects where shapes, or the structure of the fabric, remain intact despite the destruction of its component parts, as obtained through a metamorphosis.

2. The Research Subject

Since the first publication of the phenomenon in 1922 it is well known that medieval *“Bilddrucke”* – printed sculptures or images, i.e. some plastic figures, reliefs, pastry moulds and small-sized figures made of fired pipe-clay – sometimes show traces of textiles (KASZAB-OLSCHEWSKI 2013, 155–161). These ceramic objects have been manufactured in series by applying negative or hollow forms (moulds). The statuettes were mostly produced by using separate moulds for the front and back sides by means of a two-part mould (like antique terracotta figures or today’s Santa Claus chocolate figures). The aforementioned textile traces are either concealed inside the objects or more or less clearly visible on the front- and backsides. The creators of particular *“Bilddrucke”,* the so-called *“Bilderbäcker”* (images-baker), worked on a high artistic level and persisted successfully in the 15th century in competing with other arts and crafts producers (graphic artists, woodcarvers, etc.) (GRIMM 2013, 53–54).

Although this material forms an important source, a comprehensive study of these textile-technological aspects is still needed. My interest in the topic began in 2011, when pipe-clay reliefs with traces of textiles were discovered in Aachen (Germany) inside a pit for misfired objects of a “Bilderbäcker” (GIERTZ *et al.* 2014). In attempting to understand this subject, I found only sporadic and contradictory statements. This article also cannot provide definitive answers. It merely represents a current state of research.

2.1 The Genesis of Textile Traces

For the relevant pipe-clay artworks two phenotypes of fabric structures can be identified: positive and negative. A further method for which the lattice structure of the fabric was used to form parts of a composition or an ornament will be considered later. The negative impressions may emerge by placing the unfired clay object for example on a towel, in order to dry it. Or it is intentional by using a textile (perhaps folded into several layers) to press the unfired object, especially from the back. The textiles were used as (auxiliary) tools in order e.g. to cushion the pressure, absorb excess water or prevent clay from sticking to the hands, etc. At the end of the work the textile towel was discarded.

It is more difficult to detect the positive structures, which can be seen sometimes on the rear side of the figures and sometimes in their hollow interior. The last possibility leads to the conclusion that the textiles were left behind permanently on the inside of the clay. In my opinion this is occasionally true. Some positives are visible on the surface when a textile was used in the printing process. Perhaps – even recycled – textiles had been cut into manageable sizes and immersed in water or slip to become saturated with clay particles and water for this purpose. The traces of pinholes in "fossil" textiles that are located on the inside may indicate recycling (Grimm – Kaszab-Olschewski 2013, 344–345).

During the manufacturing process of pipe-clay figures the textiles are placed between two layers of clay or as a final layer on the backside. The clay-pastes used were prepared according to different water content and fineness (including with creamy-soft clay-texture). During the ceramic firing process, at a temperature of 800–1.000°C, the organic substance of the tissues apparently burns, because raw materials such as linen and wool are combustible (Grömer 2010, 49–52; 61–64; Farke 1986, 7–15; fire check: 21). The loss of tissue probably caused no big financial damage, because the final artistic product was significantly more expensive than the fabric used.

2.2 The Analysis of the Tracks

The semi-liquid clay lay like a tough porridge on the textile fibres or on the tissue and shrinks during the firing process. In most cases the structures of the threads are poorly preserved. Only the weave density and type of binding can be detected in describing and determining the features of the textiles commonly used. Colour analysis is impossible and conclusions about the thread rotation or warp and weft can only be determined in exceptional cases. The type of weave is primarily tabby. Trying to classify the weave density with the help of a thread counter (orientated for example as in Grömer 2010, 120, fig. 55; 2014, 16, tab. 3), showed that the upper end of the scale with 50, 70, or more threads per square centimeter cannot be determined. With densities like these, the question arises, how meaningful is the distinction between fine, very fine and extremely fine fabric in this context? For the lower end of the scale, however also a new classification had to be undertaken. This was done as a medium-fine (10–12 threads), fine (up to 20 threads) or very fine fabric (more than 20 threads). In the late Middle Ages and early modern times the weaving technique was, in contrast to the prehistoric period, so far advanced that the distinction is difficult.

3. Explanation and Experiment

But what happened inside the pipe-clay objects and why? According to theoretical considerations, and in collaboration with my colleague G.V. Grimm, in 2013 we conducted a series of experiments to help understand and interpret the processes (*Fig. 19.1* and *2*). We tried to imitate the same steps that the "Bilderbäcker" may also have undertaken – from the creation of clay forms using textiles (linen, silk, cotton) to the drying and firing of the objects. At the end we smashed the pieces to examine their interiors (Kaszab-Olschewski – Grimm 2014). As the experiment could be repeated easily under laboratory conditions, we intend to carry out tests with other fabrics too.

In our experience, the theory was confirmed that the textile inside helps to cake the individual layers of clay during the firing phase. The layers of clay sometimes differ in respect of consistency and

Fig. 19.1: Experiment: creation of clay reliefs using textile (photo: T. Kaszab-Olschewski).

material structure. The different clay-pastes with textile inserts allowed a sharper impression and prevented air bubbles in the product. By printing with textile, the force could be distributed better and was not exercised selectively. The lattice structure of the fabric also had a stabilizing effect on the product; it could be moved more easily after the surface drying of the item during removal from the mould.

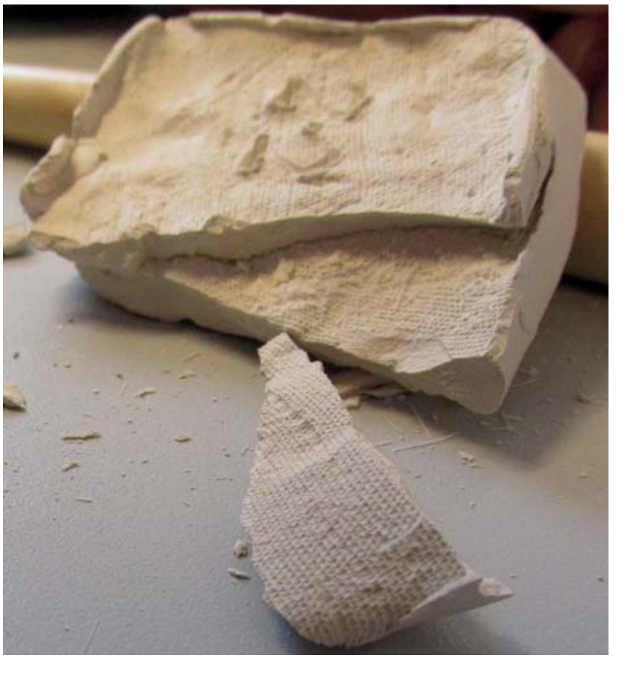

Fig. 19.2: Experiment: interior of the pipe-clay reliefs with negative traces of textiles after breakage (photo: T. Kaszab-Olschewski).

After the burning of the fibres / filaments only microscopic cavities remained, whose emergence from a technical standpoint was probably intended. The hollow figures were otherwise perforated before firing with so-called stick-holes to enable the enclosed air an opportunity to escape as steam from the clay without causing it to break. Such holes differed in size, were quite unaesthetic and conspicuous. Through the use of tissue tiny ventilation ducts were created in the figures, which made the stick-hole redundant. Contrary to my earlier assumption that a stick-

Fig. 19.3: St. Catherine from ´s-Hertogenbosch before and after conservation (photo: Restaura, Haelen).

hole and the resulting tissue caused by the use of ventilation channels cannot occur in one and the same object, there exists a St. Ursula-figure from Aachen and a St. Catherine-figure from ´s-Hertogenbosch, where both species are found. But in this case, the stick-hole is inside a relatively thick part of the relief, where no textiles had been used. So this may be reassuring especially as in this part of the image no textiles had been inlaid. Whether this phenomenon is chronologically relevant is still an open question.

The ventilation ducts or cavities resulting from the former textile threads are difficult to detect macroscopically because they can be blocked from the ashes of the textile, or by clay particles from the bottom sediment surrounding them in stratification (Kaszab-Olschewski – Grimm 2014).

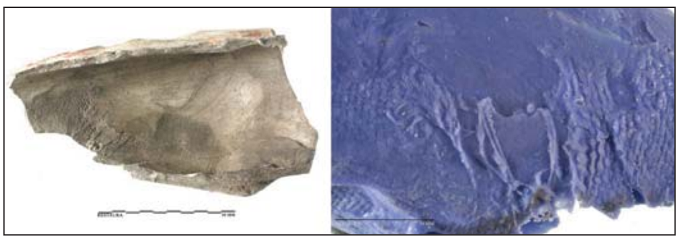

Fig. 19.4: Synthetic resin imprints from the textile (photo: Restaura, Haelen).

This type of tissue use is a technical novelty or rediscovery of the late Middle Ages. According to P. Mazare this was already a method used during the Neolithic age (Mazare 2013). She discovered positive and negative impressions in the pottery, which should increase the hardness and the resistance of the ceramics. This technique was apparently lost in the context of pottery for about 7500 years, but not in combination with gypsum or with other material, for example by Egyptian mummy portraits, or by the head of Queen Tiy´s (Teje) in the Egyptian Museum Berlin, which was covered with several layers of linen, or with mortar in wall-building (Grömer 2014, 7; Petényi 2013, 17).

4. Saint Catherine from `s-Hertogenbosch

An archeological find from an excavation in the museum quarter of the Dutch ´s-Hertogenbosch, which is today in the collection “Bouwhistorie, Archeologie en Monumenten” should be presented here (Kriele 2010). The pipe-clay statuette of St. Catherine derives from the mid-15th century (Grimm 2013, 56). The figure, which was broken into several parts, has now been conserved (*Fig. 19.3*). During conservation numerous textile traces were discovered inside (*Fig. 19.4*). These have been recorded photographically and then coated with synthetic resin. The photographs show negative and the synthetic resin (twisted) positive traces.

In 20× magnifications (*Fig. 19.5*) at a distance of 6,403 mm there are 10 threads. This means that about 16 threads per cm are recognizable. This indicates a tabby-weave fine fabric. In one case a change of the tabby weave to a twill weave can be postulated in the upper left half of the image (*Fig. 19.6*). Here mostly negative impressions of textile pieces are visible, from which the displacement of the still soft and creamy tone can be deduced. After the craftsmen regularly had distributed the clay with the help of rags, some textile pieces were left in the clay. But only a positive textile structure with S-thread rotation survived in one place (*Fig. 19.7*).

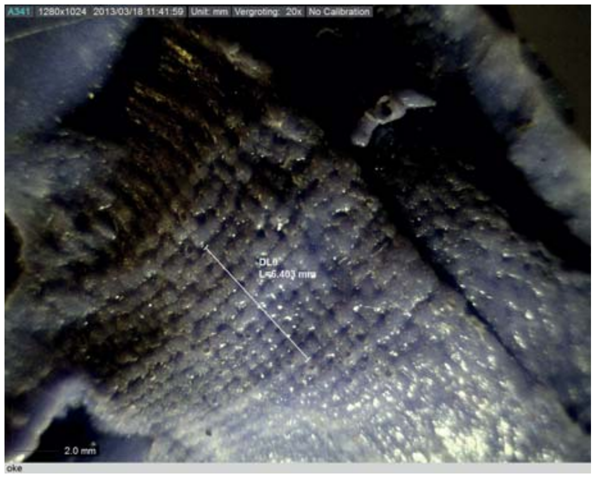

Fig. 19.5: Synthetic resin imprints from the textile (photo: Restaura, Haelen).

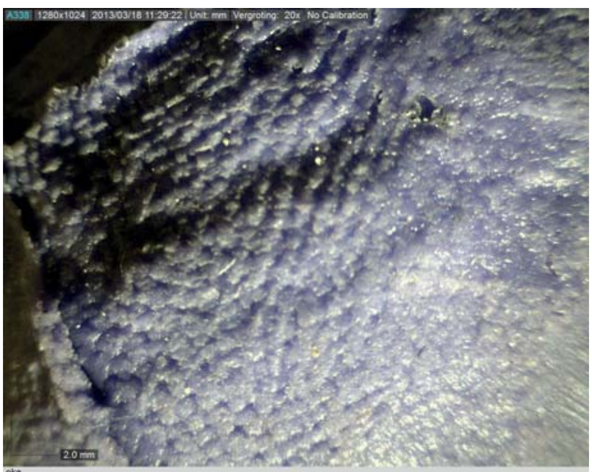

Fig. 19.6: Synthetic resin imprints from the textile with different weave structure (photo: Restaura, Haelen).

Fig. 19.7: Positive textile structures with S-thread rotation (photo: Restaura, Haelen).

Fig. 19.8: Fingerprints of the maker in synthetic resin near to textile (photo: Restaura, Haelen).

Fig. 19.9: Ornamental textile traces on the surface of the figure of St. Catherine (photo: Restaura, Haelen).

Beside the textile traces, the fingerprints of the maker repeatedly occur (*Fig. 19.8*). They reveal that the soaked clay slip fabric strips were placed upon the clay layer, and then pressed with the fingers and sometimes even blurred. This can be observed in figures from Aachen (Kaszab-Olschewski 2013, 159–160). But the figure of St. Catherine also shows the lattice structure of the fabric as an ornament on the reclining male figure (at the feet of Catherine) (*Fig. 19.9*).

5. Summary

According to recent research, the craftsmen in the late Middle Ages used textiles to assist in the manufacture of their products. Concerning the purpose of these actions based on the relevant material and experiments, the first hypotheses can be postulated. However, the study of textiles in pipe-clay figures is only just beginning. The research could be accelerated with a broader material base and better technical equipment. The data collection should be spread to other genera, for example mummy portraits, wall building and oven tiles.

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20 | Funeral dress and textiles in 17th and 19th century burials in Ostrobothnia, Finland

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Abstract: The 17th–19th century burial materials from northern Ostrobothnia are studied in order to consider the value, origin and meaning of textiles especially in child burials. The focus is on the preservation, quality and dyes of burial textiles unearthed at the yard of Oulu Cathedral as well as the clothes of the mummified bodies currently under the floors of northern Finnish churches. The materials consist of textiles of local, Swedish and central European origin. The research methods include visual and microscopic analysis, UHPLC-PDA and SEM-EDX analysis. Textiles of the naturally mummified remains of the children are studied through CT scanning images.

Keywords: Early modern funeral textiles, value, origin, dyes, funeral attire of children

This article presents recent research on the 17th and 19th century burial textiles unearthed at Oulu Cathedral in northern Finland as well as on the clothes of the mummified bodies buried under the floors of northern Finnish churches (*Fig. 20.1*). The focus is on preservation of the textiles, their quality and dyes. The burial materials from northern Ostrobothnia also offer a good opportunity to study the identities of the buried children.

1. Research methods

The research methods are non- or micro-destructive. Textile structures and fibres are studied with visual and microscopic analysis. Some wool textiles have been analysed applying UHPLC-PDA analysis (see Serrano *et al.* 2013). Mordants have been detected using SEM-EDX analysis.

Working conditions under the church floors are dusty, dark and cramped, and the documentation of the textiles is based on good quality photographs and fibre samples. Seven child coffins have been taken for Computed Tomography (CT) scanning at Oulu University Hospital (by Dr Jaakko Niinimäki, M.D.) and a number of the remains have been documented with a Dinolite portable microscope. For ethical reasons, physical contact with the coffin textiles has been avoided (on textiles on human remains see Peacock 2007). Naturally mummified remains of the children were CT scanned within their coffins, allowing detailed study of the human tissue, textiles and coffin structure.

2. Burial practices

In the territory of modern Finland, which was part of Sweden until 1809, it was customary for deceased of the highest status, such as priests, military leaders, merchants, aldermen and other burghers, to be buried under the church floors most likely from the early 13th century until 1822 (Paavola 1998, 36). Several bodies buried under the church floors have been mummified, which is caused by frost and dry and well-ventilated conditions during the Finnish winter (Núñez *et al.* 2011). At the University of Oulu, a multidisciplinary project has been launched to research the mummified bodies. The inventories aim to investigate how the cultural heritage under the floors can be better preserved and, consequently, how the parishes might create suitable conditions for prolonging the preservation of the mummified remains.

2.1 Oulu Cathedral

Altogether 317 burials have been excavated in Oulu Cathedral. Even though the majority of the burials (70%) consisted only of the remains of a coffin or human bones, in some burials a significant number of textile fragments have been preserved (c. 190). Most of the burials at Oulu are outside of the church in the graveyard (SARKKINEN 2005), and the deceased were ordinary inhabitants who could not afford burial inside the church. For this reason, compared to the materials found below the floors of rural churches, which are associated with the highest classes (church men, officers and the wealthiest peasants), the Oulu Cathedral material belongs to different social ranks.

Fig. 20.1: Map of Finland and relevant centres (graph: K. Vajanto).

2.2 St. Mikael's Church at Keminmaa

Saint Mikael's Church at Keminmaa was built during the early 16th century (Hiekkanen 1994, 227). According to archival sources, almost 100 persons were interred beneath the church between 1689 and 1784 (Paavola 1998, 77–78; 2009). During the 18th century attitudes towards burial under the floors changed. Nevertheless, sub-floor burials continued well into the 19th century as new churches were built in 1799 and 1827 (Cajanus 1927, 30; Paavola 2009). The old church was primarily used as a temporary burial place, especially for winter burials, and most of the deceased currently under the church are from the period after sub-floor church burial had fallen out of fashion (Paavola 1998, 87–88; 2009).

2.3 Haukipudas Church

The first church at Haukipudas was in use from 1640 until 1762, when a new church, the current church, was built around it. Approximately 200 deceased were buried under the floors of the Haukipudas churches (between 1689 and 1765), five of them under the new church. Local oral tradition preserves descriptions of the coffins and relates that they were opened repeatedly by curious parishioners and the textiles were handled and deteriorated significantly (Ojanlatva *et al.* 1997). Today most coffins are covered with sand and 16 coffins are visible. At least three coffins that were visible in the inventory made in 1996 were covered with wood chips and dirt and one child coffin is missing.

3. Textiles

The value of the funeral textiles, whether it was monetary or not, supposedly correlated with the social rank of the deceased. It depended on what materials were available and what the relatives could afford. The clothes of the deceased were usually not clothes made for use but parts of textiles laid over the deceased in a way that they resembled real clothes (*Fig. 20.2*).

Fig. 20.2: Light-blue silk textile arranged to look like a dress on a baby in Coffin 10 at Keminmaa (a). Detail of a roughly made cuff on the dress (b) (photo: K. Vajanto).

The value of a textile can be assessed based on its properties: fibre quality, thread thickness, density and colour. These may indicate either local or imported products, which had an effect on the monetary value of the textile. However, these do not reflect the commemorative value of the textiles, which may have been more important. It is possible that the textiles in the coffins were old sheets or other unfashionable personal textiles that held sentimental value to the deceased or the family. On the other hand, silk was recognized as the most expensive fabric available and probably indicated the importance of the deceased.

3.1 Imported and local silks and wools

Silk is the most expensive material present in the burials. It is found as parts of funerary dress, socks or caps. The silk textiles are in better condition than the wool fragments, which are mostly *nålbound* or knitted socks and fulled caps. No wool textiles have been identified in the church burials, suggesting that it was not a normal material for funeral attire or coffin interiors below the church floors.

Many of the silks are whole textiles. Despite good preservation, some micro-fractures were visible in the optical microscope. In general, textiles in church burials are in better condition because many of them have not come into contact with the soil. They are, however, at risk of mould and rodent activity. Coffin textiles offer a possibility to examine the natural decay process of textiles over time (*Fig. 20.3*).

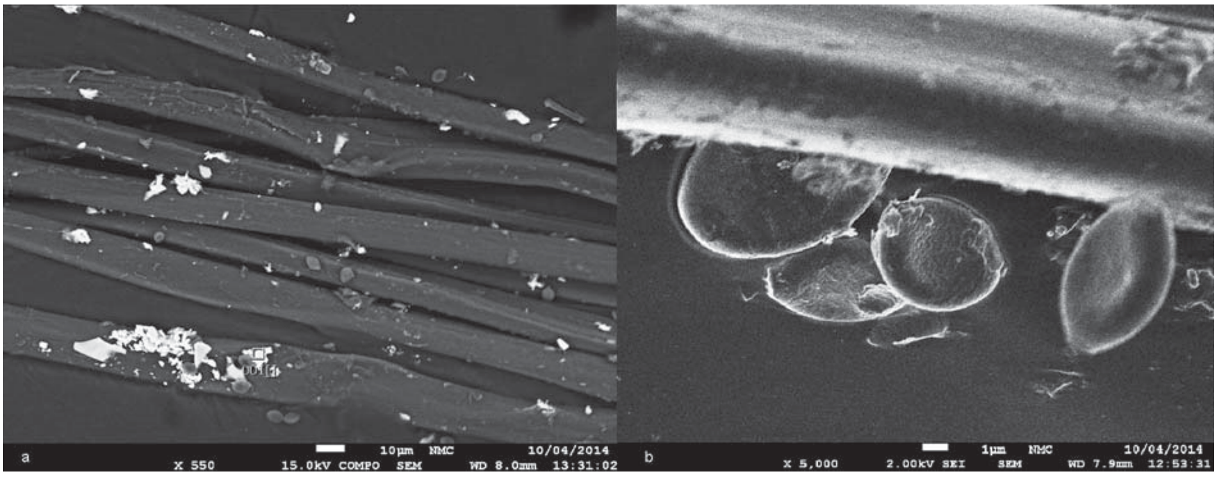

Fig. 20.3: In the fibre samples of a light-blue silk textile in Coffin 10 at Keminmaa crystallisation caused by natural decay of dyestuffs is visible both in the optical and scanning electron microscope images. According to the elemental analysis, the crystals included potassium (K) and chlorine (Cl) (a). In the sample there are also possible mould spores (b) (SEM photos: S. Lipkin).

At Oulu Cathedral, silk is the most commonly preserved textile material. However, at Haukipudas Church, only a few pieces of silk have been found. In the coffin of Isak Frosterius (son of chaplain Frosterius, d.1762 as a two-year-old) yellow silk bands are visible for around 2 cm in the cuffs. Other pieces of silk are found only in floral decorations in child coffins. At Keminmaa church fewer coffins have been studied, but in Coffin 10, a silk textile with a light-blue appearance is arranged on the child to resemble a dress (*Fig. 20.2*). SEM-EDX analysis shows that aluminium (Al) and potassium (K) were present. Since no silicon (Si) was detected, which would indicate the presence of contamination from the environment, these elements suggest alum, which was a common mordant for most natural

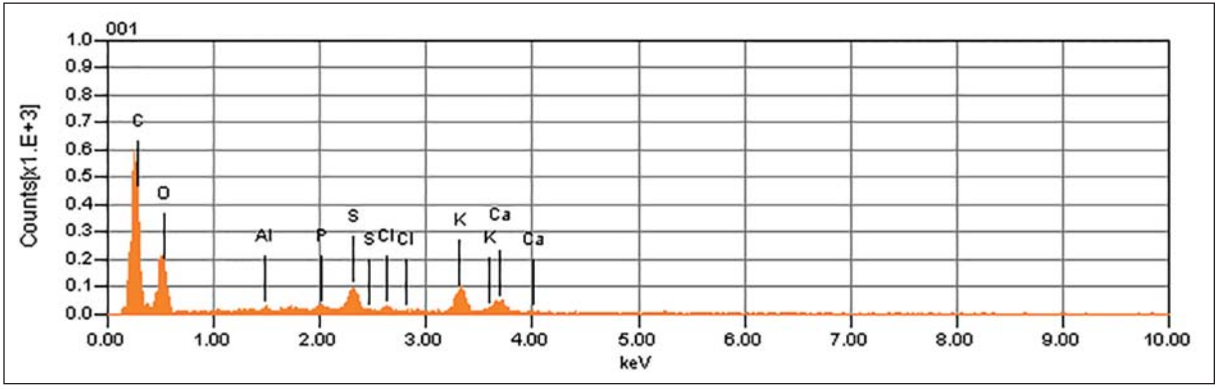

Fig. 20.4: SEM-EDX spectrum of the sample from light-blue silk textile in Coffin 10 at Keminmaa (graph: K. Vajanto).

dyes. The elements magnesium (Mg), sodium (Na) and chlorine (Cl) might imply the use of urine vat (*Fig. 20.4*). Possibly, this silk textile was dyed using both mordant and indigoid dyes, which would explain the bluish tint. The silks from Oulu Cathedral are probably of central European origin, but the 19th century silk in Coffin 10 from Keminmaa was probably made at a Swedish silk factory (for Swedish silk weaving see CISZUK 2012).

The role of Oulu as a regional centre of trade is clearly discernible. Even though the 18th-century agrarian contexts represent the wealthiest part of the community, silks are rare and found mostly as parts of accessories. At Oulu Cathedral, however, silks are fairly common, even in the contexts outside the church, i.e. in the burials which did not belong to the highest ranks of the town. At Oulu, import products are more common than in agrarian contexts. Imported textiles were brought directly to Oulu from abroad, but in 1740, due to the mercantilistic politics of Sweden, new sumptuary laws allowed only clothes made of domestic, Swedish textiles to be worn (PYLKKÄNEN 1982, 29). From then onwards, foreign textiles were brought to Northern Ostrobothnia by Russians via Arkhangelsk (LEHTINEN – SIHVO 2005, 23–29). Strict sumptuary laws regulated materials, decorations and colours of the clothes, and citizens were expected to dress according to their class even at their own funeral (MODÉE 1774, 7142–7147; PYLKKÄNEN 1982, 26–37; VAN DER WEE 2003, 452). That these regulations were obeyed is manifest in the material from Oulu, as foreign dyestuffs, including dyer's madder and woad/indigo, were detected in some woollen textiles (*Tab. 20.1a*). Some wools or broadcloths were assumed to be local products from Oulu due to coarse hairs in the fleece, while some of the others containing finer wool may be imported. Sometimes dyed and imported yarns were combined in a cloth with local yarns to raise the value of the textile products (*Tab. 20.1b*).

Evidence of the long sea trade routes of the textiles and eastern contacts are present in one exceptional, early 18th century burial at Oulu Cathedral (Grave 10). It belongs to an adult man who is wearing his better clothes. His attire includes imported, Swedish and local textiles. His breeches are made of multi-component corduroy with cotton, wool and silk fibres. The breeches and *nålbound* socks were attached with leather straps with buckles of Karelian origin. He had a wide, squirrel skin belt and another belt which held a knife and fire-making tools. His attire also included a bast fibre shirt with a silk collar and possibly a woollen bodice (LIPKIN – KUOKKANEN 2014), a piece of which is black and woven in 2/1 twill from shiny wool. Naturally pigmented black and brown fibres were found in optical microscope analysis. The wool type was defined as Hairy medium (*Tab. 20.1b*, sample 1a–b). The UHPLC-PDA analysis revealed that two woollen textiles from Grave 10 contained unidentified reddish and yellow dye compounds (*Tab. 20.1,* samples 1–2). These same compounds have been found in some

Tab. 20.1a. Results of UHPCL-PDA and SEM-EDX analyses.

Sample	Indigoids from woad or indigo shrub	Unknown reds	Antrhaquinones from Dyer's madder and/or bedstraws	SEM-EDX (JEOL JSM 7500F) detected elements
1a.	Isatin?	Red -468 nm, two red-oranges and a yellow component	-	C, O, P, S, Ca
1b.	Isatin?	Red-468 nm, three red-oranges and a yellow component	-	C, O, Fe, Mg, Al, Si, P, S, Ca, K, Cu, Alum?
2.	Isatin?	Unknown red (468 nm), three unknown red-oranges and one yellow component	-	C, O, Al, Na, Si, P, S, Ca, Ag, Cu Alum? Vat dye?
3a.	Indigotin Indirubin Isatin	-	Alizarin Purpurin (trace)	C, O, S, Al, Si, K Alum?
3b.	Indigotin (trace)	-	Alizarin Purpurin	C, O, S, P, Al, Si, Ca Alum?
4a.	Indigotin (trace)	-	-	C, O, Al, Si, P, S, K Alum?
4b.		-	Alizarin (trace) Purpurin (trace)	C, O, Fe, P, Si, Al, S, K Alum?

Tab. 20.1b. Results of fibre analysis.

Sample	Wool type	Count of fibres (100%)	Medullated (100%)	Pigmented (100%)	Mean (µm)	Mode (µm)	Median	Variance	Standard deviation
1a.	GM/HM, Local?	51	24	98	41.31	30	37	259	16.08
1b.	GM/HM Local?	61	10	95	33.64	26	30	145	12.05
2.	GM/HM Local?	56	5	21	29.13	30	26	142	11.90
3a.	SF Imported?	68	0	0	24.59	28	25	37	6.09
3b.	F Imported?	60	0	0	21.45	24	21	20	4.45
4a.	GM/HM Local?	65	12	2	32.12	26	26	251	15.84
4b.	F Imported?	63	0	0	17.76	14	17	27	5.16

Samples:
Oulu Cathedral, Grave 10 (PPM12161:47), male
Possible bodice, spin direction s/z, thread thickness 0.8/1 mm, 2/1 twill, 8/8 threads/cm
1a: warp
1b: weft
Sock, nålbound with Finnish stitch, spin direction s, thread thickness 1 mm
2: stitching yarn
Oulu Cathedral Grave 66 (PPM 12161:181), male?
Striped textile, spin direction z, weft with two parallel beige yarns and one reddish, warp yarns are white, 9/5 threads/cm
3a: beige yarn
3b: reddish yarn
Oulu Cathedral, Grave 104 (PPM 12161: 246), adult
Shepherd's check twill, spin directions z/z, 7/7 threads/cm
4a: beige yarn
4b: brown yarn

Finnish Late Iron Age textiles, suggesting a local dye source (van Bommel 2013; Vajanto – van Bommel, forthcoming). The SEM-EDX analysis revealed possible alum (Al+K) in the reddish dye, which indicates a mordant dye. Isatin was detected in all samples, but because no other indigoids were found, the presence of indigoid dye is uncertain. However, the SEM-EDX analysis detected sodium

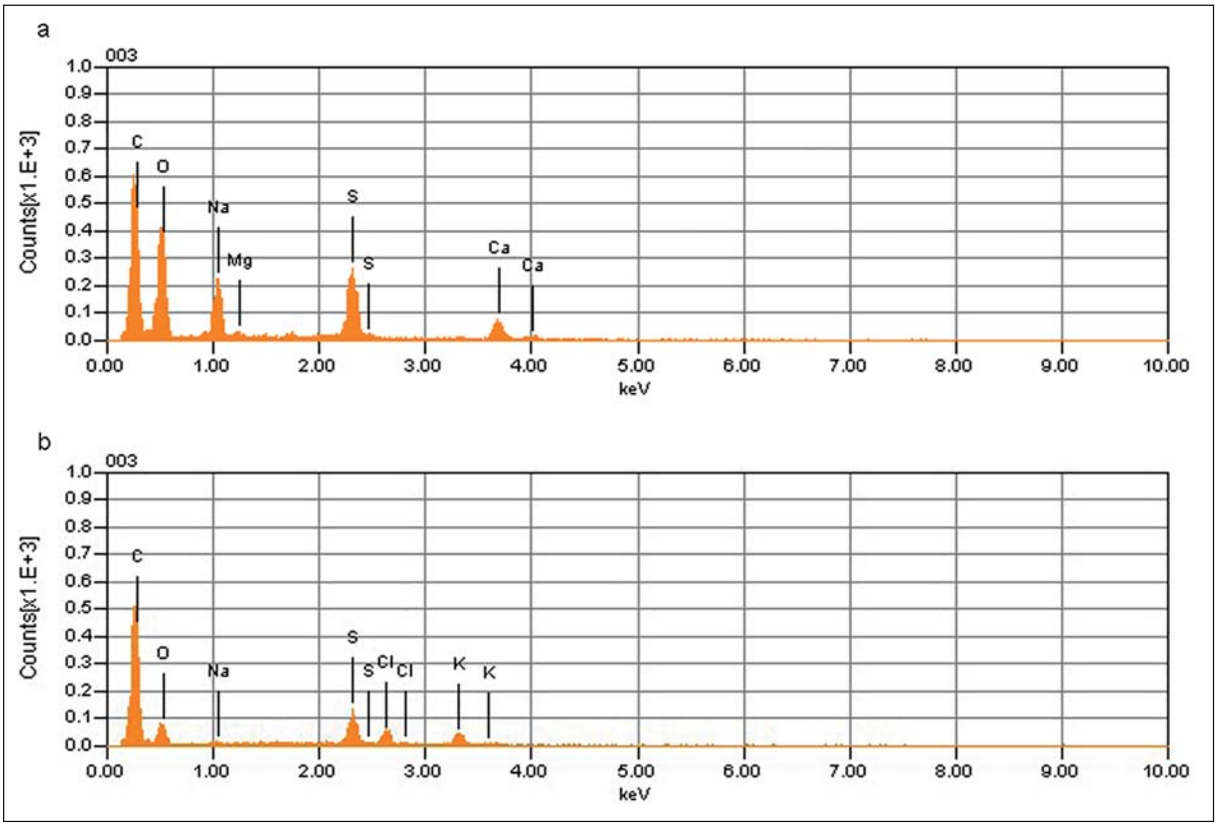

Fig. 20.5: Element spectra of the wool reference dyed with fresh woad leaves in urine vat using wood ash lye as alkaline substrate. Measurement time was 50 seconds, acceleration voltage 15 KeV and emission current 10mA. Sample was coated with carbon (graph: K. Vajanto).

(Na) and magnesium (Mg) in the *nålbound* textile, suggesting dyeing in a urine vat (*Tab. 20.1a,* sample 2, *Fig. 20.5*).

3.2 Plant fibre textiles

Because of the acidic conditions of the Finnish soil, plant fibre textiles are in considerably poorer condition than wool and silk textiles. At Turku Cathedral (south-western Finland), linen started to displace silk as a material for funeral garments at the beginning of the 18th century (Pylkkänen 1955, 29). There are only a few textiles identified as being made of, or including, plant fibres at Oulu Cathedral, and it is likely that those burials at Oulu with no textile remains (70%) originally contained plant fibre garments (Lipkin – Kuokkanen 2014, 41). This is supported by the sub-floor church burials, where bast and cotton are the most common types of fibre.

Generally, plant fibres are well preserved in the sub-floor church burials, but occasionally they are extremely fragmentary. This may be related to the season of interment. Those individuals buried during summer have probably not become mummified, and the preservation of their textiles is similar to those unearthed in other archaeological contexts. There are, however, at least two exceptions at Keminmaa: the remains of vicar Nikolaus Rungius (c. 1560–1629) are well preserved, though his clothes have mostly decayed (*Fig. 20.6* and *7*). Johan Herva, who is identified by means of a name plate, presumably

Fig. 20.6: Mummified remains of vicar Nikolaus Rungius (c. 1560–1629) at Keminmaa. He is probably Finland's best known mummy for his words: "If what I have said is not true, my body will decay, but if it is true, it will never decay" (photo: S. Lipkin).

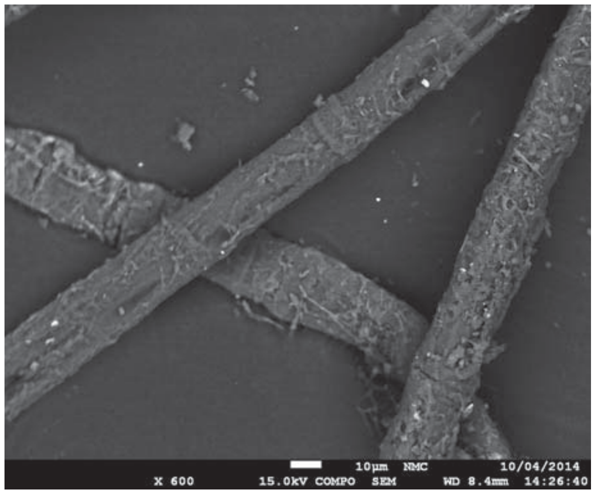

Fig. 20.7: Flax fibres from the sock of vicar Rungius pictured with SEM using backscattering detector and COMPO mode. Dislocations, cross-markings and S-oriented fibrils visible (SEM photo: K. Vajanto).

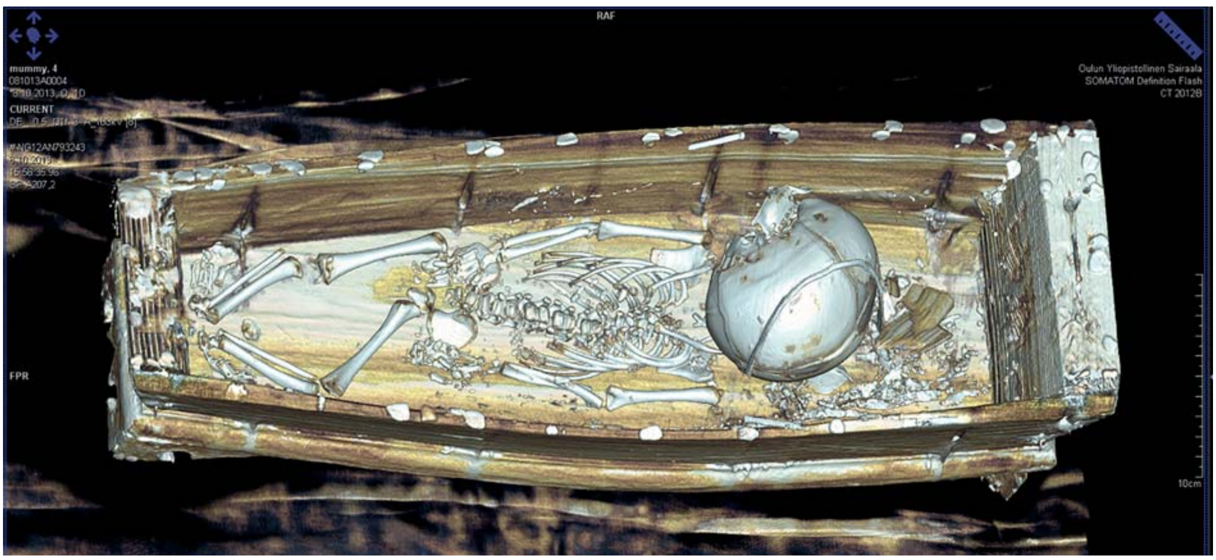

Fig. 20.8: Needles and sealing wax can be seen on the edges of the coffin in the CT-scan image of Coffin 20 (Mummy 4) at Keminmaa. Window width and length for imaging density were chosen for rendering metals, bones and other dense materials (image: J. Niinimäki).

died in April 1845. Cold conditions mummified his remains, but did not preserve his clothes. It is possible that poor preservation is connected to the mummification process and the chemicals resulting from the decomposition of human remains.

Plant fibre textiles were used to cover the coffin mattress, which was made of birch bark and coarse flax fibres. This is usually attached to the edges of the coffin with red sealing wax (*Fig. 20.8*). Plant fibres were also used for the pillow, as well as for attaching the funeral dress to the mattress cover. Needles and rough stitches are used in modelling the clothes on the deceased (*Fig. 20.3, 8* and *9*).

These features have been studied both directly (when the coffins were open) and from the CT-scan images of the coffins. The CT scans have proved to be useful in documenting the textiles without disturbing the burial by opening the coffins. CT-scanned material can be observed according to differences in densities, which allows separating different materials for study. *Fig. 20.10* illustrates that window length and width can be adjusted to image a denser textile (a) and a lighter one (b). Decorations can also be imaged, such examples are the embellishment of the cap of the body in Coffin 10 and the edge of the pillow case (*Fig. 20.11*). CT scans can also account for seeds that are extraneous due to recent rodent activity.

Fig. 20.9: A headdress and three needles attaching the cloth on the chest of Mummy 2 at Keminmaa. This coffin was not opened and all information about the human remains as well as textiles and coffin construction was gained from the CT scans. Note a steel wire bundle on the right side beside the head: it was the base of a flower arrangement (image: S. Niinimäki).

4. Mourning for children in early-modern Ostrobothnia

In the past it was not unusual for children to die from diarrhoea or diseases that are nowadays vaccinated against. One common factor in pre-modern societies was high child mortality; 40% or even a higher percentage of the children died before the age of four (Turpeinen 1979). In Finland, child mortality varied from year to year, depending on epidemics (*Tab. 20.2*). This tended to decline, especially after 1880.

High child mortality must have affected the perception of childhood and burial habits. The mourning of dead children is not often described in written sources, but Sara Wacklin (a writer who described life in Northern Ostrobothnia at the turn of the 19th century, 1844, 9) gives us an example of the way a grieving mother mourns: “by the coffin of her dead child she represses her pain and thanks God, who had

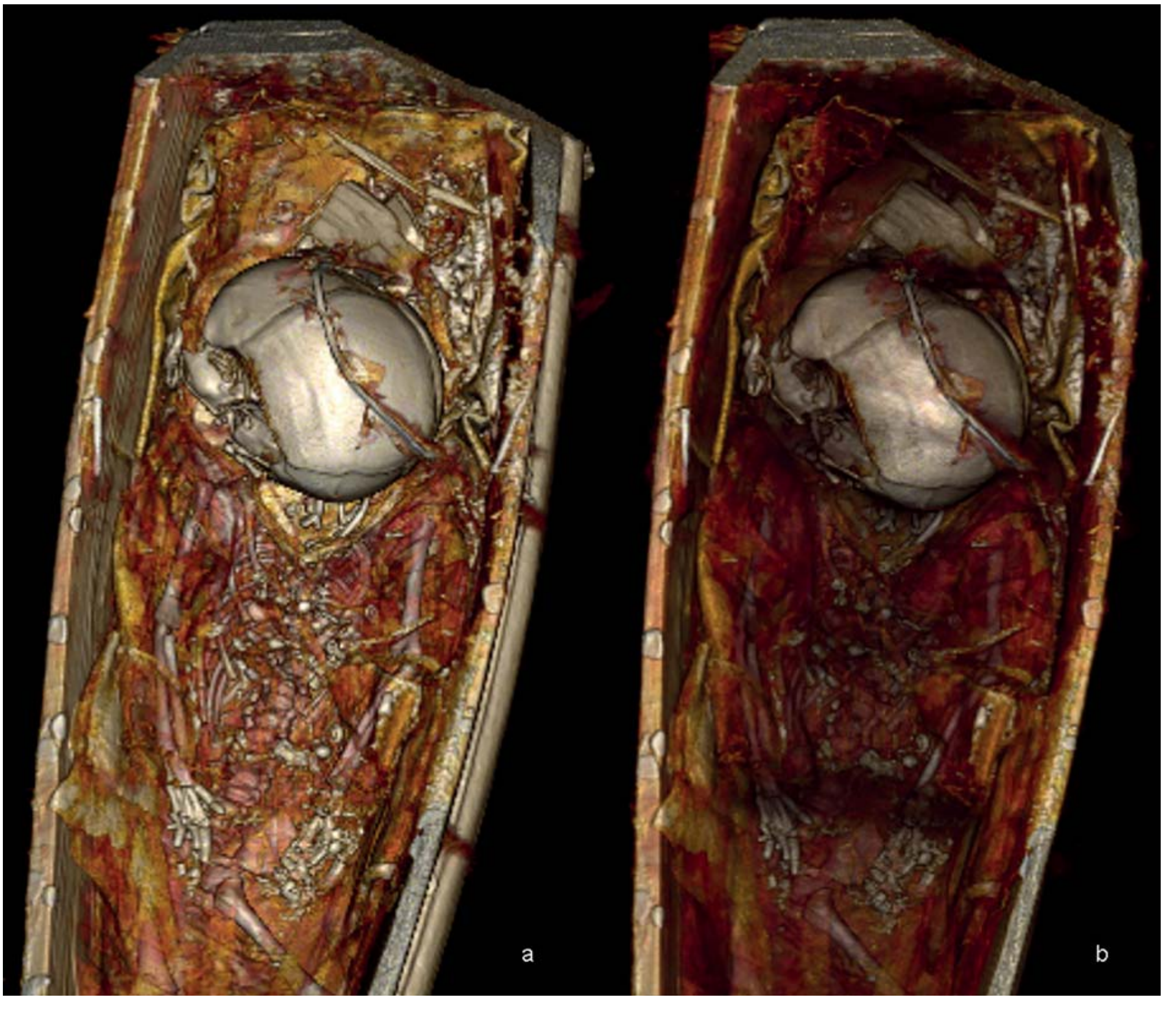

Fig. 20.10: Window length and width adjusted to render different densities of fabric in the funeral attire of Mummy 4 (Coffin 20) at Keminmaa: denser on the left (a) and lighter on the right (b) (image: S. Niinimäki)

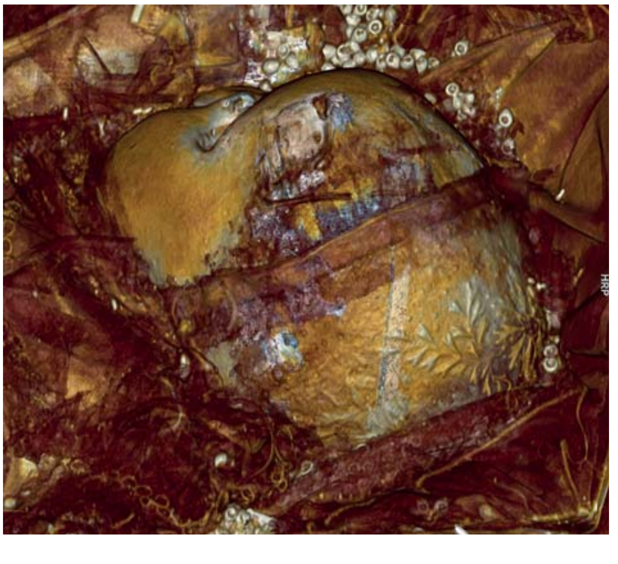

Fig. 20.11: Decoration of the cap as well as edge of the pillow case seen as loops below the neck of the deceased in Coffin 10 at Keminmaa. White particles are seeds extraneous and brought by recent rodent activity (image: J. Niinimäki).

mercy to take the child away from this miserable land". Wacklin also says that the old saying of the women was: "If only I had had mercy to die as a three-night-old, vanish in swaddles." Even children who died prematurely were buried in the old Keminmaa church (mummies 3 and 4 at foetal weeks 38–40 and 36–38, respectively).

Tab. 20.2. Child mortality rates in Finland 1751–1925 (after Turpeinen 1979, Table 1).

Years	Infant (%)	1–2/3–4/0–4 years (%)	Total mortality 0–4 years (%)	Total mortality of the population (%)
1751*–1775	23	17	40	3
1776–1800	21	18	39	3
1801–1825	21	19	40	3
1826–1850	19	16	35	2.5
1851–1875	19	20	39	4
1876–1900	15	13	28	2
1901–1925**	11	8	19	2

**1751: mortality of the children under 4 years of age is 33.6%.*
***1925: mortality of the children under 4 years of age is 13.1%.*
Two peak years: 1808 under-4-year-mortality is 73.9 %, the total mortality of the population is 6.2%, 1868 under-4-year-mortality is 81.3%, the total mortality of the population is 7.8%.

Children were buried according to their family status – they are listed in church records after their father's name and profession – but it has been noted recently that children received more valuable textiles and more elaborate accessories, such as flower crowns, than adults (Lipkin – Kuokkanen 2014, 44). This is probably a manifestation of a local habit in which the making of funerary adornments for dead children was a pleasant social event arranged by a virgin godmother (Wacklin 1844, 81–82). For the decorations, old dress parts of silk, metal wire and wool threads were used (*Fig. 20.12*).

Fig. 20.12: Flower bouquet in a hand of a baby, possibly Isak Frosterius's sister who died in 1763 as a one-day-old child (photo: S. Lipkin).

In some cases, the gender of the mummified children has been identified based on soft tissues, and occasionally the name of the child is written in the coffin. This has provided an opportunity to analyse the differences between boys and girls when sex could not otherwise be determined from the remains. More coffins need to be studied, but so far the only difference seems to be the flower bouquets in a girl's hands (*Fig. 20.12*). Otherwise, boys and girls seem to have had similar funeral attire.

5. Final words

The funeral materials from early-modern northern Finland are varied and well preserved. However, we are working against natural and human-influenced decay. The necessary documentation needs to be carried out as soon as possible, and better conditions for the preservation of many sub-floor burials need to be created. New methodologies, including CT scanning and SEM-EDX analysis, are aimed at the study of the current state of the textiles and possible requirements for their better preservation, but they also enable research to be undertaken from theoretical starting points.

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Utdrag utur alle ifrån 1764 års slut utkomne publique handlingar, placater, förordningar, resolutioner och publicationer, som riksens styrsel samt inwårtes hushållning och författningar i gemen, jämwål och Stockholms stad i synnerhet angå; med ett fullkomligt ordregisteröfwer des innehåll [...] åttonde delen, til 1767 års slut. Griefing, Stockholm.

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21 | "He is of no account … if he have not a velvet or taffeta hat": A survey of sixteenth century knitted caps

JANE MALCOLM-DAVIES – HILARY DAVIDSON

Abstract: A preliminary study of more than 100 knitted caps worn by ordinary men in the 16th century identified six broad categories in terms of style. Many of the items were discovered in early 20th century London excavations but others come from far flung locations across Europe. The caps show remarkable similarities in the materials and methods of construction. The Museum of London has responded to this by making a significant proportion of relevant data, including high quality digital images, available online.

Keywords: knitting, headwear, hat, cap, typology, construction

1. Introduction: background to the research

There is an increasing demand for information about ordinary people's clothing in the early modern period both for experimental archaeological research and pedagogical projects. The primary aim of the project reported here was to survey extant 16th century caps in European collections to determine typical characteristics with a view to producing instructions for accurate reconstruction (Malcolm-Davies – Mikhaila, forthcoming). The second aim was to facilitate access to the evidence available about the sixteenth-century knitted caps at the Museum of London, which received increasing numbers of enquiries from people keen to reproduce accurate headwear for costumed interpretation projects. This aim also intended to satisfy the museum's targets for collections digitisation (Ross 2014).

There are relatively few extant garments from the sixteenth century and many have been well researched and reported (for example, Arnold 1985, 1988 and 2008). Most items originate from élite society (Aneer 2008, 103) and tend to belong to dress collections. This paper presents new insights into the largely overlooked and surprising number of extant examples of knitted caps, worn by lower and middle class men, found and conserved in archaeological contexts. This project draws new conclusions from these objects by using modern methods of collaborative investigation to draw together disparate data.

2. Literature review

For the purposes of this paper, hat is a generic term, whereas bonnet, cap and night cap are specific types of headgear (Hayward 2002, 1). Bonnets were often made of woven fabric or felt (fur and/or raw wool), pieced or shaped to make a hat. Night-caps were usually made of linen, frequently embroidered, as represented in a miniature of Henry Fitzroy dated circa 1533/4 in the Royal Collection. "Wool was also used for daywear by the middling and lower ranks of society" (Hayward 2002, 2–3). It seems that such caps were knitted, although the "cap of maintenance", a specific form of sixteenth century headwear awarded to some appointed officials of the crown, was made of fabric (Devitt 2007). Tudor people seemed to regard knitted caps as suitable for, and indicative of, lower rank: "He is of no account or estimation amongst men, if he have not a velvet or taffeta hat" (Stubbes, quoted in Hayward 2002, 2). Despite its lowly status, Henry VIII did not eschew the cap completely. He ordered one cap in 1516/17 and another in 1523/25 along with the 54 hats and 49 bonnets during the accounting years from 1510 to 1545 (HAYWARD 2002, 97). Henry's reign saw the knitted cap become a fashionable youthful accessory, according to John Stowe in his 1565 *Chronicles:* "the youthful citizens also took them to the new fashion of flat caps, knit of woollen yarn black" (quoted in LEVEY 1982, 34).

The knitted cap seems to have been a ubiquitous item of headwear. A Basque seaman of the sixteenth century had a woollen cap with a natural white lining (WALTON1987, 3). Amsterdam crossbow makers in 1533 too crowded sported caps with the tell-tale tufts at the crown centre which suggest knitting (*De Braspenningmaaltijd* by Cornelis Anthonisz, Amsterdam Museum, inventory no: SA7279), and two woman are depicted wearing what are probably knitted caps atop their linen headwear in *The field of the cloth of gold* by an unknown artist (undated, Royal Collection, Hampton Court Palace, London).

There is very little published material on sixteenth-century knitted caps, although seven extant examples have been studied in some detail, mostly by conservators preparing the caps for display (BOTICELLO 2003; FLURY-LEMBERG 1988, 328–333, 222–231; LAND 2005, 31–35). There are no known written accounts of how early modern caps were made, despite clues as to some of the processes involved (BUCKLAND 2008/9; THIRSK 2003). An English statute of 1571 lists fifteen specialists involved in "capping": carders, knitters, parters of wool, forcers, thickers, dressers, walkers, dyers, buttelers, shearers, pressers, edgers, liners, bandmakers and "other exercises" (*For the continuance of the making of caps ...* 1571, quoted in BUCKLAND 2008/9, 41). Some of these processes may be safely assumed, such as carding and knitting, but others remain unclear. It is noteworthy too that essential stages in the preparation of the fleece, such as spinning, are omitted. Knitting instructions do not appear to have been circulated until much later eras and it has been assumed that most cappers learned their trade by eye and experience (BUCKLAND 2009). Previously published reconstructions of early modern caps include one based on a late seventeenth-century cap at Gunnister in the Shetland Islands (CHRISTIANSEN – HAMMARLUND 2013), a cap more closely dated to circa 1577/1600 from Groningen, The Netherlands (ZIMMERMAN 2000), a shipwrecked Croatian example (CURIOUS FRAU 2009), and another more loosely based on two caps at the Metropolitan Museum, New York (MERRILL *et al.* 1990).

3. Methodology

All the caps were observed with the naked eye and under very basic analogue magnification, measurements taken, photographic records compiled and the provenance details logged. Those at the Museum of London were the focus of further scrutiny as the data specification for online publication became apparent. There are fifty-seven relevant items at the museum, which all came from early urban building excavations in the City of London. They represent a well-preserved but unglamorous specimen collection (sadly without detailed provenance) which reveals a range of production techniques, yarns, colours, finishing quality, and knitting tensions. Comparison with other extant examples provided guidance on construction, typical features and techniques from which a typology was deduced.

4. Findings

A total of 143 items was examined: there were eighty-six caps, and twenty-four linings and partial linings. In addition, there were twenty-six cheek pieces (nineteen of which are no longer attached to caps), and seven cap fragments. This is sufficient to make some general observations about knitted caps in the sixteenth century. Some show evidence of having been dyed but without chemical analysis it is impossible to know how they appeared originally. The colours are remarkably consistent for many of the caps given the different conditions in which they were found. The Munsell colour system was used to record the various hues of brown observable in thirty-seven of the Museum of London's caps and linings. The majority (68 percent) are 10YR (dark browns), a noteworthy minority (19 percent) are 10R (light browns), and a few (11 percent) are 2.5YR (red browns). The Munsell system is based on soil colour values and allows for more precise recording than reported here (such as the lightness and purity of the colour), which may prove useful if further research such as dye analysis is undertaken in the future.

Close examination of the caps produced a list of typical features in terms of shapes and construction techniques, and some atypical features, such as tabbed brims, slashings and ribbons threaded through the knitting. Vocabulary presents a challenge in describing the typical features of early modern caps. Historical terms such as "turf" for the brim are not very helpful as they are unfamiliar to most dress historians and knitters. However, defining the various sections of a cap was essential for useful collaborative investigation. Terms such as crown (for the uppermost surface of the cap on top of the wearer's head) remained, while brim (for the various sections which project from the head circumference) was supplemented by "under brim" for the surface of a horizontal brim facing down and "over brim" for the surface of a horizontal brim facing up. All terms referred to the orientation of a cap in wear (*Fig. 21.1*).

The general condition of the caps shows their hard use in wear before reaching their sixteenth-century resting places. Crown diameters and head circumference measurements suggest the caps were mostly for adult men and a few for boys. The caps were knitted in the round in plain (not purl) stitches on four or five needles. The stitches-per-inch (SPI) counts vary considerably but cap crowns are usually finer than linings, a subtlety which is not apparent from the averages. The other crucial measurement is rows per inch. This data is still being collated. Other interesting features are cut, cast-off and sewn edges – sometimes all on the same cap. The cut edges show no evidence of unraveling, probably because fulling or felting processes stabilised the stitches. A feature confirming the idiosyncrasy of individual knitting is the random increase or decrease of stitches. The yarn in most cases is very tightly S or Z spun

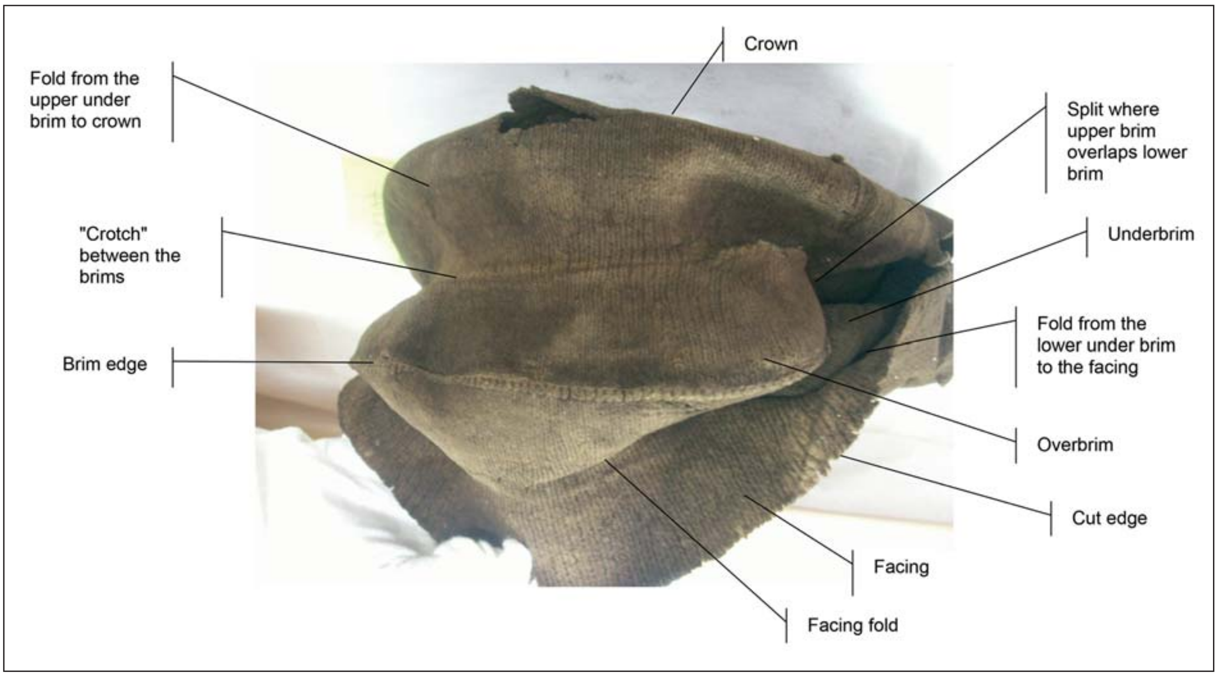

Fig. 21.1: Emerging terminology for early modern knitted caps (graph: M. Bolton).

in two- or occasionally three-ply. The yarn has a much smoother surface than would be expected for wool even after felting, fulling or other surface treatments, and intense wear.

The surface treatments obscure the knitted stitches in well-preserved areas of the caps (for example, between brims). In the best examples, a velvet-like plushy pile is both shiny and dense, although not sufficiently widespread to demonstrate the all-over nap shown in contemporary portraits such as Holbein's *Simon George,* circa 1535 (The Royal Collection). The yarn colour on several caps was considerably paler than the pile, suggesting the caps were dyed post-construction rather than the yarn-dyed in advance, as was the case with a reported Swiss example (MAEDER 1980).

5. A typology of knitted caps (see *Fig. 21.2*)

The Museum of London's online catalogue shows examples of each type (inventory numbers are indicated).

5.1 Flat caps: three types

Flat caps are the most numerous (59 percent) with three distinct types: single-brimmed, half-brimmed, and split-brimmed caps. A feature identified on many flat caps was named a "facing" (see *Fig. 21.1*). This is an additional section of knitting around the head circumference, usually with a cut (not cast-

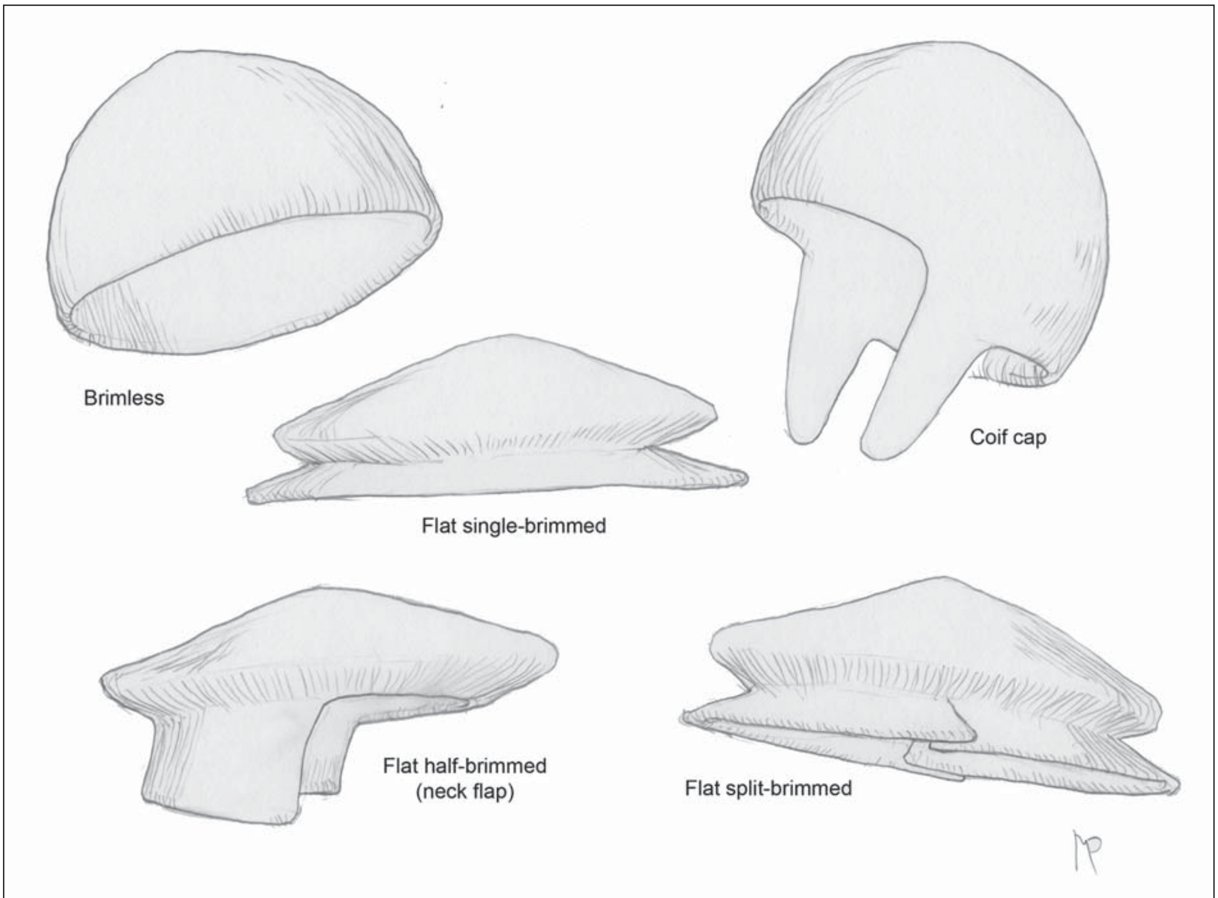

Fig. 21.2: Emerging typology of knitted caps in the early modern era (drawing: Michael Perry).

off) edge. During conservation, several were arranged to lie outside the cap whereas others, which had undergone less invasive treatment, showed their original position was tucked inside the under-brim. However, this feature of a facing with a cut edge on the inside led to speculation as to whether all the caps were originally double throughout and that when wear on the inner surface of the crown was bad, it was cut out and a separate lining added instead.

5.1.1 Single-brimmed caps

There are fifteen examples of single-brimmed caps (including, for example, MoL: 5008). These caps are characterised by one complete double-layered brim circling the head circumference of the cap approximately one inch (2.54 cm) wide. Usually, these brims do not project past the circumference of the cap crowns but match them. However, the caps in Biograd na Moru, which were made in Venice for export, have brims which are wider than average at 1¼ inch (3.25 cm) but these are considerably smaller than the circumferences of the cap crowns which project beyond by the same width again. This may be the style of cap represented in a floor tile fragment dated 1536–1565 at the Museum of London (A25388), produced in Antwerp.

5.1.2 Half-brimmed caps

It has been suggested that this style of cap "has the appearance of a modern-day peaked cap" (Black 2012, 21) but contemporary illustrations show the half brim to have been a neck flap (falling vertically from the head circumference of the cap) rather than a peak over the forehead (in, for example, Breughel's *Peasant dance,* circa 1568, in the Royal Collection). There are 30 examples of half-brimmed or "necked" caps (including, for example, MoL: A6060).

5.1.3 Split-brimmed caps

There are 33 examples of this style (including, for example, MoL: 5013), representing 30 percent of all the caps investigated. Holbein's portrait of *John More* dated circa 1527–1528 (Royal Collection) clearly represents a split-brimmed cap, characterised by two overlapping brims with rounded ends. Most have an approximately equally sized underbrim and overbrim. A few split-brimmed examples have a back brim which could fall as a neck flap in wear (for example, MoL: A6341).

5.2 Coif caps

Coif caps fit closely to the wearer's head mimicking headwear often made of linen or velvet. They represent 22 percent of the data and are typical of clerics and lawyers (Holbein's sketch of Bishop John Fisher dated circa 1532 in the Royal Collection is a good example), often worn with a flat cap on top for outdoor wear (as does Joos Van Cleve in his *Self-portrait,* c. 1530/35 in the Royal Collection). There are nineteen examples of these coif caps (including, for example, MoL: A26567).

5.3 Linings

One of the most interesting discoveries was the existence of separate, roughly circular, linings inside nine caps (including, for example, MoL: 22388). There were also 15 separate linings. All were knitted in the round using knit (not purl) stitches. The separate linings tended to be larger in circumference than the crowns of the caps in which they sit. They were made to fit by a slit or pleat from circumference to centre (for example, MoL: A6342). All of the linings were cut (not cast off) around their circumferences and very flat, except for one, which had been erroneously conserved as a cap (V&A: T619A-1913).

A cast-off edge makes it difficult for knitted surfaces to lie flat as they tend to roll. However, it is not certain that a cast-off edge was cut away at the circumference, as the linings could have been cut out of caps with double-layered crowns and recycled. Most linings were of a much lighter colour than the caps. A Munsell value of 10, a red brown, was recorded for five of the Museum of London linings. Of these, three were 10R and two were 10YR. Another three had values of 2.5YR or 5YR – also red-brown hues. A cap lining is just visible in Breughel's *The payment of tithes* dated circa 1620, sold at auction in Paris in 2013.

Tab. 21.1: Stitches per inch (2.54 centimetres)

	Crowns (78)	Brimless (2)	Single-brimmed (12)	Split-brimmed (30)	Half-brimmed (16)	Coifs (18)	Linings (24)
Stitches per inch (average)	8	9.5	8.5	8.0	8.5	6.7	8.1
Ranges	3.5–12	9–10	3.5–12	6–11	7–11	5–9	5–14
Mode	8	N/A	9.0	8.0	8.0	7.0	7.0

6. Publication online

Information held in the Museum of London's catalogue was reviewed for each cap to determine what could be published online. Standard paragraphs on the social context of the caps and explaining the incomplete provenance were included for each item together with individual measurements and Munsell colour values. Specific known details such as the place of excavation and/or how the cap came to be in the collection were also added. The museum undertook photography of each item and, where possible, showed the top of the cap, the underside and right and left views. The project published a total of 70 caps plus other related items with as much catalogue and technical information as is currently known (*Fig. 21.3*). This provides instant global accessibility to object-related information, which went beyond the requirements of the museum's digitisation targets.

7. Reconstruction projects

7.1 Schoolboy's coif cap

The child or youth's caps identified included three split-brimmed flat caps and four coif caps. The latter were similar to those in the Royal Charter given to Queen Elizabeth's Hospital in Bristol in 1590. This charity school provided a uniform for its pupils similar to garments issued to schoolboys at other sixteenth-century charitable foundations. The measurements and details of the extant caps were used to collate instructions for knitting a six-year-old boy's coif cap. Sally Pointer, a specialist in reconstructing historical knitwear, developed prototype instructions, which were tested by three knitters and wearers. Corrections were made before publication in *The Tudor Child,* 2013 (p. 143) together with recommendations for commercially available yarns resembling the original materials. The instructions also suggested a rudimentary surface treatment of the caps after knitting by vigorous hand or machine washing. However, there is more work necessary to recreate the plush surface that seems to have been typical of most knitted caps.

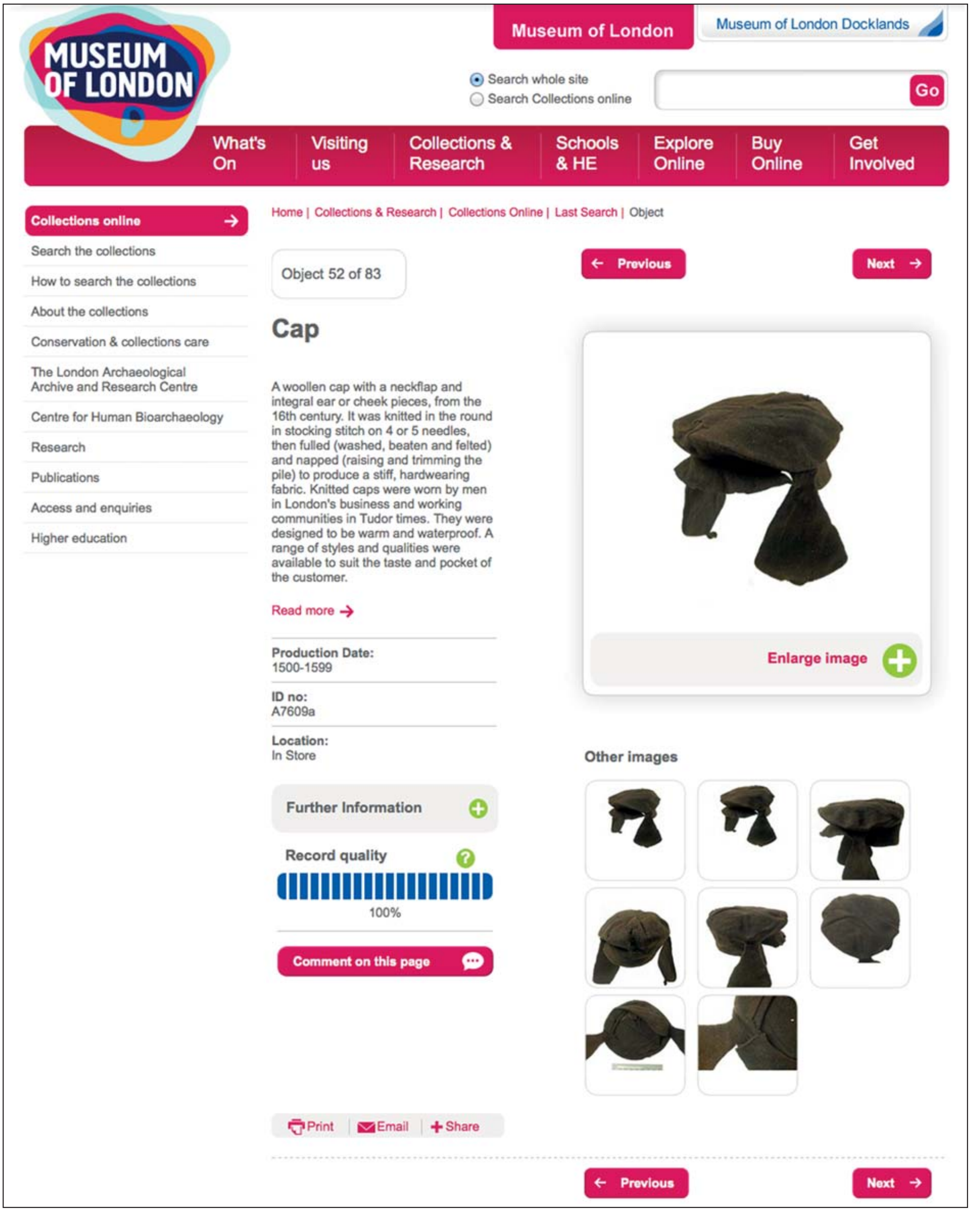

Fig. 21.3: Example of a webpage publicising a cap with technical data, contextual information and provenance as recorded in the Museum of London's catalogue.

7.2 Typical adult man's split-brimmed cap

The most numerous cap in the archaeological evidence was the split-brimmed version. A number of contemporary pictorial and documentary sources suggested this would be a typical one to reconstruct. Average measurements were calculated from 31 caps. These data were used to identify caps nearest to the overall average. The best match was a cap at the Museum of London (MoL: 5013), with a crown diameter of 9½ inches (24 cm), a head circumference of 20½ inches (51 cm), a top turf (overbrim) of 1¾ inches (4.44 cm) and a bottom turf (underbrim) of the same width, 8 SPI, and an extant lining measuring 9 inches (23 cm) in diameter with 5 SPI. This cap became the blueprint for reconstruction.

Specialist hat maker Rachel Frost developed several prototypes and identified commercially available yarn which was close to the original. Maggie Bolton and Ania Mora Mieskowska tested and critiqued the instructions extensively. The test caps were washed vigorously and then brushed to raise a nap with a stiff metal cat comb. The shape of the cap was satisfyingly close to the original but the surface did not replicate the pile. The fluffy finish lacked the sheen observable on the well-preserved extant caps. Further work is underway with a view to publication of improved instructions in *The Typical Tudor* (forthcoming).

8. Recommendations for further research

The preliminary study of the archaeological evidence suggests there is a great deal more to be learned from it. Detailed scientific analysis including radiocarbon dating, fibre and dye identification using microscopic, x-radiographic and amino acid-based techniques may reveal the origins of the raw materials and whether the caps were part of an extensive early modern trade in knitted goods. Closer inspection of the twist, ply and knitting of the yarn may explain more about the methods of construction. Further research into contemporary contextual information may demonstrate the significance of knitted caps in fashionable menswear during the sixteenth century. Two Swiss caps are yet to be examined and further European examples have now come to light (at Nürnberg, Basel and in Norway) in addition to those in international collections (for example, the Royal Ontario Museum, Canada and the Metropolitan Museum, New York).

9. Conclusion

This paper has demonstrated how an archaeological approach to fragmentary remains (as is used for ancient textiles) may be applied to a large number of excavated early modern garments held in dress collections by, for example, creating typologies of garments. Surprisingly little is known about the history of knitting despite tantalising indications that it quickly became a highly specialised industry producing sophisticated goods. This preliminary study has shown that the caps are a treasure trove of information from which statistically valid conclusions may be drawn.

Acknowledgements

Many thanks to the curators at the Museum of London, the V&A Museum, the Cuming Museum, Platt Hall, The Mary Rose Museum, Biograd Museum, the National Museum of Ireland, Norwich Costume Research Centre, British Museum, to the curators who brought more knitted caps to our attention at and after the conference, and especially to Beatrix Nutz for bringing two more caps to Hallstatt for us to examine.

http://collections.museumoflondon.org.uk/Online/SearchAdvance.aspx.
Use: Keyword=cap; Date from=1500; Date to=1599

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22 | Ein mittelalterlicher Schatzfund aus Silber und Seide von der Burg Dollnstein, Lkr. Eichstätt

BRITT NOWAK-BÖCK

Abstract: Bei archäologischen Ausgrabungen auf der Burg Dollnstein, Lkr. Eichstätt in Bayern wurde in einem Wohngebäude des frühen 14. Jahrhunderts ein Silberschatz entdeckt. In einem Keramikgefäß fanden sich, eingeschlagen in ein Leinentuch, rund 4000 Silbermünzen mit Prägungen vor 1200 bis 1360/70 und verschiedene wertvolle Gegenstände wie vergoldete Beschläge, eine Adlerfibel, über 100 Korallenperlen, ein Fingerring und weitere Verzierungselemente. Zu den Wertstücken wurden außerdem kostbare Gewebe aus Seide und Leinentextilien deponiert. Die heute sehr fragilen Reste konnten am Bayerischen Landesamt für Denkmalpflege konservatorisch gesichert und auf ihre Herstellung und Verwendung untersucht werden.

Keywords: Schatzfund, Bayern, Seide, Leinen, 3D-Computertomographie

1. Der archäologische Kontext und Detailbefunde

Es war eine Sensation, als bei archäologischen Ausgrabungen 2007 auf der Burg Dollnstein im Altmühltal in Oberbayern der Grabungsleiter Dr. Mathias Hensch (Schauhütte-Archäologie, Regensburg) unverhofft einen mittelalterlichen Silberschatz entdeckte. Unter dem Fußboden eines Wohngebäudes des frühen 14. Jahrhunderts fand sich in einer Grube ein unscheinbarer Keramiktopf. Das Gefäß war mit einem großen Kalkstein und einem Axtblatt abgedeckt, was vermutlich als Rechtssymbol oder als Warnung an einen unrechtmäßigen Finder zu deuten ist. Mit weiteren Steinen war der Topf in der Grube verkeilt und mit Erdmaterial zugeschüttet (Hensch – Hirsch 2010, 210; Hensch 2008/2009, 63–68). Bereits bei der Entdeckung war zu erkennen, dass das Kochgefäß bis zum Rand mit Münzen und Erde gefüllt war. Stellenweise zeichneten sich erste textile Strukturen ab. Für die Bergung wurde das Gefäß mit Folie und Gipsbinden stabilisiert und unmittelbar zur konservatorischen Versorgung und Röntgenprospektion in die Restaurierung des Bayerischen Landesamtes für Denkmalpflege transportiert (*Abb. 22.1*).

Bei der Bearbeitung in der Werkstatt konnten die organischen Anhaftungen an den Münzen und auf der Innenwandung des Schatzgefäßes als köperbindiges Textil aus pflanzlichem Material (Textil T1) identifiziert werden. Offensichtlich wurden die Geldstücke in dieses Köpergewebe eingeschlagen und anschließend in das Keramikgefäß gelegt. Hinweise wie Nähte oder Bändchen, die auf eine Verarbeitung des Gewebes zu einem Beutel oder zu einer Tasche schließen lassen, fehlten (*Abb. 22.2* und *3*).

Abb. 22.1: Entdeckung des Schatzgefäßes mit Axtblatt und Kalksteinen (Photo: M. Hensch, Schauhütte-Archäologie, Regensburg).

Die Bestimmung und Datierung der Münzen wurden von Dr. Martin Hirsch an der Staatlichen Münzsammlung München vorgenommen. Den Ergebnissen zu Folge sind unter den insgesamt rund 4000 Silbermünzen die Ältesten sogenannte

Abb. 22.2: Schatzgefäß während der Bearbeitung und Entnahme der Münzen (Photo: B. Nowak-Böck, BLfD).

Abb. 22.3: Köperbindige Textilstrukturen (T1) auf der Gefäßinnenwand, das Gewebe wurde als Verpackung für die Münzen verwendet (Durchmesser der Silbermünzen: 1,6 cm) (Photo: B. Nowak-Böck, BLfD).

Händlein-Heller mit einer Prägung vor 1200, die jüngsten Münzen datieren um 1360/70, was den frühesten Zeitpunkt der Niederlegung des Schatzes festlegt. Zwischen den Geldstücken lagen außerdem ein silberner *mani-in-fede*-Ring (ein Treuering) und ein Rosettenbeschlag aus Silber (A 1 und A 2) (Hensch – Hirsch 2010, 210).

Seitlich im Keramikgefäß fand sich auf halber Gefäßhöhe zusätzlich zu den Münzen ein sehr kompakter Bereich mit vielen Metallteilen, in dessen Umfeld vermehrt textile Reste erkennbar waren. Der zusammenkorrodierte Teilblock wurde in verschiedenen Positionen geröntgt, wobei unter den textilen Schichten mehrere, eng übereinanderliegende Metallgegenstände aus Eisen und Silber entdeckt wurden. Um weitere Informationen zu den Stücken zu erhalten und deren Zusammenhang mit den Textilien zu klären, mussten die bereits sichtbaren, teilweise losen Beschläge abgenommen werden. Dieser Komplex (B 1 – B 16) bestand aus zehn Zierbesätzen mit sechsblättrigem Rosettenmotiv (B 12 mit rückseitigem Haken) bzw. einem Beschlag mit Adlerdarstellung, vier vergoldeten Buchstaben aus Silber, einer silbernen Ringschnalle ohne Dorn und einem kleinen, halbkugelförmigen Silberbuckel. Alle Rosettenbeschläge mit runder bzw. dreieckiger Form haben eine Blechstärke von 3 mm und sind auf den Vorderseiten vergoldet. Zumindest sechs der runden Beschläge tragen ein identisches Rosettendekor und gehörten offensichtlich zu einem „Ensemble“. Die weiteren Gegenstände und der zwischen den Münzen aufgedeckte, sehr ähnliche Beschlag (A 1) zählten ursprünglich wohl nicht zu diesem „Satz“ und wurden lediglich gemeinsam mit den Rosettenbeschlägen niedergelegt. Machart und Befestigungslöcher sind verschieden gestaltet und geben keine eindeutigen Hinweise auf eine Zusammengehörigkeit der Stücke (*Abb. 22.4*).

An einigen Gegenständen haften im Bereich der Lochungen wenige Fadenreste, die aber an keiner Stelle eindeutig als Reste von Nähfäden anzusprechen sind. Trotz erhaltener Textilfragmente (Textil T1, T3 und T7) an den Vorder- bzw. Rückseiten einiger Beschläge konnte nicht belegt werden, dass sie mit diesen Textilien in funktionalem Zusammenhang standen. Auch die scheinbar wahllose Abfolge der Gegenstände und die unterschiedliche Ausrichtung der Schauseiten sprechen dafür, dass die Stücke zum

Abb. 22.4: Vergoldete Zierbesätze mit Rosetten- und Adlermotiv (B 1, B 5–7, B 9, B 11–12, B 14–16) vier vergoldete Buchstaben aus Silber (B 2–4, B 10), silberne Ringschnalle ohne Dorn (B 13) und kleine halbkugelförmige Silberkappe (B 8). Abbildung der Gegenstände in dokumentierter Reihenfolge bei der Entnahme. Zwischen den Münzen aufgedeckter Rosettenbeschlag (A 1) und ein mani-in-fede-Ring (A 2). Maßstabbalken entspricht 1 cm (Photo: St. Gasteiger, BLfD).

Zeitpunkt der Niederlegung lose zusammengepackt und nicht auf einen textilen Träger aufgenäht waren. Ursprünglich wurden diese Zierelemente vermutlich als Gewandapplikationen bzw. als Verzierung von Kleidungsaccessoires wie z. B. Gürtel oder Stirnbinden verwendet. Vergleichbare Stücke gibt es viele, so z. B. sehr ähnliche Rosetten, abgebildet am Stirnband einer um 1407 entstandenen Konsolfigur in St. Johannis in Schweinfurt (Diözesanmuseum Bamberg 1992) oder an einem Gürtel aus dem Schatzfund aus Colmar aus der Mitte des 14. Jh. (Fingerlin 1971, 90, 422–423). Ähnliche Beispiele finden sich auch in Zusammenhang mit sakralen Gegenständen wie z. B. Rosetten und kleine Buckel am Fürleger aus dem Kloster Wienhausen, Niedersachsen (15. Jh.), in Zweitverwendung aufgenähte Silberbleche an einem „Skulpturenkleidchen“ des 14. Jh. im Halberstädter Domschatz (Richter 2008, 348–349), sowie aufgenähte silbervergoldete Brakteaten und Silberbuckel auf einer Palla (um 1400) aus dem Kloster St. Marienstern, Panschwitz-Kuckau (Wetter 1998, 187). Vergleichbare Metallbuchstaben sind z. B. als Applikationen an einem Lederstreifen (1350–1400) aus London erhalten (Egan – Pritchard 1991, 200–201).

Der restliche Teilblock mit einem “Sammelsurium” von verschiedenen Metallgegenständen war von vielschichtigen Textilien umgeben, deren Substanzerhalt und Untersuchung im Vordergrund der weiteren Bearbeitung stand (*Abb. 22.5* und *6*). Die Gewebe lagen in sehr unterschiedlichen Erhaltungszuständen vor. Neben stabilen mineralisierten Resten in direktem Kontakt zu den Eisenteilen

Abb. 22.5: Adlerförmige Fibel mit umgebenden Textilien als Teil eines Sammelsuriums von verschiedenen zusammenkorrodierten Metallgegenständen (Photo: B. Nowak-Böck, BLfD).

waren insbesondere die Seidentextilien sehr spröde und fragil. Der Erhaltungszustand variierte innerhalb kleinster Flächen, so lagen noch flexible, organische Bereiche unmittelbar neben schwarzen strukturlosen Substanzen ohne jegliche charakteristische Merkmale.

Mit Hilfe der 3D-Röntgen-Computertomographie (Firma Carl ZEISS) konnte ein Blick in den Befund geworfen werden, ohne die Textilien dabei abtragen bzw. zerstören zu müssen (*Abb. 22.7* und *8*). Mit dieser Methode war es möglich, ein 5,7 cm großes und 3,8 cm breites Silberobjekt in Form eines Adlers mit vier mugeligen Schmuckeinlagen auf Brust, Schwanz und Flügeln als Fibel zu identifizieren, da auf der verdeckten Rückseite eine stark korrodierte Nadelkonstruktion visualisiert werden konnte (zur Trageweise vgl. z. B. Rüber-Schütte 2014, 8). Im rechten Winkel zu der Fibel lagen mehrere tordierte Eisenstäbe mit endständigen, ineinander

Abb. 22.6: Rückseitige Ansicht des Sammelsuriums mit 14 Silberbeschlägen in Verbindung mit einem Seidengewebe (T5), Verzierungselementen aus Metallfäden (T6), tordierten Eisenstäben und anhaftenden Zwirnen (T7) (Photo: B. Nowak-Böck, BLfD).

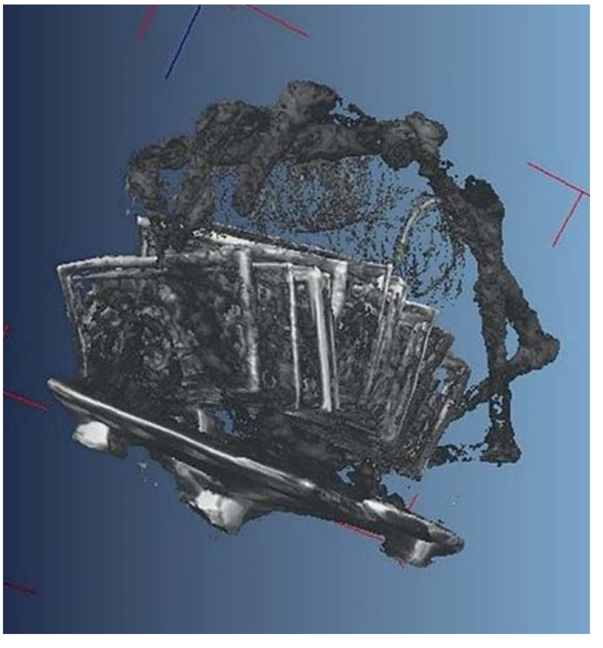

Abb. 22.7: 3D-Computertomografieaufnahme: Sichtbar sind die eng zusammenliegenden rechteckigen Silberbeschläge mit Blumenmotiv, darüber schwach erkennbar die Verzierungselemente aus Metallfäden (T6) und die tordierten Metallstäbe. Im unteren Bereich ist die Fibel in Seitenansicht zu sehen (Grafik: P. Hoyer, Firma Carl ZEISS).

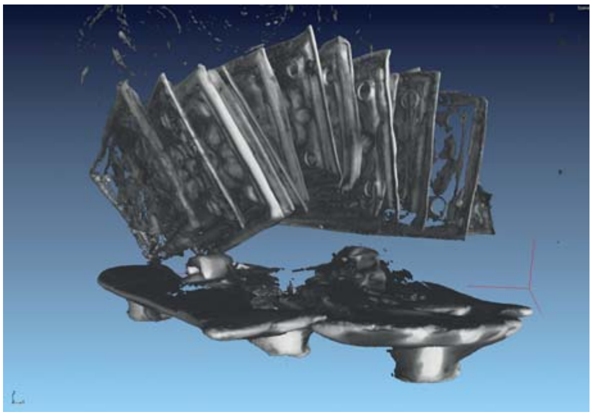

Abb. 22.8: 3D-Computertomografieaufnahme: Auf der Rückseite der Fibel ist der Nadelapparat und die Eisennadel zu erkennen (Grafik: P. Hoyer, Firma Carl ZEISS).

Abb. 22.9: Losgelöstes Fragment mit zwei Verzierungselementen aus Metallfäden (T6) und einem rechteckigen Silberblech mit rückseitigen Seidenbandresten und groben Nähfäden (Photo: B. Nowak-Böck, BLfD).

greifenden Ösen (Stärke der Stäbe: ca. 0,3 cm, L: bis zu 3,3 cm). Die Stäbe waren regelmäßig abgewinkelt und zusammenkorrodiert; an der Öse eines zerbrochenen Stangenfragmentes war ein mehrfach umwickelter Faden erhalten. Die einstige Verwendung der Eisenstäbe ist bislang ungeklärt.

Des Weiteren konnten insgesamt fünf eichelförmige Verzierungselemente aus Metallfäden (Textil T6) erkannt werden. Größe und Durchmesser dieser Elemente variierten (Dm: 0,8–1,4 cm, L: ca. 2 cm). Sie waren teils rund, teils leicht zugespitzt geformt und aus 0,3–1,0 mm starken, vergoldeten (?) Silberlahnfäden mit Seidenseele gebildet. Die Metallanalysen wurden mittels REM/EDX-Messungen (Oberflächenmessungen) am Zentrallabor des BLfD durchgeführt. Jeweils zwei Metallfäden waren mit Hilfe von leicht schräg geführten Überfangfäden in ihrer Position fixiert. Im Inneren der eichelförmigen

Abb. 22.10: Detailaufnahme der vergoldeten Silberfäden (T6) (Photo: B. Nowak-Böck, BLfD).

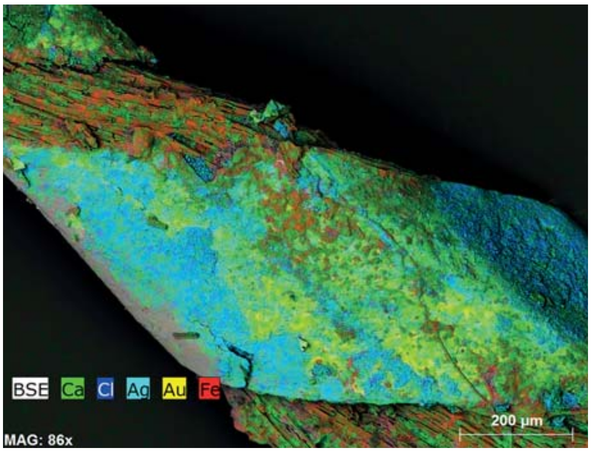

Abb. 22.11: REM/EDX-Aufnahme eines Metallfadens (vergoldeter Silberstreifen) mit Seidenseele (T6) (Bild: Chr. Gruber, BLfD).

Verzierungen verliefen senkrecht rot-braun verfärbte S-Zwirne, die aber nicht präzise charakterisiert werden konnten. Ihre Verwendung ist bislang nicht rekonstruierbar, vielleicht handelt es sich um verzierende Applikationen von textilen Gegenständen (*Abb. 22.9–11*).

In der Mitte des Konglomerats befanden sich 14 eng aneinander liegende rechteckige Silberbeschläge mit stilisiertem Blumenmotiv (L: 2,7 cm, B: 1,6 cm). Die Schauseiten waren

Abb. 22.12: Detailaufnahme des Seidenbandes mit in Reihen angeordneten Korallenperlen (Maßstabbalken entspricht 2,5 mm) (Photo: H. Voß, BLfD).

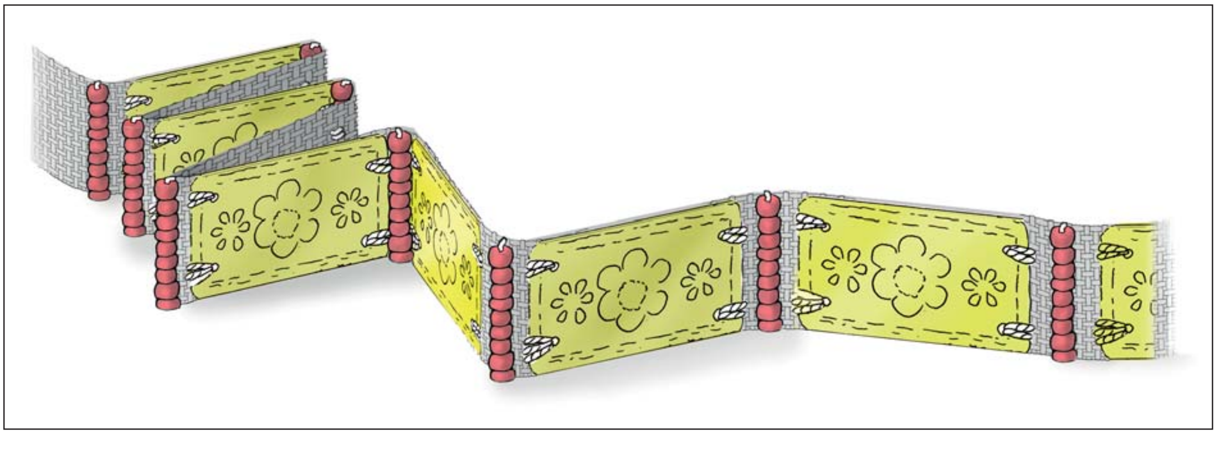

Abb. 22.13: Rekonstruktion des zusammengefalteten Seidenbandes mit applizierten Zierbeschlägen und Perlenreihen (Grafik: H. Voß).

abwechselnd einander zu- bzw. abgewandt. Die vergoldeten Beschläge standen in Verbindung mit einem 1,6 cm breiten, der Längsseite nach eingeschlagenen Seidenband (Textil T5). Auf dieses leinwandbindige Band waren sie mit grobem Nähfaden im Wechsel mit je einer Reihe von acht bis neun Korallenperlen (Dm: ca. 2,5 mm) aufgenäht. Noch heute ist deutlich zu erkennen, dass das Zierband für die Niederlegung in das Kochgefäß akkurat zusammengefaltet worden war (*Abb. 22.12–13*).

Im Umfeld der Objekte fanden sich außerdem zahllose in Farbe und Stärke variierende Seidenzwirne (Textil T7). Die ungeordnete Lage und Ausrichtung der S-gedrehten Zwirne, sowie das Fehlen eines zweiten Fadensystems legen die Vermutung nahe, dass sie in unverarbeitetem Zustand als Vorrat versteckt worden waren (*Abb. 22.14*).

An vielen Stellen der Gegenstände konnten außerdem Reste eines leinwandbindigen Textils aus pflanzlichem Material (Textil T3) nachgewiesen werden. Es ist anzunehmen, dass die Fibel, die Eisenstäbe, die Verzierungselemente aus Metallfäden (Textil T6), das zusammengefaltete Zierband mit Silberbeschlägen und Korallenperlen (Textil T5) wie auch die Seidenzwirne (Textil T7) in dieses Gewebe eingeschlagen und somit getrennt von den Münzen verpackt wurden (*Abb. 22.15*).

Auf der Außenseite der leinwandbindigen "Verpackung" (Textil T3) fanden sich in fadenparalleler Ausrichtung Reste eines weiteren köperbindigen Textils mit Metallfäden als Schusseintrag (Textil T2). Nach ersten REM/EDX-Analysen (Oberflächenmessungen) des Zentrallabors des BLfD handelt es sich vermutlich um versilberte Kupferlahnfäden (?), weitere Messungen stehen noch aus. Leider konnte weder die Gewebetechnik eindeutig analysiert, noch ein Musterrapport (vermutlich sehr kleinteilig) festgestellt werden. Aufgrund der stratigrafischen Abfolge ist davon auszugehen, dass dieses Gewebe nicht Inhalt des Päckchens war, sondern auf dessen Außenseite lag (*Abb. 22.16*).

Abb. 22.14: Detailaufnahme der Zwirne (T7) (Maßstabbalken entspricht 2,5 mm) (Photo: B. Nowak-Böck, BLfD).

Abb. 22.15: Detailaufnahme des leinwandbindigen Gewebes (T3), das vermutlich als Verpackung der Metallgegenstände verwendet wurde (Maßstabbalken entspricht 2,5 mm) (Photo: B. Nowak-Böck, BLfD).

Abb. 22.16: Detailaufnahme der Gewebestruktur (T2) mit Metallfäden (Photo: B. Nowak-Böck, BLfD).

2. Zusammenfassung der Ergebnisse

Insgesamt befanden sich in dem mit Kalkstein und Axtblatt abgedeckten Schatzgefäß rund 4000 Silbermünzen, die zusammen mit einem Fingerring und einem silbernen Rosettenbeschlag in ein Leinentuch (Textil T1) eingeschlagen waren. In einem weiteren Päckchen aus einfachem Köpergewebe (Textil T3) befand sich ein "Sammelsurium" aus Adlerfibel, tordierten Eisenstäben, filigranen Verzierungselementen aus Metallfäden (Textil T6), ferner ein feines Seidenband (Textil T5) appliziert mit 14 vergoldeten Silberbeschlägen und über 100 Korallenperlen, sowie viele Seidenzwirne (Textil T7). Ob auch die dicht zusammengelegten Gegenstände wie vergoldete Silberbeschläge, Buchstaben, Buckel und Schnallenbügel (komplex B1-B16) ebenso in dieses Gewebe (Textil T3) eingepackt oder separat beigelegt worden waren, wie das sicherlich kostbare Gewebestück mit Metallfäden (Textil T2), ist nicht mehr zu klären (*Abb. 22.17*).

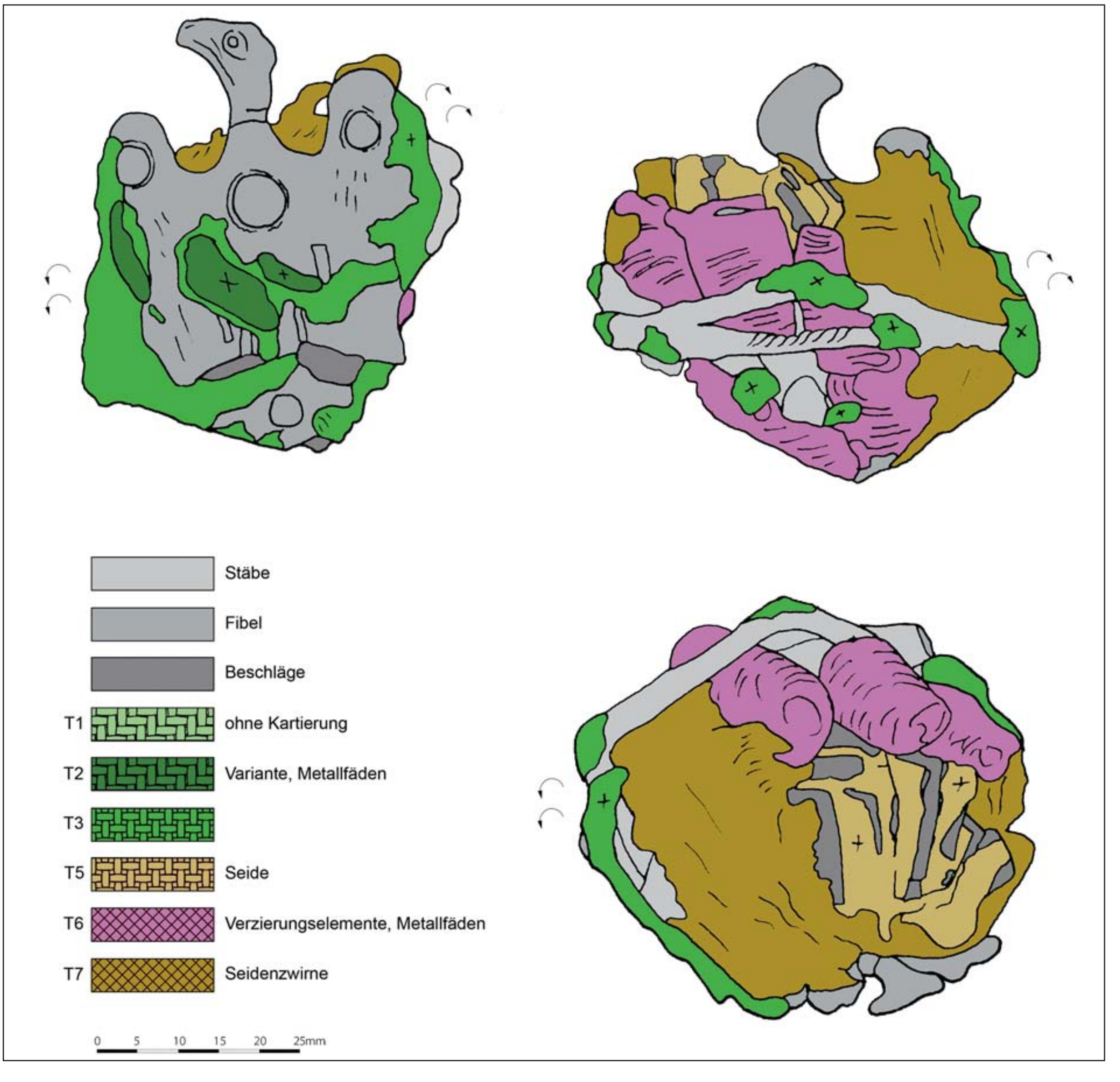

Abb. 22.17: Kartierung des zusammenkorrodierten "Sammelsuriums" mit Adlerfibel, Eisenstäben und Silberbeschlägen (Grauabstufungen) und allen anhaftenden Textilstrukturen T1–T7 (Grafik: H. Voß, BLfD).

Wie es zu der Zusammenstellung des Schatzes aus Silber und Seide kam und von wem und aus welchen Gründen der gefüllte Kochtopf versteckt wurde bleibt spekulativ. Der Besitzerwechsel der Burg um 1360 von den Grafen von Oettingen an die Herren von Heideck, aber auch Kriegshandlungen, Intrigen und gar tödliche Erbstreitigkeiten innerhalb der Burgherrenfamilie, wie eine mittelalterliche Sage aus Dollnstein drastisch berichtet, könnten mögliche Motive gewesen sein. Konkrete historische Anhaltspunkte gibt es dafür aber nicht (Hensch – Hirsch 2010, 210–211). Vielleicht war auch die Angst vor dem "Schwarzen Tod", der Bayern erstmals 1349 und dann in mehreren Wellen bis ins späte 14. Jh. heimsuchte, der Beweggrund für das Deponieren der persönlichen Wertgegenstände (Mittelstrass 2012, 79).

Aus heutiger Sicht ist es ein besonderer Glücksfall, diesen mittelalterlichen Burgenschatz viele Jahrhunderte später im Rahmen einer professionellen Ausgrabung "zufällig" aufgefunden zu haben. Somit war es möglich, nicht nur die wertvollen Münzen und Gegenstände zu bestimmen, sondern insbesondere ihren Zusammenhang in der vorgefundenen Situation zu dokumentieren und zu untersuchen. Durch den erhaltenen Befundzusammenhang kann heute rekonstruiert werden, dass das Versteck unter dem Fußboden mit Bedacht ausgewählt wurde und die Niederlegung des gebrauchten Kochtopfes offensichtlich geplant war. Auch die Befüllung des Gefäßes wurde vermutlich nicht überstürzt ausgeführt, wie die Verpackung der Wertgegenstände sowie der geschätzten Textilien und nicht zuletzt das sorgsame Zusammenfalten des Seidenbandes mit den silbervergoldeten Beschlägen vermuten lassen.

Tab. 22.1: Textiltechnologische Daten der Textilstrukturen

Textil	**Bindung**	**Material**	**Drehung**	**Fadenstärke in mm**	**Fadendichte pro cm**	**Mögliche Funktion**
T1	Köper 1/2	pflanzlich/ pflanzlich	z/z	ca. 0,3-0,4/ca. 0,3-0,7	12-16/20-24	Verpackung der Münzen
T2	Köper, Variante	pflanzlich?/ versilberter Kupferlahn?, pflanzliche Seele	z/Ss	0,25-0,7/ca. 0,3-0,6, Metallstreifen: ca. 0,4-0,9	24/18	?
T3	Leinwand	pflanzlich/ pflanzlich	z/z	0,2-0,5/0,3-0,6	17/16	Verpackung der Metallteile
T5	Leinwand	Seide/Seide	z/o. erkennb. Drehung	0,05-0,1/0,2-0,3	36-44/32-40	Seidenband mit Applikationen
T6	-	vergoldete Silberstreifen, Seidenseele	Ss Überfangfaden: o. erkennb. Drehung	ca. 0,3-0,5, Metall-streifenbreite: ca. 0,4-0,5, Stärke Seele: ca. 0,1-0,3 Überfangfaden: 0,3-0,5	-	eichelförmige Verzierungsele-mente
T7	?	Seide/-	Sz/-	Zwirn: ca. 0,2-0,5, Garn: ca. 0,1-0,25/-	-	Zwirnvorrat?

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23 | Gold and silver decorative metal laces in the 16th and 17th centuries in Ireland and Europe

ELIZABETH WINCOTT HECKETT

Abstract: The significant increase of gold and silver pouring into Europe in the 16th and 17th centuries from South America made the kings of Spain and Portugal incredibly rich. Thus the making of metal filaments and decorative laces also became very profitable because of the developing techniques of 'casting and drawing'. This paper describes some 17th century metal laces found in excavations in Ireland. The work of the Scanning Electron Microscopy Department, University College Cork, and the Conservation Department of the National Museum of Ireland, who photographed two Clogh Oughter Castle laces, is discussed. Irish and European portraits of the period illustrate the significance of clothes trimmed with silver and gold laces.

Keywords: gold and silver lace, 17th century, SEM Department University College Cork, Castle Donovan, Co. Cork, Clogh Oughter, Co. Cavan, Irish portraits

1. Introduction

The term 'lace' has a long history that pre-dates the use of the word as understood nowadays. In the English language the noun, *lace,* and the verb, to *lace,* are related to the Old French word, *laz.* This usage may have accompanied incomers from Normandy into England after the conquest of the Anglo-Saxon kings in the eleventh century (1066 AD). The words *lace* and *to lace* have been used for the thin bands made from textile strands twisted together. These laces tied together the bodices of doublets and dresses; doublets and hose (stockings) were also tied together this way. Modern French still uses the verb, *lacer* in 'to lace, or to do up' shoes. *Lacet* is used in *chausseur à lacet* (lace-up shoes). Modern English also continues to use 'shoe-laces' as the correct terms for the flat or rounded cords put through the several holes in both shoes, and tied together tightly.

Other terms used for similar purposes are the words 'braid', 'to braid' and 'braiding.' These are sometimes used nowadays instead of the word 'lace' and have become common in many English-speaking countries. These words also occur in North America where the term 'braiding' is more popular than 'plaiting.' In general, flat braiding is made up by bringing an outer left strand and an outer right strand over, or under, an adjoining strand. In the use of English now the word 'braid' is often used for any kind of narrow band decorating or trimming cloth. It is also used for plaiting or intertwining hair. The origin of the word is from the Old English *'bregdan,'* or 'swift side to side movements.' However, the word 'braid' now seems to be widely used for both woven and plaited bands.

There are contemporary examples of Irish and English personal comments on metal laces and linen or silk lace. For example, in 1599 the two sons of the Irish nobleman, Hugh O'Neil were seen in London 'in good towardsly spirit'. They were described as wearing expensive English clothes with gold lace decorating their velvet jerkins (Maxwell 1923, 338).

In 1623 English Protestant families arriving in Ireland to seize land from the Irish, condemned the richness of Irish clothes, ordering that 'no apparel or lace of whatever sort soever be worn.' It is clear that different sorts of laces were recognized by then. The word, lace, as we now understand it, became an extremely popular item. By the middle of the 17th century gold and silver laces were completely swamped by the very high quality and unexpected delicacy of hand-made lace cravats, cuffs, partlets and *parures*.

2. Gold and silver thread

Two major changes developed the easy availability of gold and silver threads in Europe in the 17th century. The first, the significant increase of gold and silver that poured into the continent in the 16th and 17th centuries, was largely secured by the kings of Spain and Portugal who, in conquering South America, became enormously rich (Ferguson 2012, 100–101). This wealth then spread through royal courts and aristocratic families in many European countries, and some part could be used generously to decorate luxurious clothes with gold and silver embroidery and laces.

The second change is that, from the late Middle Ages onwards, the making of metal filaments and decorative laces became very profitable as the methods of production were changed by the new techniques of 'casting and drawing.' Gold thread for laces of this period was not made of pure gold but from a rod of silver covered with gold leaf which fused together in a furnace. The rod was drawn out and then flattened between rollers so it could be spun around a fine core of silk or linen to make the metal thread. This is a much cheaper and quicker way of producing the threads than the 'beating and cutting' techniques of antiquity and the early medieval period. The increased volume of the new technique enabled great quantities of metal thread to be produced, so that decorative laces became widely available (Barker 1980, 1–7).

These two factors enabled wealthy people to demonstrate very clearly, through decorating their clothes, their power and importance. Also, a wardrobe of high class dresses and suits made from expensive cloth with gold and silver decorations could be used as easily for currency as owning a bag of coins. It seems that individual craftsmen and women in Europe were making such laces and braids for wealthy patrons. Indeed discarded pieces of metal thread were returned to the gold and silversmiths and thread-makers to be melted down to be used again. It is likely that some laces would be imported from Italy since cities like Florence were centres of luxury cloth-making and decorative trimmings. It may be that in Ireland merchants and even smugglers were bringing these fashionable items ashore to sell to the gentry and aristocracy.

In this period gold filament was often made of best quality 2% gilt (gold leaf) on 90% silver alloyed with some copper. Another imported type known as 'Nuremberg' gilt was made up of 2% gilt on 98% copper. It was, however, of such poor quality that it was banned by the London authorities; by the 18th century its manufacture and import was forbidden.

3. Excavated laces from Irish castles

Dating to the time of the seventeenth-century European religious wars, examples of both expensive and cheap metal lace have been found in three Irish castles. (From 1649 to 1660 a dreadful war in Ireland was waged by Oliver Cromwell, known in England as the Lord Protector). These laces survived because rooms and courtyards of castles were destroyed and covered with rubble. Metal lace finds from domestic sites are rare, since, as noted above, it was common practice to return them to the lace makers. High-quality laces were excavated at Clogh Oughter, Co. Cavan; another came from Castle Donovan, Co. Cork. The third, of poor quality, was found in Dublin Castle; this piece of belting has a linen warp and a weft of metal thread (copper). Copper with small amounts of silver could be made to look like gold. The recycling of expensive clothes and their embellishments was very common at this time; at least one-third

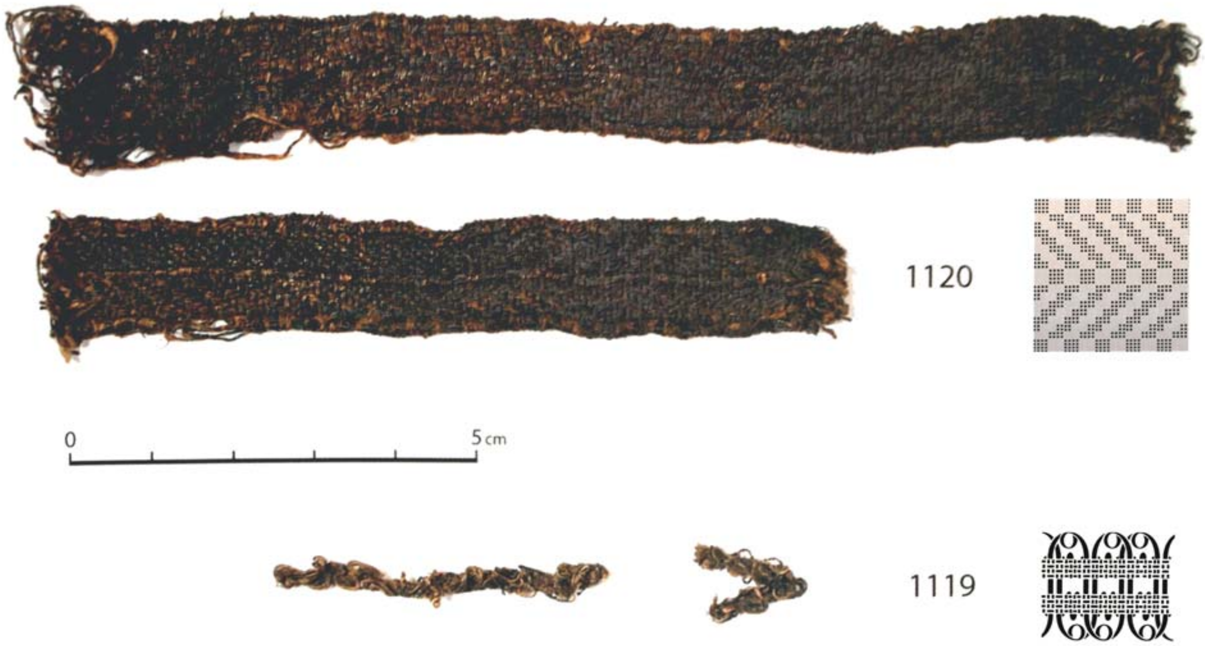

Fig. 23.1: Samples of high quality laces excavated at Clogh Oughter, Co. Cavan (after MANNING *2013, Pl. 6.65, Fig 6.25, Fig 6.26).*

of a collection of textiles from a Dublin tailor's workshop of the 16th/17th centuries, perhaps 30 out of 92 had been re-worked for further use (WINCOTT HECKETT 2005, 108–109).

In the courtyard of Clogh Oughter Castle some gold lace, now in two pieces, and some silver lace also in two pieces, were found (*Fig. 23.1*). The thread used in the main systems, and the finer threads, consist of a twisted silk core covered with metal stripping. Known as orris lace, the first piece is a luxurious type of gold lace being a narrow weave band in a chevron pattern with a wide rib at each side and in the centre. Unusually, both warp and weft systems are made from the same gold metal thread. The covering has deteriorated over some of the band but enough remains to demonstrate the clear gold colour that originally would have made this an imposing and luxurious decoration. The silver lace is a delicate and decorative metal narrow-weave band made with two other adjacent fine narrow-woven bands holding in place convoluted arcs of thicker metal (WINCOTT HECKETT 2013, 156–160).

From Castle Donovan, Co. Cork, seven pieces of a length of gold lace crumpled together were found with other domestic items in the main chamber where fighting had taken place in the 17th century (*Fig. 23.2*). These small pieces would normally have been used again perhaps to decorate a child's dress, or to be returned to a goldsmith to be melted down as was the custom. However, the destruction of the Castle concealed the pieces for generations and so preserved the gold lace. Here again, unusually, this was made with both warp ends and weft picks in gold lace, rather than more thriftily, with dyed silk or linen yarn. This woven warp-faced structure is known as belting, with the warp threads predominant, and the weft system hardly visible. As also happened in Clogh Oughter, both warp and weft of the gold lace are made from similar gold metal thread. These seven pieces had been stitched to a garment, but later were cut off in small pieces. Silk threads were stitched by hand along the lace edges but had also been cut off. There are tiny remnants of clothing on the undersides of the lace. Three pieces have been

Fig. 23.2: The seven pieces of a length of gold lace found in Castle Donovan (after Bolger – Hegarty *2012, Pl. 5).*

folded or mitred, and stitched, so that they outlined the panel of a skirt attached to a bodice or doublet. Two other Y-shaped pieces were made up by one piece being stitched at an angle to the other. This type of embellishment in slanting strips was stitched into place to decorate the bodice of a gown or a doublet (Wincott Heckett 2012, 73–75).

4. Analyses of the laces

The two laces from Clogh Oughter Castle, Co.Cavan were analysed by Scanning Electron Microscopy (SEM) at University College Cork and the Conservation Department of the National Museum of Ireland (*Fig. 23.3*). This demonstrated the fine details of the composition of the metal lace threads, and determined the death of the person who wore the laces. High definition photographs were also taken of the gold and silver threads showing the metal filaments spun round a silk core.

The SEM analysis showed a very high concentration of sodium chloride. This indicates body ether fluids or the decay of bodily tissues over a period of time. It may well indicate that the laces were worn by a defendant of the Castle during the Cromwellian wars. Not far from the laces the head and shoulders of a man was hurriedly buried; also nearby a damaged finely decorated pistol was found.

In addition, Energy Dispersive X-ray (EDX) analysis was undertaken of the samples to determine chemical elements present in the metal filaments *(Tab. 23.1*).

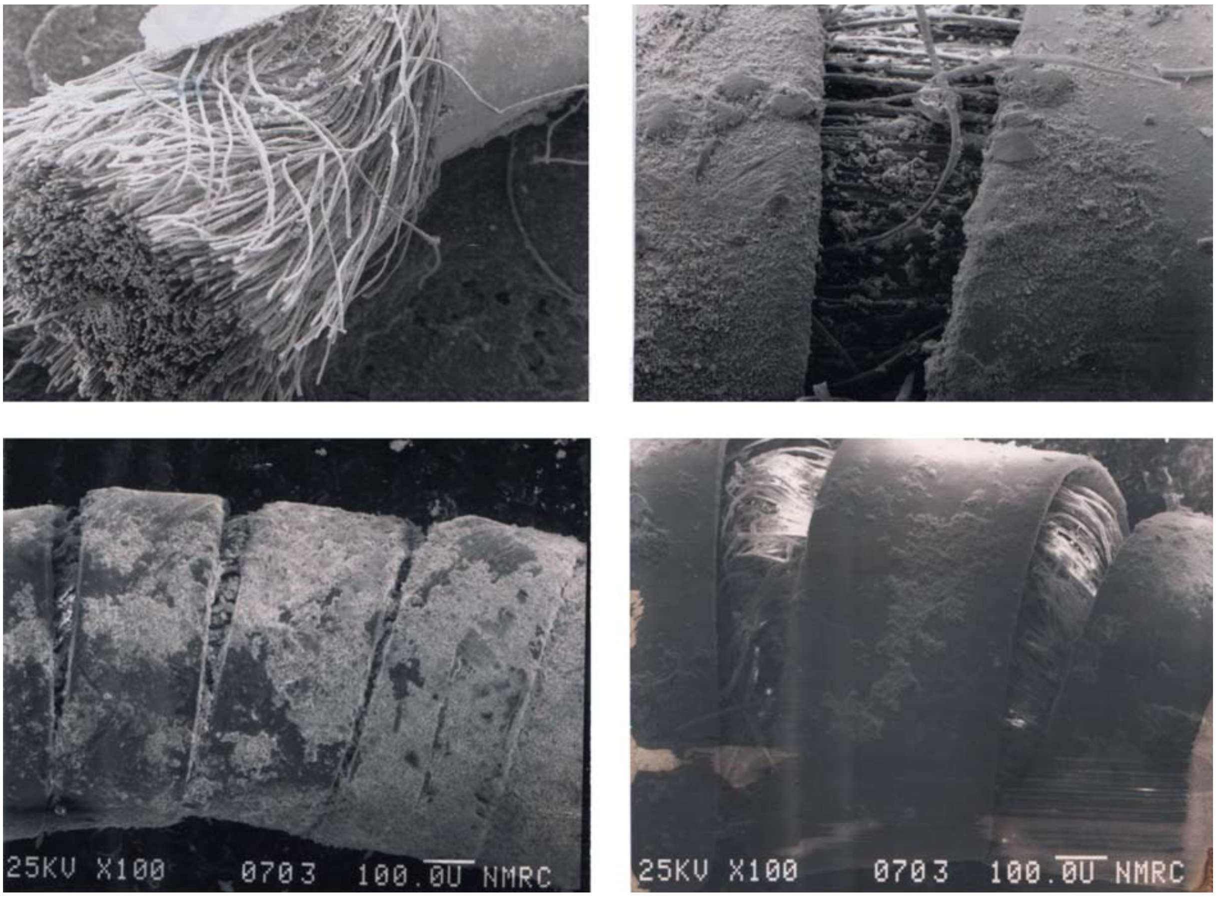

Fig. 23.3: Clogh Oughter Gold Lace E409:1120 @ © Tyndall National Institute, University College Cork, Ireland (after MANNING 2013, Pl 6.68).

Tab. 23.1: EDX analysis of the samples to determine chemical elements present in the metal filaments

Lace Reference	Heavy Element Detection (No light, Window Closed)	Light Element Detection (BE Window Open)
E409:1119	Very high detection of silver, high detection of chlorine, low detection of sulphur and silicon.	Very high detection of silver but slightly less than in heavy-element detection, medium detection of chlorine, low detection of sulphur, very low detection of silicon. Silk fibres: high detection of silicon, medium detection of silver, low detection of calcium, carbon and oxygen, very low detection of chlorine, sulphur and aluminium.
E409:1120	One grain 60,000 x: Very high detection of silver, low detection of manganese.	Area smooth: High detection of silver, low detection of chlorine, very low detection of sulphur and silicon. Gold was identified in this examination.

5. Evidence from portraits

Portraits of the Irish aristocracy show that the use of metal laces and fringes was an important part of the identity of both nationality and status. At that time a major change, the destruction of the Irish nation, occurred. This was largely due to the enforced reformation of the Irish church. The Catholic religion remained strongly linked with the indigenous way of Irish dress and culture. Such important changes can be seen in Irish portraits. A painting by John Michael Wright (1617–1694) of Sir Neil O'Neill, known as 'The Irish Chief' (1680), relates the complex story of his dress, status and history, by wearing and using specific items of clothing, arms and other accoutrements including Japanese armour (*Fig. 23.4*), However, The O'Neill's cloak is clearly made of silk with lavish silver fringes. Silver and gold embroideries and laces decorate his hat, shirt, doublet and apron. Even his shoes are decorated in gold. John Derricke's publication, *The Image of Irelande,* 1581 had already shown a chieftain wearing important clothes that included a fine shaggy wool cloak (in Irish, *brat*), a conical hat, a quilted leather doublet, and hose (MURRAY – FATTOR 2010, 65)

Another important Irish portrait (1635–1640) is that of Maire Rua O'Brien, (1615–1686) daughter of Torlach Rua MacMahon, chieftain of much land in the west of Ireland (*Fig. 23.5*). Known as a woman of boundless energy and great determination in retaining her family's status and lands, Maire Rua chose to wear an elegant Flemish pillow lace collar and cuffs, a partlet with metal lace and silk ribbons and an imposing Renaissance jewel with pearl figures suspended on a gold chain. On her head is a fine silver

Fig. 23.4: Portrait of Sir Neil O'Neill, (1680), known as 'The Irish Chief', painted by John Michael Wright 1617–1694 (© Private Collection).

Fig. 23.5: Portrait of Maire Rua O'Brien, Unkown Artist (c. 1935–1940) (© Private Collection).

Fig. 23.6: Left: Donal O'Sullivan Beare, unknown artist, Spanish School 17th cent.
Right: King Phillip III of Spain, painted by Juan Pantola de la Cruz (1553–1608)
(© St. Patrick's College Maynooth, Dublin & Royal Collection Trust HM Queen Elizabeth II, London).

lace band (with a red silk ribbon) that may well be similar to the silver lace found at Clogh Oughter Castle (Murray – Fattor 2010, 109).

The painting of Domhnall O'Sullivan Beare (1560–1618) portrays this Irish chief c.1605 when he was in the service of King Philip III of Spain in Madrid (*Fig. 23.6*). His trunk-hose was seemingly completely decorated with silver lace in a most elegant way. As noted, the amount of silver then available in Spain could be used lavishly for the decoration of clothes of the wealthy. However, King Philip lll of Spain with his trunk-hose completely decorated in gold, was dressed far more magnificently than the O'Sullivan Beare. His consort, Queen Margaret of Austria, outshone everyone by wearing a gown covered with embroidery, jewels and gold lace. This was because the vast amounts of gold and silver plundered from South America enriched the Spanish court beyond belief (Murray – Fattor, 28).

Acknowledgements

My thanks are greatly due to the work of the Scanning Electron Microscopy Department, University College Cork for the analysis of one lace piece from Clogh Oughter, and the work of the Conservation Department of the National Museum of Ireland on two lace pieces also from Clogh Oughter.

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24 | The reliquary of Starigard/Oldenburg

GABRIELE ZINK

Abstract: The so-called "reliquary of Starigard" was block-lifted and has remained frozen for thirty years until recently. It is the last find not assessed or interpreted yet, in the otherwise completely analysed Slavonic settlement of Starigard. Initial analysis included X-radiography. However, it was hoped that questions regarding the form, function and materials could be answered by a micro-excavation of the block. Initial results of this "work in progress" are presented here, as well as an evaluation of the lifting technique and an outline of future tasks.

Keywords: Slavs, graveyard, block-lift, jingle sheets, gold threads

1. Introduction

The northern graveyard of Starigard, which was the main fortification of the Slavs in Wagrien, was discovered in 1974. The ten year excavation was directed by Dr. Ingo Gabriel, who published his results in cooperation with Torsten Kempke (Gabriel – Kempke 2011). The only find not yet processed was a block-lift from grave 74. The block was lifted in 1983 and measures approximately 30x27x6 cm. It has been frozen at -20°C until now. The block is thought to contain the so called "reliquary of Starigard". A reconstruction drawing based on X-ray images was published in 2001 and 2006 (Gabriel 2006, 150 –155; Wieczorek – Hinz 2001, 168). The block was thawed, opened and micro-excavated in 2013. Excavation is still ongoing and the preliminary results are presented here (*Fig. 24.1*).

2. History of Starigard and the "northern grave yard"

A fortification with a circular rampart marks the beginning of Starigard possibly as early as the 7th century AD. At the end of the 8th century AD the fortification expanded to incorporate the eastern settlement and changed from a round to an oval-shaped hill fort, measuring 260 m across. The fortification remained like this until it ceased to be occupied in the 13th century AD. The church of Starigard evolved from a double-span royal hall which was altered several times until finally "church 2" (16x6.2 m) was constructed in the time of the first diocese of Oldenburg (972–983) and later destroyed by a fire-related disaster during the great uprising of the Slavs. Subsequently a pagan sacrificial area was established at the same place until the castle was abandoned.

The approximately 100 graves of the "northern grave yard" are inhumation burials, all of which are oriented in an east-west alignment. The majority of the graves are located inside the church. Some graves overlap or form clusters. The remaining graves are located on the outside, along the southern wall of the church. The main graves are situated in the centre close to the position of the presumed altar. Such positions are – according to the different interpretations of the building – designated for founders and their close relatives or for persons of high Christian rank. Oversized tree-coffins and unique grave goods emphasise their high status. It was the time of the Ottonian mission and expansionist policy when members of the ruling class became Christians and old Slavic traditions merged with influences of the Christian West and the Viking North. So the grave finds from Starigard represent the newly developing "European noble culture" (Gabriel – Kempke 2011, 11–12). As well as the "northern grave yard" in the north-eastern area, a second, the so-called "eastern grave yard" with an additional four graves, was found in 1986. A more detailed summary of Starigard´s history can be found at Gabriel – Kempke (2011).

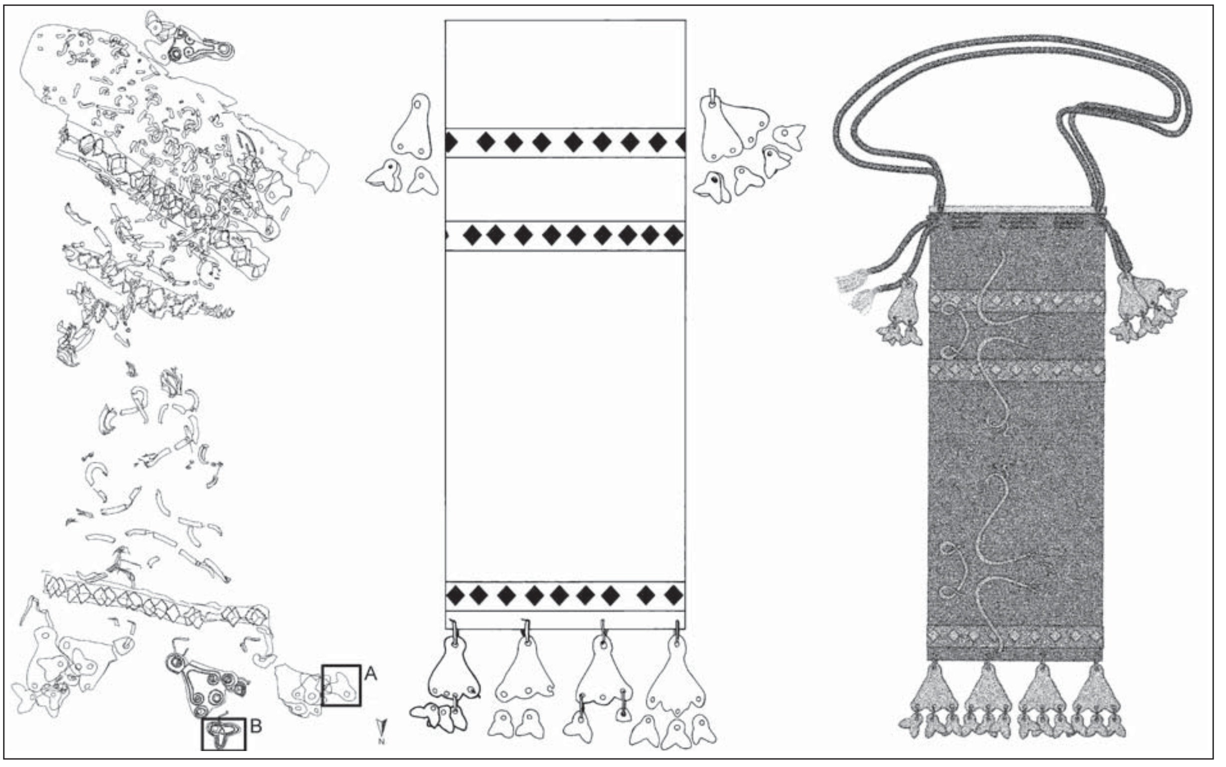

Fig. 24.1: Dr. Gabriel's graphical interpretation of the X-ray images (left) with two jingle sheets (A and B) visible in the opened block-lift in Fig. 24.4 and the reconstructions based on his research (right) (after GABRIEL – KEMPKE *2011, 215–216;* WIECZOREK – HINZ *2001, 168).*

Fig. 24.2: Overview plan of all graves, two churches and the sacrificial area with the horse-head deposits from pagan times. The reliquary belongs to grave 74 (red) on the west side of the altar (after GABRIEL – KEMPKE *2011, Beil. 1).*

3. The reliquary from grave 74

Grave 74 overlaps grave 75 and both were found in a prime position: in the first row in front of the altar. They belong to burial phase 2 of "church 2", the time the first diocese of Oldenburg was founded. Both tree-coffins (300 and 310 cm in length) have an exceptional ship-like form and due to their similarities are thought to be the two halves of one tree. The body (male, 179.9 cm, more than 75 years) was lying stretched in supine position with his skull turned slightly to the left. Besides the reliquary, a hollow gold-bead, a sword, a knife, a whetstone, a buckle and strap-end and a wooden gaming board, or box, with 37 gaming pieces were retrieved (*Fig. 24.3*).

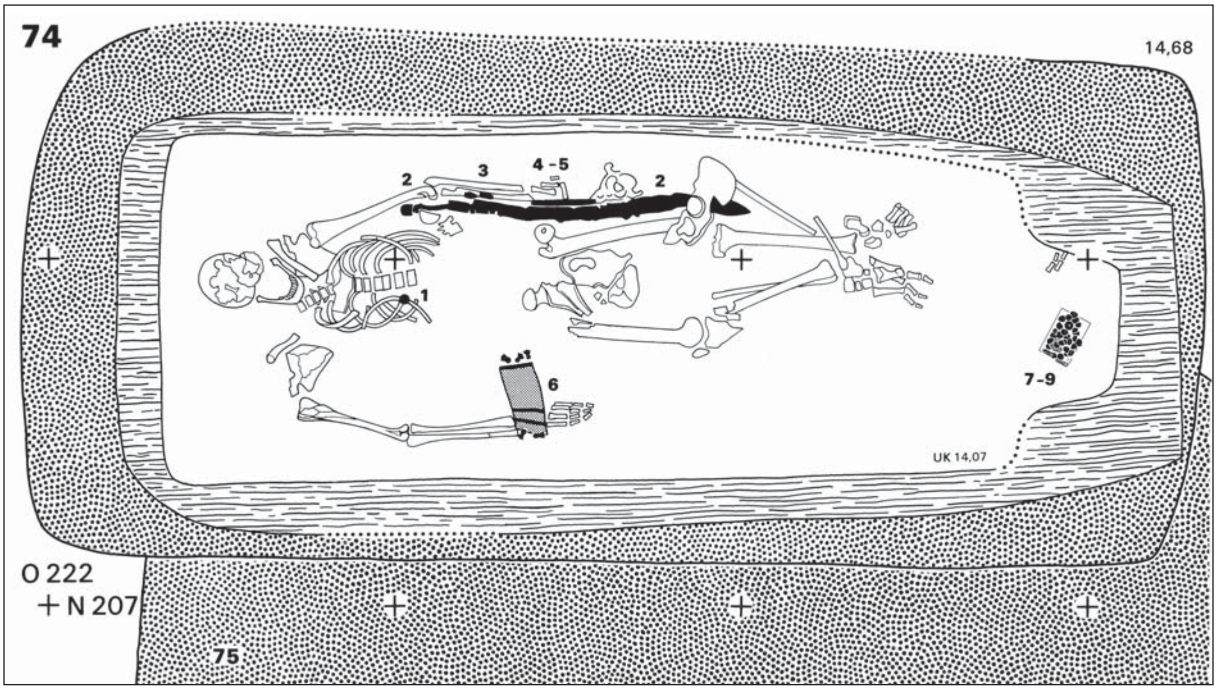

Fig. 24.3: Grave 74 is overlapping grave 75 in the south with the skeleton and the grave goods (1: hollow gold bead, 2: sword, 3-5: buckle and strap-end, 6: reliquary, 7-9: game board, or box, with 37 gaming pieces) (after Gabriel – Kempke *2011, 149).*

The reliquary was located on the right-hand side of the body. Remains of wood – probably from the coffin lid – covered most of this area but traces of gold led Dr. Gabriel to prepare a highly stable block-lift: the section was covered with aluminium foil, followed by alternating layers of glass fibre fabric and plaster of paris bandages. Finally the bottom was cut from the soil. To aid X-ray analysis, lead letters were attached to a sheet of paper in a grid-like fashion. The paper was then attached to the plastic cover on the top of the block-lift. In March 1998 the block-lift was CT scanned without gaining any new information.

4. The micro-excavation in 2013

Since its recovery it was thought that the items within the block were too fragile to be retrieved. However, a recent loan request for the upcoming exhibition "CREDO Christianisierung Europas im Mittelalter" in Paderborn prompted a reassessment of the block and its contents.

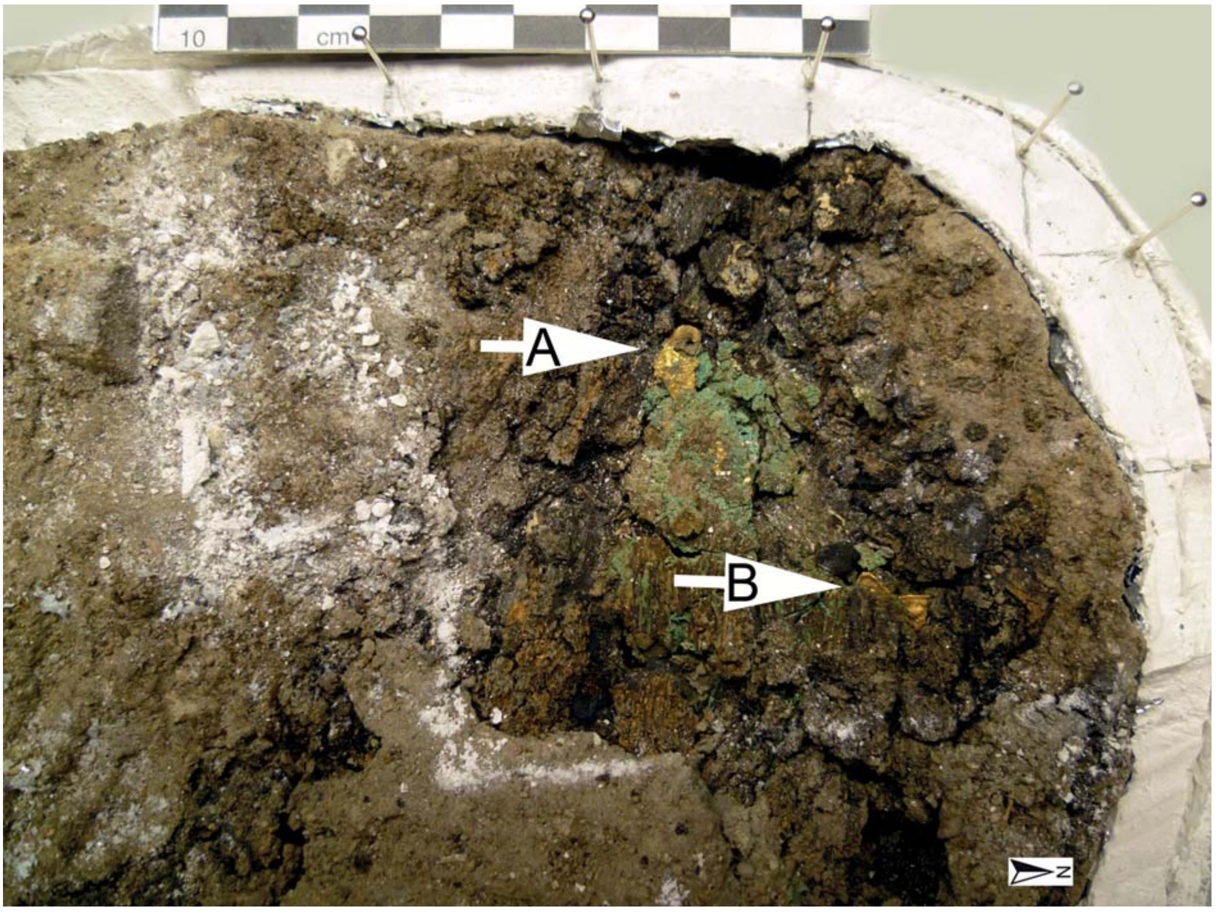

Fig. 24.4: The north-west corner (see Fig. 24.6, square 1) after opening the complete block-lift: jingle sheets A and B (see Fig. 24.1) covered by wooden remains and adhering to black-grey-ish textile remains below. Green corrosion between both jingle sheets points to components made from copper-alloys. The surface is covered by white dust from opening the plaster of paris capsule (photo: G. Zink).

There was a great deal of uncertainty about the state of preservation after being frozen for 30 years. The lead letters visible on the X-rays were transferred to the plaster capsule and the corner was opened up to the letters E and F. It became evident that the block had totally dried out. The gold remains are very brittle and the micro-stratigraphy is too complex to attempt the lifting of even one gold sheet for analysis. Moreover dust from cutting the plaster case settled on the fragile surface despite the micro air extraction (*Fig. 24.4*).

Finally it was decided to open the block-lift completely. Cutting the capsule along the outside

Fig. 24.5: Cleaning the surface with glass pipettes on a micro vacuum-cleaner and insect needles at the south-east corner (see Fig. 24.6, square 2): between wooden remains and the remains of the body, the "reliquary" is visible: a black-grey-ish substance with gold-threads (photo: I. Sommerfeld).

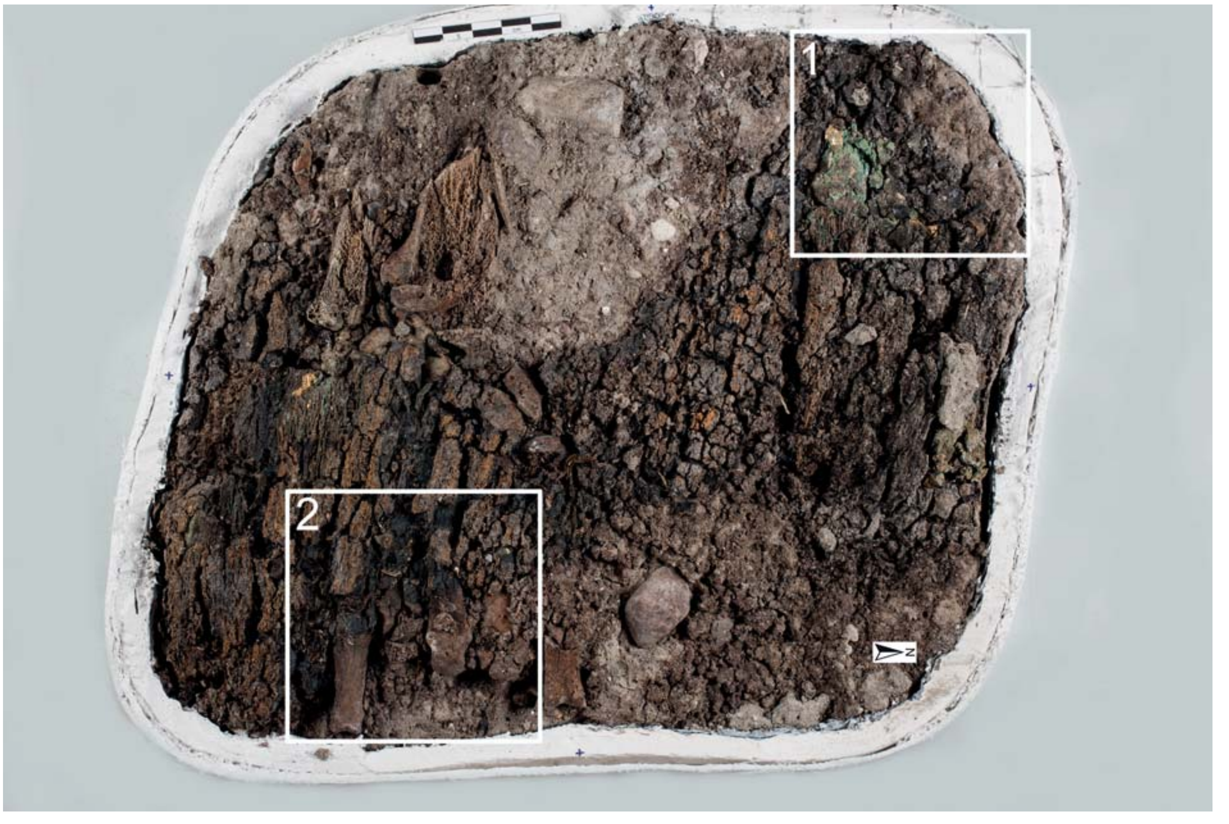

Fig. 24.6: Overview of the exposed surface in 2014. 1 = corner opened first (see Fig. 24.4); 2 = black-greyish textile remains with gold thread (see Fig. 24.5) (photo: C. Janke).

avoided spoiling the delicate surface with plaster dust. As the block was dried completely mechanical cleaning with minute tweezers, insect needles (size 000) and a micro vaccuum cleaner with a millimeter sized opening was the most appropriate method. In some parts the dry soil, rich in silicate and mica, was so compact that it had to be rewetted. In order to minimize contamination and to allow for later analyses, 100% ethanol was applied by means of a syringe. For future aDNA-analyses all instruments were cleaned with DanClorix© (a chlorine containing detergent) in tap water before being used (*Fig. 24.5*).

5. Initial findings, conclusions and prospects

The decision to block-lift part of the grave goods of grave 74, proved to be beneficial. The find is extremely complex and the materials are in a poor state of preservation. A conventional on-site excavation and presentation of the find would not have been possible. With hindsight, the use of lead letters on a sheet of paper was not as useful as was hoped. The sheet had a tendency to move and a realignment of block and X-ray image was not always possible. It would have been better if the letters had been fixed into the plaster of paris.

Dr. Gabriel's initial observation could be confirmed after the block-lift was opened. However, it was possible to answer further questions regarding the nature and composition of materials present.

– The jingle sheets are made of a copper alloy, possibly bronze and covered on both sides with a thin sheet of gold (see *Fig. 24.8/A* and *B*).

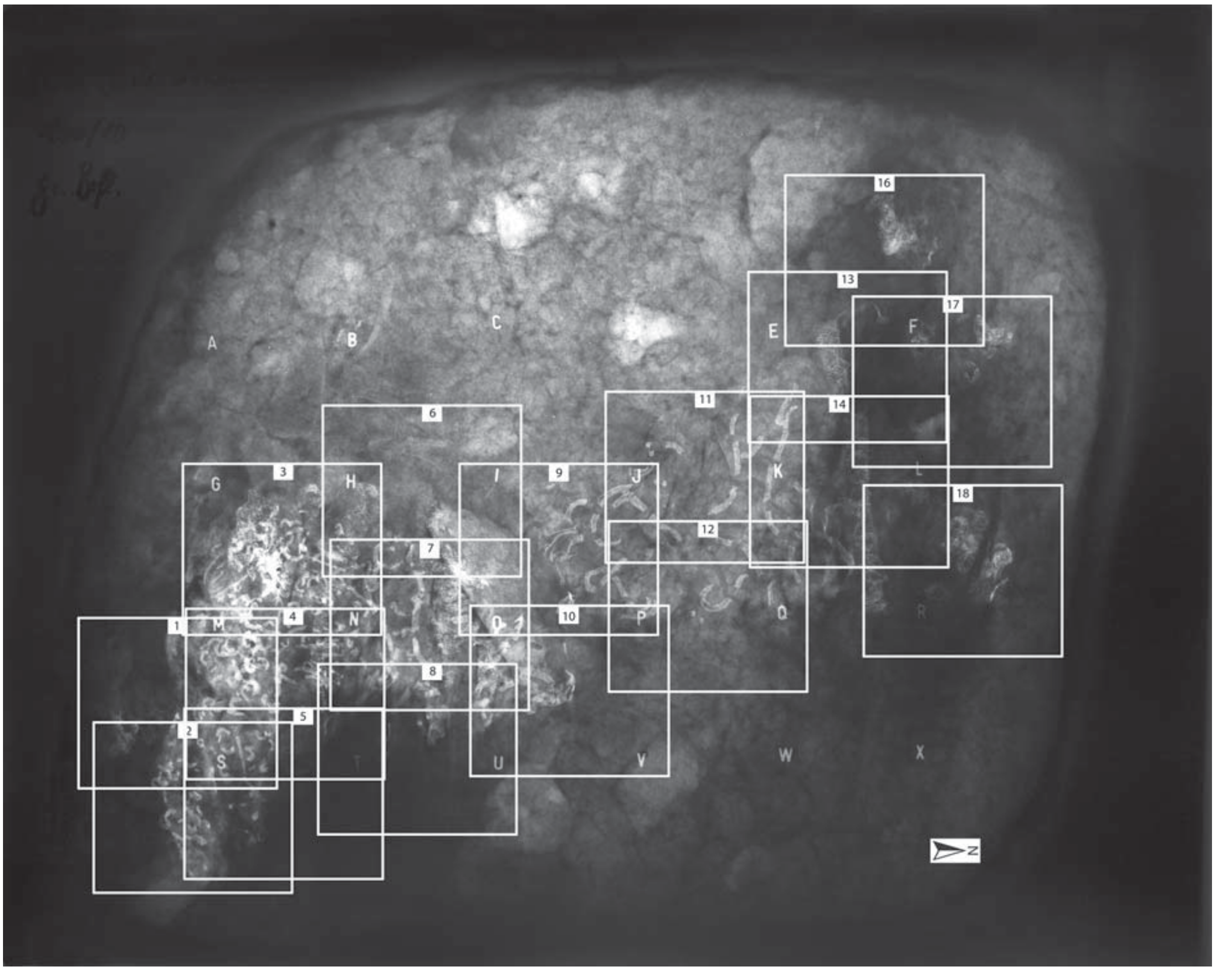

Fig. 24.7: X-ray overview of the block and location of detailed x-rays (no. 1 – 18 from left to right) (photo: G. Zink).

– The three horizontal braids with rhomb-shaped ornamentation are visible as dark stripes in the X-rays (see *Fig. 24.8/C*) but only preserved as a black-grey substance which is too decayed to be sampled for fibre analysis. However, FTIR-analysis carried out by the colleagues of the conservation centre Vejle, Denmark showed, that it is a protein based material. FTIR also detected carbohydrates on the underside, which we cannot interpret yet. Plied threads with knots made from a similar looking substance can be found at different places all over (see *Fig. 24.9/2*).
– The gold threads are made of gold strip wound in z-twist around a non-spun fibrous core. The gold is discoloured black, along the edge where it is in direct contact with the textile of the braids. If further analyses prove that the textile is wool and the gold thread to contain silver, then we could be looking at a reaction with hydrogen sulphide. It could not be analysed yet how the gold threads were attached to the textile – by weaving or by embroidery (see *Fig. 24.9/1*).
– Long threads in light brown colour could be found several times along the rhomb-shaped ornamentation with gold threads (see *Fig. 24.9/3*).
– A second type of textile was found in the south-east corner (see *Fig. 24.6*, square 2). The fibres have not been analysed but they are in a much better state of preservation. It is tabby woven and covered by a not yet analysed substance (see *Fig. 24.10*).

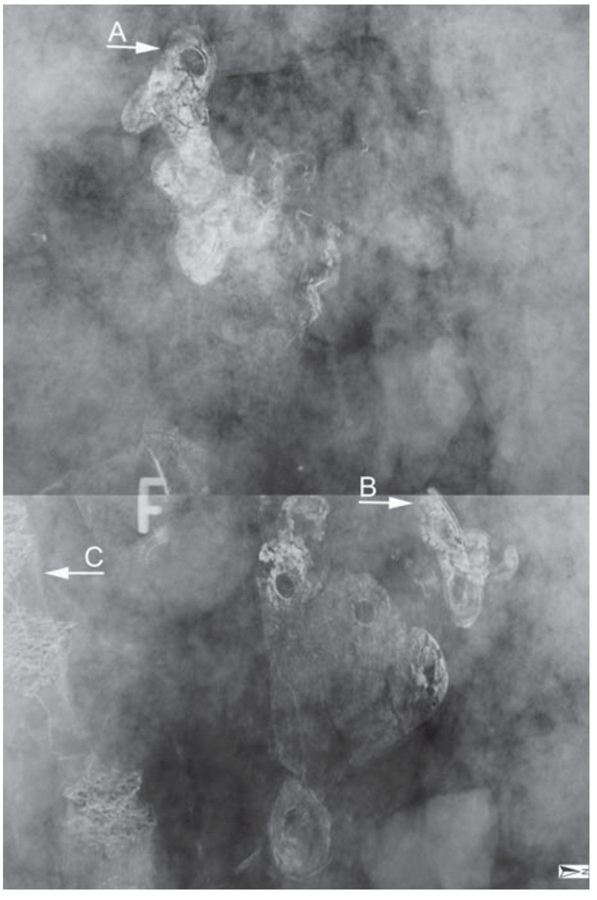

Fig. 24.8: X-rays 13, 16 and 17 stitched together show the two jingle sheets (A and B) and one of the braids with rhomb-shaped ornamentation with gold thread (C) (photo: G. Zink).

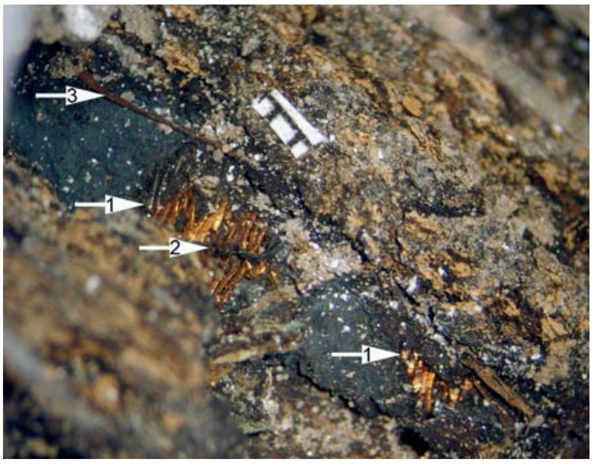

Fig. 24.9: The uncovered surface proves what X-ray no. 13 already implied (see Fig. 24.8/C): rhomb-shaped ornamentation with gold thread in a black-grey-ish substance which is the completely decayed original textile. The FTIR-analyse proved that it is a proteinous material with carbohydrate on it´s underside. 1: gold thread discoloured black along the edges of the rhomb-shaped ornamentation, 2: two plied threads with a knot, 3: long and light brown threads along the braid (photo: G. Zink).

Initial results are promising and it is hoped that work will continue and answer the remaining questions regarding the materials, form and function of this fascinating find.

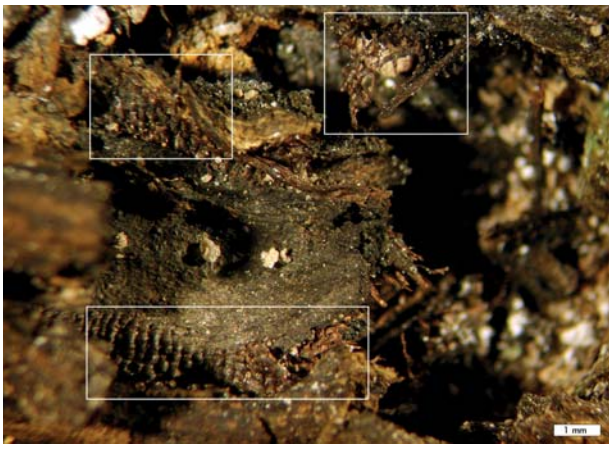

Fig. 24.10: A second type of textile in the south-east corner (see Fig. 24.6, square 2) covered by a not yet analyzed black substance (photo: G. Zink).

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I would like to thank Angela Middleton (English Heritage Portsmouth/UK) for her good advice and proof-reading, Inga Sommerfeld and Claudia Janke (both Schloss Gottorf) for their photographs and moreover I want to thank Lise Raeder-Knudsen and Clara Bratt Lauridsen (Conservation Centre Vejle/DK) for their wonderful offer to help us with FTIR-analyses of the black-grey-ish substance. I would also like to thank Dr. Bleile (Schloss Gottorf), who actually initiated this project, by agreeing to the opening of the block-lift in 2013. And finally Dr. Gabriel as this research could only begin because of his lifelong careful approach to his work as archaeologist!

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Chapter 5:
Tools and Textile Production

25 | Production and Consumption: Textile Economy and Urbanisation in Mediterranean Europe 1000–500 BCE (PROCON)

MARGARITA GLEBA

Abstract: The paper presents a new project "PROCON: Production and Consumption: Textile Economy and Urbanisation in Mediterranean Europe 1000–500 BCE" (2013–2018), funded by a European Research Council starting grant. The aim of the project is to test the hypothesis that textile production and consumption were significant driving forces of the economy and of the creation and perception of wealth in Mediterranean Europe during the period of urbanisation and early urbanism in the Iron Age (1000–500 BCE). The project structure encompasses four research strands within the *chaîne opératoire* of textile economy: ***Resources***, ***Production***, ***Product*** and ***Consumption and Exchange*** which address the specific objectives of the project on the basis of selected case studies and using an interdisciplinary combination of methods to investigate textiles, textile tools, textile iconography, archaeozoological and archaeobotanical remains, as well as relevant written sources.

Keywords: textile, production, consumption, Iron Age, Mediterranean Europe, urbanisation

1. Introduction

It has been convincingly demonstrated that intensive production and consumption of textiles was at the heart of urbanisation throughout the history of the world. The lords of the Inca state extracted heavy tribute of cloth from its peasants, which in turn clothed and sheltered the army, dressed its citizens and filled its storehouses (MURRA 1989). In 18th century England, the Industrial Revolution was fuelled by the desire of the nobility and aspiring middle classes to invest in cloth and clothing, with its opportunities for self-promotion and political investiture (SCHNEIDER – WEINER 1989). In the ancient past a similar pattern is recognisable in the emergence of the Bronze Age urban state centres of Mesopotamia (MCCORRISTON 1997; WATTENMAKER 1998) and the Aegean (KILLEN 1984; 2007). Here, early written state archives provide abundant evidence of the importance of textile production and consumption in the formation of the political systems synonymous with urbanisation. Archaeologists have focused particular attention on the fluorescence of urbanism in the 1st millennium BCE in ancient Greece, Italy and Spain (e.g. GUIDI 1998; OSBORNE – CUNLIFFE 2005). Yet, despite the promising early evidence for the influence of textiles in the Bronze Age eastern Mediterranean, the role of textiles in the formation of these Iron Age Mediterranean urban centres is largely lacking, mostly due to the absence of written evidence. To address this gap, the PROCON project (2013–2018), funded by the European Research Council starting grant, is investigating the role of textile production and consumption in the formation of north Mediterranean urban centres during the Iron Age (1000–500 BCE).

The aim of the project is to test the hypothesis that textile production and consumption were significant driving forces of the economy and of the creation and perception of wealth in Mediterranean Europe during the period of urbanisation and early urbanism in 1000–500 BCE. The focus is on the significance of the production and consumption of textiles for the development of city-states (as clothing, elite regalia, trade and exchange items) and the implications of this for other aspects of the economy, such as the use of land, labour resources and the development of urban lifestyle. The project is concerned with the following questions:

– How was this production and consumption organised: where did the various resources come from, what were the technologies used, what was the level of organisation?
– Who was involved in textile production and consumption?
– What was the quality and quantity of textiles produced and how did they change over time in response to urban consumer demands?

In exploring these questions the project follows not only a functional approach, but also considers the value ascribed to these goods and the customs that came with them. The project furthermore conceives the economy of textile production as a network that stimulated the mobility of goods, people, ideas and technologies in the context of developing urbanisation (see Riva 2010).

2. Objectives

The questions outlined above lead to the following objectives for the PROCON project:
1. To evaluate the availability and degree of exploitation of the various resources for textile production;
2. To assess the technological and organisational parameters of textile production;
3. To explore the consumption of textiles as clothing and utilitarian goods and to trace the increased demand for clothing through changes in fashion and in wealth accumulation, and demand for sail cloth with increased mobility;
4. To identify the modes, means and directions (through time and space) of the resource, technology and textile consumption and exchange;
5. On the basis of the above, to provide a new reading of economic history for the period and area under consideration, which sees textile production and consumption as a major economic factor during urbanisation of Early Iron Age Mediterranean Europe.

3. Project Structure and Methods

Consumption of textiles is defined by the quantity and quality of consumables produced, which in turn depends on the level of production organisation and the availability of material and human resources. The project structure hence encompasses four research strands within the *chaîne opératoire* of textile economy: ***Resources***, ***Production***, ***Product*** and ***Consumption and Exchange*** (*Fig. 25.1*). The four research strands of the project address the specific objectives of the project on the basis of selected case studies and using interdisciplinary combination of methods which has not been attempted before.

3.1. Resources

The generic term 'textile' covers a wide range of finished products, made from a variety of raw materials. Resources for making textiles include plant and animal products used for fibres and dyes, as well as those used in various stages of textile manufacture, such as washing. In this way, agriculture (flax cultivation), animal husbandry (sheep keeping) and exploitation of environmental resources (fibres from nettle and tree bast, wild dye plants such as woad and madder, minerals for mordants used in dyeing such as alum) are closely linked to textile production. An important distinction between the exploitation and management of wild resources and the curation of domesticated species is the fact that former can be harvested directly whereas the latter require investment of effort, time and resources for a period before harvesting (Bailey 1981). There are therefore two important aspects to the investigation of resources. One is biological (botanical or zoological) and focuses on the analysis of the resources themselves. The

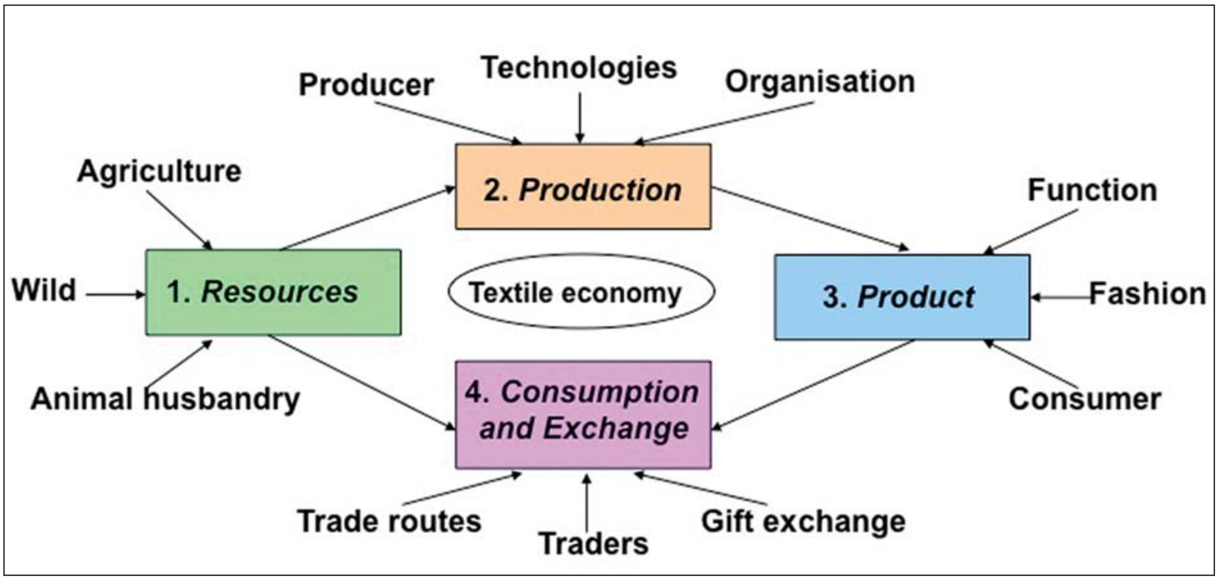

Fig. 25.1: PROCON structure (© M. Gleba).

second, more culturally oriented, concentrates on the means by which resources are acquired, maintained and controlled, i.e. human economic behaviour.

Fibre and dye resources used in textile production are investigated through textile analysis and investigation of archaeobotanical, archaeozoological and geological evidence. The data sets collected will make it possible to evaluate the availability and degree of exploitation of the various resources for textile production.

3.2. Production

Transformation of raw materials into final products involves a set of technologies and organisation on the part of a producer who possesses certain skills and recipes. Technology may be defined as "a corpus of artefacts, behaviours, and knowledge for creating and using products that is transmitted intergenerationally" (Schiffer – Skibo 1987). Thus, information about technology can be deduced from every archaeological artefact. Artefacts, in turn, represent a part of technology which can be recovered archaeologically, and, through their variability, attest technological changes. Beyond the material aspects of technology, the technical decisions a craftsperson makes are also embedded in the worldviews, cultural practices and social relations of a given society (Dobres 2000; Lemonnier 1986). Changes in technology may be caused by experimentation, change in demand involving function of the product, or economic processes such as competition (Schiffer – Skibo 1987, Van Der Leeuw – Torrence 1989).

Textile tools are ubiquitous at archaeological sites throughout Mediterranean Europe and often constitute the single most important and plentiful type of evidence for assessment of the scale of textile production and technology at a given site (Gleba 2008). These implements include tools associated with various stages of textile manufacture: preparation of the fibres (shears), spinning of the yarn (spindle whorls), weaving of the fabric (loom weights), and secondary processes such as sewing and embroidery (needles). Through ethnographic studies we often have knowledge about tool function and different processes such as fibre preparation, weaving techniques, and/or tools made of perishable materials (Hoffmann 1964).

The manufacture of any object requires a more or less organised production process. Each stage of this process is dependent both on the assured supply of raw materials or unfinished goods from the preceding operation, and on the steady demand for its own products from the one which followed (Bender Jørgensen 1992). Technology combined with social relations defines a particular mode of production (Sassaman 1992). Four levels of production are widely recognised for ancient crafts (Costin 1991). Household production is the simplest mode in which each household produces what it requires for its own consumption. Household industry produces not only for its own use, but also for sale. In a workshop industry, the product is manufactured for sale and requires increased efficiency and specialisation on the part of a craftsperson. Finally, in a large-scale industry, production takes place outside the household on a full-time basis and exclusively for sale and requires capital investment and extensive product distribution. The three more advanced modes of production require a lesser or greater degree of specialisation, or concentration on a specific type of production, on the part of the craftspeople involved in the production process (Dark 1995). Most discussions of craft specialisation in ancient societies involve the question of sedentariness (e.g. Nijboer 1997), the degree of which is perceived as a major defining factor for each mode of production (Arnold 1988; Peacock 1982). With the more complex modes of production generally associated with urbanised societies, division of tasks is likely to occur, culminating with the establishment of specific textile professions, such as carder, comber, spinner, weaver, fuller *etc*., as in the Roman period when they are attested in literary and epigraphic sources (Larsson Lovén 1998). Actors involved in textile production vary by gender and archaeological, written and iconographic evidence indicates that in Mediterranean societies spinning and weaving were carried out by women but resource acquisition and product exchange more likely involved men (Gleba 2008).

The investigation of textile production is approached by ascertaining the gender and status of textile producers and investigating the techniques and organisation scale through textile tool data analysis. These data sets will make it possible to assess the technological and organisational parameters of textile production.

3.3. Product

Once produced, goods as commodities have functional but also social content and hence have material, cultural and social value (Schneider – Weiner 1989). A textile is the result of complex interactions between resources, technology, and society and as such, it is a repository for (prized) fibres, dyes, dedicated human labour, skill and art, as well as social meaning (Andersson *et al.* 2010). The very broad possibilities of construction, colour and patterning give textiles almost limitless choices for the communication of social values. Worn or displayed in an emblematic way, textiles can denote variations in age, sex, rank, status and/or group affiliation. Textiles are hence a cultural product the design and use of which are subject to cultural patterning (Sørensen 1997). As such, they have been used by power-holders and have even been a standard of value, serving to legitimate political elites.

While textiles were used for a wide variety of purposes, their most important function has always been that of clothing. Dress may express individuality and symbolise affiliations to family, social class, occupation, religion, nationality, etc. Clothing may also be instrumental, involving the rational use of dress in goal-directed behaviour, relating to utility, protection, comfort, occupation, winning friends or a partner in marriage, change of status, etc. What one wears and how one wears it are key aspects in the discussion of clothing as an indicator of identity. Both can be put into the category of fashion and both can be regulated. Fashion must be interpreted by means of the associations that people make between ideas and garments, by some understanding of the language of clothes. Fashion is enigmatic and no completely satisfactory explanation of its metamorphoses has ever been proposed. A system of fashion is structured on change, because fashion supports status. Changes in fashion thus affect consumption patterns. A garment is discarded not only when it wears out but also because it ceases to bear the right message about the identity of the wearer. Clothing changes with changing social values and historical circumstances. It is therefore a material that is particularly useful for understanding of consumption patterns. Goods as elements of consumption are also the visible signs of people's success. And since dress is always in evidence, it affords an indication of an individual's pecuniary standing to observers. It is therefore particularly likely to be chosen as a medium of display by individuals who are anxious to demonstrate conspicuous consumption.

Textiles are also used for a variety of utilitarian purposes: as furnishings for the house, or house itself (tents), as books (Etruscan *libri lintei*), to carry and contain things, and in movement as sails for ships. The latter is particularly relevant for this project since sailing has contributed to the spread of the pan-Mediterranean Orientalising culture.

Textiles do not need energy resources like other crafts (e.g. wood for pottery and metallurgical production); rather, they require human skill and time in order to produce, prepare and transform the raw materials into final products. Experimental archaeology provides important data on the quantity of time needed to produce specific quantities of certain type of textiles (Andersson – Nosch 2003).

Clothing and utilitarian textiles are investigated on a qualitative and quantitative level in order to explore the consumption of textiles as clothing and utilitarian goods and to trace the increased demand for clothing through changes in fashion and in wealth accumulation, as well as demand for sail cloth with increased mobility.

3.4. Consumption and Exchange

Consumption studies may be used to examine the social as well as material aspects of goods and thus help explain why exchange is a compelling phenomenon (Bourdieu 1984; Dietler 2010; Douglas – Isherwood 1979; Miller 1987; 1995; Mullins 2011). Under conditions of increasing social complexity that emerged in Early Iron Age Mediterranean, exchange activities become even more important. As an item of consumption, textiles range between luxury and necessity and are susceptible to the creation of specialised products, the manufacture of which is narrowly localised. Such a localisation creates demand and necessitates redistribution, resulting in textile trade. In Early Iron Age Mediterranean, the demands of the ever-growing urban centres, where the consumer needs of concentrations of people extended beyond the local resources, led to the intensification of production (Foxhall 2005; Osborne 2005). While some products were produced in the surrounding countryside, others had to be imported over long distances.

The movements of goods, raw materials, and entire exchange systems can be reconstructed through studies of the distribution and sources of certain materials. Many theoretical frameworks have been constructed for the study of the ancient economy. Karl Polanyi (1957) postulated three main modes of exchange: reciprocity, redistribution and market exchange, the later taking the form of either treaty trade or market trade. Gift giving, linked to the traditions of hospitality (Mauss 1954) had more than a purely economic significance, reinforcing the relationship between the trading parties and taking place within a framework of reciprocity. Despite the difficulty in distinguishing archaeologically between gift-giving and commercial exchange, the presence of prestige objects (including textiles) in princely tombs throughout the Mediterranean during the Orientalising period has made it possible to reconstruct the elite exchange circuits.

Another and probably more complex mode of exchange existed on the level of information or technology-related know-how involving ideas, symbols, inventions, fashions, values and, consequently, the technology and tools associated with them. The role of migrant craftsmen in spreading new technologies has been highlighted for ceramics, metalwork, and other crafts (e.g. NIJBOER 1997). In the case of textile production, since women were the principal agents of the craft, this last mode of exchange was probably often carried out through intermarriage.

A core-periphery perspective, based on the world systems theory developed by Wallerstein in relation to the rise of the modern capitalist economy, has also been applied as an explanatory model to the economy of Mediterranean Europe in the first half of the 1st millennium BCE (e.g. SHERRATT–SHERRATT 1993). Such an approach can offer economic insights at the macro-scale, but the relationship between centre and periphery was not a unidirectional one and the internal dynamics driving change also needs to be explored (STEIN 2002; WHITEHOUSE – WILKINS1989).

Consumption and exchange are investigated by estimating quantity of textiles produced and analysing textile provenance and trade routes to identify the modes, means and directions of the resource, technology and textile consumption and exchange.

4. Conclusion

The project is concerned with broad patterns and adopts a Mediterranean-wide rather than a regional perspective, along with recent scholarship on 1st-millennium BCE Mediterranean (e.g. RIVA 2010; VLASSOPOULOS 2007). The geographical area selected for this study is Mediterranean Europe, consisting of eastern (Greece), central (Italy) and western (Spain) regions. In doing so, the project explores similarities and differences between these regions as they followed their trajectories towards urbanisation. The reason for choosing the area in question in the Early Iron Age period is that this was the first time in history when a more or less exclusive preference for urban settlement – prevalent in Europe to this day – achieved a truly large scale. Urban life led to new consumption practices requiring new and different structures to sustain them.

Using established and novel approaches to textile research, the project results aim to change the landscape of urbanisation research by providing new data sets demonstrating textile production and consumption as major economic and social factors. Taking the developments in a specialist research field of textile archaeology we hope to apply them to modelling the dynamics behind the broader phenomenon of urbanisation in Europe.

Acknowledgements

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26 | Against all Odds: Pure Science and Ancient Weaving

ELLEN HARLIZIUS-KLÜCK

Abstract: The distinction between pure and applied science can be traced back to Plato and is involved in his dialogue of the Statesman as weaver. This contribution investigates the role that the diagram of the doubled square plays in this fundamental distinction. Furthermore the possibility of its origin in arithmetical and geometrical constraints of pattern weaving on a warp-weighted loom is discussed. The focus of the argument relies on the three explanations for the so-called Greek revolution that have been favoured in scholarly texts so far: the discovery of the harmonies by Pythagoras, the *tertium non datur* of Parmenides, and the pebble proofs of Greek arithmetic.

Keywords: weaving technology, pattern weaving, ancient arithmetic, advent of science in Greece, warp-weighted loom, Plato

1. Introduction

Plato, in his dialogue *Statesman*, was the first to divide all sciences (*epistēmas*) into two classes: pure and applied (258c). The arithmetic of odd and even numbers or dyadic arithmetic is his paradigm for pure and craft for applied science (258d-e). In that dialogue, a nameless stranger from Elea is talking with a young man called Socrates and tries to define what the *epistēme*, the science, knowledge, or art of the true statesman would be like. In the end, the statesman has to compose a state by "royal weaving" (310e; cf. BERNADETE 2006, III.66) that connects the citizens harmonically.

The quantity of scholarly publications discussing the weaving paradigm in Plato's *Statesman* is huge. However, it is hardly ever noticed that weaving serves here as a replacement for a pure science that goes beyond the understanding of the young man who is involved in this dialectical conversation: Socrates (not the philosopher, who instead listens to this conversation without interrupting) is asked to classify living beings by comparing the number of their feet (two or four) to the ratio of diagonal and area of a two-feet-square and a four-feet-square (266a-b; see *Fig. 26.1*). It has been stated that the living subjects ruled by the statesman are described thus "in the most laughable manner" (BERNADETE 2006, III.93).

Obviously, we shall think of this exercise as a joke, but the crucial point is to test Socrates' knowledge of incommensurable quantities and the way in which they can be related. Doubled squares are the best examples for discussing the problem that the relation of side and diagonal cannot be expressed by a ratio of integers (which is incommensurability by definition). This mathematical knowledge on incommensurable quantities is what the young interlocutor fails to master. How can the art of weaving replace such a pure science?

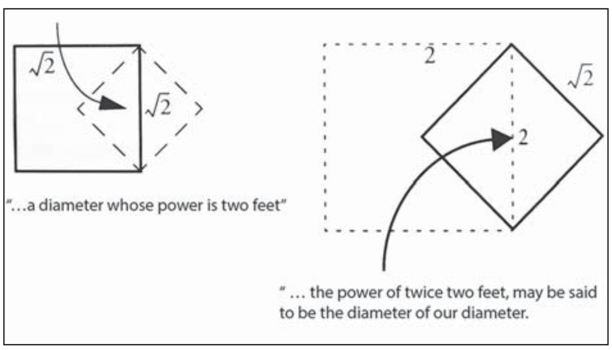

Fig. 26.1: Square problem discussed in Plato's Statesman, 266a-b (drawing: E. Harlizius-Klück).

The doubled square also serves as an example for the very first lesson in geometry we find in literature, namely Plato's dialogue *Meno*

(82a-85b; cf. *Fig. 26.2*), but also as the presumably best case for inventing a sort of arithmetic that enabled indirect mathematical proofs: the theory of odd and even or dyadic arithmetic. Both, the arithmetical theory and the proof of incommensurability in the square are handed down to us in the famous Elements of Euclid, written around 350 BCE.

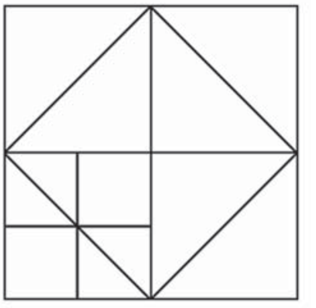

Fig. 26.2: Square problem discussed in Plato's Meno, 82a-85b (drawing: E. Harlizius-Klück).

There is no doubt that Euclid's book is an example of pure science; likewise the proof of incommensurability that argues via the distinction of odd and even numbers. What is debated in the history of mathematics is the question where this distinction and the theory come from. Candidates are

– Music theory, especially the discovery of harmonies by Pythagoras (cf. SZABÓ 1978, 94).
– The Eleatic school that follows Parmenides and his discovery of the excluded middle as a means of logical reasoning (hence the "Stranger from Elea" in Plato's dialogue; cf. SZABÓ 1978, 304).
– Argumentations with pebbles as source for the invention of proofs and dyadic arithmetic (cf. BECKER 1966, 40–50).

We can say that the diagram of the doubled square is at the heart of the revolution of Greek mathematics (cf. SZABÓ 1978, 94), however no diagrams are presented in the ancient texts mentioned here. The first mathematical diagrams we know are from Aristotle (cf. HARLIZIUS-KLÜCK 2004, 66).

The diagram of the doubled square, which can be seen in *Fig. 26.3,* is depicted as a fabric pattern woven on a warp-weighted loom. In weaving, everything we see as woven pattern or motif is a logical composition of elements, namely the threads, going over or under each other: in tabby, if odd threads are up, even ones are down. Furthermore, every geometric shape has to be transferred into relations of numbers, which in mathematical language means: ratios of positive integers.

Fig. 26.3: Detail of a plate from Cyprus with the depiction of a warp-weighted loom, ca. 850-750 BCE, collection of the University of Bonn, The doubled square pattern is marked with a white square (drawing: E. Harlizius-Klück).

The picture on the plate and hence, with the weaving of such patterns, the depiction of geometrical shapes by ratios of countable elements thus predates the logical reasoning and proofing of the geometrical properties by almost 5 centuries. My point is to ask whether weaving, because of this, might have induced logical reasoning on number properties like odd, even, prime, prime to each other, which are at the core of dyadic arithmetic. Did ancient textile technology matter for the so-called revolution in ancient Greece mathematics that started deductive sciences by formalized deduction and proofs?

Let us investigate the main sources for the three hypotheses: harmonies, excluded middle, and pebbles, and ask if there are contact points to weaving.

2. Discovering Harmonies or: Setting up the loom

One of the sources that are claimed to be responsible for the dyadic number theory is the discovery of musical proportions or harmonies. Nikomachus tells us that Pythagoras, when walking along a forge deep in thought about an aid for hearing similar to the pair of compasses, the straight edge, and the scale, "he heard by a divine chance hammers beating iron on an anvil, and making mixed sounds in full harmony with one another" (Iamblichus after REIDEMEISTER 2005, 28). Pythagoras walked into the forge, noted all the weights of the hammers, and went home to set up an experiment. "From a single peg fixed to an angle between two walls (…) he suspended four strings of the same material, of the same number of strands, of equal thickness, and of equal torsion. And from each string he hung one weight by attaching the weight at the bottom and making certain that all the strings had equal length. Then, striking groups of two strings alternately, he found the aforementioned concords sounded in the various combinations of strings" (Iamblichus, cf. REIDEMEISTER 2005, 28; see *Fig. 26. 4*).

Fig. 26.4: Pythagoras discovering the harmonies (after: F. Gaffurio, Theorica musica, Brescia 1496).

It is likely that Pythagoras found all necessary tools at home in one place: the peg, the threads, and the weights are the constituents of a warp-weighted loom that was common to every Greek household (see Fig. *26.5*). And the technology of combining the threads to some sort of instrument that Pythagoras is applying here is nothing but the setup of a warp-weighted loom, where threads of the same material, thickness, and torsion are fastened in equal distance to a peg lent against a wall and stretched by weights that are attached at the bottom while making certain that all threads have equal length.

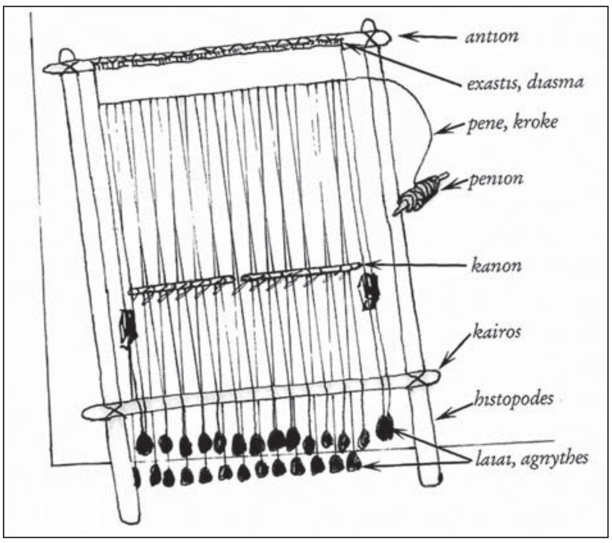

Fig. 26.5: Diagram of a warp-weighted loom (drawing: E. Harlizius-Klück).

What we learn from the story is that Pythagoras, in need for a musical instrument similar to the mathematical ones namely the pair of compasses, the straight edge, and the scale discovers the mathematical qualities of the warp-weighted loom. Indeed the names of some loom parts strongly support this connection; the Greek word for straight edge is *kanōn* and denotes the heddle rod that divides the odd and even warp threads for providing the shed to insert the warp.

And this is not an accident of Pythagorean times if we consider the fact that the Latin word for the straight edge is *regula*, designating the same weaving device. On top, a Latin word for the pair of compasses, *radius*, signifies the shuttle.

3. Excluded middle or: Setting up the Warp

The aim of the weaving model in Plato's Statesman is not to mix the brave and tempered citizen to achieve a third mixed or middle temper. In the end there is not one modest character but a harmony of the existing two. This reminds us that the stranger who leads the conversation is said to come from Elea indicating the circle around Parmenides who is famous for the foundation of logic by using the law of the excluded middle or *tertium non datur.* Weaving, where the threads are either warp or weft and either over or under the threads they cross, can thus replace the idea of contradictory number classification of odd and even in dyadic arithmetic.

Dyadic arithmetic not only defines what a number is or which classes can be distinguished (even number, odd number, even-times-even number, even-times-odd number, odd-times-odd number, prime number, etc.) it also includes theorems on their behaviour in generating new numbers. For example proposition 21 says: "If as many even numbers as we please are added together, then the sum is even." Or proposition 32: "Each of the numbers which are continually doubled beginning from a dyad is even-times even only" (cf. EUCLID, Book IX).

As we know from finds like the one from Tegle, where a starting border was discovered that was prepared to be used on a loom, already in weaving this border what later become the warp threads are divided into odd and even ones (eg. HOFFMANN 1964, 153–159). Fixing the starting-border at the upper beam or *antion* and distributing the odd and even threads behind and in front of the *kairos* for shedding, is how the warp setup is done on an ancient loom. This is usually done in a way that provides pairs of threads and always results in an even number of total warp threads (which is expressed in prop. 21).

The difference of odd and even is an arithmetical distinction that structures patterns in several weaving techniques. When weaving diamond twill (see *Fig. 26.6*), the motif itself needs an odd number of warp threads because of the pointed peak in the middle (in this case 15 threads). The repeat however uses the last thread as part of the next repeat and therefore is always even. In repeating the even motif, no matter if odd or even times, the whole thread number of a repeat is always even (see proposition 21 in Euclid). But for the last repeat, an additional warp thread is needed to make the whole symmetrical: the number of warp threads in neatly woven diamond twill is therefore always odd.

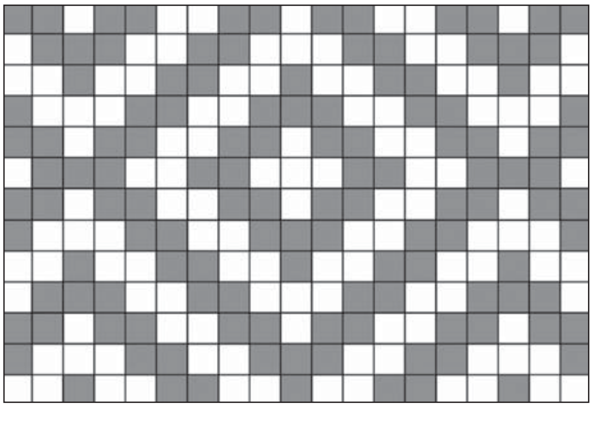

Fig. 26.6: Diagram of diamond twill (drawing: E. Harlizius-Klück).

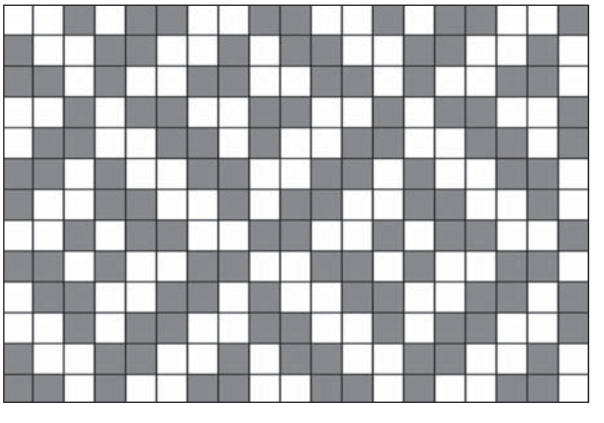

Fig. 26.7: Diagram of broken diamond twill (drawing: E. Harlizius-Klück).

For broken diamond (see *Fig. 26.7*), the structure seems to be more complicated but the considerations are easier. The motif as well as the repeat is even and so is the overall number of warp threads (proposition 21 again).

In case of an uneven repeat, the considerations are more complex, because one has to distinguish between odd times (proposition 23) or even times repeat (proposition 22) which give different results.

4. A Cosmos consisting of numbers or: Weaving patterns and figures

Given this connection of dyadic number arguments and the fact that the broken diamond twill resembles the doubled square, such weaving arithmetic might well lurk behind the theory of odd and even and its application in the proof of incommensurability in the square. The proof, as it is handed down by Euclid, may be characterized by the aim to double a square as was pointed out by Oskar Becker; and because of the age of the proof he stated that it had developed from a former pebble version related to the figure of the doubled square (Becker 1966, 51–52) which we already know from Plato's *Meno* dialogue (see *Fig. 26.2*) and the fabric on the Cypriote plate (*Fig. 26.3*).

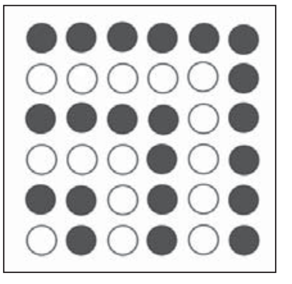

Fig. 26.8: Pebble proof: The sum of subsequent odd numbers starting with one is a square number (drawing: E. Harlizius-Klück).

What are pebbles? Pebbles or *psephoi* are black and white stones, arranged in forms and used as arguments in proofs (see *Fig. 26.8*). This way of proofing is a reconstruction derived from a quote of Aristotle in the *Metaphysics*. In refusing the Pythagorean idea of a cosmos consisting of numbers, Aristotle wrote: "Nor is it in any way defined in which sense numbers are the causes of substances and of Being; whether as bounds, e.g. as points are the bounds of spatial magnitudes, and as Eurytus determined which number belongs to which thing – e.g. this number to man, and this to horse – by using pebbles to copy the shape of natural objects, like those who arrange numbers in the form of geometrical figures, the triangle and the square" (Met. 14.1092b).

The odd-even distinction is not only necessary for the starting border and the pattern repeats, but also for the structure of the pattern itself. Double-faced tablet weaving as well as double weaves like the one I tried for the reconstruction of the weave on the Skyphos from Chiusi need a precise distribution of light and dark colour to the odd and even threads of the warp and sometimes also the weft (*Fig. 26.9*).

For such woven things like the horse of my reconstruction in *Fig. 26.6*, Aristotle's account on Eurytus makes perfect sense. Maybe the use of *psephoi* as something like a visual algebra was an instrument to transfer arithmetical rules that have been tacitly applied in weaving since millennia into a practice without threads but with keeping the logic of composition.

5. Conclusion

If we look at a patterned weave like the one from the Cypriote plate, it is clear that such a neatly woven piece would make use of all this arithmetic. Could it be then, that weavers invented the arithmetic that started the logical construction of mathematics in ancient Greece? The historians of mathematics never consider weaving as a source of mathematical argumentation. For them the theory of odd and even numbers has no application and is a pure invention for the purpose of mathematical proofs. Even if we agree that weaving already applied the knowledge behind this theory, proving clearly did not concern weavers very much.

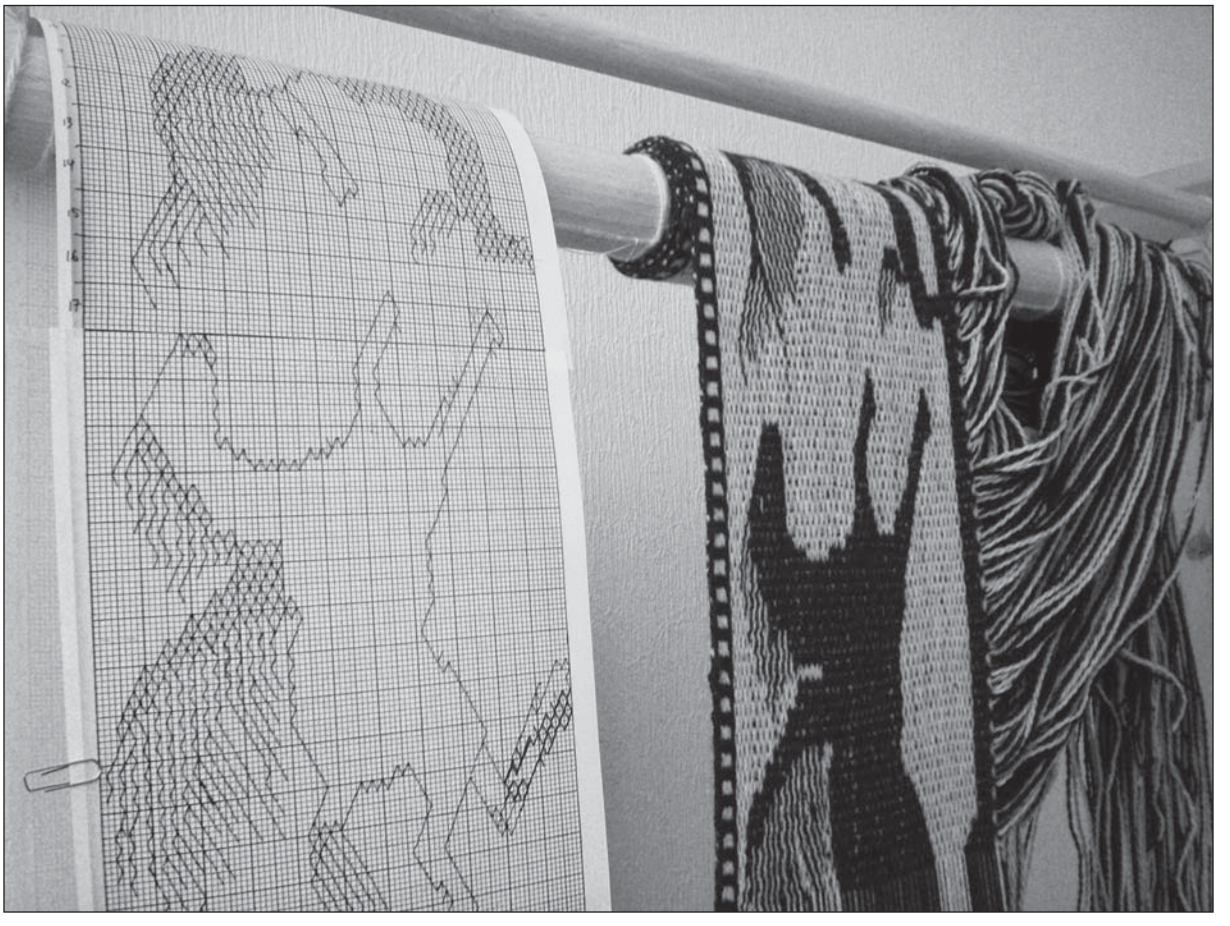

Fig. 26.9: Tablet-woven starting border with winged figures from the skyphos Chiusi, double-faced, draft slightly compressed on pattern grid with 4 times 4 unit (photo and reconstruction: E. Harlizius-Klück).

Weaving as an everyday activity was an occupation of mainly women and slaves. Maybe it is not an accident then, that Plato draws a sharp line between pure and applied knowledge in the Statesman dialogue where he extensively deals with weaving. And in the end the nameless stranger even reminds us "no one in his right mind would ever consider the knowledge of weaving for its own sake" (285d). It is high time to get this changed.

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27 | Textile production in a medieval village in Siksälä (Estonia)

RIINA RAMMO – AVE MATSIN

Abstract: The article deals with textile finds from Siksälä cemetery in South-Eastern Estonia. Most of the textiles have been dated to the 13th–15th centuries. The focus is on the textile production process, as much as it is possible to detect on the basis of funeral clothing preserved. The making and the usage of fabrics in Siksälä seem to be uniform during these centuries and it was obviously domestic handicraft carried out by women at home. Instead of stressing this obvious fact, the paper concentrates on possible influences, contacts and communication in the context of medieval rural textile handicraft. Thus we are looking for traded goods (e.g. imported dyestuffs, fabrics, or even clothing items) and specialisation.

Keywords: archaeological textiles, textile production, Middle Ages, dyeing, woad (*Isatis tinctoria* L.), specialised handcraft

1. Introduction

This paper focuses on medieval rural textile craft, based upon the abundant textile materials in Siksälä cemetery (12th–15th centuries). The aim was to detect possible external influences upon textile making in a small village, stressing the complexity of production processes in their social context. Our research involved finding and analysing textiles that differed from the norm, for example foreign fabrics, imported raw materials and hints at specialisation.

A detailed study of Siksälä cemetery is published by Silvia Laul and Heiki Valk (Laul – Valk 2007). Siksälä "Cemetery hill" is nowadays situated in the South Eastern corner of Estonia, close to the borders of Latvia and Russian Federation (*Fig. 27.1*). By the Middle Ages the area had already been regarded as peripheral or borderland, as it was a ´contact´ area for different political entities (i.e. Bishopric of Tartu, Livonian Order and Pskov State). The hill at Siksälä was used for cremation burials from the 11th century. The earliest inhumations with preserved textiles date to the middle of the 12th century. Inhumations became the predominant type of burial in the first half of the 13th century. In an Estonian context it is important to note that violent Christianisation at the beginning of the 13th century resulted in a remarkable transition in local circumstances. Graves with abundant jewellery and grave goods gradually disappeared in Estonia owing to the new Christian faith. In Siksälä however the pagan habit to dress the dead in garments richly adorned with metal accessories and put weapons and tools in coffins continued until the 15th century. The community using the Siksälä cemetery was relatively small, most likely

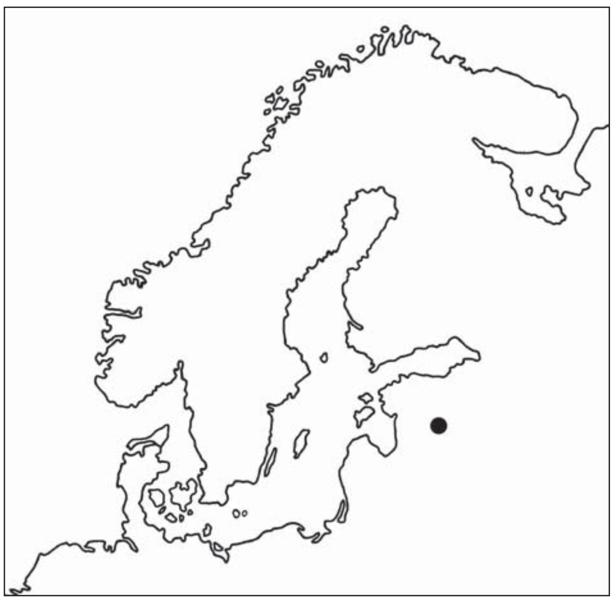

Fig. 27.1: Location of Siksälä graveyard (drawing: R. Rammo, A. Matsin).

consisting of 4–6 or even 7 households from the 13th–14th centuries. The grave goods, textiles and clothing items of Siksälä have close parallels with those from sites that are now in neighbouring areas of Latvia and the Russian border (Laul – Valk 2007, 119–120; Zariņa 1999).

Comparison between Siksälä graves dating from the 12th to the end of the 14th century reveal similar cloth and garment types. It appears that textile crafts remained largely unchanged over the course of these centuries. The impression of maintaining traditions might be partly due to the evidence coming from grave finds. People were probably buried in their festive attire. Women, for example, were buried in their wedding dress. Clothing related to important transition rituals changed more slowly than everyday clothes, which has the potential to create a false impression of stasis in clothing production.

2. Methods and finds

The authors' databases contain information on 243 textile items, consisting mainly of clothing from 107 graves. The grave textiles date mainly from 13th–14th centuries, but finds also came from 12th and 15th century graves. The majority of preserved textiles are made from sheep wool; wholly plant fibre textiles number only 12. One of the reasons for the excellent preservation of grave textiles is the presence of tiny, decorative metal elements (e.g. spiral tubes, clasps and ringlets of copper alloys) used to adorn clothing items (*Fig. 27.2*).

For studying textile technology each step in the production process and subsequent textile use was examined. We attempt to produce an Operational Chain for textile production that includes not only sequential material operations but the creation of a social background as well. The social background includes people, their social relations, beliefs, contacts and communications (e.g. Dobres 2000, 4–5; Thingnaes 2010). The databases provide technical data of the grave textiles (as outlined by Walton – Eastwood 1983): dimensions, thread count, spin direction, binding, colour, finishing, sewing, use, wear, repairs and grave deposition. Study of the raw materials has provided information on fibre types and

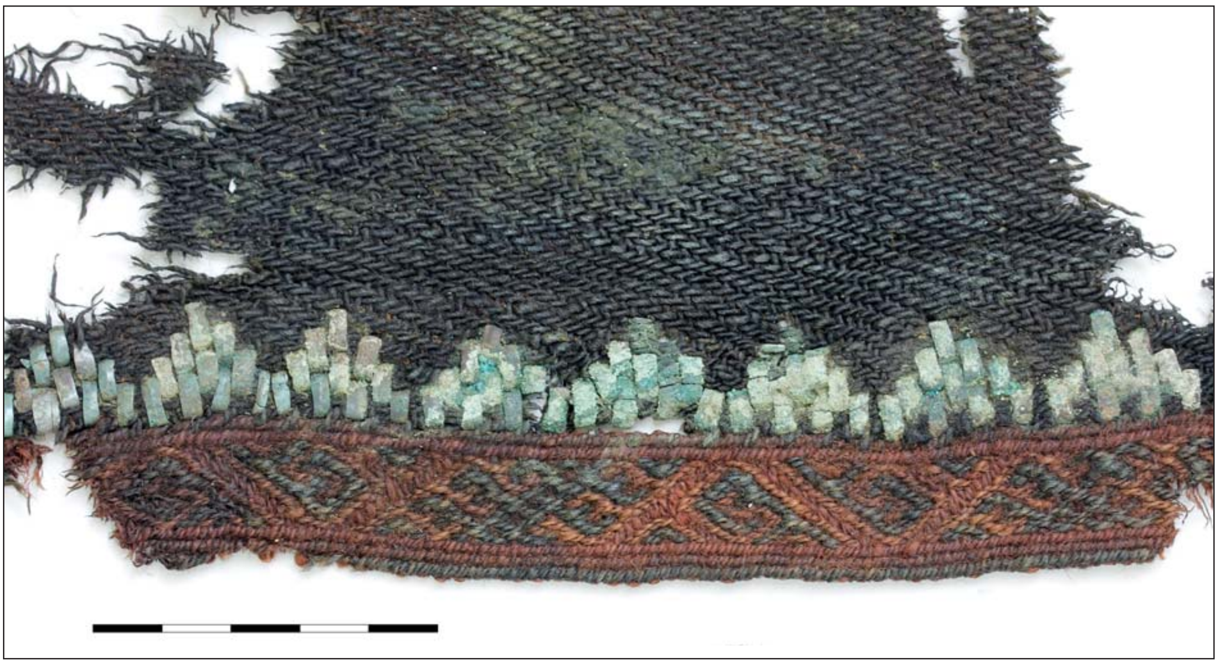

Fig. 27.2: Shawl made of blue twill fabric and adorned with spiral tubes and clasps. The warp is shown horizontally (AI 5101: CCXX: 3) (photo: J. Ratas).

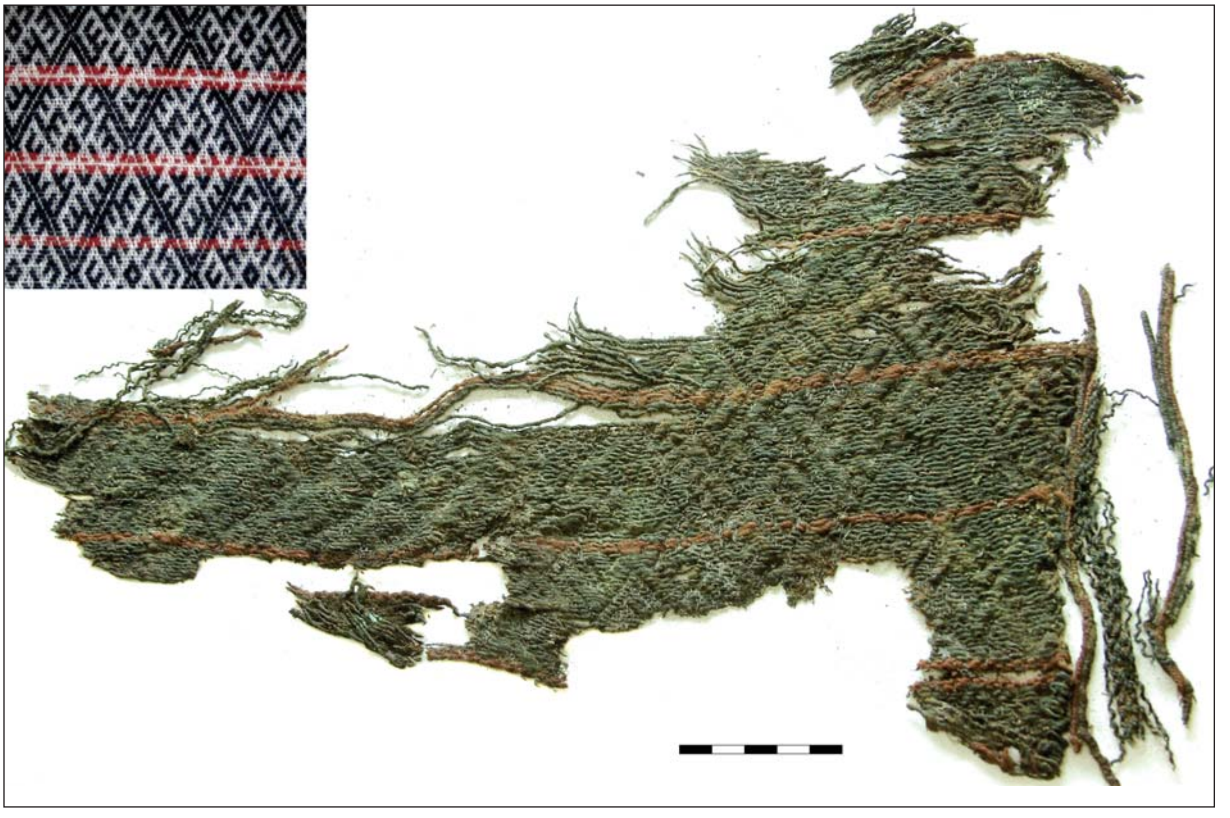

Fig. 27.3: Mixed fabric of linen and wool with geometric weft-patterns (AI 5101: CCXX: 13) (photo: J. Ratas).

qualities. Altogether 54 samples of wool fibres from 36 textile items have been measured and analysed by different researchers (in additions to the authors also: LUIGES 2004, 32–33; PEETS 1992, 21–22, table 11; about method NAHLIK 1963, 229–242). For ascertaining dyestuffs 25 different textiles blue in colour have been tested using sodium dithionite (LUIGES 2004, 30; PEETS 1992, table 28; SCHWEPPE 1993, 294 no. 3). Analyses of six samples with HPLC-DAD were carried out in the Royal Institute for Cultural Heritage, Amsterdam (VANDEN BERGHE 2013). Reconstruction experiments into spinning and weaving have been carried out for a better understanding of medieval textile technology (MATSIN 2010; 2013; RAMMO – MATSIN 2008).

All evidence (e.g. techniques used, wool analyses) supports the view that textile making in Siksälä village in Middle Ages was a traditional domestic handicraft carried out by women in their homes for a household's own needs. A common characteristic of woven fabrics from Siksälä is the use of a single yarn that is z-spun in both warp and weft. In contrast almost all threads in bands, fringes, seams, embroideries and other decorative elements are plied (S/zz). The main weave type was a slightly warp faced 2/2 diagonal twill (40% of woven fabrics) that was used mainly for upper-garments (shawls, kirtles). Two types of fabrics were created by mixing linen and wool, but usually in artefacts only the threads of wool are preserved. The first is a linen tabby with geometrical patterns woven into the cloth by adding coloured weft yarns of wool (*Fig. 27.3;* LAUL 2006; RAMMO – MATSIN 2008). The second is a chequered blue-white textile of 2/1 chevron twill weave (LAUL – VALK 2007, 50). To a lesser extent tabbies of sheep's wool also occur. Tabby was the main weave type for the most widely used plant-fibre fabrics (mainly linen), but only a few fragments have been preserved (RAMMO 2014, appendix). Textile items were also commonly produced using tablet weaving, braiding, and *nålebinding* techniques.

3. Contacts and communication

To what extent was textile craft dependent on traded goods and influenced by ideas coming from the outside world? Contacts and communication can be seen in various spatial spheres: neighbouring areas, regional and supra regional. The aim behind these contacts could be various: on one hand trade and commerce and on the other personal relationships (e.g. gifts, exchange, heritage, marriage).

The clearest evidence for foreign contacts is foreign items themselves. From Siksälä cemetery seven textile scraps can be identified as coming from relatively distant areas, most likely West European production centres (*Tab. 27.1*). The main basis upon which these scraps of foreign textiles can be distinguished from local ones is the use of finer wool and technical traits not common in rural craft. First, the overall appearance of foreign fabrics is distinct in comparison with the ´ordinary´ local textiles. The difference in appearance of foreign fabrics is caused by using threads with opposite spinning direction and in some cases heavy finishing treatment (e.g. fulling, raising the nap and shearing woollens). The wool used to make the foreign textile scraps is finer in comparison with those of local origin. Close parallels for these foreign textile types have been found in contemporaneous Hanseatic towns in medieval Livonia (e.g. Tartu, Tallinn, Pärnu) and other parts of Northern Europe (after RAMMO 2010).

It is noteworthy that most foreign textiles were found in the graves of men, for example the kirtle made of red fine broadcloth from Siksälä (*Tab. 27.1,* 143; *Fig. 27.4*). Textile remnants indicate that the entire garment was made of fine foreign cloth, they were not just small scraps intended to adorn edges and hems as is common for similar examples from other medieval village cemeteries. In the same grave as the kirtle (no. 143), fragments of knitted mittens were found. The ordinary technique for such items in Siksälä was *nålebinding*, hence it is probable that the knitted mittens were also foreign made. Two cases of leg wrappings made of non-locally produced cloth can also be cited (*Tab. 27.1,* 53, 247). In contrast to these pieces from men's graves, women´s graves produced two headbands adorned with imported cloth where small strips of cloth had been sewn inside each band (*Tab. 27.1,* 163, 262). Fine foreign textiles were therefore largely the preserve of men. A similar division between men's and women's textiles is also highlighted by Finnish researcher JAANA RIIKONEN (2006) on the basis of 11th–12th-century grave finds.

It is not known whether foreign items reached Siksälä as fabrics or readymade clothing, but either way they are quite rare. These rare finds of foreign textiles are unlikely to be related to regular long-distance trade networks or markets. We believe that foreign textiles might indicate gift giving and social relations between men of high status and their male lineage.

Contact with the outside world can be seen on a regional scale, i.e. the neighbouring regions that in present day represent Latvia, Russia and the eastern coast of Estonia. One clear example of contact with the wider world comes from a textile fragment found in a girl's grave (no. 18; *Fig. 27.5*). Although the fragment is 2/2 diagonal twill, its appearance is distinct when compared with ordinary Siksälä twills.

Tab. 27.1: Foreign fabrics from Siksälä graveyard. M – male; F – female; C – child; F – fine; SF – semi-fine; M – medium (drawing: R. Rammo, A. Matsin).

Grave	M/F/C	Clothing item	Binding	Wool	Spin dir.	Colour	Remarks	Date
53	M	Leg wrapping	2/1	SF	zz/S	Blue		13 c
143	M	Mitten	Knitted	M	z	Undyed (?)		14 c I half
143	M	Kirtle	2/1	F	zz/S	Red	Finishing	14 c
163	C	Detail of head band	1/1	F	zz/S	Red		14-15 cc
224	M	Kirtle	1/1	F	zz/S	Red	Finishing	13-14 cc
247	M	Leg wrapping	2/1	SF	zz/S	Blue		12 c II h
262	F	Detail of head band	1/1	F	zz/S	Blue		13 c

Fig. 27.4: Imported cloth of kirtle (AI 5101: CXLIII: 10) (photo: J. Ratas).

The reason is the plied warp (S/zz) in this exceptional piece. The decoration of braided small spiral tubes attached to the fabric with ringlets does not match techniques characteristic of Siksälä clothing. Parallels for this textile fragment can also be found in western, northern and north-eastern directions. For instance, the adorned fragments of leg wrappings from Vejsturu (Latvia) and an apron from Kaberla (Estonia) are very similar (Rammo 2006; Zariņa 1988, fig. 35, VI: 2, 6). These finds are clearly associated with women and could indicate communication through female lines, for instance via marriage. Distinctions in textile production in a local sphere are harder to detect and prove because in general techniques and aesthetical values were similar throughout the eastern shore of the Baltic Sea.

One aspect of textile production dependent on trade contacts is the dyeing process. The main colour of women's dress was blue – they wore blue garments, shawls and leg bindings. Almost no blue fragment, except two imported ones (*Tab. 27.1*), has been found in a man's grave. Blue was coupled in women's dress with white and red. Red yarn was used only for bands, trimmings, sewing, fringes and adornments. White clothing consisted of costume pieces made from bleached plant fibre textiles (e.g. shirts of mixed wool/linen cloth).

Fig. 27.5: Twill fabric of wool from a girl's grave (AI 5101: XVIII: 2) (photo: J. Ratas).

Woad (*Isatis tinctoria* L.) plants were used for dyeing textiles blue. Woad did not grow naturally in Estonia, so the dye was probably imported to Siksälä (Peets 1998b, 294–295). For dyeing textiles red people used the locally growing Northern bedstraw (*Galium boreale L.*) (Vanden Berghe 2013). Alum was required as a mordant when using bedstraw (Peets 1998a, 286–287). Both dried woad balls and alum were traded all over Europe in the Middle Ages, including in Livonian towns (e.g. for alum see Horoshkevitsh 1963, 318–319).

Wool fibres were dyed in villages. Prior to spinning coloured wool, both blue and red were mixed with uncoloured wool (Peets 1998a, 287). This wool blending technique was confirmed by fibre analysis. All samples of dyed yarn from Siksälä showed a mixture of dyed and undyed fibres, with the amount of coloured fibres varying from 40–80%. Mixing fibres of different colour to achieve a desired shade is well known in historical descriptions (Astel 1968, 240; Vallineheimo 1956, 18). It seems that for blue dyeing and wool blending only brown fibres were selected. The reason why brown wool was selected may be because the most valued shade was a dark blue-black, with brown wool helping to achieve this colour. For red yarns however, which were used in weft patterned textiles (*Fig. 27.3*), fine light wool was selected (*Fig. 27.6*). The use of finer wool was probably to achieve as bright a shade of red as possible. For weaving a patterned tablet band, yarns of at least two or three different red hues were

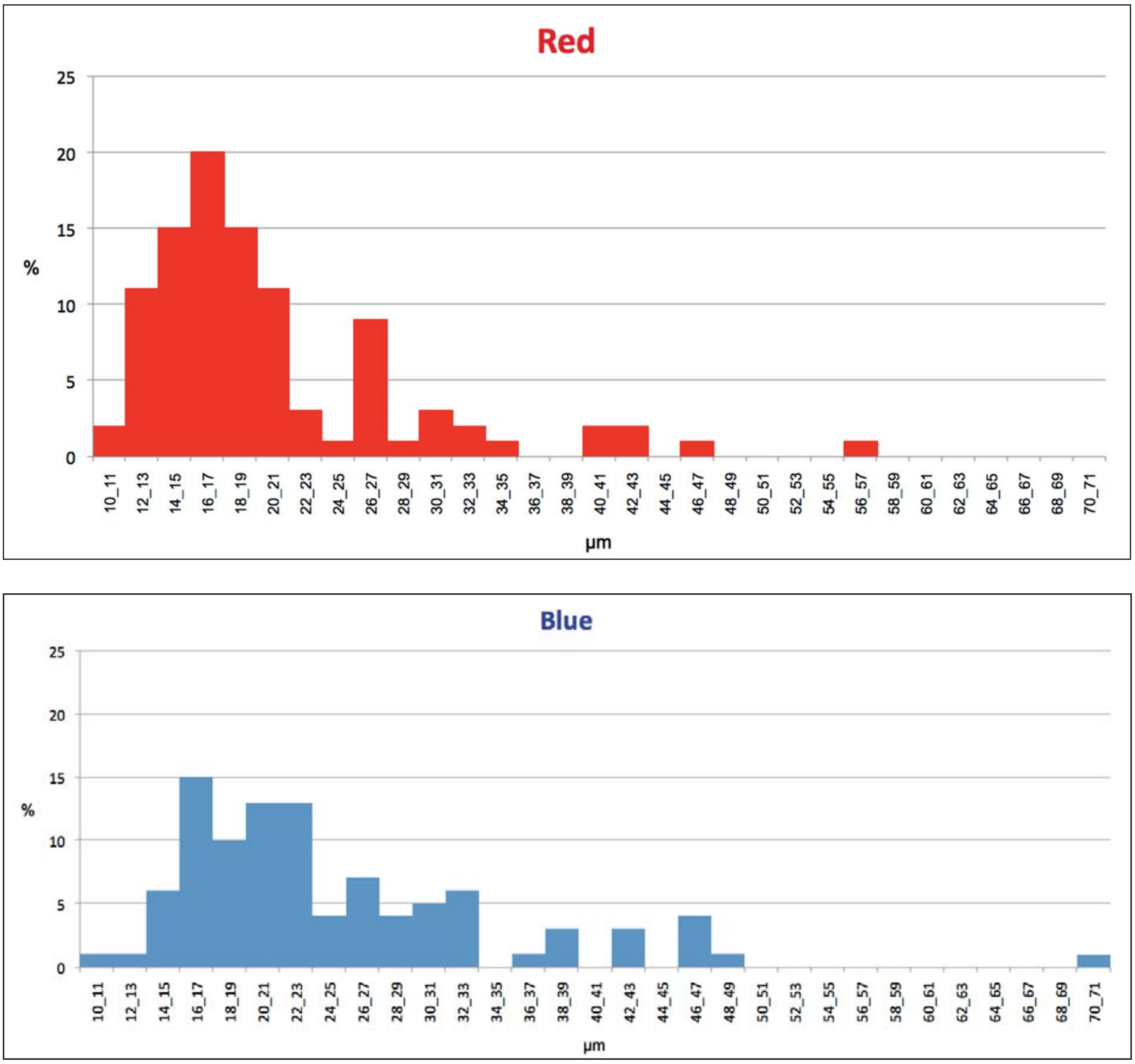

Fig. 27.6: Comparison of fibre composition in blue and red yarns from a weft-patterned textile (grave no. 220) (drawing: R. Rammo, A. Matsin).

needed. Another reason for mixing wool may have been economical, as dyeing wool required expensive imports of raw materials.

4. Specialisation and mastery in village crafts

Was textile production an exclusively domestic activity or was there a kind of specialisation? Leather belts with mounts, fine silver jewellery and some other types of dress accessories were made by more or less professional artisans living in towns, castles or travelling around (e.g. Johansen – Mühlen 1973, 198–201; Linnus 1975, 17). Although most textiles were produced at home by women for their own household, there are clues to the existence of a more complex manufacturing system. In textile crafts specialised production can be defined by the qualities of the finished cloth. The sorting of homogeneous wool and use of imported or valuable raw materials in the production process generally required specialist knowledge (after Andersson 1999, 14).

With regard to specialist knowledge of production, the dyeing stage in the textile making process deserves attention. For instance woad dyeing involves a combination of chemistry and technology acquired through practical experience. Wool fibres are first soaked in a bath of dissolved and fermented woad, with the soluble indigotin penetrating the fibres (Hoskins 1989, 151; Schweppe 1993, 295). After exposing wool to the air for oxidation, an insoluble compound is formed on the threads. Owing to the association of blue cloth and women, we surmise that blue dyeing was not just a technological process but a ritual and magical act related to women and their fertility (cf. Hoskins 1989; Thingnæs 2010, 237). Experience and recipes were also needed for creating various hues of red using Northern bedstraw. If imported and valuable raw materials included in the dyeing process indicate a limited distribution of specialised knowledge, who were these dyers?

According to ethnographic data, textile dyeing was a purely female domain. A written source from the 17th century points to specialised and very skilful female dyers in villages (Linnus 1975, 19). Other time consuming and fashionable items were made by more skilled persons, including weavers, band weavers, lace makers and embroiderers (Voolmaa 1990, 23, 27). One type of textile found in Siksälä consisting of linen with weft-patterning in wool is noteworthy (*Fig. 27.3*). These fragments have been interpreted as coming from linen shawls and shirts worn by women. According to reconstructions and experiments, this type of textile was complicated to weave (Rammo – Matsin 2008). The ethnographic examples of similar technique and with simple patterns from the same area have been woven using pattern rods (Konsin 1973, 200–203). But this does not work well with the Siksälä patterns. The unique and asymmetric geometric pattern needed to be picked row by row and it needs lots of daylight time. We conclude that these linen fabrics with weft patterns in wool may have been produced by skilled craft persons more or less specialised in weaving.

The activity of these “village masters” of crafts such as weaving was probably limited to one community and its surrounding villages. Specialisation enables craftspeople to supplement their foodstuffs or other everyday items by trading their wares. Often elderly people were involved in earning a living from specialist crafts (Linnus 1975, 193). Based on the complexity of the production process, there was certainly specialisation present among medieval rural village crafts. Evidence of dyeing, and complex weaving (e.g. tablet weaving) all point to specialisation in the textile production process.

5. Summary

The most notable outcome of this study is the conclusion that medieval rural textile production was more complex and varied than previously thought. In villages various types of textiles were made using different techniques and specialisations. Secondly, our research shows that textile production did not exist in isolation from the outer world, even in "peripheral" areas. People were able to obtain outside knowledge about new practices and tools. We were not however able to detect a spread of technical innovations and new ideas in the course of the 12th–15th centuries in Siksälä. The textile culture which had become well established in Siksälä in the Late Iron Age extended with little change into the Middle Ages. The traditions of home weaving passed down through the female line remained unchanged in spite of political, economic and social transformations marking the transition from the Late Iron Age to the Medieval Period. In part there was no need to develop new skills as traditional methods functioned well under the local circumstances. On the other hand maintaining traditions that distinguished people from "them" and "us" can be seen as a deliberate choice.

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Abbreviations

AI – Archaeological collections of the Institute of History of Tallinn University

28 | The Toothed Blades of Medieval Novgorod[1]

HEIDI M. SHERMAN

Abstract: This essay reassesses the identification of a large group of wooden toothed blades unearthed during the excavations of medieval Novgorod. The more than 1,000 toothed blades are assumed to be hackles used for the processing of flax fibre. This conclusion is based on modern ethnographic flax hackles from Estonia. The Estonian tooth-blades are not flax hackles, thus casting doubt on the attribution of the medieval Novgorodian tooth-blades as tools used for flax processing.

Keywords: flax, flax hackles, wooden tooth-blades, Novgorod, Estonian flax

In his monograph, Wooden Artifacts of Medieval Novgorod, the long-time Director of the Novgorod excavations, Boris Kolchin, identified a large group of wooden toothed blades with a serrated edge as flax heckles (Kolchin 1968; 1989, Part I, 107–110, Part II, 356, pl. 111). When found whole, the objects range in length from 45 to 55 cm, with the 12–15 cm blade handle and the blade making up the remainder of the tool's length. The blades themselves possess an average 35 to 50 notches, which are often pitched in the direction of the handle (*Fig. 28.1*). Well over 1,100 toothed blades have been unearthed in excavations and their uniformity of shape and size is striking, especially considering that they occur over a long chronological period of about 400 years from the 12th through the 15th centuries.

The toothed blades' identification as flax heckles is important to the study of the medieval Novgorodian economy. It is assumed that flax and linen production were integral to Novgorod's medieval near- and far-distant export economy, but pre-sixteenth century sources attesting to flax and linen are rare, making the toothed blades a significant part of the evidentiary base (Sherman 2015, 107–8, fig. 28.1). Furthermore, archaeologists working at other medieval sites in the former Soviet Union in which wooden objects are found, use Kolchin's study as a guide to identify toothed blades at sites such as Staraia Ladoga (Davidan 1981, 110, fig. 3), Berest'ye (Lysenko 1985, 361, fig. 248), and Kiev (Sagaidak 1991, 139, tab. XVII) among many others, which suggests the ubiquity and urban nature of a linen industry in the medieval Rus lands. Although it is certain that textile production with bast fibres such as flax, hemp, and nettle was a prominent feature in the domestic and commercial economy, it is not certain that the toothed blades can be used as evidence for this.

A heckle is one among several tools employed to remove flax fibre from its woody outer stalk. After flax is harvested and dried, it must undergo a biological process in which the plant stems are laid in water to rett (rot), allowing bacteria to break down the pectin that binds the internal fibre bundles to the plant. After drying, the flax straw is first beaten, or beetled, with a mallet or flax break and then scraped with a scutching knife against a wooden board to further break and remove the straw. The final cleaning stage amounts to combing with tools called heckles, which were used to accomplish three functions: to remove remaining straw and dust, straighten the fibre, and separate out longer from shorter fibres, or the line from tow flax. Sorting the fibre according to length is a significant part of the process since different fibre lengths were used for different purposes, such as line for fine textiles and tow for rope. After heckling, the fibre is ready to be spun into thread.

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[1] I wish to thank Elena Rybina and Sergei Troyanovsky for their assistance in providing access to both the wooden artifacts in Novgorod and field journals in Moscow. Appreciation is also owed to Frances Pritchard, Riina Rammo, and Penelope Walton-Rogers for assistance with bibliography and sharing of their heckle knowledge in northwestern Europe and Estonia.

Fig. 28.1: Heckles, "toothed blades" from Novgorod, Medieval (photo: H. Sherman).

The Novgorodian toothed blades' form raises doubts regarding their interpretation as flax heckles. Ethnographic heckles take a variety of forms. A common type resembled a miniature bed of nails with closely spaced iron or wooden spikes of at least ten centimetres driven into a rectangular, flat piece of wood. To thoroughly clean and separate fibres of different lengths, differently-sized heckles of progressively finer spacing were used in succession. The height and spacing of the spikes was designed to both catch and hold the fibre as it was pulled through the heckles, creating a slight tension that removed the remaining straw, and straightened and separated the long fibres.

Archaeological examples of this category of heckle have been identified in Northwestern Europe in sites ranging from the late Roman through the Viking era. Rarely, the spikes are found still embedded in their wooden base (Petersen 1951, 323, fig. 171 from Hedemark). For the most part, however, the handle has decayed leaving behind a pile of smooth, round-ended spikes that had been embedded in the wooden base and sharpened at the other end. Archaeologists have identified heckles from spike remains in over 100 Viking-age graves in Norway (Petersen 1951, 319–324, fig. 171 and 172), the late Roman period villa at Shakenoak (Brodribb 2005, 134), the late Saxon sites Maxey (Addyman 1964, 60) and Southampton (Addyman 1969, 65), and Viking-age York (Walton-Rogers 1997, 1727–31), among others. Taken altogether, the archaeological and ethnographic evidence demonstrates more than one thousand years of continuity of this type of heckle's use in northwestern Europe.

Yet another type of ethnographic heckle was a brush made of hog bristles, or a hedgehog hide fastened to the brush base with tar. This type was easy to use because it did not have to be mounted on a table, but it was not as effective for separating fibres into various lengths. Ethnographers observed the brush heckles wide use by Russian and Ukrainian peasants in the 19th and 20th centuries, including in the Novgorod lands (Osipova 2009, 15). To my current knowledge, there are no archaeological examples of this type. We can, however, look to another type, a long-toothed comb, that was found in Novgorod in both ethnographical and archaeological contexts. These are large wooden combs with single rows of closely-set teeth with the tines at least 10 cm in length. These combs might have a long handle that was attached to a stand, freeing the hands of the user. Combs with short handles, while requiring one hand to hold them, would also work for combing/heckling flax. There are many examples of such combs found in the Novgorod excavations, but these have not always been interpreted as heckles, indeed, most of them have not (Kublo 2007, 140, fig. 9.3).

None of the ethnographic or archaeological tools described above resemble the toothed blades interpreted so frequently by Novgorod's archaeologists as flax heckles. To identify the toothed blades, Kolchin sought out ethnographic parallels in other regions of the Soviet Union neighbouring the Novgorod lands and located a series of wooden flax combs, called linakam, housed in Estonian ethnographic collections. These wooden toothed blades do resemble the Novgorod combs, measuring on average 35–60 cm long, 5–6 cm wide, and the teeth 1 cm high. While true that the Novgorodian blades resemble the Estonian ones, the linakam were not used for heckling flax. Estonian flax merchants kept linakam on hand at the marketplace to straighten flax sheaves, making them look more presentable to buyers (Jäe 2014). From the 14th century, flax was grown and exported from western Estonia via the Hanseatic League, and it remained the second most important export, after cereals, until the end of the 18th century. The real boom in flax cultivation and trade began in the years 1860–1870 when, due to the American Civil War and the decline in cotton exports, flax took up the slack in the fibres market. Large quantities of flax were grown in Viljandi County (Southern Estonia) (Pärdi 1998, 76). The linakam are usually dated from the 19th century onwards because that is when the Estonian export trade in flax experienced a boom, although we should regard this sceptically since flax straw was sold to Hanseatic merchants in the Middle Ages and linakam could have been used then as well.

There are no known ethnographical or archaeological flax heckles resembling the Novgorod toothed blades. Kolchin considered it possible to heckle flax with the toothed blades by combing the fibre whilst it lay on the worker's lap. Heckling on one's lap could be achieved, but only with a stiff bristle brush, such as discussed above, or with something resembling a wool comb, i.e. a tool with long spikes. In fact, the form of the Novgorod blades raises doubts regarding their interpretation. Flax heckles need to have long spikes or teeth to attain sufficient tension for separating and cleaning flax fibre as it is pulled through the device. The teeth of the Novgorodian toothed blades are all shallow cuts averaging 1 cm deep, which would allow the heckle to only skim, but certainly not penetrate, a bundle of only partially-cleaned flax fibres.

Yet another problem is the disproportionately high number of toothed blades relative to other fibre processing tools found in the Novgorod excavations. Tools include wooden mallets or "beaters" (*pral'nik*), three threshing sticks (*trepal'naia lapa*) to break the stems after they have dried from the retting process, remnants of a few flax brakes, and 65 scutching blades (*trepalo*), most of which were knife shaped, while there are more than 1,100 toothed blades interpreted as flax heckles (chesalo). Kolchin observed, "If compared with other spinning tools, the amount of mallets, threshing sticks, and scutches was small. It may seem that flax and hemp processing was an industry of few households which marketed the raw materials for spinning. However, every household practiced spinning and this explains why flax hackles and spindles with whorls were found in nearly all the houses." (Kolchin 1989, 109). Kolchin's conclusion is problematic since scutching and heckling generally occurred in near proximity to one another and in quick succession because scutched fibres are best heckled quickly to avoid knots and tangles, which render the fibre unusable to the spinner. And scutching knives were not found in nearly every household in medieval Novgorod. They are, in fact, a rare find. If we were to accept the toothed blades as heckles, the logical conclusion would be that there was a higher demand for heckling than scutching, which does not seem a logical one since both processes were equally important for fibre cleaning.

If we conclude that the toothed blades cannot be interpreted as flax heckles, which I think they cannot have been, we are left with the challenge to determine what they actually might be. A theory put forward interprets the toothed blades as fish de-scaling knives, to be replaced by iron knives as technology evolved (KUBLO 2007, 137). Nevertheless, compelling evidence suggests that they were indeed associated with fibre working or textile production. While excavating the area of Troistky X in 1989, archaeologists unearthed what appears to be a weaver's residence, as evinced by finds of various loom pieces, including pedals for a horizontal loom, several drop spindles and whorls, scutching blades, and about a dozen toothed blades. Although this material as of yet has not been properly plotted to determine whether all of the textile related finds belong to the same layer and to nearby quadrants, it nevertheless is suggestive of a textile-related function for the toothed blades (Unpublished excavation report 1989, Troitsky X). It is possible that the toothed blades functioned as weaving swords, with the teeth used to separate and straighten the warp threads on a loom. Yet another possible interpretation is of the toothed blades as hemp scutching knives. Hemp and flax fibers undergo analogous cleaning processes since they are both bast fibres, but hemp stems have tougher rinds than flax stems. Ethnographic hemp brakes and scutching knives often had serrated edges on the working part of the blade (HOFFMANN 1991, 58, fig. 62–63, p. 62, fig. 69).

Although it is premature to state without equivocation that the toothed blades were hemp scutching knives, hemp's widespread use for rope, durable cloth, and cooking oil should not be underestimated. In medieval eastern sites such as those in Russia, hemp is generally more prevalent than flax. Based on palaeobotanical sampling of Troitsky XI, it has been shown that there was "considerably more hemp than flax" in Novgorod (MONK 2012, 307). Archaeologists and historians, myself included, have assumed that flax and linen were more prevalent than hemp in Novgorod during the 13th through the 15th centuries, in part due to a lack of material evidence for this period and a booming Novgorodian flax export economy from the late 15th century onwards. Further work with Novgorod's fibre processing tools and examination of the surviving vegetal fibre textile fragments should make significant contributions to refining this research question.

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29 | Interdisciplinary reconstruction of weaving on the warp-weighted loom in the Hallstatt Period

TEREZA ŠTOLCOVÁ – JURAJ ZAJONC

Abstract: The paper deals with a reconstruction of the warp-weighted loom based on the actual find of loom weights found *in situ* at the Hallstatt period settlement of Dunajská Lužná – part Nové Košariská, Slovakia. The experiment includes all preparation procedures, for example calculations of the quality and quantity of the yarn and calculations for warping. It describes the warping process and making of the starting border, knitting the heddles and weaving. A wool fabric in 2/2 chevron twill was reconstructed on this loom, based on an actual find from Hallstatt – Kilbwerk, Austria. This case study follows previous theoretical and practical knowledge of both authors, connecting archaeological and ethnological data.

Keywords: Hallstatt Period, warp-weighted loom, loom-weights found in situ, reconstruction of technology, weaving, warping

1. Introduction

In 2009, the Archaeological museum of the Slovak National Museum in Bratislava approached the authors of this paper to make a functional reconstruction of the Hallstatt period warp-weighted loom for an exhibition called "Early Iron Age – the Hallstatt period in the south-west Slovakia." The request was also initiated by a find from Dunajská Lužná, part Nové Košariská, where a weaving house with remains of two warp-weighted looms was uncovered in 2002 by archaeologists from the Archaeological museum.

This paper not only deals with the reconstruction of the warp-weighted loom, but it also thematically follows the work of T. Štolcová and K. Grömer, who gathered information for the NESAT X conference in Copenhagen in 2008 about textile tools in Central Europe in the Bronze and Iron Ages (Belanová Štolcová – Grömer 2010). At that time it was stressed, that *in situ* finds of loom weights are very important sources of information, from which data about the type of loom and quality of textiles woven on it can be gained. The experiment was undertaken in cooperation with an archaeologist who excavated the site in Nové Košariská, an ethnologist who is experienced in old textile techniques, and a textile archaeologist.

The main goal of the work was to make a functioning reconstruction of the warp-weighted loom based on an actual find from Nové Košariská, to reconstruct the weaving process and to confirm or compare already established knowledge, as well as to gain some new knowledge. Another aim was to find out the optimal size of the warp-weighted loom and to estimate the quality of fabric woven on it. During the work, essential questions rose: how was the warp prepared, and what kind of unit system of length and width could have been used for warping and weaving in the Hallstatt period? Dilemmas also arose whilst weaving concerning specific construction elements of the loom and their effect on the weaving process.

2. Sources for the reconstruction

Lacking actual textile finds from the Hallstatt period in Slovakia, one has to look for another type of evidence for the production of textiles. These consist exclusively of textile tools found in settlement contexts. Therefore the main source of information that was used, was an *in situ* find of loom weights from a lowland settlement in Nové Košariská belonging to the Kalenderberg group, excavated in years 2002 and 2005 and dated between the phase Ha C2 and the end of Ha D1 (BELANOVÁ *et al.* 2007; ČAMBAL 2006; ČAMBAL – GREGOR 2005). Amongst other features, a pit house No. 1/02 of wattle and daub construction was uncovered (*Fig. 29.1*). Only one third of it was preserved, but its original size could be estimated at 4.5x5.5 m. On the ground near the north-east and south east walls were found 170 loom weights of truncated pyramidal shape with a hole in the upper part, made of sun-dried clay and bearing traces of secondary burning. They could be clearly divided into two groups, not only by their position within the house, but also by their different size and weight. A set of 91 weights from loom No. 1 formed a 4 m wide line. Their average width at the base was 10 cm and their average weight was 1300 g. Weights from the loom No. 2 formed a 2 m wide line and were smaller, with an average width at the base of 7 cm and an average weight of 600 g. In both sets, some of the loom weights bore various marks on the top in the shape of a cross, a circle, or combinations of similar marks. Next to the wider loom No. 1, about 70 cylinder-shaped spools made of sun-dried clay with a weight of approx. 150 g and a length of 8–9 cm were scattered on the floor.

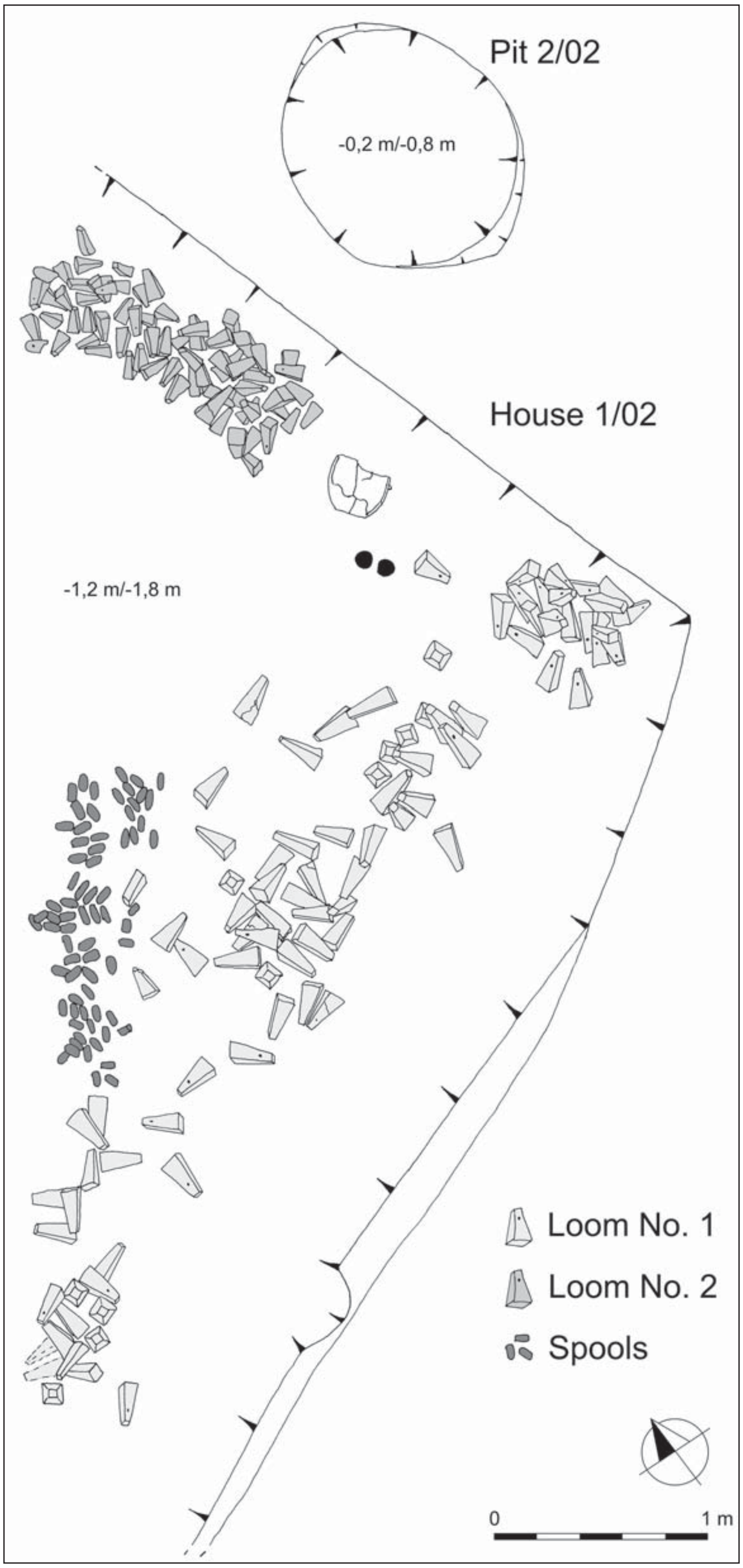

Fig. 29.1: In situ find of two sets of loom weights and one group of clay spools from Dunajská Lužná – part Nové Košariská (modified after ČAMBAL – GREGOR *2005, 37).*

Analysis of parallel finds of *in situ* loom weights from the East Hallstatt cultural area has shown, based on the width of the rows, three standard loom sizes (BELANOVÁ ŠTOLCOVÁ – GRÖMER 2010, 17): (1) looms 60–90 cm wide, e.g. from Stillfried

Fig. 29.2: Fragment of a wool fabric from the salt mines in Hallstatt - Kilbwerk (Austria), on which the reconstruction was based. Arrows indicate weft crossings (© Natural History Museum Vienna, HallTex 74 (Inv.No. 75.793); after GRÖMER – RÖSEL-MAUTENDORFER 2013, 398).

(EIBNER 1974); (2) looms 120–160 cm wide, e.g. from Smolenice-Molpír (BELANOVÁ 2007, 41–43; BELANOVÁ ŠTOLCOVÁ – GRÖMER 2010, 12–13; DUŠEK – DUŠEK 1995, 49) or Michelstetten (LAUERMANN 2000, 19–20); and (3) looms 300–400 cm wide, e.g. loom No. 1 from Nové Košariská or Hafnerbach (PREINFALK 2003, Abb. 12), Freundorf (BLESL – KALSER 2005, 88) and Kleinklein (DOBIAT 1990; SLONEK 1990).

The reconstruction was also based on a fragment of wool fabric made in 2/2 chevron twill from Hallstatt – Kilbwerk which was woven on a warp-weighted loom (*Fig. 29.2* and *3*).[1] Also a detailed study about the Iron Age textile collection from the Hallstatt salt mines was taken into account (cf. GRÖMER 2005; 2013; GRÖMER – RÖSEL-MAUTENDORFER 2013, 319–574; HAMMARLUND 2013). Any missing data were supplemented with other published archaeological data or experimental reconstructions (e.g. ANDERSSON STRAND 2012; BARBER 1992; BELANOVÁ *et al.* 2005; GÖTTKE-KROGMANN 2002; HALD 1980; MÅRTENSSON *et al*. 2009; NØRGÅRD 1999; OLOFSSON 2009; PIETA 1996; SCHIERER 1987, 2005; SCHLABOW 1976; STÆRMOSE NIELSEN 1999). The main ethnographic source for the reconstruction was the work of MARTA HOFFMANN (1964). Knowledge about household textile production was gained from ethnographical research in Slovakia (e.g. MARKOVÁ

Hallstatt Textile 74, Reg. No. 75.973	
size	23 x 13.3 cm
colour	olive green and dark brown
threads	single in warp and weft, both wool
twist direction	z/z
twist angle	30-50°/30-50°
thread diameter	0.5/0.4-0.7
thread count	14/10
cover factor	0.88
weave type	2/2 chevron twill with point repeat
pattern	brown checks on olive green background
miscellaneous	weft crossings

Fig. 29.3: Basic parameters of the wool fabric from Hallstatt salt mines, which served as a template for the reconstructed fabric (after GRÖMER – RÖSEL-MAUTENDORFER 2013, 398).

[1] Hallstatt Textile 74, Inv. No. 75.973 stored in the Prehistoric department of The Natural History Museum in Vienna. Detailed analysis by GRÖMER – RÖSEL-MAUTENDORFER 2013, 398.

1972; ROSENFELD 1958; STAŇKOVÁ 1969; ZAJONC 2002, 2005, 2009). Last but not least we used our empirical knowledge from the reconstruction of the La Tène Period warp-weighted loom in Devín castle, as carried out in 2004 (BELANOVÁ *et al.* 2005; BELANOVÁ 2007, 44, Fig. 5).

3. The reconstruction of the warp-weighted loom

3.1 Loom and the loom weights

Based on the *in situ* finds from Nové Košariská, we decided to reconstruct the smaller of the two warp-weighted looms (No. 2) with 79 loom weights and an average weight of 600 g. Exact replicas in material, size, shape and weight of these loom weights were made. Construction of the wooden loom frame was undertaken by a professional carpenter; its material and measurements can be seen in *Fig. 29.4.*

3.2 Calculations of the quality and quantity of the yarn

The aim was to reconstruct the wool 2/2 chevron twill from Hallstatt with a chequered pattern consisting of olive green and brown stripes. Due to its availability, we used machine spun green (0.8–0.9 mm thick) and red wool yarn (0.6 mm thick). The width of the future fabric (140 cm) was derived from the width of the loom after subtracting 2x30 cm as a space needed for manipulation with a shuttle during weaving. We used a calculation sheet from E. Andersson Strand, where we filled in all relevant data

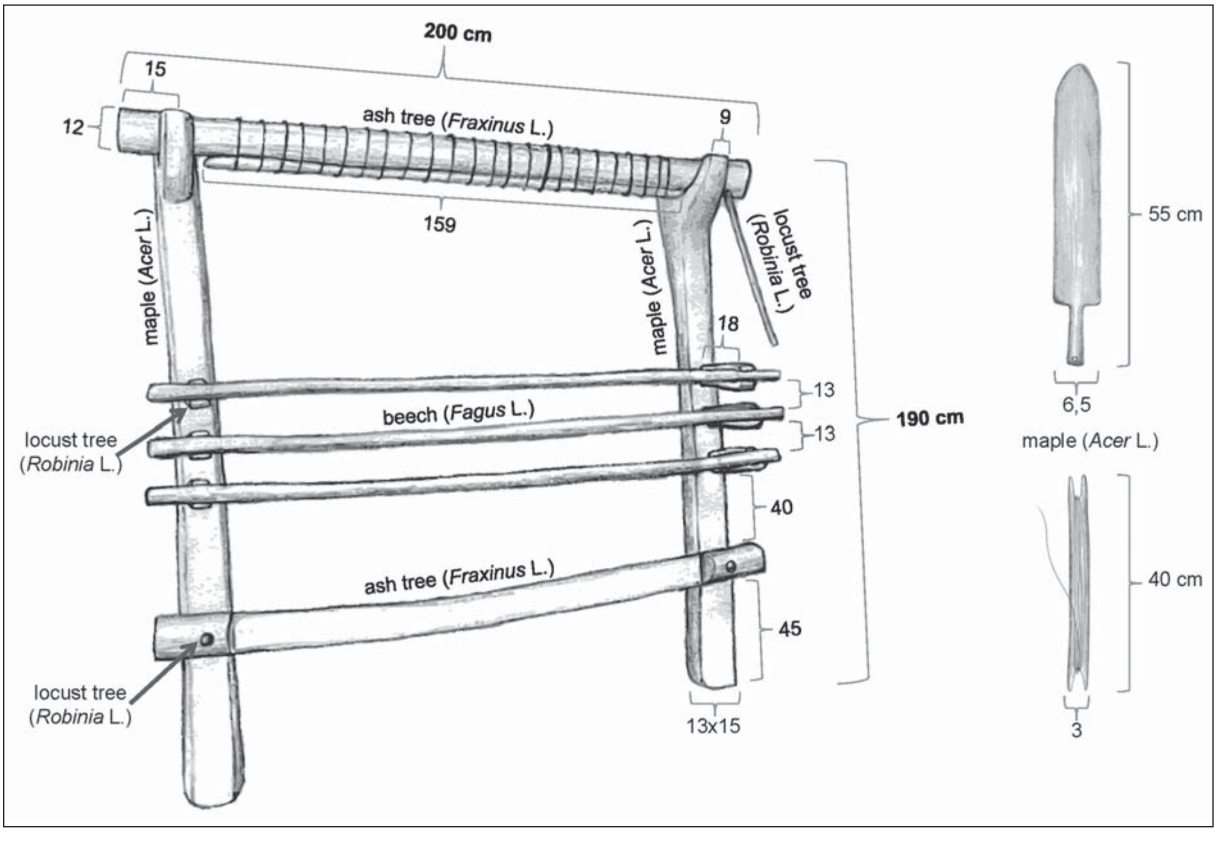

Fig. 29.4: Technical drawing of the reconstructed warp-weighted loom No. 2, a weaving sword and a shuttle. Based on the in situ find of loom-weights from Dunajská Lužná – part Nové Košariská (drawing: T. Štolcová, 2014).

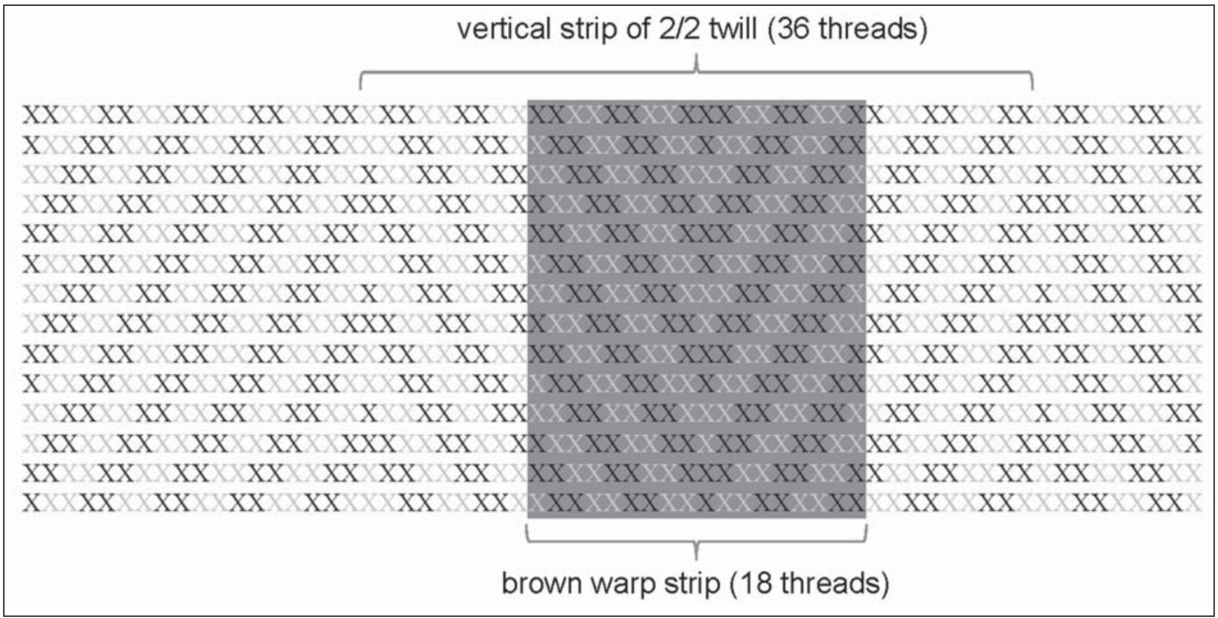

Fig. 29.5: Schematic drawing of 2/2 chevron twill with indication of the vertical brown stripe of warp threads (drawing: T. Štolcová, J. Zajonc 2014).

concerning the relation between the number, weight and thickness of the loom weights and thickness of thread and type of weave.[2] The number of threads in the warp was decided by the type of weave. A vertical stripe of 2/2 chevron twill created by 36 threads was chosen as the basic unit for the width of the future fabric (*Fig. 29.5*). The fabric from Hallstatt was however made of thicker threads than those used for the reconstruction. Therefore we warped a piece of starting border consisting of 36 threads and measured the width. By this value the presumptive width of the future fabric was divided. The result determined how many chevron stripes would show up in the fabric (140 cm: 3.5 cm = 40 chevron strips). The number of stripes was multiplied by the number of threads in one stripe and consequently the number of warp threads was determined (40 chevron stripes x 36 threads = 1440 warp threads). The number of warp threads was divided by the number of loom weights and thus was calculated how many threads were needed to be attached to one loom weight (1440 threads: 79 loom weights = 18.23 threads per 1 loom weight). The result was not a whole number and therefore it was rounded off to 18, which slightly changed the total number of warp threads (18 threads x 79 loom weights = 1422 threads).

The composition of the fabric was schematically drawn (*Fig. 29.6*). The determination of the number of warp threads in relation to the number and basic features of the loom weights was verified in the calculation sheet made by Eva Andersson Strand. Values from this sheet only confirmed the data we had chosen, e.g. the type of weave, the count of 11 warp threads per 1 cm or the number of threads stretched by one loom weight. The only difference was in the number of warp threads, which can be explained by an ambiguous determination of the thickness of threads when inputting it in the calculation sheet and consequently by our adjustments.

2 Details about the future fabric as well as basic features of the loom were filled in and calculated in an Excel data sheet, which was assembled by Eva Andersson Strand for the research programme entitled "Tools and Textiles – Text and Contexts, Textile Production in the Bronze Age Eastern Mediterranean Research (TTTC)" undertaken in the Danish Research Foundation's Centre for Textile Research, Copenhagen (Olofsson *et al.* [in print]; *http://ctr.hum.ku.dk/tools/*). She combined her practical knowledge of spinning and weaving with analysis of textiles woven on the warp-weighted loom and sets of in situ loom weights found in various archaeological sites.

3.3 Calculations for warping and the starting border

The warping frame was used from the previous reconstruction of the La Tène Period warp-weighted loom, using a rigid heddle (Belanová *et. al* 2005, Fig. 4c; Belanová 2007, Fig. 5a). Warping consisted of two operations. Step 1 included wrapping the threads of the future warp around vertical pegs and inserting them as the weft in the starting border. Step 2 comprised of taking off the length of threads from pegs, making the dividing knot and rolling it into a ball. The warp of the starting border was created by 36 green threads. Prior to warping, the basic unit of number of warp threads prepared during one set of operation (step 1 and 2) was determined (*Fig. 29.7*). Ascertaining the basic unit of warping was based on relation between warping process

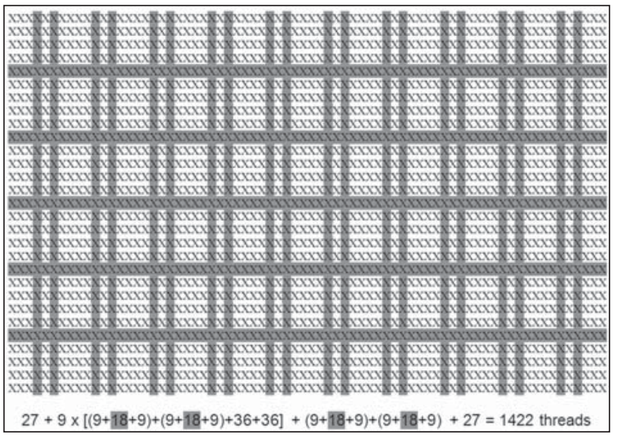

Fig. 29.6: Schematic drawing of the composition of the whole fabric. The dark horizontal row represents four thin lines (drawing: T. Štolcová, J. Zajonc 2014).

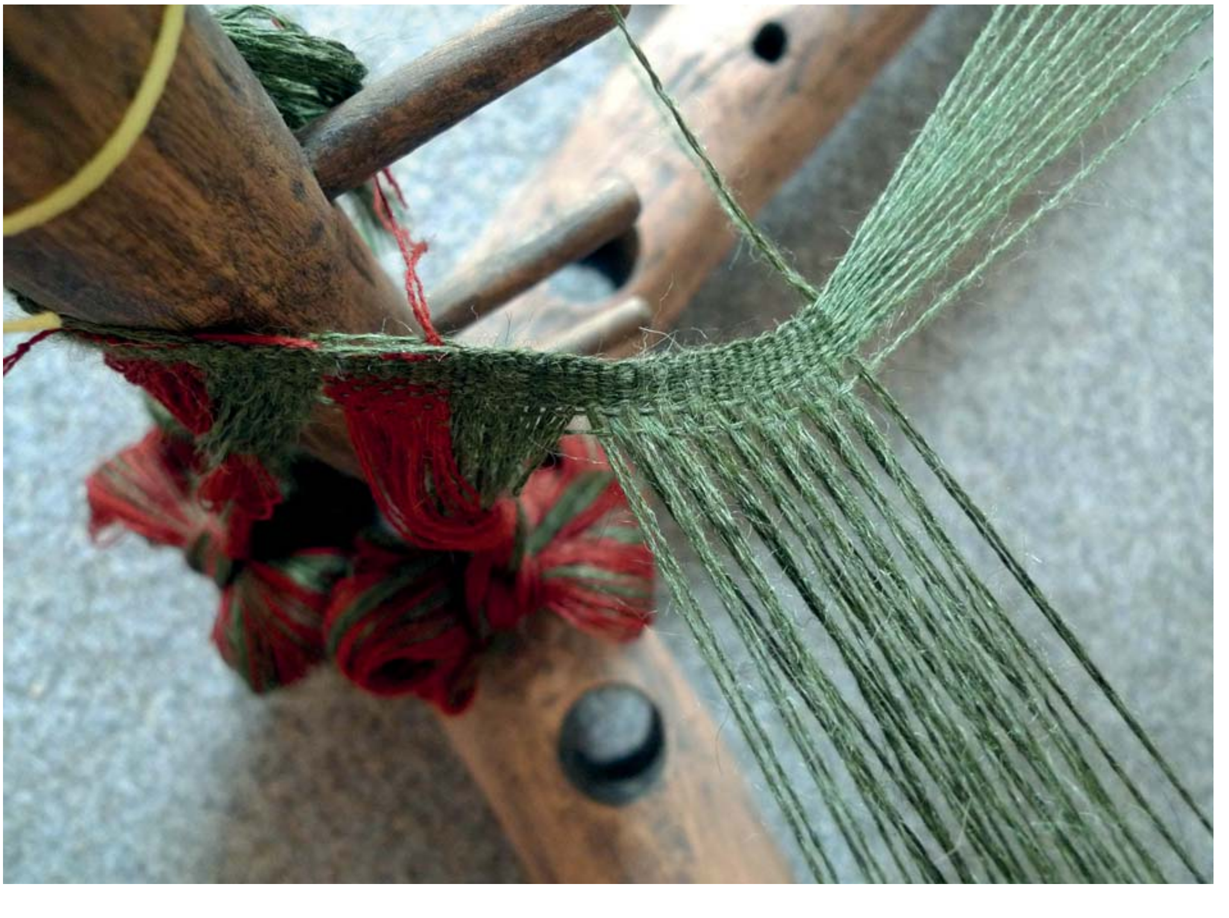

Fig. 29.7: Starting border with part of the warp containing 36 threads (1 part), before rolling it in two balls (photo: T. Štolcová, 2010).

and the number of threads in vertical colour or structural warp stripes from the Hallstatt fragment. We came to the conclusion, that the basic unit has to be repeated 40 times (1422: 36 = 39.5). The length of the future fabric was set by the distance of two larger pegs of the warping frame, between which the threads were stretched (2x100 cm). During warping for 2/2 twill the threads were divided into four layers. After each set of warping operation, the lengths of threads were rolled into two balls. The finished warp consisted of 79 balls of yarn.

Archaeological and ethnological publications lack details about warping for the warp-weighted loom. The relation between the number of warp threads in the coloured stripes and the basic unit of warping made us look at the find complex of Iron Age textiles from Hallstatt salt mines. We examined 38 examples of various weaves containing simple tabbies or basket weaves and predominantly 2/2 twills. The patterns contained regular or irregular multi-coloured stripes, sometimes spin-patterned (GRÖMER – RÖSEL-MAUTENDORFER 2013, 319–574). In conclusion, the basic unit of warping was always the number two. Odd numbers of threads in the stripes also occurred, but the final sum of threads in all stripes of a single fragment was even. It indicates that our basic unit of warping was not universal. This fact corresponds to units of warping in traditional domestic and handicraft production of fabrics in Slovakia around the 18th to 20th century. For better understanding of warping methods in prehistory, it is necessary to search for more starting borders like the one from Tegle (STÆRMOSE NIELSEN 1999, Fig. 7; WILBERG HALVORSEN 2010, 97–100). Furthermore it is important to study the number of threads in various twill stripes and to look for any information about warping, including the unit systems in the ethnographic sources from the 19th–20th centuries.

3.4 Attaching the starting border and the loom weights

The starting border was sewn onto a wooden stick which was tied to the upper horizontal beam. The lengths of warp threads were stretched and divided into four layers, hanging one behind the other. Each length consisting of 19 threads was finished with a chain. In the upper loop of each chain a small wooden peg was inserted, to which a loom weight was

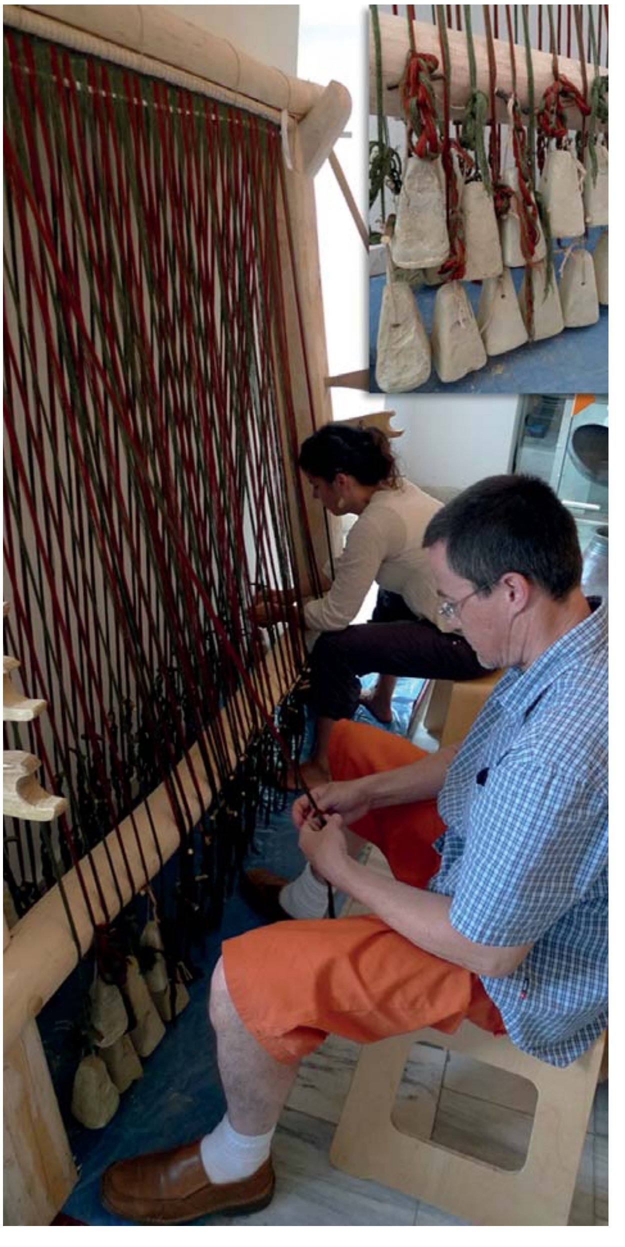

Fig. 29.8: Attaching the loom weights to lengths of threads and the detail of the front row of loom weights arranged in two layers above each other (photo: T. Štolcová, R. Čambal 2010).

attached. The loom weights were tied to the warp in two rows, and in each of them in two layers above each other (*Fig. 29.8*).

3.5 Knitting the heddles

When weaving our 2/2 twill, it was necessary to use four sheds, from which three were made by shed rods and one was naturally created by the lower beam of the loom. The shed rods were knitted with one continuous thread according to Scandinavian ethnographical sources (Hoffmann 1964, 134, Fig. 58). Each heddle loop held one, two or three threads from the two layers of warp. Heddles were knitted by two persons proceeding from edges to the middle.

3.6 Weaving

Three basic operations were repeated during weaving: creating the shed, inserting new weft with a slatted shuttle and beating the weft in the preceding shed with a sword (*Fig. 29.9*). The reconstruction of the fabric with horizontal stripes required the use of two coloured wefts.

During weaving we dealt with several technical difficulties. Supports for the three heddle rods were not long enough to create a proper shed. Subsequently, the slope of the loom is important for creating a shed, which is wide enough to insert the weft. Last but not least, we had to estimate the position of the

Fig. 29.9: Weaving on the warp-weighted loom: creating a shed by lifting the heddle rod (left), inserting the weft through the shed (right below) and beating the weft with a wooden sword (photo: T. Štolcová, R. Čambal 2010).

lower horizontal beam. It was not clear how high from the ground it should be. We only found out during weaving that the higher it is, the larger the shed that is created. A combination of these facts complicated the whole weaving process.

4. Conclusions

Despite the above mentioned problems, our reconstruction of weaving on the Hallstatt period warp-weighted loom was successful. It could be stated that the loom No. 2 from feature 1/02 in Dunajská Lužná, part Nové Košariská, cannot be categorized in the typology of the warp-weighted looms from the Hallstatt period (Belanová Štolcová – Grömer 2010, 17), but represents a new type which belongs between the wider ones (120–160 cm) and very large ones (300–400 cm).

The reconstruction also resulted in the verification of methods to determine the quantitative and qualitative parameters of the reconstructed fabric, based on data gained from analysis of an authentic Hallstatt period fabric as well as an *in situ* find of loom weights. Furthermore it was possible to determine the basic unit of the number of threads during the warping process. To specify the basic unit it is important to explore how much time the warping process takes. The reconstruction showed that the relation between the size of shed and slope of the loom, as well as the length of the heddle supports, influences the weaving. A functional model of the warp-weighted loom as well as the reconstruction of warping and weaving process was the main outcome of the experiment. Its product was a fabric of which the type of weave and pattern was identical to an original fragment dated to the Hallstatt period (*Fig. 29.10*).

Fig. 29.10: Reconstruction of the Hallstatt period fabric (photo: T. Štolcová 2011).

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Chapter 6:
Specific Analyses

30 | Analysis, Reconstruction and Interpretation of Two Early Medieval Embroideries from Kruszwica

MARIA CYBULSKA – EWA MIANOWSKA-ORLIŃSKA

Abstract: The subject of the paper are two silks from the Collection of Textiles at the National Museum in Warsaw, dated from the turn of the 12th century, found in 1961 during archaeological excavations in St. Peter and Paul collegiate church in Kruszwica. They have not yet been analysed, except for some approaches to the interpretation of ornaments made in the 1960s. They represent fragments of silk fabrics woven in weft-faced compound weaves embroidered with silk and metal thread. One of the fabrics is a band with a Latin inscription, the second one represents fragments of a stole ornamented with the figures of bishops. The paper presents the results of structural and physicochemical analysis of the fragments and an approach to computer reconstruction of their original appearance. Comprehensive analysis with similar objects from the same period as well as the analysis of re-read inscriptions lead to some hypotheses concerning the origin of the textiles. The quality of the finds demonstrate the high status of the men buried within the graves in the church hierarchy. They, therefore, confirm historical investigations indicating that Kruszwica was a seat of the Wloclawek bishop at that time.

Keywords: archaeological textiles, silk, medieval embroidery, byzantine silks, incised samitum, history of catholic church, liturgical vestment, stole, cingulum, Romanesque inscriptions

1. Introduction

Among the oldest historical textile objects deposited in the Collection of Textiles at the National Museum in Warsaw are two silks recovered during archaeological excavations in St. Peter and Paul collegiate church in Kruszwica. They have not yet been analysed. Previous studies on the Kruszwica silks, which are now in the collection of the National Museum in Warsaw (inv. number dep. 2741/1 and 2741/2), have focused only on the iconography of the textiles and its symbolic meaning [1].

In the 10th and 11th century Kruszwica, which is today a small town in the region of Poland called Great Poland (Wielkopolska), became an important urban centre with a castle on the island, where Polish kings and princes resided. After it was burnt in 1096, the town was re-developed in the 12th century and the population increased. From the end of the 12th century, the castle was the seat of Kruszwica castellany. During this period the Romanesque collegiate church of Saint Peter and Paul was built.

Excavations in Kruszwica began in 1948 and continued in the 1960s. In 1961 archaeologists discovered a number of damaged graves located in the church, some of them from the Romanesque period. Dating the graves was based on stratigraphy and cursory research on the style between the 11th and the turn of 13th centuries. Clergymen were buried in the graves, as was indicated by a pewter chalice and paten and fragmentary textiles. Fragments of the first textile lay on the sides of the damaged skeleton, those of the second one lay on the upper part of the skeleton (Cofta-Broniewska *et al.* 1962; Springer 1964, 338–339; 1981, 3–4, 30, 175). Some fragments of both textiles are presented in *Fig. 30.1.*

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1 The stole was studied in the 1960s by the custodian of the textile collection of the National Museum in Warsaw, Maria Markiewicz. The unpublished manuscript contains iconographic analysis of the embroidery and its interpretation. The manuscript is preserved without a title page.

Fig. 30.1: Fragments of Kruszwica silks. At the top: end fragment of the stole; at the bottom: fragment of the cingulum. The stole is shown horizontally (photo: M. Cybulska).

2. Analysis of the material

2.1 Methodology

The material was carefully analysed. To determine structural parameters of the threads and woven fabrics, optical microscopy and image analysis were applied allowing determination of basic parameters, as thread thickness and twist, number of warp and weft threads per centimetre and weaves. Atomic Absorption Spectroscopy and FEI Quanta 200F electron microscope with elemental composition analyser were used to analyse the properties of metal threads. Ultraviolet and infrared filters photography was used to determine the original colours of the woven silks and threads used for embroidery. In addition, the original appearance of the textiles was visualised by means of computer graphics.

2.2 Material

The fragments represent two different objects. The first one is a stole, as can be seen from analysis of the position of fragments in relation to the buried body and embroidered figures of bishops. The stole was preserved in two parts lying on both sides of the damaged skeleton. Only the end parts were preserved, the middle section placed probably under the arms of the body was completely decayed (Springer 1964, 338–339). After conservation and unfolding the object, it turned out that these two pieces, right and left, consist of five fragments[2]. The right part, which is decorated with four figures of bishops and

[2] Conservation was carried out in 1966 at the Textile Conservation Department of the National Museum in Warsaw in connection with sending the stole to the United States for the exhibition "Treasures of Polish Culture".

a meandering tendril terminating with a palmette, is 7 to 8 cm wide and 71.8 cm long. The left part consists of four smaller fragments. The largest of them, as one might guess from the similar floral decoration, is the left end of the stole with one figure of a bishop (*Fig. 30.1*). It has a length 6.8 to 7 cm and width 22 cm. Next is a fragment of width 6–7 cm and length 18 cm with the single figure of a bishop and an embroidered bar approximately 2 cm wide, which separates the repeated figures, and, finally, a fragment with a single figure 6–6.6 cm wide and 15 cm long. Therefore, the total dimensions of the stole as preserved are approximately 7 cm wide and 129 cm long. It is probably less than half the entire object.

The second textile was preserved in three pieces lying on the damaged skeleton. The rest of the object placed under the body was completely decayed (Springer 1964, 30, 175). The first fragment is 4.1–4.3 cm wide and 79.2 cm long, the second one 3.7–4.2 cm wide and 70.9 cm long and the third 4.2–4.5 cm wide and 13.2 cm long. It gives the total length of approximately 164 cm. There is an embroidered inscription along its entire length. As will be shown later, the analysis indicated that this was probably a cingulum.

2.3 Results of analysis

The materials include silk threads of different colours and thickness, metal threads and woven silk fabrics used as background for the embroidery. The woven silk used for the stole is a type of weft-faced compound twill called samitum. It has two warps and two wefts. The warp threads have a high Z-twist and the wefts are thicker with a very low twist. The embroidery threads include single and plied silk and metal thread in the form of pure gold strips wrapped around a silk core. The embroidery displays a variety of techniques using silk and gold threads: laid work with underside couching, split and stem stitches, which are typical of medieval embroidery, for example *opus anglicanum* or medieval byzantine embroidery. Embroidered patterns are outlined with a couched plied silk thread or in split stitch. The colours were determined as a blue for the samitum, and gold, red, white and yellow for the embroidery (*Fig. 30.2*).

Fig. 30.2: Detail of the stole. At the top: reverse of embroidery with couching threads; at the bottom: embroidery face-up with silk samitum as a background (photo: M. Cybulska).

The second object was also made from silk and metal threads. Looking at the woven silk used as a background for embroidery we can see an irregular pattern in the form of engraved-like lines: straight, curved or circular (*Fig. 30.3*). It means that the silk was a type of weft-faced compound twill, which was patterned with wefts of the same colour passing from the upper to the lower layer of the fabric. This technique is called incised samitum and was popular around the year 1000. Incised samitum could have a relatively large pattern as, for example, that used for the cushion of St. Remy from Musée Historique Saint-Remi in Reims and the chasuble of St. Willigis from Episcopal Cathedral in Mainz, made in Syria circa 1000 (SCHORTA 2011, 73, 263). The pattern in the form of straight and slightly wavy lines and small circles on the analysed silk was hard to determine not only because the material was decayed but also because the embroidered inscriptions, or rather their traces in the form of stitch holes made by needle and metal thread. However, if we visualise a 4 cm wide strip from a large patterned incised silk, we can see that the silk was probably a strip of this type of cloth.

The embroidery features laid work with underside couching, split and stem stitches and satin stitch worked in silver-gilt thread. *Fig. 30.2* shows the embroidery face up and face down with traces of gold threads. Details concerning the structure and materials of both objects are shown in *Tab. 30.1*.

Fig. 30.3: Detail of cingulum. One can clearly see traces of silver-gilt thread and holes made by a needle. As a background for embroidery an incised samitum was used (photo: M. Cybulska).

Tab. 30.1

object		threads	diameter, mm	twist direction, no of twists/cm	material	number of threads / 10 cm
the stole	woven fabric	main warp x 2	0.33	Z, 122	silk	167 x2
		binding warp	0.19–0.22	Z, 120	silk	167
		weft 1	0.33–0.44	very low	silk	462
		weft 2	0.33–0.44	very low	silk	462
	embroidery	metal thread	0.29			
		metal strip	width 0.33; S wrapping		gold	
		core thread	0.23	Z	silk	
		embroidery threads	0.23	Z, 60	silk	
		couching thread	0.31	S2Z, 43	silk	
		outlining thread	0.36	S2Z, 49	silk	
the cingulum	woven fabric	main warp x 2	2x(0.16–0.21)	Z, 138	silk	205 x 2
		binding warp	0.16–0.22	Z, 138	silk	205
		weft 1	0.17–0.21	very low	silk	495
		weft 2	0.20–0.26	very low	silk	495
	embroidery	metal thread	0.35			
		metal strip	width 0.31; S wrapping		silver gilt	
		core	0.26	?	silk	
		outlining thread	0.36	S2Z	silk	

3. Reconstruction of the objects

3.1 Computer graphics

The objects, like most archaeological textiles, have been to a large extent destroyed. For many reasons conservation of textiles of this type rarely includes reconstructing their original appearance, because it can be hazardous to apply new materials on fragile, weakened silks. We made an attempt to reconstruct the appearance of our objects using computer graphics. On the basis of the material remains, we created a collection of digital patterns reflecting the different types of threads and woven fabrics and applied them using brushes, stamps and many other tools. Then, using computer graphics we visualised the objects on a 3D model of a clergyman (Cybulska 2010; 2011).

3.2 The stole

The whole textile was carefully analysed. The figures of the bishops differ: those on the right hold pastorals in the right hand and these on the left in the left hand. The height of the figures is the same. After further analysis it appeared that the bishops on left and right differ also in some details of their vestments, as it is shown in the reconstruction presenting figures of bishops from left and right part, separating bar and the stole ending (*Fig. 30.4*).

Before reconstructing the whole object we had to answer some questions. Thus we first tried to find some similar textiles. First of all we should mention a stole and a maniple from the Benedictine monastery in Tyniec. They are tablet woven in silk and date to the mid 12th century. They show repeated figures of a priest in the orant pose separated by Latin inscriptions relating to St. Ninian (Markiewicz 1971). The next is St. Cuthbert's stole from Durham Cathedral, decorated with prophets of the Old Testament. On the coronation mantle of St. Stephen in the Hungarian National Museum there are also figures of prophets and apostles. Analysis of these textiles is important because we do not know how long the stole was, or how many times the figure of the bishop was multiplied.

The stole was one of the earliest liturgical vestments. It was used not only by priests but by all serving at the altar. Later it became a sign of the priesthood. It should be noted that according to historical data in the Middle Ages, clergy wore a stole constantly, not only during the celebration of the liturgy. As established by researchers of ecclesiastical vestments, medieval stoles were very long and may have a length of up to 3 m. This is clearly visible in the costume of the bishops presented at that time. The ends of the stole can be seen from under dalmatics, on the background of a long alb and almost reaching to episcopal sandals.

In the art and architecture of the Middle Ages numbers of figures, motifs and so on, were never accidental. They had their mystical meaning. Pythagorean numerology mysticism in the Middle Ages was almost an obsession. Numbers having a hidden meaning were 3, 4, 12, referring to the Trinity, the number of apostles or some biblical symbols. If we would like to show the idea of the priesthood we may present twelve figures of bishops. However it would give the stole the length 220 centimetres, which would be too short. The next meaningful mystic number of the Middle Ages is 16 referring to the prophets of the Old Testament. It makes the stole approximately 3 m long. Thus in the reconstruction we can see the stole with eight bishops on each side (*Fig. 30.6*).

3.3 The cingulum

As to the second textile, first we had to read the inscription and prepare the appropriate fonts which are capital letters in medieval style. The whole inscription in Latin on the three fragments is:

Fig. 30.4: Reconstruction of the stole pattern. Figures of bishops on the left and right ends of the stole differ in some details (image: M. Cybulska).

1. ISTIS • APTATVR • Q • MENTE • DEO • FAMVLANTVR
2. SACTI • SPE ASSIT • NOBIS • GRACIA • AMEN
3. IAM

One should notice a lack of certain letters, as N in the word sancti. There are also different forms of the letters, some scribal abbreviations, often used by medieval scribes writing in Latin. After transcription the text can be read:

1. Istis aptantur, qui mente Deo famulantur
2. Sancti spe assit nobis gracia. Amen
3. Iam

The letters were placed on the silk band as shown in the reconstruction (*Fig. 30.5*).

Fig. 30.5: Reconstruction of the cingulum (image: M. Cybulska).

There is an earlier approach to the translation and interpretation of the inscription in the aforementioned manuscript of Markiewicz, which is, however, concerned with the spiritual and theological meaning. It must be remembered that it is not the whole inscription and we are still working on it. Anyway it is about being destined to serve the God and the hope for grace from the Saints. The word IAM (amen) at the end suggests that it is a kind of prayer.[3]

Inscriptions on textiles were popular in the Middle Ages. An example occurs on the cushion of St. Remi that has already been mentioned. One of the most splendid examples is the coronation mantle of king Roger from the Hofburg Kunsthistorisches Museum in Vienna, with a Kufic inscription on the border stating when and where it was made. Inscriptions on the coronation mantle of St. Stephen refer to the act of the royal donation. Then there are also the names of the figures, and the text written in verse interpreting the images. On a bell-shaped chasuble from St. Peter's abbey in Salzburg there is an embroidered inscription in capital letters around the hem and edges stating that the act of donation was undertaken as help for a sinner (Von Lerber 1992, 27, 34).

In Polish collections, the most important example is the chasuble of St. Hedwig depicting scenes from the life of the Virgin Mary and Christ and figures of saints and donors (Gieysztor *et al.* 1968, Figs 122 and 123).

The question arises as to what the textile represents. Taking into account the position of fragments on the dead body and to the lack of any other silk fragments it could not be part of a larger cloth such as a chasuble or the stole. An illustration from the Durand manuscript shows a monk wearing the cingulum, a kind of narrow band which the clergy wore around the waist (Durand 1374, 44). Medieval cinguli had different forms. They were usually from 3 to 5 cm wide and served as decoration rather than for tying the alb. For this purpose they had two silk ribbons or bands woven or twisted from multiple threads called funiculi. They could be tablet- or loom-woven, from silk or cheaper materials. They were often richly embroidered. Those with letters were called *zonae litera,* as with the one associated

3 The inscription is the subject of research on Romanesque inscriptions in cooperation with Institute of History, University of Warsaw.

Fig. 30.6: Visualisation of the stole and the cingulum on the 3D model of a clergyman (photo: M. Cybulska).

with bishop Witgarius from Augsburg dated to the 9th century (Nowowiejski 1883, 171–172; Müller-Christensen 1973, 192).

Therefore, the conclusion as to what our object represents is that it has to be a cingulum, most probably in the form depicted in *Fig. 30.6.*

4. Interpretation

The origin of the objects and their artistic level are relevant to research on the Kruszwica collegiate and its importance in the history of the church in Poland. The chronicler Jan Długosz mentioned the burial in Kruszwica of the bishop of Kruszwica, Swidger, and two other bishops, Baptist and Paulin. The exact date of the death of Swidger is not known, but according to some church registers it was in 1156. Therefore, the key to the whole matter – who was buried in the grave – may be those bishops reportedly buried there (Długosz 2009, 49 and 67; Hewner 1996, 433)

Medieval funeral rites were very important, especially those relating to clergymen. In works of art from this period, we see the dead in a shroud and also buried in pontifical robes. For the purpose of comparison, we analyzed well-documented burials from St. John's Cathedral in Wroclaw dated to a similar period. Out of 15 burials of bishops, textiles were found in 6 tombs, a complete liturgical vestment – mantle, chasuble, stole and gloves in one of them, fragments of a chasuble and another unidentified vestment in the next four only (Wojcieszak 2012, 22–23).

Tombs of the clergy were also variously equipped. There were chalices and patens, rings and crosses, usually used as a sign of priesthood. Bishops could be buried either in a pontifical vestment or in an alb, which was usually more susceptible to biodegradation as it was made from linen. However there had to be some insignia of their position.

5. Conclusions

The objects represent two items of a liturgical vestment – a stole and cingulum. Both were made from expensive materials and show a high level of workmanship indicating that they were luxury objects. As the objects are unique, it is difficult to identify anything similar in museum collections. The small number and large variety of embroidered silks from 11th–13th centuries do not show any features in common. Many ecclesiastical vestments of that time have their entire surface covered with embroidery, and many are embroidered on smooth silk fabrics especially samitum, thus it is hard to determine their origin. Silks used at that time in Europe for liturgical vestments or shrouds usually were imported, mainly from Egypt, Persia, Syria and Byzantium. In Europe, apart from Sicily and Spain, silk fabrics were not produced at the time.

Comprehensive analysis of similar objects from the same period, as well as consideration of the re-read inscriptions lead to some hypotheses concerning the origin of the textiles. It seems that the persons buried in the graves were very high in the hierarchy of the Church. No one has so far linked the discoveries of archaeologists with the legendary bishops of Kruszwica, which seems very likely based on the content of the graves – chalice, paten and luxury silks.

The results of the analysis are extremely important for further historical research as they form evidence confirming the hypothesis that Kruszwica was a seat of the Wloclawek bishop at that time.

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31 | Analysis of Silk Yarn Attributes: Cross-Collection Characterisation of Historic Weft-Faced Compound Weave Figured Silks

JULIA GALLIKER

Abstract: Surviving silk textiles attributed to the Mediterranean and Near East c. AD 600–1300 are significant in both historic and technical terms. This paper presents some results from my dissertation research pertaining to yarn characteristics in 87 weft-faced compound weave figured silks found in ten museum collections. Objective measurement of diameter and inserted twist is aided by use of computer vision software tools. Yarn component analysis provides information about workshop production methods and suggests transmission of standard conventions throughout the Mediterranean and Near East at this period.

Keywords: silk, samite, microscopy, yarn, computer vision, digital image

1. Image analysis for textile component research

This paper presents my analysis of yarn attributes found in weft-faced compound weave figured silks attributed to Mediterranean and Near East workshops between c. AD 600–1300. As part of my PhD research, I applied computer-based technologies to examine historic silk production evidence more intensively than was formerly possible (Galliker 2014). The technical portion of my programme combined high-resolution images with a computer vision software application to measure some quality and technical characteristics of surviving fragments through detailed, cross-collection analysis.

During the past decade, dramatic advances in digital imaging have led to new methods of documentation and investigation. As shown in *Fig. 31.1,* my equipment setup combines a research grade digital microscope with a custom-built stand to perform precise digital 'sampling' for measurement of selected attributes including yarn components, textile structure, density, and pattern unit features. By using my portable equipment setup, I was able to document 125 silk fragments in ten different collections in North America and Europe as noted in the acknowledgements section below. Among these, 87 textiles fit the specific requirements of my study.

Fig. 31.1: Equipment setup comprising: Hirox digital microscope lens, Lumenera research camera, light diffuser lens with U/V filtered light box connected to lens with a fibre optic cable, custom-built stage, laptop computer, and digital camera (photo: J. Galliker).

Use of high-resolution images for non-invasive comparative measurement of silk textile components provides new opportunities for analysis. The research framework presented here is developed from a production point of view. Textile components are evaluated as products of organised processes, comprising sub-assemblies for textile weaving. At the outset of my research programme, I thought that a systematic approach to materials analysis would enable technical similarities to be established as a means of distinguishing the products of various workshops.

Within the field of computer engineering, computer vision refers to technologies associated with acquiring and using information from digital images (Nalwa 1993, 3–29). The application developed for this project represents a method for 'industrial inspection' of ancient textiles. The software comprises a set of three tools to study photographs captured according to a defined protocol (Patel *et al.* 2013). The pattern-matching tool combines alignment and change detection image processing operations to identify non-trivial differences. The template-matching tool is based on an algorithmic model for automated feature detection. The shape detection tool applies a feature extraction technique to detect silk fibres by transforming line data into parametric space. Additional measurements are performed directly by the user with a collection of tools in the application interface. The resulting data enable specific comparison of objective attributes across different collections.

2. The Historical Silk Research Problem

From a historical perspective, the favourable characteristics of silk differentiated it from other natural fibres. The material's westward spread from East Asia to the Mediterranean through long-distance trade was a major factor in cultural and economic exchange among distant civilisations (Hansen 2012, 235; Loewe 1971; Young 2001, 14–15). While the expansion of silk production and consumption in the region is widely acknowledged, specific features of the industry's development are more difficult to discern. Chroniclers had little reason to document silk manufacturing processes, and producers were not inclined to record or publicise their trade secrets. Apart from the Cairo Genizah (Goitein 1967–1993, I, 1–28), few commercial documents involving silk processes and trade have survived. Historical knowledge of silk comes mainly from accounts of its consumption in a variety of forms and contexts. Consequently, detailed examination of textile remains is necessary to obtain a better understanding of production characteristics.

Examples of the type of patterned silks included in this study are shown in *Fig. 31.2.* Thousands of such fragments survive in collections in Europe and North America, mainly from poorly documented archaeological excavations and church treasuries. The lack of find and contextual information represents a formidable obstacle to the interpretation of this large and important body of material. To date, representational analysis is the dominant means of attributing silks to particular cultures and time periods. The technical textile scholarship associated with this material is mainly confined to piece-specific analyses of the most intact and impressive surviving examples. The lack of comprehensive collections surveys and standard technical analyses accompanied by quality images has meant that available evidence has been selectively considered.

Weft-faced compound weave textiles are produced by separating the warp into two functional units. The binding warp secures inserted weft yarns into a coherent cloth. The main warp is manipulated independently to create a weft design on the textile face. Production of large scale repeating figured patterns required a drawloom equipped with a figure harness for repetition of woven patterns. Although the origin and development of these looms is obscure, they were important labour-saving devices (Becker 1987, 253–270; Cieta 1987, 16–24). Patterns tied-up in a figure harness provided a means of recording and storing work for mechanical reproduction.

Fig. 31.2: Examples of weft-faced compound weave figured silks: a. Cooper Hewitt 1902_1_221, b. Museum of Fine Arts Boston 96_35_ab, British Museum AN34973001 (photos: J. Galliker).

3. Fibre Measurements

In the early stages of my project, I attempted to define a methodology to study the material characteristics of figured silks on a hierarchical basis in terms of both fibres and yarns. Some researchers have tried to use silk fibre diameter measurements as a means to assign geographic origin. In his study of silk finds from Palmyra, Pfister (1934, 39) presented a chart that attempted to correlate silk fibre diameter and weight measurements with geographic place of origin. Separately, in a series of detailed studies, Nunome (1992) sought to determine chronological and geographical variation in East Asian silk (Riboud 1981).

Despite such attempts, two problems make such findings invalid for the purposes of dating and attribution. First, engineering studies of silk show significant intra-fibre diameter variation, a factor that has limited wider application of the material beyond textile use, despite its favourable mechanical properties (Perez-Rigueiro *et al*. 1998; 2000; 2002). Second, the methodologies applied by both Pfister and Nunome relied upon destructive physical sampling. For characterisation purposes, the number of possible measurements is too few to establish valid findings.

Development of high-resolution digital microscopy has now made it possible to measure fibre diameter non-invasively for intact textiles and apply standard statistical methods. My initial plan was to measure fibre diameter as a means of characterising yarn attributes. However, my experiments showed that reliable recording required higher magnification than was possible with the equipment suitable for yarn and textile attributes. Given financial and practical considerations, I decided to pursue comparative measurement of fibre diameter in a possible future project.

4. Yarn measurements

Yarn is defined as an assemblage of fibres twisted or laid together to form a continuous strand suitable for textile applications (Mauersberger 1954, 32). While fibre is important in determining the characteristics of a textile, the type and structure of yarn also has a significant effect on appearance, texture, and performance (Kadolph 2007, 20–21). Consequently, both the inherent properties of silk and the choice of yarn structure have bearing on textile construction.

The two yarn measurements included in this programme are diameter and surface helix angle. For both of these data sets, mean values were derived from a statistically valid number of measurements of intact components across the face of a textile. To provide an accurate representation of textile properties, measurements of visibly degraded or damaged areas were excluded.

4.1. Yarn diameter

Yarn diameter is the cross-sectional width of a textile component and should remain consistent in a lengthwise direction. The two main factors contributing to diameter are the number of fibres in cross-section, and the amount of fibre compaction (Morton – Hearle 1993, 129). The methodology developed for this study represents the first instance in which yarn diameter has been systematically measured for intact historical silk fragments. The following discussion considers warp and weft characteristics separately, then in terms of their combination within a given textile.

For all loom-woven textiles, the warp is the active component and has to withstand the tension and friction associated with repetitive opening and closing of sheds for weft insertion (Lord – Mohamed 1982, 17–19). In this research programme, warp diameter measurements were recorded only for binding warps, which are visible on the cloth surface. In weft-faced compound weave textiles, the main warp is entirely covered by the pattern wefts it manipulates. The main warp can only be observed at the edges of a textile fragment and in damaged areas, so does not provide a reliable basis for measurement.

While binding warp diameters vary within a given textile, mean measurements are comparable among different fragments in terms of relative fineness. As shown in *Fig. 31.3,* average binding warp yarn diameter measurements in micrometres (µm) are grouped into five categories: fine (less than 169 µm), medium fine (170–209 µm), medium (210–239 µm), medium coarse (240–279 µm) and coarse (greater than 280 µm). Measurements follow a normal distribution with the majority of textiles in the middle categories.

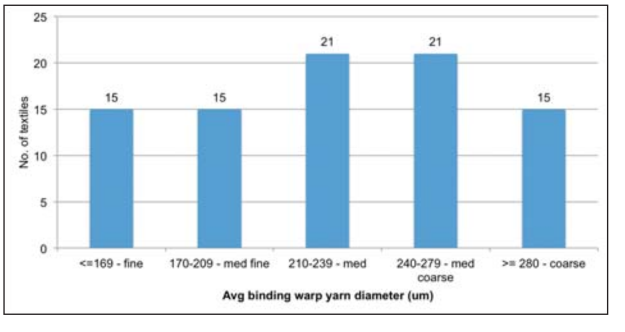

Fig. 31.3: Average binding warp yarn diameter distribution (µm) (graph: J. Galliker).

Unlike warps, weft yarns are not subject to mechanical stress and provide filling for cloth construction. Excluding four instances of special yarns, all of the weft-faced figured silks in the collection comprise weft yarns with no discernible twist. The absence of twist provides a smooth, reflective surface interrupted only by the binding warps used to secure the wefts in place. A second reason for the lack of twist is that weft yarn fibres spread out between binding points to disguise the warps underneath.

Analysis of various yarn component measurements provides a perspective on the selection of yarn components for silk weaving. Comparing the diameter of ground wefts and dominant colour pattern wefts for each of the textiles in the study group shows a high degree of consistency in the selection of weft yarns for all silks in the collection.

An enigmatic finding from this study coincides with observations by DESROSIERS (2004, 16–17) and VERHECKEN-LAMMENS (2000, 42, fig. 5) regarding the large diameter differences in alternate wefts on some textiles. As shown in *Fig. 31.4,* these differences are clearly visible on at least ten textiles in the study group. Analysts have generally considered discrepancies in weft diameters as faults attributed to inconsistent yarn preparation (DESROSIERS 2004, 16). Alternatively, use of different weft diameters may have been intentional as a means of reducing the appearance of diagonal twill lines on the face of a textile. Whatever the cause or purpose, the practice indicates that two shuttles were used to weave each weft colour.

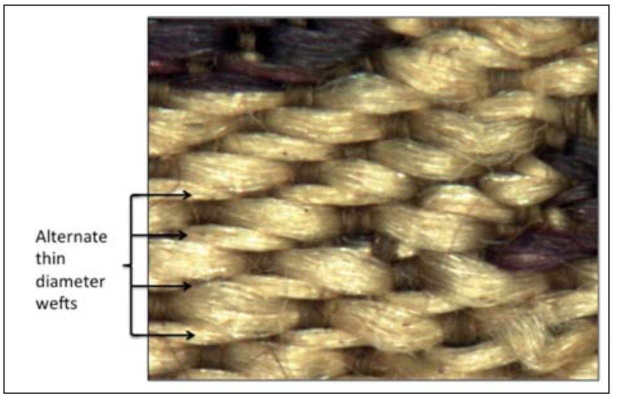

Fig. 31.4: Magnified view of alternate weft diameter size difference for British Museum AN34973001 (photo: J. Galliker).

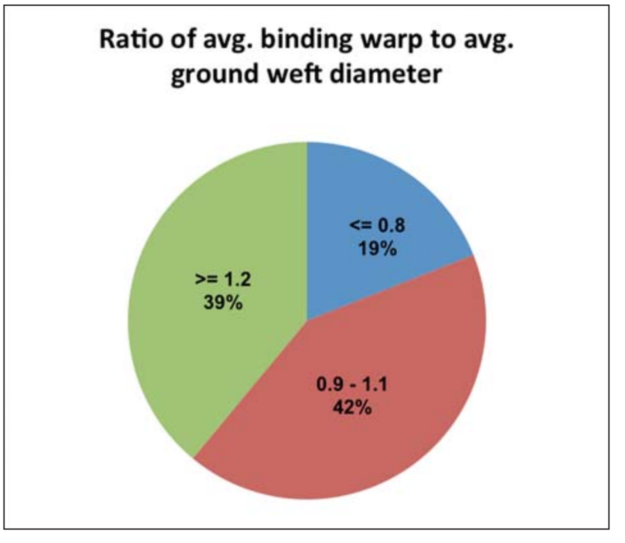

Fig. 31.5: Ratio of average binding warp to average ground pattern weft diameters (graph: J. Galliker).

Analysing measurements for the ground weft in relation to the binding warp provides a different perspective on specification conventions. As shown in the chart in *Fig. 31.5,* the ratio of these measurements shows that 42% of silks in the collection have roughly equal binding warp and ground weft diameter widths, despite having different functional roles and construction techniques. In 39% of silks, the diameter of the binding warp is larger than the ground weft, resulting in a prominent binding warp that detracts from the appearance of the represented design. The binding yarn is finer than the ground weft in 19% of the examples, possibly as a later development to minimise the appearance of binding warps on the textile face.

4.2 Surface helix angle

Twist describes the process of rotating a strand of fibres about its axis to improve strength and elasticity (BOOTH 1968, 229; HUDSON *et al.* 1993, 160). In the closely set warps used to weave figured silks, abrasion resistance is important to reduce yarn wear and breakage. Twist varies in two ways: the direction in which

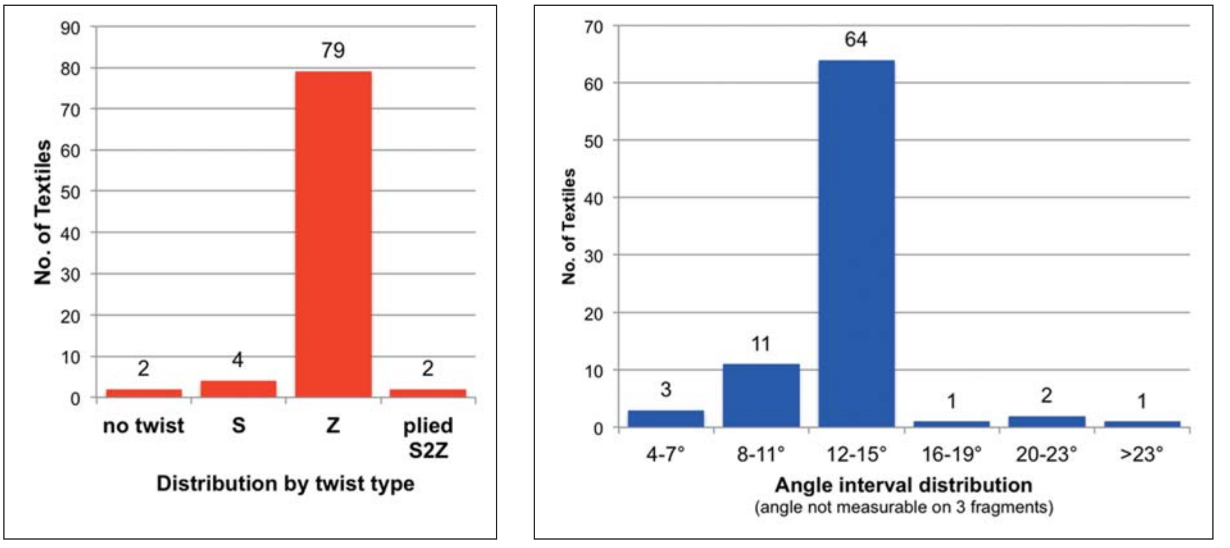

Fig. 31.6: a: Twist direction comparison. b: Average surface helix angle comparison (graph: J. Galliker).

fibres are twisted and the amount of twist applied over a given length of the yarn. Twist is inserted by rotating fibre strands in either a clockwise (Z) or anti-clockwise (S) direction in relation to the fibre axis.

Surface helix angle measures the relationship between the twisted fibres on the surface of the yarn with the longitudinal axis (HEARLE *et al.* 1969, 63). As a function of both turns per unit length and yarn width, this measurement can be used to compare yarns of different diameters. EL-HOMOSSANI (1988, 28) described measurement of yarn helix angle in his protocol for reconstructing weaving technologies using an electronic image analyser. The most extensive analysis to date was developed in the mid-1990s using digital analysis methods available at the time (CORK *et al.* 1996, 337–345).

All but two of the weft-faced compound weave silks in the study group have a twisted warp. Much has been written about the reasons for twist direction including conservation of established craft practices, transmission of skills, and cultural contact (BELLINGER 1959; PETERSON 1993). For single strand filament yarns, the direction of twist does not influence the mechanical properties of a finished textile and is considered to be a convention (EL-HOMOSSANI 1988, 28). As shown in *Fig. 31.6a*, among the weft-faced compound weaves in the collection, 95% have a Z-twist binding warp. This high degree of consistency evidently constituted a standard practice that coincided with the use of the weave structure in both the West and in Central Asia.

Among the weft-faced figured silks attributed to the Near East and Mediterranean, the graph in *Fig. 31.6b* shows that 83% have average helix angles in the range of 10–15°. Values for most remaining textiles are grouped around this mean. Looking at data for each individual textile, the majority of values are around 13°, but some measurements are outliers at about 5 and 32°. The distribution of data suggests that low or high measurements are local effects in the yarn caused either by twist that was not evenly distributed over the full length of the yarn, or that in handling, twist was unintentionally removed or inserted.

5. Summary

This discussion demonstrates how the information obtained from the computer vision protocol developed for this project aids in documentation of historic textiles. While the types of design varied among the textiles, particular production conventions were applied to most of the silks studied. Analysis of mean yarn diameters provides information about the selection of components and their relative relationship to each other. Such measurements support objective cross-collection analysis of textiles, particularly for pieces with similar pattern designs and structural characteristics. Component analysis also provides some process information and detection of errors.

Yarn evidence shows that a body of conventions existed that provided a means of standardising work. The uniformity of twist direction and angle suggest that technologies associated with silk were transmitted with the material and adopted by specialised producers at various locations throughout the region. The work involved in yarn preparation was apparently fibre-specific since the choice of twist direction for silk textiles differed from established craft habits in some locations. A combination of material, technique and equipment may explain one aspect of the regional transmission of silk textile production practices.

Acknowledgements

Museum collections included in this research project are: Boston Museum of Fine Arts, British Museum, Cleveland Museum of Art, Cooper Hewitt Museum, Detroit Institute of Art, Dumbarton Oaks, Katoen Natie, Kelsey Archaeology Museum, Textile Museum of American, and Yale University Art Gallery.

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32 | An Assemblage of Medieval Archaeological Textiles from Prague: a Study of Current and Original Colours

DAVID KOHOUT – HELENA BŘEZINOVÁ

Abstract: The study presents research into medieval textile and dyeing technologies by means of a detailed study and modern analytical methods (liquid chromatography with mass spectrometry detection and X-ray fluorescence) of a unique assemblage of 1,500 textile fragments obtained from archaeologically investigated medieval waste layers. The set of textile fragments was obtained during rescue archaeological excavations of the entrance shafts of utility tunnels in the New Town in Prague conducted between 2004 and 2008. The vast majority of textile finds are wool cloth, while silk textiles, bands, cords, threads and felt are also represented.

Keywords: archaeological textiles, waste layers, dyes, mordants, LC-MS, SEM-EDX

1. Introduction

This study focuses on the research of medieval textile fragments collected during archaeological excavations in the historical centre of Prague. To date in the Czech Republic, systematic and consistent attention has not been paid to the remains of ordinary textiles found in waste layers and features, mostly in the urban environment, and connected with the everyday life and work of the broadest classes of the population (Březinová 2007; 2010).

The remarkable state of preservation of the large assemblage of 1,500 medieval textile fragments from Prague thus presents an extraordinary opportunity to conduct a detailed study using modern analytical methods (liquid chromatography with mass spectrometry detection and X-ray fluorescence), to investigate an important assemblage of textile products and to track the techniques and procedures of textile production and related crafts.

The main aim of the project is to describe medieval dyeing methods and to determine the raw materials utilised in these processes. The information from historical sources is compared with the results of analyses conducted on textile fragments from the Prague assemblage. An attempt is made to identify trends in the way individual colours faded when exposed to light during the period of use, and how the colour changed when the fabric was deposited in the ground for hundreds of years and conserved by restorers. The article describes the current condition of the fragments, analyses of organic dyes and inorganic mordants. A synthesis of analyses is used to describe procedures and raw materials employed by medieval dyers and the resulting colours on textiles.

2. Textile fragments

2.1 Find circumstances

Textile fragments were collected during rescue archaeological excavations of the entrance shafts of utility tunnels in Prague´s New Town district (Jungmannova, Vodičkova and Školská streets) conducted between 2004 and 2008. The excavations involved the investigation of a thick formation of organic origin representing the remains of a dump for domestic waste from the nearby lots and for the construction waste from the rebuilding of houses during the fourteenth and fifteenth centuries. The site produced an unusually large amount of artefacts made from organic materials – wood, textiles and leather.

2.2 Laboratory treatment

After being retrieved from the ground, the fragments were turned over to a specialised conservation laboratory (restorer: V. Otavská), where they were carefully disinfected and cleaned. The fragments were stored flat in specially manufactured containers on pre-stressed acid-free wood panels with a countersunk bed for individual fragments (*Fig. 32.1*). The panels were also lined with unbleached cotton fabric and covered with a pane of glass, which, thanks to the recessed compartments for the textiles, does not rest directly on the fabrics and deform their shape.

Fig. 32.1: Wood panel with a countersunk bed for individual textile fragments (photo: D. Kohout).

2.3 Variability of the textile assemblage

The entire assemblage is composed of 1,500 fragments, including 1,350 fragments representing 500 different types of fabric, bands, twisted cord, felt, unprocessed animal fibre and individual threads. The good condition of the preserved fragments and the conservation method are a good foundation for conducting a detailed textile-technology study, for collecting samples and performing the analyses. As the colour of the fragments today is diverse, it is reasonable to expect the representation of a broad spectrum of the original textile colours.

The vast majority of all preserved textiles are wool cloth with a plain weave (300 specimens) or a twill weave (100 specimens), three-quarters of which show signs of their original fulling (*Fig. 32.2*).

Other animal fibres are represented in the form of sheet felt, clumps of raw material, horsehair and the textiles made from them.

A valuable part of the assemblage is thirty monochromatic and colour patterned silk textiles with more intricate weaves and patterns (damask, lampas, satin, samite – *Fig. 32.3*)*,* in some cases even the remnants of metal thread in the form of gold-plated membranes from animal material wrapped around a flax core.

Due to their lower durability during long-term deposition in the wet ground, only fifty fragments of textile material from fibres of plant origin were preserved in the form of the remains of sewing thread, twisted cords and bast fibres.

Fig. 32.2: Wool cloth with a plain weave – a typical finding in the Prague assemblage (photo: D. Kohout).

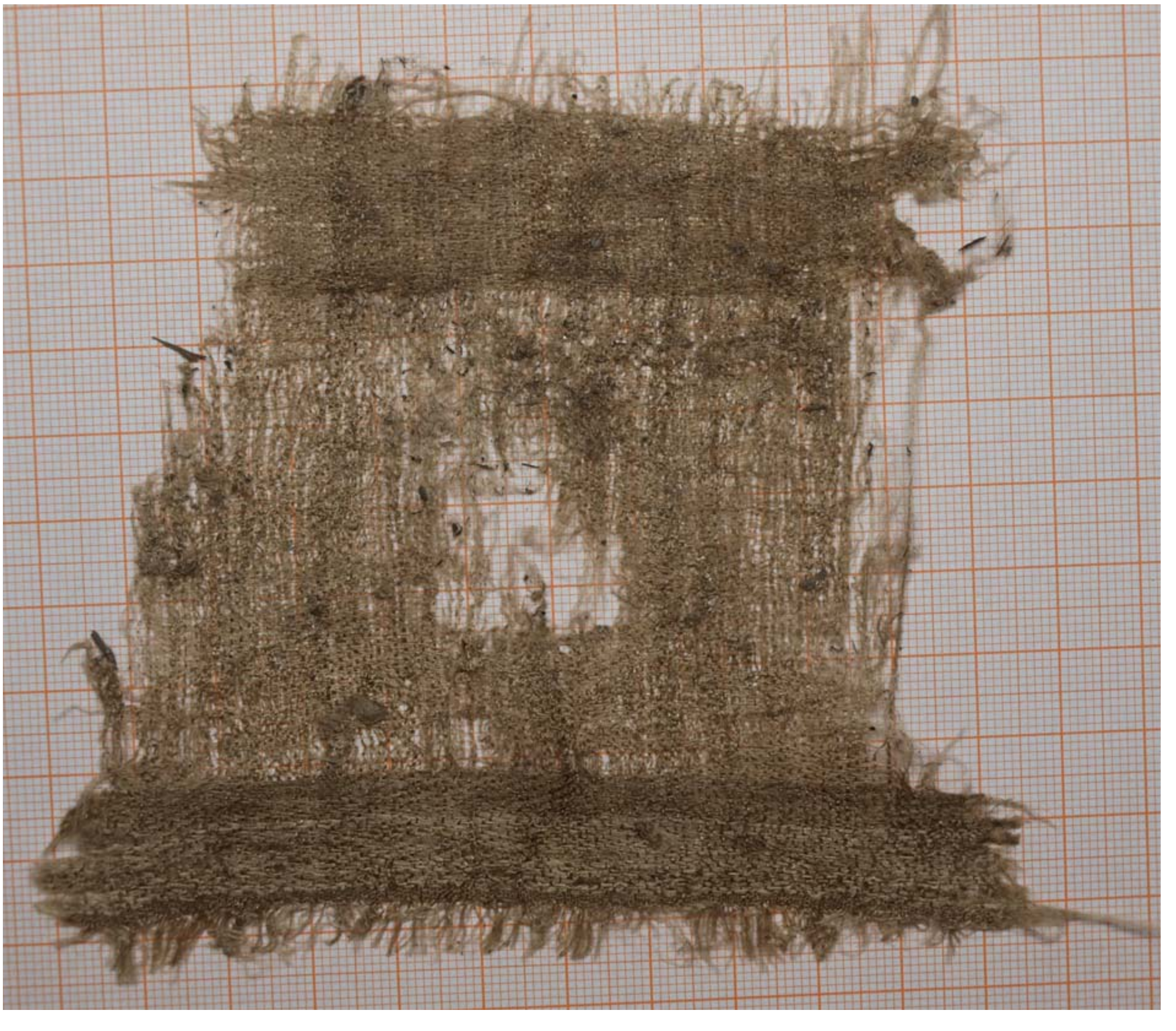

Fig. 32.3: Fragment of silk textile with samitum weave (photo: D. Kohout).

2.4 Textile techniques and products

An important part of the entire assemblage is made up of textiles produced on a horizontal loom, other textile techniques are also represented, especially bands woven with tablets and by other means. The assemblage also includes cords, string twisted in various ways and felts.

Collected from the dump layers at the site, the preserved textiles are mostly small fragments that had already lost their function and cannot be positively interpreted today. No reconstructable parts of clothing or specific products were preserved, and only separate insertions, pieces or insoles can be identified. Observable on many fragments are holes from stitching and sewing thread, selvedges, overcast edges, hems with decorative trims, pleating, buttonholes (*Fig. 32.4*)*,* knots and braids.

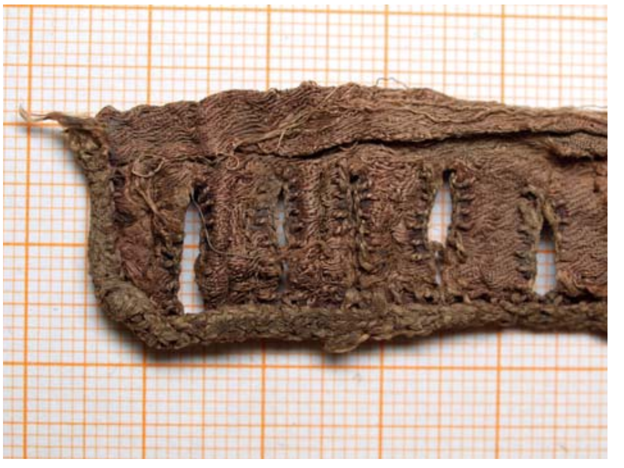

Fig. 32.4: Fragment of silk textile with stitched buttonholes (photo: H. Březinová).

3. Methods

Visible spectroscopy (Vis) was measured with a Datacolor Mercury 20, loaned by the Institute of Chemical Technology in Prague, Department of Chemical Technology of Monument Conservation, and the data were analysed in the Datacolor Tools program. Mass spectrometry (LC-MS) was measured using Thermo Scientific Orbitrap, and the data were analysed with the Xcalibur program. Scanning electron microscopy (SEM-EDX) was performed at the Technical University of Liberec, Department of Material Science, with a Tescan Vega 3 SBH with Oxford X-MAX. The data were then analysed using the AZtecEnergy program.

4. Experimental

4.1 Current colour measurement (Vis)

A spectrophotometer in the visible region of the spectrum was used to determine the shade of the fragments. Data were acquired on how textile fragments reflect visible radiation and hence what colour is perceived by the human eye. The colour is produced by substances that absorb certain parts of the visible spectrum.

The data are processed in a CIELAB 1976 colour coordinate system. Colour is represented by three coordinates: the L-axis is from black to white, the A-axis is from green to red and the B-axis is from blue to yellow. The columns that appear in the figure, are in fact points (*Fig. 32.5*). Data from the studied assemblage was most frequently measured around these points, i.e. near the top of the columns. Current colours are brown, red, yellow, black and white. The colours blue and green have not been preserved. Individual shades of colours are not clearly defined; instead, they are described, for example, as a shade between black and dark brown or brown and light brown. There

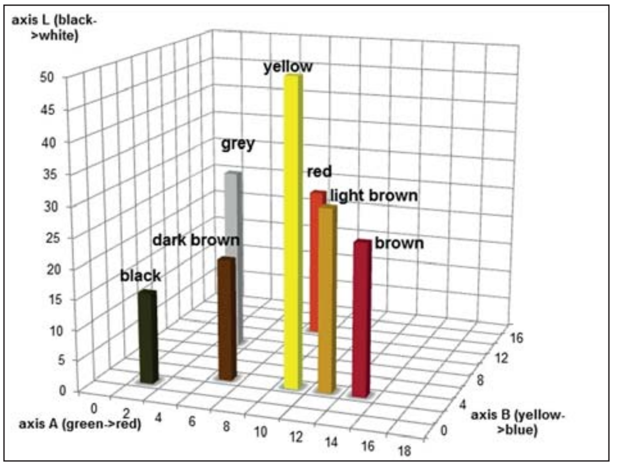

Fig. 32.5: CIELAB 1976 Colour space coordinates (graph: D. Kohout).

were visible differences between the preserved colour of silk fibres and wool fibres (*Fig. 32.6*). Silk was preserved in lighter shades of yellow and light brown. Wool was most frequently represented by brown and dark brown shades. The difference could be the result of the larger surface area of the thinner silk fibres: silk fibres are 10 µm in diameter and wool about 20 µm. The concentration of chromophores – substances that absorb visible light – can hence be higher in the case of silk. It is also assumed that the silk fibres were much more thoroughly dyed and that higher quality, more permanent natural dyes were used in this process.

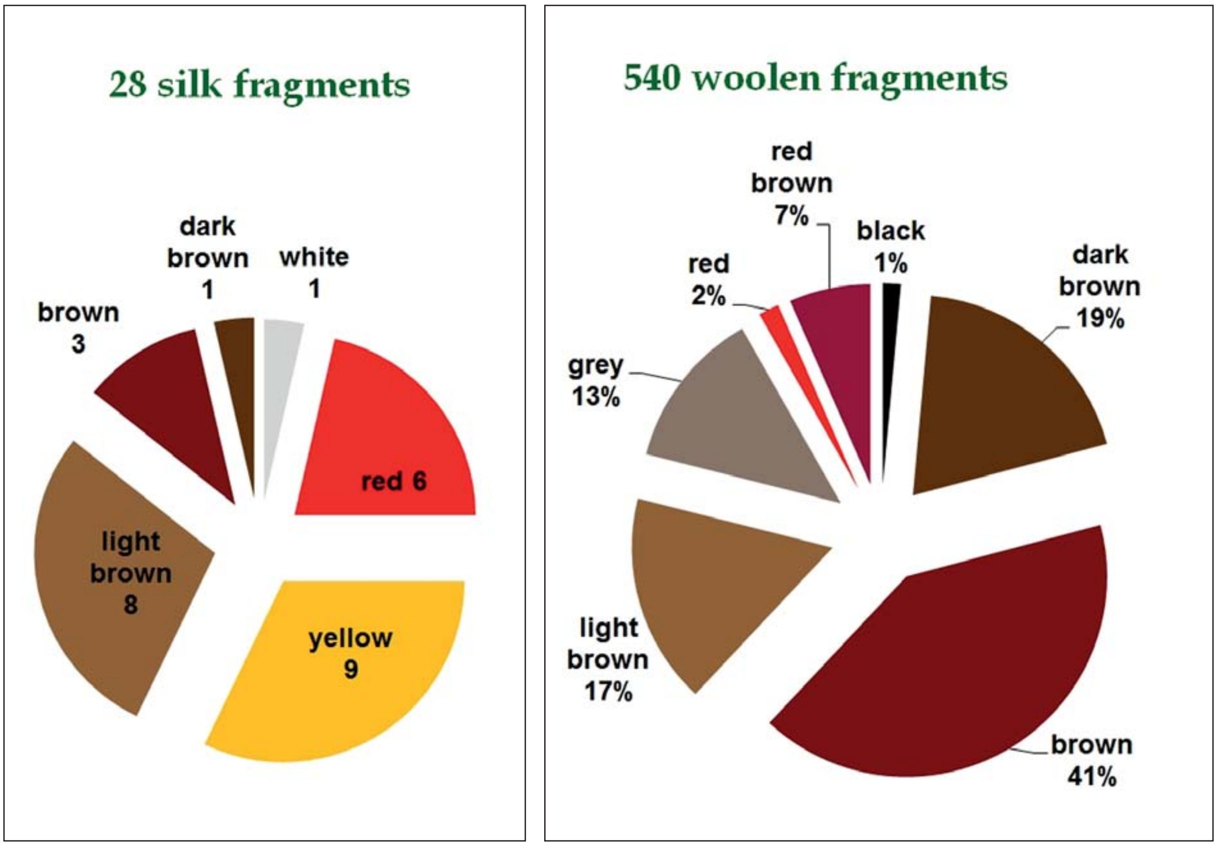

Fig. 32.6: Preserved colour of 28 silk fragments and 540 woollen fragments (graph: D. Kohout).

4.2 Original dyestuff determination (LC-MS)

The original colour can be determined by analysing the organic dyes used by medieval dyers. By extracting fibres, it is possible to determine the solution of the dye bath, or the substances that bond to the surface of the fibres during the dyeing process. Based on their application, natural dyes can be divided into three groups: mordant dyes, vat dyes and direct dyes. The majority of natural dyes are mordant dyes, which are fixed to the fibre in a complex bond through the central atom of the mordant compound (ions of Al, Fe or Cu; GRAAF 2003; SCHWEPPE 1993) The mordant on the fibres has an impact on the resulting shade. Vat dyes are a type of dye that is not soluble in water; they bind to fibres in the dye bath in their reduced 'leuco' form, which is soluble. Once removed from the dye bath, the dye oxidises once more into its insoluble colour form and is firmly fixed to the fibre. Direct dyes have a high affinity for the fibre due to many hydroxyl groups in the molecule. In the case of protein fibres, hydroxyl groups bond to the function groups of amino acids.

4.2.1 Extraction of dyes from fibres

To identify dyes made from natural sources, an extract from a small amount of collected fibres is used. The extraction is based on the principles of the technological processes employed by dyers. The extraction mixture contains three components – methanol (48%) for polar dyes, dichloromethane (48%) for nonpolar dyes, and formic acid (4%) for breaking the complex mordant-dye bond (ZHANG – LAURSEN 2009). The advantage of a complex mixture is one-step extraction for the entire range of natural dyes that were used. Approximately 0.1–1 mg of fibres are diluted in 100 μL of this mixture: extraction takes place in an ultrasound bath at a temperature of 60°C for 30 minutes. A smaller amount of silk is collected due to its lower area density compared to wool.

4.2.2 Separation and detection of dyes

In the analysis that follows, the extraction used the separation technique of high performance liquid chromatography, where individual analytes are divided on the column with reverse phase. The separated analytes go through an electrospray atmospheric pressure ionisation technique to an Orbitrap mass analyser. Using mass spectrometry, approximately 100 of the most common natural textile dyes, whose occurrence on the fibres could be assumed, were examined (*Tab. 32.1*). The specific analyte is therefore confirmed by two factors: first by the retention time, in which the given molecule flows from the column and is recorded by the detector. Secondly, the mass spectrum confirms the molecular formula of the ionised dye molecules. The examined analytes are from the group of polyene dyes, indigotins, naphthoquinones, anthraquinones, flavonoids, neoflavonoids, tannins and their glycosylated precursors. (PETROVICIU *et al.* 2010; ROSENBERG 2008) The individual sources contain a complex mix of dyes (different chromophores), and medieval dyers often used a combination of natural sources. Techniques that separate these complex mixtures are therefore important for analyses of the original colour. In the case of mordant dyes, it is useful to determine the mordant that was used (MANHITA *et al.* 2011). In the case that organic mordants such as tannins were used, they are examined using methods focused on organic components.

4.3 Inorganic mordant determination (SEM-EDX)

The determination of mordants is important both for understanding technological procedures and for identifying the resulting colours of the fibres. The method employed combines the use of a scanning electron microscope and an energy dispersive detector (KRAMELL *et al.* 2014). Special attention is paid to this method due to the presence of impurities that can occur on archaeological fibres even following conservation. These impurities can significantly influence the analysis. Owing to the method of mapping the elements of the scanned part, the described equipment can both distinguish the composition of the impurities and confirm the presence of mordant elements on the entire surface of the fibres. The XRF spectrum in the figure shows the presence of all mordant elements such as iron, aluminium and copper

Tab. 32.1: Monitored dyes, chemical formula and high resolution mass spectrometry ions [M-H] (graph: D. Kohout).

Analyte	Formula	m/z [amu]	Analyte	Formula	m/z [amu]
alizarin	$C_{14}H_8O_4$	239,0350	apigenin	$C_{15}H_{10}O_5$	269,0455
alizarin O-glucoside	$C_{20}H_{18}O_9$	401,0878	apigenin O-glucoside	$C_{21}H_{20}O_{10}$	431,1008
ruberythric acid	$C_{25}H_{26}O_{13}$	533,1301	luteolin	$C_{15}H_{10}O_6$	285,0405
lucidin	$C_{15}H_{10}O_5$	269,0455	luteolin O-glucoside	$C_{21}H_{20}O_{11}$	447,0933
lucidin O-glucoside	$C_{21}H_{20}O_{10}$	431,0984	fisetin O-glucoside	$C_{21}H_{20}O_{11}$	447,0933
lucidin O-primeveroside	$C_{26}H_{28}O_{14}$	563,1406	fustin	$C_{15}H_{12}O_6$	287,0561
pseudopurpurin	$C_{15}H_8O_7$	299,0197	fustin O-glucoside	$C_{21}H_{22}O_{11}$	449,1089
galiosin	$C_{27}H_{28}O_{15}$	593,1512	quercetin	$C_{15}H_{10}O_7$	301,0354
rubiadin	$C_{15}H_{10}O_4$	253,0506	quercitrin	$C_{21}H_{20}O_{11}$	447,0933
rubiadin O-glucoside	$C_{21}H_{20}O_9$	415,1035	quercetin O-rhamnoside	$C_{21}H_{20}O_{11}$	447,0933
rubiadin O-primeveroside	$C_{26}H_{28}O_{13}$	547,1457	quercetin O-primevero-side	$C_{26}H_{28}O_{16}$	595,1305
antraflavic acid	$C_{14}H_8O_4$	239,0350	isoquercitrin	$C_{21}H_{20}O_{12}$	463,0882
quinalizarin	$C_{14}H_8O_6$	271,0248	kaempferol	$C_{15}H_{10}O_6$	285,0405
purpurin	$C_{14}H_8O_5$	255,0299	kaempferol O-rutinoside	$C_{27}H_{30}O_{15}$	593,1512
munjistin	$C_{14}H_8O_6$	271,0248	rutin	$C_{27}H_{30}O_{16}$	609,1461
emodin	$C_{15}H_{10}O_5$	269,0455	laccaic acid A	$C_{26}H_{19}NO_{12}$	536,0834
chrysazin	$C_{14}H_8O_4$	239,0350	laccaic acid B	$C_{24}H_{16}O_{12}$	495,0569
morindone	$C_{15}H_{10}O_5$	269,0455	laccaic acid C	$C_{25}H_{17}NO_{13}$	538,0627
morindone O-primeveroside	$C_{26}H_{28}O_{14}$	563,1406	santalin	$C_{15}H_{14}O_5$	273,0768
soranjidiol	$C_{15}H_8O_4$	251,0350	santalin A	$C_{33}H_{26}O_{10}$	581,1453
asperuloside	$C_{18}H_{22}O_{11}$	413,1089	santalin B	$C_{34}H_{28}O_{10}$	595,1610
carminic acid	$C_{22}H_{20}O_{13}$	491,0831	lawson	$C_{10}H_6O_3$	173,0244
flavokermesic acid	$C_{16}H_{10}O_7$	313,0354	catechin	$C_{15}H_{14}O_6$	290,0796
kermesic acid	$C_{16}H_{10}O_8$	329,0303	gallocatechin	$C_{15}H_{14}O_7$	305,0667
kermesic acid O-glucoside	$C_{22}H_{20}O_{13}$	491,0831	epicatechin	$C_{15}H_{13}O_6$	289,0718
indigotin	$C_{16}H_{10}N_2O_2$	261,0670	lapachol	$C_{15}H_{14}O_3$	241,0870
indirubin	$C_{16}H_{10}N_2O_2$	261,0670	alkanin	$C_{16}H_{16}O_5$	287,0925
dibromindigotin	$C_{16}H_6Br_2N_2O_2$	414,8723	morin	$C_{15}H_{10}O_7$	301,0354
monobromindigotin	$C_{16}H_{10}Br_1N_2O_2$	339,9853	rhamnetin	$C_{16}H_{12}O_7$	315,0510
dibromindirubin	$C_{16}H_6Br_2N_2O_2$	414,8723	xanthorhamnin	$C_{34}H_{42}O_{20}$	769,2197
monobromindirubin	$C_{16}H_{10}Br_1N_2O_2$	339,9853	myricetin	$C_{15}H_{10}O_8$	317,0303
gallic acid	$C_7H_6O_5$	169,0142	maclurin	$C_{13}H_{10}O_6$	261,0405
ellagic acid	$C_{14}H_6O_8$	300,9990	orcein	$C_{28}H_{24}N_2O_7$	499,1511
pentagalloyl glucoside	$C_{41}H_{32}O_{26}$	939,1154	crocetin	$C_{20}H_{24}O_4$	327,1602
tetragalloyl glucoside	$C_{34}H_{28}O_{22}$	787,0999	crocin	$C_{44}H_{64}O_{24}$	975,3715
trigalloyl glucoside	$C_{27}H_{24}O_{18}$	635,0890	orientin	$C_{21}H_{20}O_{11}$	447,0933
digalloyl glucoside	$C_{20}H_{20}O_{14}$	483,0780	diosmetin	$C_{16}H_{12}O_6$	299,0561
galloyl glucoside	$C_{13}H_{16}O_{10}$	331,0671	sulfuretin	$C_{15}H_{10}O_5$	269,0455
catechin gallate	$C_{22}H_{18}O_{10}$	441,0827	maclurin	$C_{13}H_{10}O_6$	261,0405
brazilein	$C_{16}H_{12}O_5$	283,0612	curcumin I	$C_{21}H_{20}O_6$	367,1187
brazilin	$C_{16}H_{14}O_5$	285,0768	curcumin II	$C_{20}H_{18}O_5$	337,1081
haematein	$C_{16}H_{12}O_7$	315,0510	curcumin III	$C_{19}H_{16}O_4$	307,0976
haematin	$C_{16}H_{14}O_7$	317,0667	bixin	$C_{25}H_{30}O_4$	393,2071
safflomine A	$C_{27}H_{32}O_{16}$	611,1618	norbixin	$C_{24}H_{28}O_4$	379,1915

ions (*Fig. 32.7*). The mapped area depicted by secondary electrons is shown in the black and white image (*Fig. 32.8*). Cuticular scales of wool fibres with impurities are visible. The three colour pictures to the right are focused on the individual examined mordant elements. The light areas indicate a higher concentration of the given element. The scan with the yellow colouring demonstrates the presence of aluminium ions on the entire surface of the fibres; a higher concentration of impurities is also present. The red scan shows the concentration of copper, a

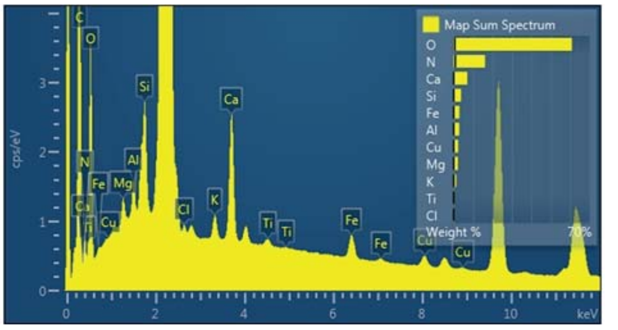

Fig. 32.7: XRF spectrum of analysed fibres, inorganic mordant element are presented (Fe, Cu, Al) (image: D. Kohout).

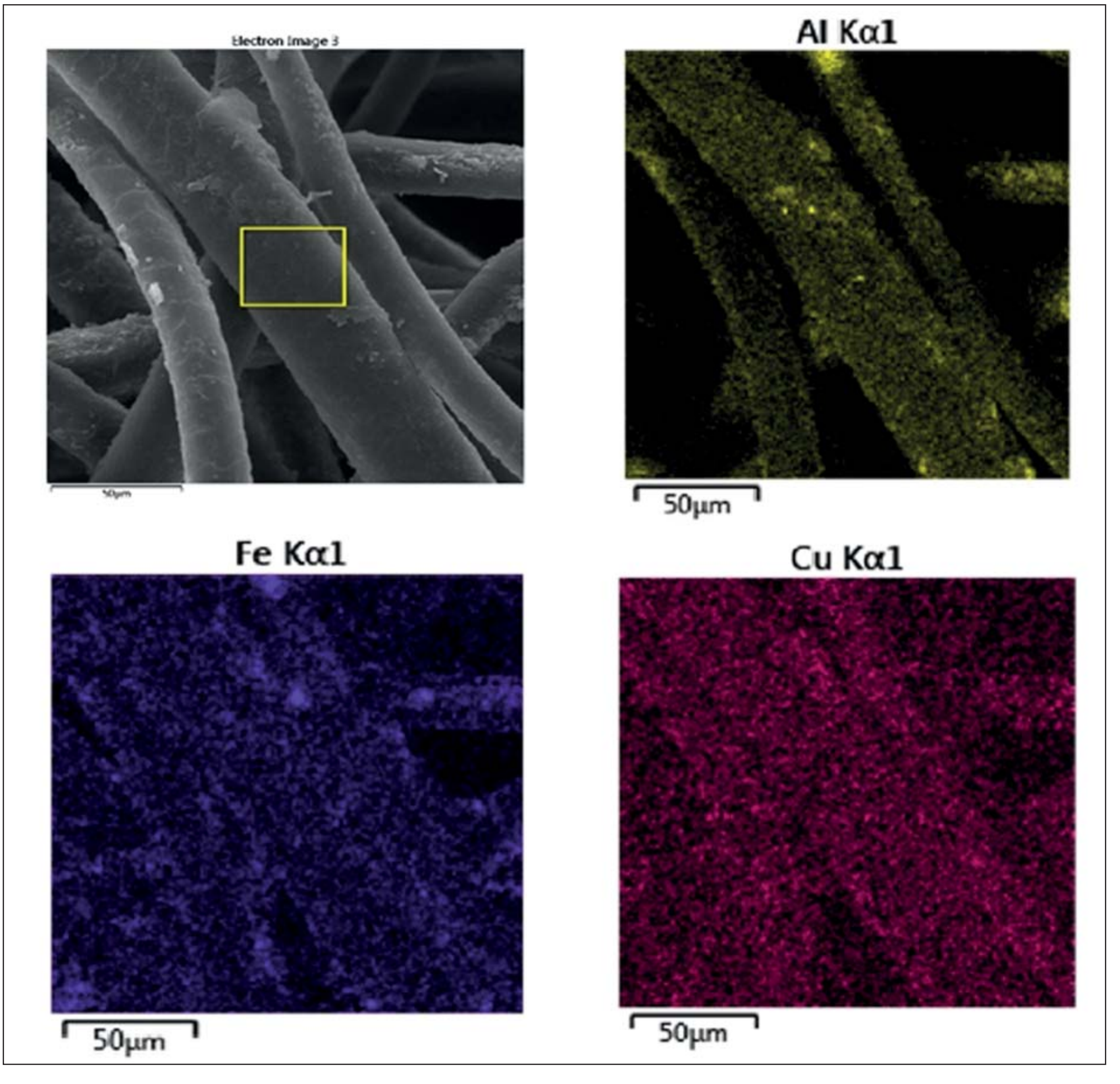

Fig. 32.8: The black-white scan is the back-scattered electron viewed part of fibre. The yellow scan is Al content. The blue scan is Fe content. The red scan is Cu content (image: D. Kohout).

similar amount of which occurs in practically the entire image, indicating that it forms a type of background that is not the result of the mordanting process. The violet scan depicting iron was not conclusive.

5. Results

Different colour stripes of yarn from fragment 1_V31_27 were sampled (*Fig. 32.9*). In the case of the yellow stripe, silk fibres were confirmed. It contains ions of aluminium as the mordant and was dyed with yellow flavonoids (apigenin and luteolin). The black wool stripe contains ions of iron as the mordant and was dyed with indigotin and re-dyed using tannins. The red wool stripe contains ions of aluminum as the mordant (*Fig. 32.8*) and was dyed with anthraquinone dyes derived from madder root.

Fig. 32.9: Fragment number 1_V31_27 (photo: D. Kohout).

6. Conclusions: historical dyeing methods

It is possible to deduce from medieval dyeing recipes which dyeing sources were used most frequently (GRAAF 2003; SCHWEPPE 1993). The primary colours (blue, red and yellow) and groups of substances from browns to black were used. A combination of primary colours was used to produce green, orange and most probably even deep black. Yellow cloth was re-dyed blue to produce green, re-dyed red to obtain orange. Red was most often obtained from the roots of the madder (*Rubia tinctorum*) and from brazilwood (*Caesalpinia sappan*); scarlet was derived from kermes (*Kermes vermilio)* polish and armenian cochineal (*Porphyrophora polonica* and *Porphyrophora hamelii Brandt*) or from very expensive purple obtained from molluscs (*Murex trunculus, Bolinus brandaris* and *Stramonita haemastoma*). Yellow could be obtained from a wide variety of natural sources, the most common of which are weld (*Reseda luteola*), sawwort (*Serratula tinctoria*), dyer's broom (*Genista tinctoria*), yellow chamomile (*Anthemis tinctoria*) and barberry (*Berberis vulgaris*). Black and brown were most often produced with a wide variety of tannins acquired from oak galls or from tree bark and naphthoquinones acquired from rotten walnut shells. Blue was obtained exclusively from indigo derived in Europe from woad (*Isatis tinctoria*), in the East from true indigo (*Indigofera tinctoria*) or dyer´s knotweed (*Polygonum tinctorium*). Alum, which provides aluminium ions, was the most common mordant. Iron ions were obtained in a bath of green vitriol or iron filings, copper in a bath of blue vitriol or verdigris. Aluminium was used primarily in combination with yellow and red. Iron was used as a mordant on dark colours such as brown and black.

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33 | Digitale Kartierung von organischen Strukturen an Metallfunden – ein standardisiertes System des Bayerischen Landesamtes für Denkmalpflege

BRITT NOWAK-BÖCK – HELMUT VOSS

Abstract: Im Rahmen der konservatorischen und wissenschaftlichen Bearbeitung von frühmittelalterlichen Funden mit anhaftenden organischen Substanzen wurde am Bayerischen Landesamt für Denkmalpflege ein standardisiertes Kartierungssystem entwickelt. Die erhaltenen Strukturen wie z. B. Textil, Leder oder Holz werden dabei in ihrer flächigen Ausdehnung und in ihrer stratigrafischen Abfolge mit Hilfe von festgelegten Farben und Piktogrammen abgebildet. Die einheitliche und auf das Wesentliche reduzierte Darstellungsweise erleichtert nicht nur die Dokumentation der beobachteten Details und die Vermittlung der wissenschaftlichen Ergebnisse, sondern ermöglicht zudem eine schnelle Vergleichbarkeit von organischen Befunden auch für fachfremde Leser.

Keywords: organische Materialien, Kartierungssystem, Dokumentation, Standardisierung, Fläche, Stratigrafie, Adobe Photoshop®

1. Notwendigkeit und Entwicklung eines standardisierten Kartierungssystems

Metallfunde, an denen sich mineralisierte organische Strukturen in der Korrosion erhalten haben, sind bei jeglicher Handhabung besonders gefährdet. Die anhaftenden, meist stark zersetzten Substanzen sind äußerst fragil, die an ihnen ablesbaren Informationen zum ursprünglichen Befundzusammenhang jedoch ausnehmend bedeutsam. Folglich kommt der Erfassung der Strukturen während verschiedener Arbeitsschritte von der Ausgrabung bis zur Auswertung eine besondere Bedeutung zu. Insbesondere im Zuge von Konservierungs- und Restaurierungsmaßnahmen, die von unterschiedlichen Personen und mit zeitlichem und räumlichem Abstand erfolgen können, ist die Dokumentation als langfristige „Informationssicherung“ unerlässlich. Zu den konservatorischen Maßnahmen zählen beispielsweise die Auflösung von Blockbergungen, die Behandlung von Metallen (wie z. B. Entsalzung, Festigung usw.), Tätigkeiten im Rahmen der „Investigative Conservation“ (z. B. Teilfreilegung der Metalle) oder die eigentliche Objektrestaurierung. Nur wenn die organischen Schichten während dieser Arbeitsschritte nachvollziehbar in ihrer Fläche und Stratigrafie erfasst werden, können alle Informationen in einer späteren wissenschaftlichen Auswertung entsprechend berücksichtigt werden (*Abb. 33.1*).

Auf die Notwendigkeit eines in Form und Inhalt systematisierten Verfahrens bei der beschreibenden Dokumentation wurde bereits vielerorts hingewiesen (vgl. z. B. GILLIS – NOSCH 2007; MITSCHKE 2001; PEEK 2013a, 183–198; 2013b, 37–44; WALTON – EASTWOOD 1983). Der Bedarf wird insbesondere bei der bodendenkmalpflegerischen Arbeit mit hohem Fundaufkommen, wie bei der Planung von Projekten mit vielen Beteiligten und letztlich der Vermittlung von wissenschaftlichen Ergebnissen im Zusammenspiel mit anderen Fachdisziplinen deutlich (NOWAK-BÖCK 2013, 131–143). Eine einheitliche Vorgehensweise bei der Dokumentation kann Informationsverlusten vorbeugen und die Qualität der erhobenen Daten sichern. Zudem liegt der Nutzen in einer enormen Arbeitserleichterung bei der Datenzusammenstellung für eine anschließende wissenschaftliche Auswertung und Publikation der Ergebnisse.

Um diese Vorteile auch für die grafische Kartierung der organischen Substanzen an Metallen nutzen zu können, wurde im Rahmen der Bearbeitung der frühmittelalterlichen Funde aus Unterhaching, Lkr. München ein digitales Kartierungssystem erstellt (NOWAK-BÖCK – VON LOOZ – VOSS 2013, 156–

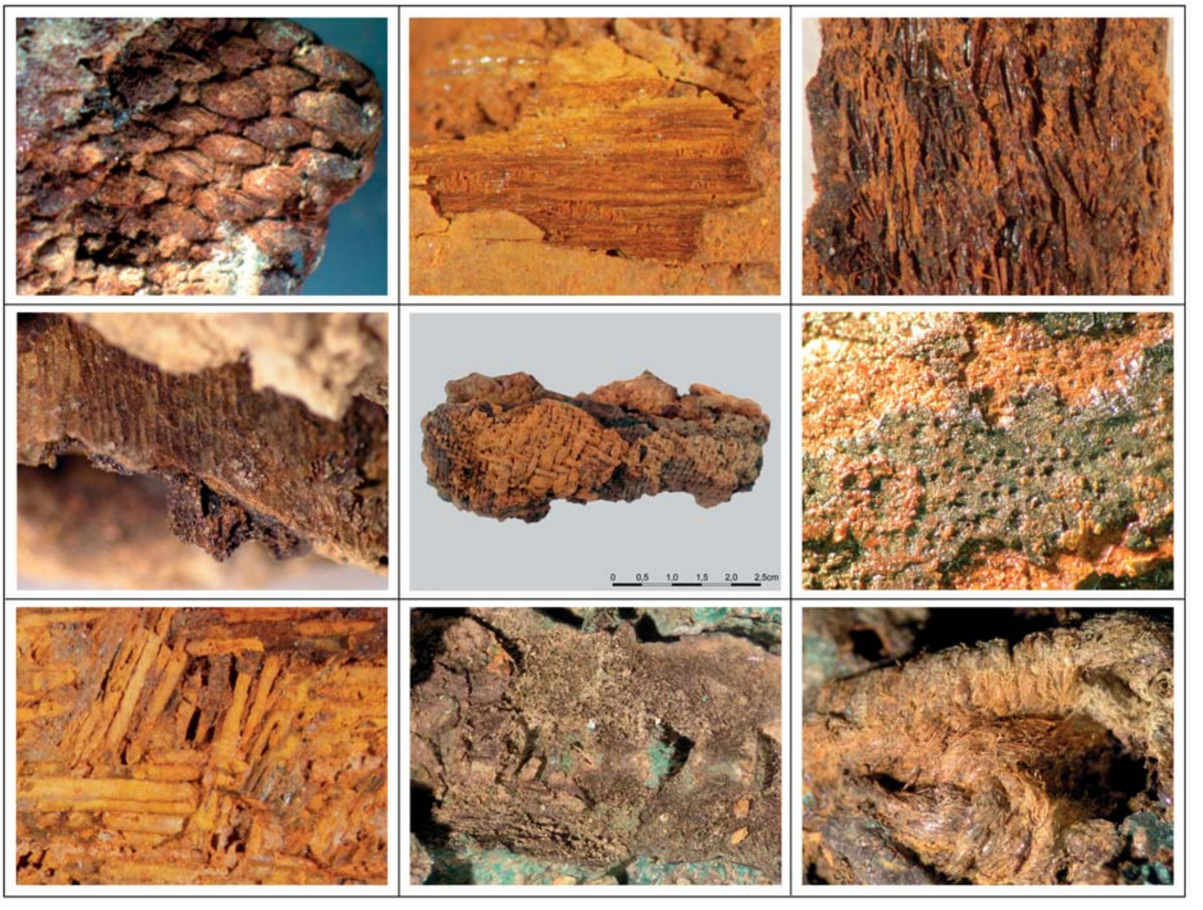

Abb. 33.1: Verschiedene organische Strukturen an Metallen (von l. o. nach r. u.): leinwandbindiges Textil, Holz, Fell, Horn, mehrschichtige Textilien, Leder, botanisches Material, Leder, Öse (Grafik: H. Voß, B. Nowak-Böck, BLfD).

185 und 258–300) (*Abb. 33.2*). Es basiert auf dem Bildbearbeitungsprogramm Adobe Photoshop® ab Version CS3. Im Folgenden konnte dieser “Prototyp” weiterentwickelt, auf andere Projekte übertragen und für ein größeres Anwendungsspektrum angepasst werden (vgl. z. B. Nowak-Böck – Bartel – Voss 2014, 98–110). Ziel der Entwicklung war eine für den Anwender und für den Leser leicht nachvollziehbare und einheitliche Kartierungssystematik für organische Substanzen an Einzelfunden und in Befundblöcken aus unterschiedlichen Zeitstellungen. Die standardisierte Darstellungsweise mit festgelegten Farben, Piktogrammen und Kurzbezeichnungen sollte eine einfache Vermittlung und eine optische Vergleichbarkeit von Einzelstücken und Komplexen ermöglichen. Weitere Zielsetzungen bei der Entwicklung waren flexible Anpassungsmöglichkeiten des standardisierten Systems an individuelle Einzelfälle, sowie die Fortschreibung bzw. der einfache Nachtrag von im Verlauf der Bearbeitung gewonnenen Detailinformationen.

2. Erläuterungen zur Anwendung des digitalen Kartierungssystems

Das System setzt sich aus einer flächigen Kartierung mit definiertem Farbschlüssel und einer stratigrafischen Darstellung mit Hilfe von farbigen Piktogrammen zusammen. Eine festgelegte Kurzbezeichnung ist zudem zur Identifikation der zu kartierenden Substanzen notwendig.

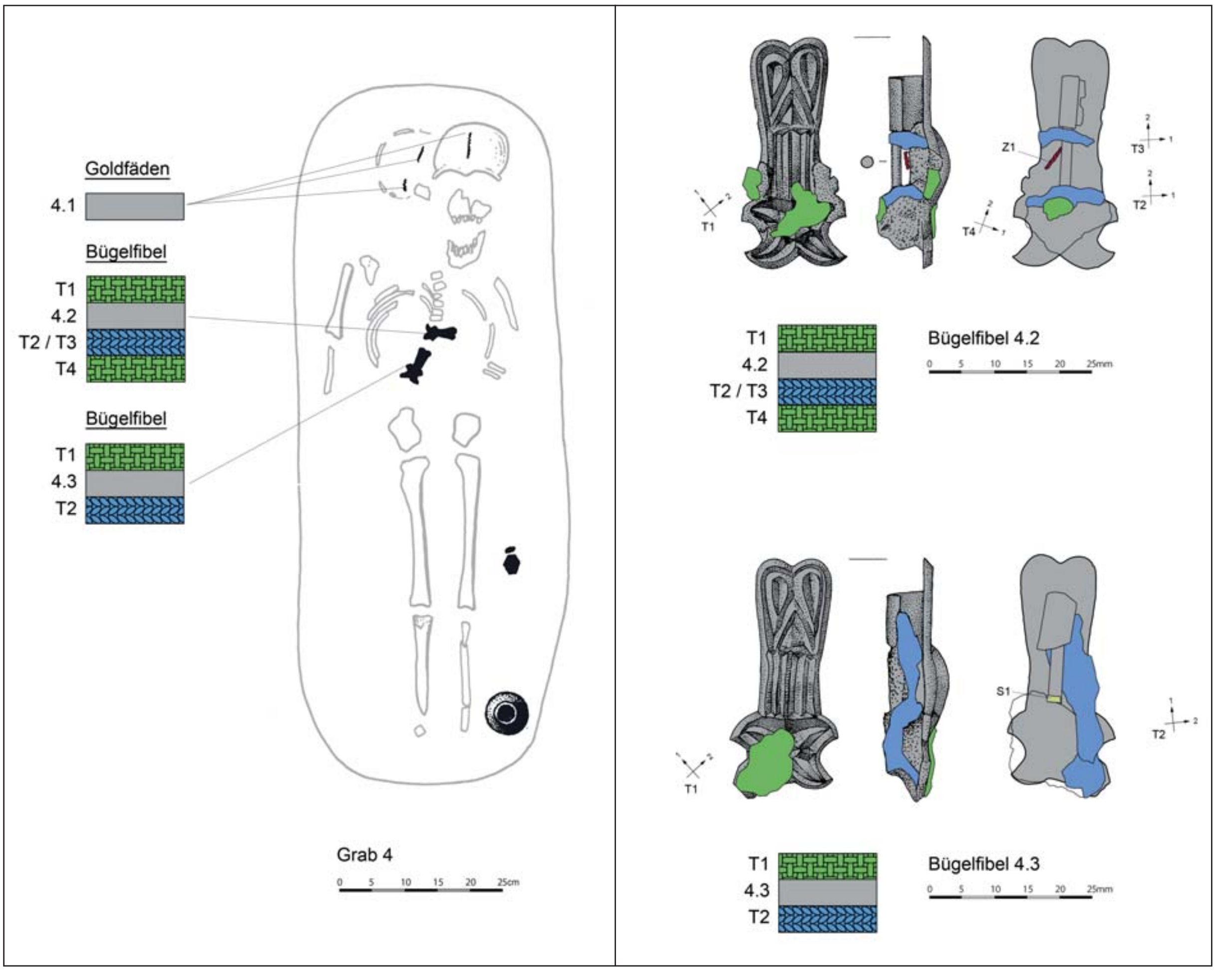

Abb. 33.2: Grabplan und Kartierung der organischen Strukturen an den beiden Fibeln 4.2 und 4.2 aus Grab 4 von Unterhaching, Lkr. München. Fibel 4.2: Vorderseite: LW aus Leinen/Hanf T1, Rückseite: Brettchengewebe aus Wolle T2/T3, LW aus Leinen T4 und Zwirn Z1. Fibel 4.3: Vorderseite: LW aus Leinen/Hanf T1, Rückseite: Brettchengewebe aus Wolle T2 (Grafik: H. Voß, B. Nowak-Böck, BLfD).

2.1 Flächige Kartierung mit definierten Farben

Als Grundlage für die Kartierung der organischen Substanzen werden die Objekte von ihrer Vorder- und Rückseite, wenn notwendig auch von ihrer Seitenansicht dargestellt. Hierfür können möglichst entzerrte Fotos oder Zeichnungen mit klaren Umrisslinien verwendet werden, die auf Abbildungsgröße zu skalieren sind (bei kleinen Funden meist im Maßstab 1:1). Das Fundstück wird in grauer Farbe angelegt. Liegen zwei oder mehrere Objekte miteinander verbunden vor, so können sie zur optischen Unterscheidung in unterschiedlichen Grauabstufungen dargestellt werden. Alle organischen Reste werden in ihrer maximal nachgewiesenen Ausdehnung angegeben und die verschiedenen Materialien nach einem standardisierten Farbschlüssel kartiert. Für die am häufigsten vorkommenden mineralisierten Strukturen sind neun Farben mit jeweils einer dunkleren und einer helleren Farbabstufung (Deckkraft immer 100%) festgelegt. Die Farben sind aufeinander abgestimmt und liegen im Farbraum von Adobe-RGB und CMYK (*Abb. 33.3*). Drei zusätzliche Sonderfarben sind keinem definierten Material zugeordnet und können für selten vorkommende Werkstoffe oder zur Markierung im Einzelfall wichtiger Substanzen projektbezogen festgelegt werden (z. B. Seide, Zwirne, entomologische Reste oder auch Mischgewebe). Liegen mehrere

Abb. 33.3: Definierter Farbschlüssel: Festgelegte Farben (mittleres Farbfeld) für verschiedene organische Materialien mit jeweils einer helleren und einer dunkleren Farbabstufung (Grafik: H. Voß, B. Nowak-Böck, BLfD).

Schichten des gleichen Materials übereinander, so sind die entsprechenden Farbabstufungen (hellere und dunklere Variante) zu verwenden. Somit ist die Mehrschichtigkeit in der flächigen und nicht nur in der stratigrafischen Darstellung erkennbar. Von Bedeutung ist hierbei die Verknüpfung mit der stratigrafischen Darstellung und den Kurzbezeichnungen der Substanzen (siehe unten). Sie zeigen an, ob z. B. ein doppellagiges Textil (T1) oder unterschiedliche Gewebe aus identischem Material (z. B. Leinwandbindung T1 und Köperbindung T2, beide aus Wolle) vorliegen. Der Verlauf einer organischen Schicht um eine Objektkante herum kann in der flächigen Darstellung mit einem gebogenen Pfeil angezeigt werden. Bei textilen Strukturen wird die Ausrichtung der beiden Fadensysteme FS 1 und FS 2 durch kleine Kreuze gekennzeichnet.

2.2 Stratigrafische Kartierung mit definierten Farben und Piktogrammen

In der stratigrafischen Kartierung wird die Schichtabfolge der organischen Strukturen auf Vorder- und Rückseite der Fundstücke schematisch mit Hilfe von definierten Schichtbalken dargestellt (zur mikrostratigrafischen Analysemethode s. Hägg 1989, 431–439; vgl. z. B. auch Rast-Eicher 2012, 56–77).

Bei Befunden mit sehr komplexer Schichtabfolge bzw. bei großen Funden (z. B. einer Spatha), ist es empfehlenswert, die Stratigrafie an mehreren Stellen am Objekt zu zeigen und mit zusätzlichen Detailzeichnungen und Beschreibungen zu erklären. Ausgangspunkt für die Stratigrafie ist das Fundstück, das als grauer Balken angelegt wird. Bei gesicherter Ausrichtung im Grabungskontext kann die Schauseite durch eine verstärkte Linie im grauen Stratigrafiebalken angezeigt werden, was für die spätere Befundauswertung von Bedeutung ist. Die Schichtbalken für die organischen Reste setzen sich aus Materialfarbe und Piktogramm zusammen. Sie sind für die Materialien Leder, Fell, Bein/Knochen/Horn, Federn, Holz und Substanz standardisiert (*Abb. 33.4*). Auf eine Verwendung der Piktogramme in der flächigen Objektkartierung wurde zu Gunsten der Übersichtlichkeit verzichtet. Häufig sind die zu kartierenden Flächen zu klein um eingefügte Piktogramme deutlich erkennen zu können.

Das Piktogramm für Substanz kann mit verschiedenen Farben kombiniert werden, so z. B. mit der unspezifischen Substanzfarbe für die Darstellung von unbestimmten Strukturen oder mit einer auffälligen Sonderfarbe, wenn ein besonderes Material dargestellt werden soll, für das kein individuelles Piktogramm bzw. keine Farbe vorgegeben ist (z. B. botanische Reste). Mit Hilfe der Kombinationsmöglichkeiten von (Sonder-)Farbe und (Substanz-)Piktogramm, welche individuell mit verschiedenen Informationen belegt werden können, kann das System dem speziellen Einzelfall angepasst werden.

Für die häufigsten Gewebetechniken (insbesondere des frühen Mittelalters) wie Leinwandbindung, Köperbindung und Brettchengewebe stehen spezifische Textil-Piktogramme zur Verfügung. Auf zusätzliche Piktogramme für Ableitungen der Leinwand- und der Köperbindung (z. B. Rips oder Fischgratköper) wurde zu Gunsten der Übersichtlichkeit verzichtet. Präzise Informationen zu den Gewebebindungen können mit definierten Abkürzungen ergänzend hinter dem entsprechenden Textil-Stratigrafiebalken notiert werden (so z. B. Rips – Rp; Panama – Pm; Köper – K 2/1 bzw. K 2/2 bzw. K 3/1; Spitzgratköper – Sgk; Rautenköper – Rak; “Rippenköper” – Rik; “Rosettenköper” – Rok; Fischgratköper – Fgk; Diamantköper – Dik; “Kreuzköper” – Krk; “Blöckchendamast” – Bld). Diese Ansicht dient nicht nur der einfachen Übersicht, sondern ermöglicht auch eine Darstellung der textilen Strukturen mit unterschiedlich detaillierten Informationen. Weitere charakteristische Angaben wie Spinnmusterung (spinnm.), grob, fein oder vielschichtig etc. sind ebenso hinter den Stratigrafiebalken zu vermerken.

Für unbestimmte aber auch für sehr seltene Gewebestrukturen (z. B. komplexe Gewebe wie Samit, Mustergewebe, zusammengesetzte Bindungen) und ebenso für andere Flächenbildungstechniken (wie Sprang, Geflechte usw.) kann ein zusätzliches unspezifisches Textilsymbol verwendet werden. Dieses ist mit entsprechender Materialfarbe zu hinterlegen und gegebenenfalls mit einer logischen Bezeichnung zu versehen.

Liegen zwei Substanzen auf einer stratigrafischen Ebene, so lassen sie sich mit Hilfe eines geteilten Balkens nebeneinander darstellen (z. B. Griff- und Scheidenreste an einem Messer). Alle „nicht-flächigen“ Substanzen werden nicht in der stratigrafischen Ansicht, sondern ausschließlich in der Fläche dokumentiert und dort mit entsprechender Kurzbezeichnung (wie z. B. Z1 für Zwirn) gekennzeichnet.

2.3 Identifizierende Kurzbezeichnungen der organischen Schichten

Für die eindeutige Identifizierung und Zuordnung der kartierten Schichten zur beschreibenden Dokumentation, zu Fotos oder zu Proben muss jede Substanz eine Kurzbezeichnung erhalten. Diese setzt sich aus Materialangabe (T = Textil, L = Leder, B/K/Hn = Bein/Knochen/Horn, H = Holz, F = Fell, Fd = Federn, S = Substanz, Z = Zwirn/Faden) und fortlaufender Nummerierung zusammen und wird vor den Stratigrafiebalken gesetzt.

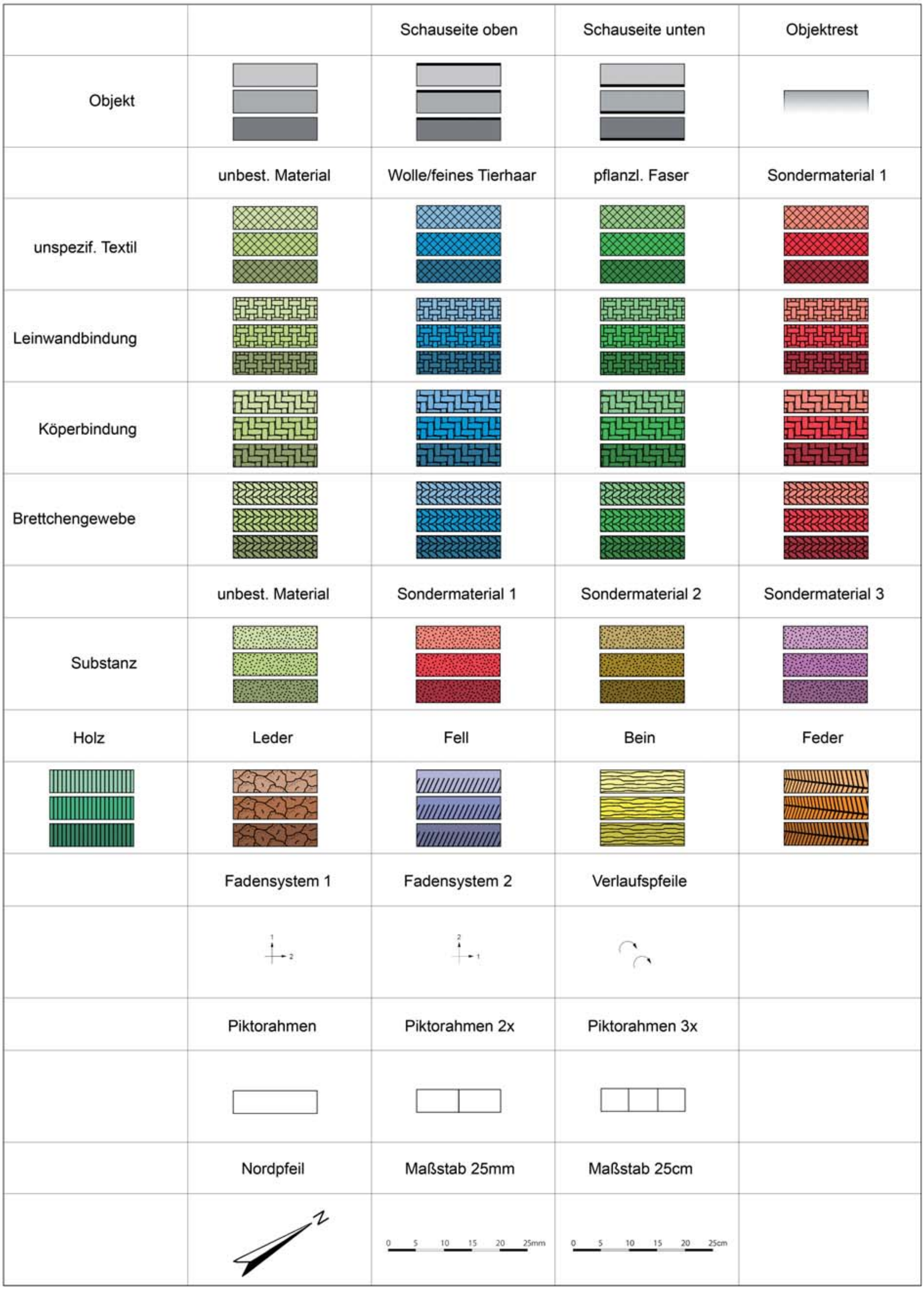

Abb. 33.4: Tabelle mit Symbolen und farbigen Piktogrammen für die stratigrafische Darstellung (Grafik: H. Voß, B. Nowak-Böck, BLfD).

3. Erfahrungswerte aus der Praxis und praktische Hilfestellungen

Das standardisierte Kartierungssystem konnte bereits für verschiedene Dokumentationsarbeiten in der Restaurierung des BLfD, bei mehreren Projekten mit externen Beteiligten und im Ausbildungsbereich für Semester- und Abschlussarbeiten von Studierenden der Restaurierung und der Archäologie angewandt werden. Im Fokus der Erfassung stand vor allem frühmittelalterliches sowie auch vorgeschichtliches und neuzeitliches Fundmaterial, das in grabungsfrischem oder bereits restauriertem Zustand vorlag.

Den bisherigen Erfahrungen aus der Praxis zufolge haben sich die eingangs genannten positiven Aspekte eines standardisierten Systems bestätigt. So konnte durch die Anwendung des Kartierungssystems eine deutlich verbesserte Qualität der Dokumentation erzielt werden, da jeder Bearbeiter grundsätzlich zu einer intensiven Auseinandersetzung mit den zu kartierenden Substanzen geführt wird. Auch wenn das Vorbereiten bzw. Anlegen der Kartierung zunächst einen Mehraufwand bedeutet, führt die Methode zu einer Effizienzsteigerung im Gesamtprozess. Dies gilt insbesondere dann, wenn mehrere Personen in versetzten Zeiträumen, an verschiedenen Orten und mit unterschiedlichen Tätigkeiten an dem Bearbeitungsprozess beteiligt sind. Dies ist beispielsweise bei Projekten in mehreren Abschnitten unter Beteiligung von verschiedenen Restauratoren der Fall. Eine einheitliche Vorgehensweise ist dabei sehr vorteilhaft, sie sichert die Daten und erleichtert das spätere Zusammenführen und Auswerten der Dokumentationen erheblich. Werden bereits bei der ersten Erfassung von Funden mit organischen Resten (z. B. im Zuge der Erstversorgung oder Konservierung) ein Fortschreiben der angelegten Kartierungsdokumentation und letztlich die wissenschaftliche Auswertung und Publikation eines gesamten Komplexes bedacht, so können viele Arbeitsschritte deutlich effizienter gestaltet werden. So kann beim Fotografieren berücksichtigt werden, dass die Objekte möglichst verzerrungsfrei (Weitwinkel vermeiden), in korrekter Ausrichtung zur Linse, mit Maßstab (auf Höhe des Objektes) und in publikationsüblicher Ausrichtung (z. B. Messerschneide nach rechts, Schnallendornspitze nach links) aufgenommen werden. Bei analogen Skizzen ist auf eine geschlossene Linie mit einheitlicher Linienstärke zu achten. Diese Vorlagen können anschließend ohne zeitaufwändige Bildbearbeitung als Kartierungsgrundlage verwendet werden. In vielen Fällen kann eine digitale Kartierung sehr aufwändige Handzeichnungen ersetzen. Sie bietet den Vorteil, dass Farbe und Piktogramm einer kartierten Schicht sehr einfach "per Mausklick" auszutauschen sind, wenn im Laufe der Bearbeitung weitere Informationen durch Material- und Textilanalysen gewonnen werden.

Es zeigte sich ferner, dass ein einheitliches Kartierungssystem für organische Materialien wesentlich zur Vermittlung und zum übergreifenden Vergleich von organischen Befunden beitragen kann. Die Darstellungsweise mit standardisierten Farben und Symbolen bietet selbst für Leser ohne spezialisiertes Fachwissen einen schnellen Überblick und verhilft zu einem leichteren Verständnis der häufig komplexen Informationen. Beispielsweise kann die Verteilung bestimmter Substanzen im Grabkontext, das Vorkommen von kombiniert auftretenden Schichten oder eine sich wiederholende stratigraphische Schichtabfolge schnell erfasst werden. Somit wird eine objektive Diskussionsgrundlage für weitere Interpretationen gegeben.

Die genannten Vorteile kommen insbesondere dann zum Tragen, wenn das festgelegte Schema möglichst einheitlich angewandt wird. Notwendige projektbezogene Modifikationen sind durch die freie Kombination von Sonderfarben und (Substanz-)Piktogramm gegeben, so dass zusätzliche Ergänzungen oder Änderungen der Systematik nur in Ausnahmefällen nötig sein sollten. Um die Anwendung des Systems so einfach und einheitlich wie möglich zu gestalten, wurde ein detaillierter „Leitfaden zur Installation und Anwendung des Kartierungssystems“ und hilfreiche Plug-ins für das Bildbearbeitungsprogramm Adobe Photoshop® mit allen wesentlichen Grundeinstellungen, festgelegten Farben und Piktogrammen erarbeitet. Zusätzliche automatisierte Aktionen für die flächige und stratigrafische Darstellung bieten praktische Hilfestellungen insbesondere für wenig erfahrene Anwender. Alle Dateien und Informationen können kostenlos von der BLfD-Homepage unter *http://www.blfd.bayern.de/bodendenkmalpflege/restaurierung_archaeologie/index.php*

(Kartierungssystem für organische Materialien und Kartierungsvorlagen) heruntergeladen oder von den Autoren angefordert werden (*Abb. 33.5*).

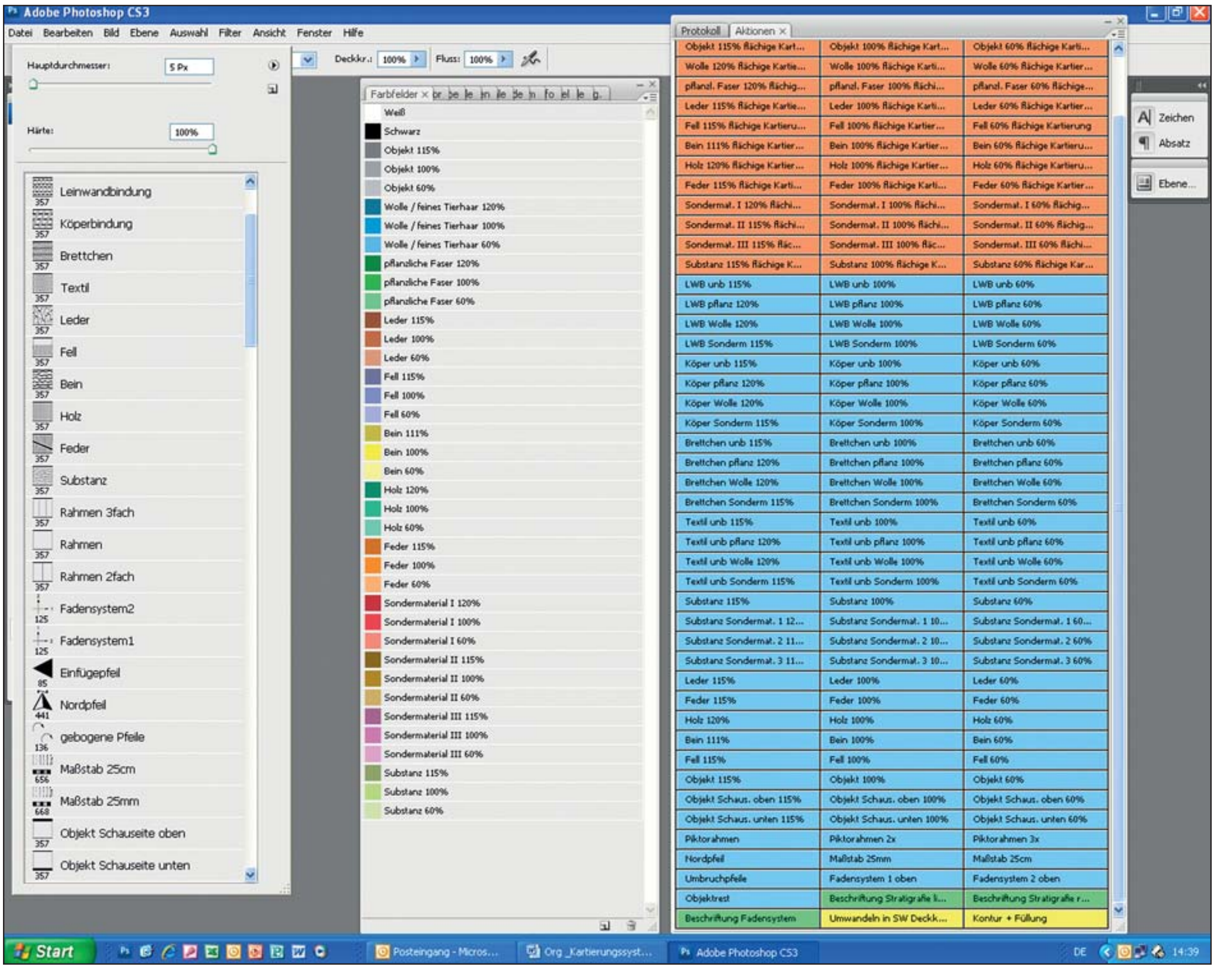

Abb. 33.5: Adobe Photoshop CS3® Oberfläche mit standardisierten Pinseln, Farbfeldern und automatisierten Aktionen (Grafik: H. Voß, B. Nowak-Böck, BLfD).

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34 | Combining isotopic and textile technical data to understand the origins of wool textiles in medieval archaeological assemblages

ISABELLA VON HOLSTEIN

Abstract: The raw materials for wool textiles (raw wool and dyes) were traded throughout much of the medieval period in Europe. Textiles in which the raw materials were non-local to the place of manufacture may therefore be expected in many medieval archaeological deposits. This article surveys how technological and scientific features of medieval archaeological wool textiles have been used to infer their provenance, giving examples from the 3rd to 15th centuries across northern Europe. It explores how direct indicators of wool provenance, such as isotope data, need to be interpreted in conjunction with the technical and technological analysis of wool textiles, in order to understand the origins of these objects.

Keywords: textile, provenance, sheep wool, medieval, light stable isotopes

1. The variability of textile manufacture and raw material demand

Textile production is highly flexible in social and economic structure (Gillis – Nosch 2007; Jenkins 2003) because of the number of technical steps involved (Wild – Walton Rogers 2003), the interruptible nature of most textile labour (Hurcombe 2000), and its labour-intensiveness (e.g. Kania 2013; Magnusson 1986, 283; Pfarr 1999). Across medieval Europe (AD 600–1500), a range of textile production systems co-existed. At one extreme, independent household-based producers carried out all stages of fibre and textile production and finishing (Walton Rogers 2007, 9–47). At the other extreme, multiple groups of specialist workers were employed to complete a specific stage of manufacture (Munro 2003). The former system can generally be considered more common earlier in the period and in rural areas; the latter, later in the period and in urban centres.

These different systems of production are expected to have very different implications for the geographical spread of both raw materials and products. Household production is conceived of as closely linked to local raw material production and consumption, and less dependent on wider networks. The specialist networks of textile production, in contrast, could be highly geographically distributed, with different regions developing strengths in the production of particular raw materials or manufacturing stages, for example, Thuringia for woad dye from the 13th century (Herbillon – Joris 1964), England for wool from the 12th century (Lloyd 1977), and towns in Flanders and Brabant for specific types of cloth from at least the early 13th century (Chorley 1987). Thus, inter-regional and international demand for raw wool existed by the late 13th century (Cardon 1999, 55–77; Munro 1978), and for dyes even by the 7th century (Campbell 2005; Walton Rogers 2005).

Thus, for much of the medieval period, textiles in which some raw materials were non-local to the place of manufacture may be expected in archaeological deposits. Understanding the origin of these objects is not only a question of the origin of the raw material, but also of the location of manufacture, as indicated by production tradition. Direct methods of provenancing, such as isotopic analysis, will not be sufficient on their own to understanding the nature of textiles in the Middle Ages, but must be combined with technological analyses. The strength of both sets of methods for ascribing a textile to a particular manufacturing tradition or location is therefore important.

2. Artefact-based provenancing

Arguments for the origins of textiles in archaeological deposits are highly specific to region and time period, and typically incorporate evidence from other sources. *Tab. 34.1* and *2* list a selection of examples of both typical and atypical wool textiles found in medieval contexts, showing the other sources of information which have been used to support a suggestion of origin. Textile artefact-specific evidences include:

1. presence of a non-local raw material (wool, indicated by fleece type, or dye),
2. the presence of (usually multiple) technical features in an individual textile which are considered outside the established textile or wool production traditions of the region/period, and
3. the relative frequency of a specific technical feature (or group of them) within an assemblage or in comparable assemblages.

Other evidence types employed are: the presence or absence of specific textile tools which are associated with particular techniques of manufacture; documentary and iconographic sources; and the association of textiles with specific technical features with other artefact types in e.g. graves.

The first of the textile-specific criteria, the identification of non-local raw wool, requires some comment. This is based on measurement of the distribution of fibre diameters within a sample, for which two classification systems have been developed, by Ryder (1968, 1981, 1991) and Rast-Eicher (2008, 121–162). In the raw fleece, the range and uniformity of fibre diameter reflects genetic inheritance, environmental conditions and farming practice (e.g. Brown – Crook 2005; Geenty *et al.* 2009; Safari *et al.* 2005; Short 1955). However, fleece preparation by selection, combing and carding can change the resultant fleece type (Christiansen 2004; Walton Rogers 2004). Thus, identifying an atypical fleece type in an archaeological assemblage does not necessarily mean the wool was derived from an atypical breed for that region/place, but could instead indicate that a typical fleece was prepared in an atypical way.

The third criterion, the relative frequency of particular textile technical features, has also to be applied with care. There are two reasons why finds with unusual technical features may not belong in the 'non-local' category:

– rarity due to low volumes of production, either because of high cost (in materials or time), or low demand, e.g. considering an item appropriate for only a small number of uses or occasions (Schneider 1987).
– movement of technology or of textile style rather than movement of textiles. The processes of development, adoption and competition of technologies depend on their functional, political, economic and social contexts (Dobres – Hoffman 1994; Pfaffenberger 1992; Rogers 1995). Geographical spread of technology need not proceed at the same rate or involve the same places as the spread of goods.

This is why this criterion is rarely considered in isolation from other categories of evidence, such as textile tools, or by comparison to other assemblages. Nevertheless, the development of direct provenancing methods, which could distinguish between objects which are unusual because they are non-local, and those which were produced only in small quantities because of the two reasons above, is clearly of interest in this case. Nevertheless it must not be assumed that non-local textiles are inevitably in the minority in an assemblage, especially for highly networked or highly industrially developed sites, usually urban centres (see examples in *Tab. 34.2*).

Tab. 34.1: Interpreting atypical wool textiles from medieval assemblages.

Textile description	Region/site	Period	Suggested interpretation	Other data used	Reference
Plain 2/2 ZZ twills (‘Haraldskjær’ type)	Norway	3rd century onwards	Local: spread of the warp-weighted loom and abandonment of the upright loom	Widespread earlier in DK; associated with finds of loom weights	(Bender Jørgensen 2003, 93-6)
Diamond twill with Z-spun warp and S-spun weft, mostly 20/18 pattern unit (‘Virring’ type)	Scandinavia	3rd–4th centuries	Non-local	Usually in more developed (finer) wool types than Haraldskjær and Huldremose types (both widespread)	(Bender Jørgensen 2003, 93-6)
Textiles with tubular selvedges, 2/1 twills, and textiles with soft finishing found at same sites	East Anglia, Great Britain	5th–7th century	Local: survivals of Romano-British textile cultures within Anglian dominated area	Toponymic evidence of geographic/political boundaries; grave goods in local cemeteries; burial practice; archaeology of wider region; documentary sources	(Walton Rogers 2012a)
2/2 ZS chevron and diamond twills	Scandinavia	4th–8th centuries	Non-local	Mixed spinning rare in this region but dominant further south	(Bender Jørgensen 1992, 142-3)
ZZ textiles with shiny fine tightly-spun yarns	Elisenhof, northern Germany	8th–9th centuries	Non-local	Relatively high quality yarn and textile production from selected fleece qualities; ZZ spinning unusual in this region/period	(Hundt 1981, 87)
Fine tabby textiles	Oseberg ship, Norway	9th century	Non-local	Use as appliqué on clothing, analogous to use of silk; rarity in Scandinavia, most often in high-status graves; ubiquity in Ireland	(Ingstad 2006, 215)
Textiles with a knotted pile	Wolin and Opole, Poland	10th century	Local	Wool type is not different to other material in the same assemblage; documentary evidence	(Maik 1988, 177-8; Maik 1992)
2/1 twills	Urban deposits in England	10th century onwards	Local: re-introduction of the upright loom	Iconographic evidence; historical evidence; absence of loom weights; change of tool types to those associated with upright loom; nature of 2/1 twill textile construction	(Walton Rogers 2001)
Tabby textiles, heavily fulled and napped, mostly in SS yarns	Reykholt, Iceland	c. AD 1400−1600	Non-local	Technical features (individually and in combination) are rare in Scandinavia but widespread in mainland Europe, where manufacture is supported by historical, archaeological and iconographic data	(Walton Rogers 2012b)
Fulled, dyed textiles in Fine-type wool	Tartu, Estonia	14th–15th century	Non-local	Wool type rare in region; cloth types resemble those from more western regions of Europe, where local manufacture is supported by historical, archaeological and iconographic data	(Rammo 2009)
Knitting fragment, kermes dyed, in Fine-type fleece	Newcastle upon Tyne, Great Britain	Early 15th century	Non-local	Unusual fleece type; unusual and very costly dye; unusual technique for region and period	(Walton 1981, 200)
Knitted caps	Newcastle upon Tyne, Great Britain	Early 16th century	Local: introduction of technique	Fleece types resemble other local material; documentary evidence for arrival of technique; contemporaneous finds of knitting at other sites in Britain	(Walton 1981, 200)

Tab. 34.2: Interpreting typical wool textiles from medieval assemblages.

Textile description	Region/site	Period	Interpretation	Other data used	Reference
2/2 ZS chevron and diamond twills with a 20Z/18S pattern repeat	Northern Netherlands and North Germany	4th–8th centuries	Local	Dominant at sites in this region and period	(Bender Jørgensen 1992, 142–3)
ZS tabbies	North Germany	7th–10th centuries	Local	Ubiquitous in this region and period	(Hägg *et al.* 1984, 111)
Finest 2/1 and 2/2 ZZ diamond and chevron twills	Birka, Sweden	9th–10th century	Non-local	Very high quality spinning and weaving workmanship (almost without parallel in the region/period at the time of interpretation)	(Geijer 1938, 35, 40–7)
ZS tabbies and 2/2 twills	York, North East England	9th–11th centuries	Local	Common types; unremarkable quality; within local tradition	(Walton 1989; 1990)
Mixed wool and vegetable fibre textiles	Novgorod, Russia	10th–14th centuries	Local	No parallels in archaeological material from other parts of Europe	(Nahlik 1976)
ZS 2/2 twills with pigmented hard-spun warp in Hairy fleece and pale, loosely-spun weft in Hairy Medium fleece (waðmál)	Reykholt, Iceland	c. AD 1000−1600	Local	Abundant in Greenland and across Scandinavia in the later medieval period (Walton 1989, 340–1; Østergård 2004)	(Walton Rogers 2012b)
ZS 2/1 twills, combed warp and weft, high cover factor and threadcount, dark dye	Bryggen, Bergen, Norway	12th cent	Non-local	Highly skilled spinning and shrinkage technique used	(Schjølberg 1998)
Various	Gdańsk, Poland	13–15th centuries	Non-local	Wool fibre diameter range and distribution resemble those of modern Merino and shortwool breeds	(Maik 1990)

3. Interpreting the results of direct provenancing methods

Direct provenancing methods offer the potential for an indication of origin which is independent of textile technology. These systems relate the chemical composition of a sample of sheep wool to either a particular geological area (strontium isotope analysis: Frei *et al.* 2009) or a climatic/vegetation/farming practice zone (light stable isotopes: von Holstein 2013). Because isotopic and textile technical data indicate different stages of the manufacturing process, different combinations of these results have different meanings for reconstructing past movements of textiles, raw materials and manufacturing techniques (*Tab. 34.3*). Significantly, for two of the four possible combinations of provenancing results, some ambiguity of origin remains possible, even if both the isotopic results and the textile technical category are considered robust. It is possible that unexpected isotopic data may prompt the reassessment of textile technical variables, either by developing new ones or re-interpreting existing ones, to modify judgments of the typical/atypical nature of a given textile. Conversely, confidence in textile technical interpretation may suggest reassessment of the resolution of the isotopic technique, by reconsideration

Tab. 34.3: Possible interpretations of isotopic and artefactual wool textile provenancing results. Options in italics indicate possible interpretations if either isotopic or artefactual categories are not considered robust.

Isotopic composition	**Artefactual category**	**Interpretation(s)**
Local	Typical	(1) The textile is of local manufacture from local wool. (2) The textile, and/or its wool, are from another location which has both similar environment/bedrock and similar textile manufacturing traditions.
Local	Atypical	(1) The textile was manufactured in a site/area/region of similar environment/bedrock type but different textile production. (2) The textile consists of local wool which was moved to a site/area/region of different textile production for manufacture, before being moved back. (3) *The textile is of local manufacture from local wool, i.e. the identification of a particular textile technique as non-local was incorrect, and local manufacture had wider range of techniques than expected.* (4) *The textile is of non-local manufacture of non-local wool, i.e. the identification of the local isotope zone is incorrect (too broad).*
Non-local	Typical	(1) The textile was locally made but from wool from outside the local isotopic zone. (2) (Light stable isotopic analysis only) The textile is of local manufacture from local wool, but the wool was produced using unusual farming practices not otherwise represented in the assemblage. (3) *The textile is of local manufacture from local wool, i.e. the identification of the local isotope zone is incorrect (too broad).* (4) *The textile is of non-local manufacture of non-local wool, i.e. the identification of a particular textile technique as local was incorrect, and local manufacture had narrower range of techniques than expected.*
Non-local	Atypical	(1) The textile is from a site/area/region with both different environment/bedrock type and different textile production.

of e.g. the characterisation of baseline isotope values, archaeological sample preparation procedures, or degree of diagenesis (von Holstein *et al.* 2014a; 2014b).

4. Conclusion

Understanding the origin of a textile from a medieval archaeological deposit requires the integration of indicators of origin from both raw material and finished object. Scientific provenancing methods, which focus on the former, cannot be considered to indicate the whole origin of a textile, and their results must be interpreted in combination with artefactual and other archaeological data.

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35 | Stokar gegen Schlabow – eine wissenschaftshistorische Betrachtung eines Streits aus der Frühzeit der Textilarchäologie

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Abstract: Die Vor- und Frühgeschichtliche Archäologie erlebte im Dritten Reich einen bis dahin ungeahnten Aufschwung. Auch zwei Organisationen partizipierten hiervon. Zum einen der "Reichsbund für Deutsche Vorgeschichte" unter Hans Reinerth, der auch Abteilungsleiter für Vor- und Frühgeschichte im "Amt Rosenberg" war, zum anderen die "Forschungsgemeinschaft Deutsches Ahnenerbe e.V.", eine Forschungseinrichtung der SS. Beide Organisationen konkurrierten miteinander, trugen den Konflikt jedoch nicht offen, sondern über ihnen nahestehende Wissenschaftler aus. Der Streit zwischen Walter Stokar von Neuforn und Karl Schlabow zeigt dies exemplarisch, unter Beachtung persönlicher Interessen und Karrierewege, auch über das Jahr 1945 hinaus.

Keywords: Wissenschaftsgeschichte der Vor- und Frühgeschichtlichen Archäologie, Amt Rosenberg, Ahnenerbe, von Stokar, Schlabow, Reichsbund für Deutsche Vorgeschichte

1. Einführung

Noch heute gehören Publikationen, deren Rezension und die Diskussion zu den wichtigsten Bestandteilen der Forschung. Hierbei sollen gegensätzliche Sichtweisen erörtert und wissenschaftlich belegt werden. Einschränkungen erfährt ein derartiger Idealfall, wenn Einfluss auf eine solche Diskussion genommen wird, der nicht wissenschaftlich begründet ist.

Eine ebensolche Diskussion wurde im Deutschen Reich von 1937–1942 in den entsprechenden Publikationen für Vorgeschichte in aller Öffentlichkeit geführt. Sie eignet sich, um die entsprechenden Kontrahenten, aber auch die Institutionen der Vorgeschichtsforschung kurz vorzustellen.

2. Der Disput in der Öffentlichkeit

2.1 Die Rezension

1937 erscheint Karl Schlabows Arbeit über "Germanische Tuchmacher der Bronzezeit" (Schlabow 1937). Sie sorgt für Aufmerksamkeit in Fachkreisen, wie Walter von Stokar, eigentlich Walter Stokar von Neuforn, in seiner Buchbesprechung (Stokar 1938a) zugibt. Zunächst lobt er das Werk und weist darauf hin, dass er nicht alleine mit dieser Aussage steht, was in seinen Augen umso bedeutender erscheint, da der Autor "Künstler" (Stokar 1938a, 284) sei und "seine schwierigen Forschungen ohne akademisches Diplom unternommen hat" (Stokar 1938a, 284), eine eindeutige Anspielung auf die Tatsache, dass Schlabow nicht Vorgeschichte studiert hat. Dies sei jedoch zu vernachlässigen, da "im Dritten Reich nur eines, die Leistung, nicht ein Titel oder ein Grad" (Stokar 1938a, 284) zählt. Schlabow habe bei der Auswahl der Textilien, die seinen Forschungen zu Grunde liegen, eine gute Auswahl getroffen, da diese doch noch in einem guten Zustand für seinen Forschungsschwerpunkt seien. Indem Schlabow die in den Baumsärgen befindliche Gerbsäure als Ursache für den guten Erhaltungszustand angibt, sei er jedoch "der alten Theorie gefolgt, die nicht stimmt" (Stokar 1938a, 284). Dies wäre jedoch auch "nicht wesentlich" für "die Spinn- und Webetechnik der Bronzezeit" (Stokar 1938a, 284), Schlabow hätte dies jedoch merken müssen: “Immerhin hätten ihn seine mißglückten Färbeversuche mit Gerbsäure stutzig machen können. Die auf S. 20/21 angegebenen biologischen Versuche mit Gerbsäure sind nicht der Wirklichkeit entsprechend” (STOKAR 1938a, 284). Walter von Stokar wirft dem Autor hiermit direkt vor, er habe wissentlich falsche Werte veröffentlicht.

Kritik übt Stokar auch hinsichtlich der von Schlabow als nachgewiesen angesehenen Technik des Walkens, da hier ein hundertprozentiger Beweis fehle, und Schlabows These vom nicht benutzten Leinen. “Leinen als Zellulose ist bald zersetzt” (STOKAR 1938a, 285), so dass es sich nicht in den Funden nachweisen lasse, selbst wenn sich andere organische Stoffe dort noch finden” (STOKAR 1938a, 285). Aus Sicht Stokars sei “ein Leinenunterkleid” unerlässlich sobald Reh- und Hirschhaare mit versponnen werden, da “die Haut empfindlich ist” (STOKAR 1938a, 285). Stokar kritisiert auch die Aussagen Schlabows, dass es nur in einem Ausnahmefall zum Einsatz eines Köpers gekommen ist, er “schloß von einem verhältnismäßig beschränkten Fundgebiet auf die ganze Germanische Kultur. Funde in anderen Gegenden widerlegen ihn.” (STOKAR 1938a, 285). Gegen Ende findet Stokar zwar lobende Worte für die Arbeit, insbesondere hinsichtlich des Nachweises der Nutzung von Haarnetzen durch die Menschen der Bronzezeit, aber auch wegen der “ausgezeichneten technischen Zeichnungen, glänzenden Photographien” (STOKAR 1938a, 285), er empfiehlt jedoch gleichzeitig bei einer Neuauflage auf zwei Abbildungen zu verzichten.

Die gesamte Rezension ist in einem jovialen Ton geschrieben. Grundsätzlich werden die Bemühungen gelobt, aber im Endergebnis attestiert der studierte Pharmazeut und Vorgeschichtler von Stokar dem Autor eine eher durchschnittliche Leistung.

2.2 Hintergrund

Walter von Stokar befasst sich selber schon früh mit Gewebefunden bei archäologischen Ausgrabungen (STOKAR 1934a, 1934b, 1935a, 1935b) und verfasst schließlich 1936 auch seine Dissertation zu dem Thema (STOKAR 1938b). Bereits 1934 steht er auf der Hörerliste bei Prof. Dr. Hans Reinerth für das Fach “Vorgeschichte” (GOLCZEWSKI 1988; SCHÖBEL 2002) an der Friedrich-Wilhelm-Universität in Berlin. Schon früh muss Reinerth das Potenzial in Stokars Forschungen erkannt haben und bindet ihn mit Stipendien an sich. Seit dem 01. September 1934 forscht er mit einem Stipendium zum Thema “Systematische Verwendung von Chemie, Botanik und Geologie in der Vorgeschichte”. Die Stipendien werden durch Reinerth zumindest bis zum 31. März 1937 verlängert (BA STOKAR). Die Gelder kommen von der Deutschen Forschungsgemeinschaft und der Reichsgemeinschaft für Volksforschung, Abt. Vorgeschichte. Reinerth fördert in vielerlei Hinsicht die naturwissenschaftlichen Forschungsmethoden und steht dafür auch ein. So wendet er sich gegen eine Prüfungsordnung, die bestimmt, dass neben Vorgeschichte ein historisches Fach als 2. Hauptfach zu nehmen ist. Er selber sieht Fächer wie “Volkskunde, Rassenkunde sowie eine Anzahl rein naturwissenschaftlicher Fächer” als “erwünscht” an. Besonders tritt er für die Kombination mit naturwissenschaftlichen Fächern ein (IAW Freiburg). Da Reinerth der Abteilung für Vor- und Frühgeschichte beim “Beauftragten des Führers für die Überwachung der gesamten geistigen und weltanschaulichen Schulung und Erziehung der NSDAP” Alfred Rosenberg, dem sog. “Amt Rosenberg” vorsteht, ist Stokar somit ein Sprachrohr dieser Institution und kann sich zu diesem Zeitpunkt der Unterstützung des Amtes sicher sein.

2.3 Das Spinngut des bronzezeitlichen Webers (SCHLABOW 1939)

In einem Aufsatz (SCHLABOW 1939) reagiert Schlabow und bringt nun die Forschungen Dritter sowie neuere Forschungsergebnisse ein. Insbesondere wird aber Stokars in Zwischenzeit erschienene

Dissertation (STOKAR 1938b) betrachtet und in bestimmten Stellen angezweifelt. In Schlabows eigenem Blickpunkt steht die Zusammensetzung der Wolle, bei der er zu neuen Ergebnissen kommt. Auch Stokars Einwand gegen die Nutzung von Wolle und nicht von Leinen als Unterwäsche kommentiert er, denn "so möchte ich nur darauf hinweisen, dass früher alle und heute noch ein großer Teil alter Leute bei uns an der Wasserkante wollenes Unterzeug tragen." (SCHLABOW 1939, 125).

2.4 Hintergrund

Schlabow geht nicht auf alle Kritikpunkte Stokars ein, er beruft sich aber nun auf neue Erkenntnisse, aber er unterwirft sich nicht dem Diktum des "Amtes Rosenberg" und greift sogar den studierten Vorgeschichtler von Stokar an. Besonders die Tatsache, dass dessen Arbeit nach Schlabows Buch veröffentlich wurde, findet Erwähnung. Dass Schlabow hierbei jedoch nicht ohne Unterstützung agiert, zeigt sich bei einer Beleuchtung seines Hintergrundes. Er veröffentlicht seinen Aufsatz in der "Offa", einer seit 1936 erscheinenden Fachzeitschrift unter der Herausgeberschaft von Gustav Schwantes und Herbert Jankuhn. Jankuhn ist zum Zeitpunkt der Veröffentlichung ein führendes Mitglied der "Abteilung Lehr- und Forschungsstätte Ausgrabungen" in der Forschungsgemeinschaft Deutsches Ahnenerbe e.V., dem sog. "SS – Ahnenerbe". Hier zeigt sich nun der für den Nationalsozialismus typische Streit um Kompetenzen zwischen verschiedenen Institutionen und Organisationen. Vorgeschichtlern, die bei Reinerth in Ungnade gefallen waren oder schon von vornherein nicht mit ihm kooperieren wollen, können somit – sofern sie persönlich den Aufnahmekriterien und ihre Forschung den Zielen der SS entsprechen – ab 1935 unter dem Schutz des Reichsführers SS, Heinrich Himmler, ihrer Arbeit nachgehen. Spätestens ab dem Frühjahr 1941 konsultiert Jankuhn mit dem Reichsministerium für Wissenschaft, Erziehung und Volksbildung regelmäßig über die Besetzung der Posten in der Vorgeschichte an den Universitäten (HASSMANN 2002, 87; KATER 1997, 287) Diesen Einfluss kann er auch noch nach dem 02. 12. 1941 aufrechterhalten, obwohl zu diesem Zeitpunkt auch der NS-Dozentenbund dem Amt Rosenberg unterstellt wird und somit nun selber nominell Einflussmöglichkeiten auf die Ämtervergabe erhält.

2.5 Die bronzezeitlichen Schafswollen (STOKAR 1940)

Walter von Stokar, inzwischen Professor für Vorgeschichte, Leiter des Museums für Vorgeschichte und Leiter des Institutes für Vorgeschichte an der Universität Köln, weist die an ihm und seiner Arbeit gemachte Kritik scharf zurück. Seinen Aufsatz (STOKAR 1940) beginnt er mit einer selbst für ihn klaren Kampfansage: "Schlabow begeht aber leider in seiner Arbeit die in ihrem schlüssigen und flüssigen Aufbau auf jeden sich nicht mit Mikroskopie beschäftigenden Vorgeschichtsforscher überzeugend wirken muss, zwei prinzipielle Fehler:

I. Er glaubt das ganze Problem der bronzezeitlichen Spinnstoffe in einem relativ begrenzten Gebiet lösen zu können.

II. Er bedient sich dabei einer Forschungsmethode, der er nicht gewachsen ist" (STOKAR 1940, 404).

Stokar wiederholt nicht nur seinen Vorwurf, Schlabow habe nur Funde aus einem "verhältnismäßig beschränkten Fundgebiet" (STOKAR 1938a, 285) betrachtet, sondern weitet ihn dahingehend aus, dass Schlabow dadurch auch nur einen sehr eng begrenzten zeitlichen Horizont in der Bronzezeit betrachtet. Drüberhinaus fehle es Schlabow an Grundkenntnissen in den Naturwissenschaften. Er beachte nicht die chemischen Vorgänge bis zur Konservierung des Toten. Die alkalische Fäulnis "wirkt sich lösend auf Hornsubstanz und muß sich zwangsläufig an dickeren Haaren mit ihren größeren Lufträumen im Mark rascher auswirken als an reiner Wolle" (STOKAR 1940, 404). Er sei auch nicht in der Lage, wissenschaftlich korrekt in der Vorgeschichte zu arbeiten, dies zeige sich in seinen Fehlern im wissenschaftlichen Wortschatz, welche sich in der ganzen Arbeit zeigen (STOKAR 1940, 404).

Besonders kritisch erwähnt Stokar Probleme im Umgang mit Quellen. So habe sich H. C. Broholm bereits beschwert, dass Schlabow "Illustrationsmaterial aus dänischen archäologischen Werken als Vorlage für seine Zeichnungen benutzt, ohne anzugeben, woher er die Ideen hat" (STOKAR 1940, 410). Stokar selber weist nochmals auf seine Anmerkungen zur Tuchwalkung hin, die er Schlabow vor einiger Zeit gemacht habe, ohne dass dieser sie benutzt habe. Er kann auch die Überraschung Schlabows beim Fund von feiner Schafwolle nicht nachvollziehen, schließlich habe Stokar ihn 1935 darauf aufmerksam gemacht und dies 1937 bei einer Tagung in Anwesenheit Schlabows nochmals wiederholt. Ein weiterer Punkt der Kritik ist die durch Schlabow nicht kenntlich gemachte zeitliche Trennung gewisser Beimischungen wie Vogelfedern, die Stokar vorgenommen hatte (STOKAR 1940, 410). Stokar habe auch nie einen Beginn der Tuchwalkung datiert, inzwischen sei es jedoch erwiesen, dass dies doch in der Bronzezeit passiert sei, ein Fakt über den Stokar Schlabow vor dessen Veröffentlichung in der Offa hingewiesen, dieser jedoch nicht berücksichtigt habe (STOKAR 1940, 406).

Stokar attackiert Schlabow auch persönlich, dieser stelle ihm "Behauptungen unter, die ich nicht gemacht habe, um dann gegen diese meine angeblichen Behauptungen zu polemisieren." (STOKAR 1940, 406). Als sich Stokar dann dem Thema "Mikroskopie" zuwendet, wirft er Schlabow vor, veraltete Grundlagen zu nutzen, modernere Arbeiten nicht zu beachten und dadurch auch den längst erkannten Fehlern bei der Analyse der Funde unter dem Mikroskop aufzusitzen, gefolgt von einer ausgiebigen Belehrung zum Thema "Tierhaare unter dem Mikroskop" (STOKAR 1940, 406–410). Dass Stokars Arbeit erst 1938 erschienen sei, sei nicht seine Schuld, aber er habe die Zeit nach der Fertigstellung 1936 noch genutzt, um weitere Funde in seine Arbeit einzubringen (STOKAR 1940, 410).

Stokar beendet den Aufsatz mit dem Hinweis, dass er Schlabow angeboten habe, "bei eventuellen Zweifeln an meinen Analysen die hergestellten und aufbewahrten Dauerpräparate zur Kontrolle anzufordern. Ich tat dies, um das Interesse an einer ehrlichen, wissenschaftlichen Auseinandersetzung zum Wohle der Forschung auf diesem Gebiet zu erwecken. Diese Aufforderung läßt Herrn Schlabow unberührt. Ex cathedra erklärt er einfach, ich könne Pflanzenfasern des Moores von Flachs nicht unterscheiden. Es ist dies eine Auffassung von ernster wissenschaftlicher Diskussion, die nicht streng genug abgelehnt werden kann" (STOKAR 1940, 411).

2.6 Hintergrund

Hinter diesen ungewöhnlich aggressiven Worten stecken neben der Verteidigung seiner Arbeit, der damit verbundenen wissenschaftlichen Reputation und der im Zusammenhang damit neu erlangten Stellung als Professor der Vorgeschichte in Köln (UAK), auch persönliche Gründe. Wie erwähnt, erschien Stokars Dissertation erst nach Schlabows Arbeit. Dies war auch nicht Stokars Schuld, denn die späte Drucklegung seiner Dissertation hatte sein Doktorvater Reinerth zu verantworten.

Bei der mündlichen Prüfung vom 29. Juni 1936 wird Stokar von Reinerth im Fach "Vorgeschichte", Dr. Mannich in "Chemie" und Prof. Dr. Diehls in "Botanik" geprüft. Da seine Dissertation mit "magna cum laude" bewertet wurde, seine mündliche Prüfung jedoch mit "cum laude", erhält er auf seinem Abschlusszeugnis die Note "cum laude" (UAB). Dies wird auch öffentlich bekannt gegeben. Jedoch verschiebt sich dann die Drucklegung der Dissertation und es kommt zum Streit zwischen von Stokar und Reinerth. Dieser hat das Manuskript bis zum Juni 1937 noch nicht dem Verlag vorgelegt (APM 10. Juni 1937). Die Schwierigkeiten bei der Drucklegung sind Stokar bereits im Sommer 1936 bekannt, da er aus seiner Arbeit mit Reinerth weiß, dass die Reihenfolge für die Erscheinungen in der "Mannus"-Bibliothek für 1936 schon fest liegt und seine Arbeit nicht dabei ist. Mit dieser Begründung versucht er eine

Ausnahmegenehmigung beim Dekan der Philosophischen Fakultät zu erlangen, um früher promovieren zu können (UAB 21. Juli 1937). Dies lehnt der Dekan jedoch aus grundsätzlichen Erwägungen ab (UAB 28. Juli 1937). Stokar tritt mit dem Verlag Curt Kabitzsch in Leipzig in Verbindung und fragt nach der Möglichkeit, das Buch außerhalb der "Mannus"-Bibliothek unterbringen zu können, nur damit es endlich gedruckt wird. Stokar habe auch schon Kontakt zu einem anderen Verlag, der ihm angeboten hätte, das Buch zu drucken. Ob das stimmt, kann nicht nachvollzogen werden, da ein solches Schreiben nicht bekannt ist; eventuell will Stokar hiermit den Druck auf den Verlag erhöhen. Eigentlich sollte seine Dissertation (STOKAR 1938b) vor der Arbeit von Schlabow (SCHLABOW 1937) publiziert werden, doch ist dessen Buch bereits erschienen und Stokar lässt den Verlag wissen, er sei "zu sehr Kaufmann, um nicht zu wissen, dass mein kommendes Buch dadurch schon viel Einbusse erlitten hat" (APM 06. April 1937).

Erst Ende 1937 liegen die druckfertigen Bögen beim Verlag vor (APM 31. Dezember 1937) und Anfang 1938 erhält Stokar die schriftliche Erlaubnis zur Drucklegung der Dissertation (APM 17. Januar 1938). Die Promotion zum "Dr. phil." erfolgt am 22. August 1938 (UAB 22. August 1938).

Somit zeigt sich, dass Stokar schon einmal gegen Schlabow ins Hintertreffen geraten war und mitunter auch finanzielle Einbußen befürchtete. Dies kann auch ein Grund für sein Handeln und die Art und Weise der Umsetzung gewesen sein.

2.7 Ein letztes Aufflackern

Aber der Disput war noch nicht beendet. Karl Schlabow veröffentlicht einen weiteren Aufsatz (SCHLABOW 1942) zum Thema, geht nochmal auf seine vorherige Arbeit ein, ohne jedoch hierbei große Teile von Stokars Kritik entkräften zu können. Er "habe nie daran gedacht, geschweige denn ausgesprochen, das ganze Problem der bronzezeitlichen Spinnstoffe in meiner Arbeit zu erfassen, sondern es handelt sich, wie klar aus der Einleitung hervorgeht, um die Lösung einer Grundfrage, in der die bewußte Beimischung von fremden Tierhaaren zur feineren Schafswolle geklärt werden soll" (SCHLABOW 1942, 328). Besonders schwer wiegt für Schlabow der Ton Stokars in seiner letzten Arbeit, die auch einige Fehler enthalte. Stokar führe die Diskussion mit "Ironie" (SCHLABOW 1942, 328) durch "Übersteigerung wissenschaftlicher Einzelheiten" (SCHLABOW 1942, 325) und "durch persönliche Angriffe" (SCHLABOW 1942, 325). Schlabow verteidigt die Grundlagen seiner Arbeit und fügt neue Abbildungen zu Tierhaaren bei, die seine These unterstützen sollen. Auch Stokars Angriff auf seine Fachbegriffe kann er nicht nachvollziehen, habe er sie doch nie benutzt, er zitiere in einigen Teilen seiner Arbeit in Sachen Beimischung sogar Stokar aus dessen Arbeiten (SCHLABOW 1942, 338). Walter von Stokar reagiert schon in derselben Zeitschrift (STOKAR 1942) indem er mitteilt, dass er die formalen Fehler erkannt und beim Verlag bemängelt habe, die dieser jedoch nicht vor dem Druck veränderte, so dass sie nicht seine Schuld seien.

2.8 Hintergrund

Es ist klar zu erkennen, dass beide Seiten Aggressivität aus dem Schlagabtausch nehmen. Stokar hat neue Aufgaben beim Reichskommissar für die besetzten Niederlande aufgenommen und nähert sich schon seit Jahren der SS (StaMSS 26. August 1935), um ebenfalls beim "SS – Ahnenerbe" aufgenommen zu werden, nachdem er mit Reinerth gebrochen hatte. Aber erst 1937 intensiviert sich der Kontakt (StaMSS 17. Februar 1937). Er habe bereits 1936 für die SS Analysen gemacht, bekam teilweise aber nur unbrauchbares Material. Er bittet nun, vor den SS-Grabungsleitern reden zu dürfen, um sie darin zu schulen, wie das Material richtig zu sichern sei. Nach einer ersten Rückmeldung aus dem Umfeld Himmlers

(BA - NS 21/766 – Mitarbeiter), teilt Himmler persönlich mit, dass sich das Reichssicherheitshauptamt (RSHA) mit ihm wegen der Klärung deren Nachwuchsschulung in naturwissenschaftlichen Methoden in Verbindung setzen wird (StaMSS 21. Mai 1937).

Der öffentliche Schlagabtausch war also beendet, doch auch nachher waren Stokar und Schlabow, von der Öffentlichkeit unbemerkt, indirekt aufeinandergestoßen.

3. Der Teppich von Bayeux

Im April 1941 bittet der Geschäftsführer des "SS – Ahnenerbes", Wolfram Sievers, Walter von Stokar den Bereich "Material und Farbanalysen" bei der Neuaufnahme des Teppichs von Bayeux durch das "SS – Ahnenerbe" unter der Leitung von Herbert Jankuhn zu übernehmen (StaMSS 30. April 1941). Inwieweit hier der Versuch unternommen werden sollte, dieses Kunstwerk zu rauben (Unruh 2002), kann nicht nachvollzogen werden. In seiner Antwort erläutert Stokar, dass er das Verhältnis zu Jankuhn gestört sieht, da er mehrfach mit ihm Kontakt aufgenommen habe, ohne eine Antwort darauf zu erhalten. Stokar habe sich selber vor dem Krieg schon mit diesem Teppich beschäftigt und dann das Material und die Fotos an Professor Franz in Leipzig gegeben. Dieser sollte ebenso benachrichtigt werden. Ein weiteres Problem sei die geplante Teilnahme von Karl Schlabow, da Stokar sich von diesem angegriffen fühlt. Er empfiehlt stattdessen, die Textilforscherin Fuhrmann mitzunehmen (StaMSS 06. Mai 1941). In Sievers Reaktion findet dieser versöhnliche Worte für Jankuhn und nimmt diesen in Schutz. Schlabow sei für dieses Projekt unentbehrlich und er bietet beiden Hilfe bei einer Versöhnung an (StaMSS 24. Mai 1941). Dieses Angebot schlägt Stokar aus, da er wirklich keine Möglichkeit sieht, mit Schlabow zusammenzuarbeiten und teilte mit, dass man wohl auf ihn verzichten müsse (StaMSS 30. Mai 1941).

4. Nach dem Krieg

Obwohl Reinerth noch am 27. Februar 1945 durch das Oberste Parteigericht der NSDAP aus der Partei ausgestoßen wurde, fanden weder er noch seine Mitarbeiter kaum eine Beschäftigung in der Vor- und Frühgeschichte nach dem 2. Weltkrieg (Steuer 2003, 467). Das Verhalten Reinerths im Nationalsozialismus hatte zu viele Wissenschaftler vor den Kopf gestoßen. Vorgeschichtsforscher des "SS – Ahnenerbes" konnten ihr Engagement bei der SS mit seinem Verhalten und der damit verbundenen "Rettung wissenschaftlicher Ergebnisse vor inkompetenten Nachfolgern" rechtfertigen (Steuer 2004, 474–475, FN 110), ohne dafür mit negativen Konsequenzen bei der Entnazifizierung rechnen zu müssen. In den Nachkriegsjahren kehrten diese Wissenschaftler in die Vorgeschichte zurück, teilweise half man sich bei der Rückkehr in das Berufsleben, und nahmen ab 1955 Positionen ein, die sie auch schon vor 1945 innehatten.

Karl Schlabow kehrte nach dem Krieg mit Unterstützung von Herbert Jankuhn (Schlabow 1976) in den musealen Bereich zurück und leitete zuletzt das Textilmuseum in Neumünster, Jankuhn erhielt eine Professur für das Fach "Vorgeschichte" an der Universität Göttingen. Walter von Stokar hingegen kehrte nicht mehr in die Vorgeschichte zurück. Zwar hatte er sich in seinem Fach einen Namen gemacht, aber auch viele Gegner, so dass er sich kein Netzwerk aufbauen konnte, welches ihm die Rückkehr in diesen Beruf ermöglichte. Besonders mit der Stadt und der Universität Köln kam es seit 1942 immer wieder zu Konflikten, die bis 1949 anhielten. Die Universität Köln schaffte den Lehrstuhl für "Vorgeschichte" wegen der Verstrickung des Faches mit dem Nationalsozialismus ab, wahrscheinlich aber auch, um eine Rückkehr Stokars zu verhindern (Golczewski 1988, 337). Er musste drei verschiedene Entnazifizierungsverfahren durchlaufen (StaM), bis er schließlich der Gruppe II "Belastete (Aktivisten, Militaristen und Nutznießer)" zugeordnet wird. Am 15. Februar 1952 kassiert der Minister für Politische Befreiung in München aufgrund eigener Ministerialentschließung alle Sprüche der Entnazifizierungsverfahren gegen Stokar wieder ein. Das Verfahren wird eingestellt. Stokar arbeitet zu diesem Zeitpunkt wieder in der Pharmazie und verstirbt 1959.

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APM - Archiv Pfahlbaumuseum Unteruhldingen.

- 10. Juni 1937. Schreiben Stokar an Reinerth.
- 06. April 1937. Schreiben Stokar an Verlag Curt Kabitzsch, Leipzig.
- 31. Dezember 1937. Schreiben Verlag Curt Kabitzsch an Reinerth.
- 17. Januar 1938. Schreiben Reinerth an Stokar.

BA - Bundesarchiv.

- BA Stokar, Personalunterlagen.

BA - NS 21/766 – Mitarbeiter.

- 01. April 1937. Schreiben Höhne, SS-Ober- später Hauptsturmführer im Persönlichen Stab des Reichsführers SS an Stokar.

IAW Freiburg - Institut für Archäologische Wissenschaften Freiburg.

- Schreiben Reinerth an PhilFak Universität Berlin vom 28. 01. 1937.

StaM - Staatsarchiv München. Karton 3015, Wiederaufnahmeverfahren.

StaMSS - Staatsarchiv München. Karton 3014, Spruchkammerverfahren Ordner “SS”.

- 26. August 1935. Schreiben Stokar an Alexander Langsdorff, Persönlicher Stab des Reichsführers SS.
- 17. Februar 1937. Schreiben Stokar an Himmler.
- 21. Mai 1937. Schreiben Himmler an Stokar.
- 30. April 1941. Schreiben Sievers an Stokar.
- 06. Mai 1941. Schreiben Stokar an Sievers.
- 24. Mai 1941. Schreiben Sievers an Stokar.
- 30. Mai 1941. Schreiben Stokar an Sievers.

UAB - Universitätsarchiv Humboldt-Universität Berlin. Promotionsakte Dr. phil. der Friedrich-Wilhelms-Universität zu Berlin. Universitätsarchiv Humboldt-Universität Berlin. PhilFak P/4/Vol.654, Promotionen 16. Februar 1938, J-Z.

- 21. Juli 1937. Schreiben Stokar an Dekan Philosophische Fakultät der Friedrich-Wilhelms-Universität.
- 28. Juli 1937. Schreiben Dekan Philosophische Fakultät der Friedrich-Wilhelms-Universität an Stokar.
- 03. Januar 1938. Schreiben Stokar an Dekan Philosophische Fakultät der Friedrich-Wilhelms-Universität.
- 22. August 1938. Verpflichtung der Achtung der Würde des zu verleihenden Titels durch den Dekan Philosophische Fakultät der Friedrich-Wilhelms-Universität.

UAK - Universitätsarchiv Köln.

- Zugang 44 Nr. 418 – Handakte von Stokar 1936-1944 + 1946.

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The North European Symposium for Archaeological Textiles (NESAT) was founded in 1981 as a discussion forum between various disciplines: textile archaeologists, historians, art historians, natural scientists, conservators and craftspeople. The NESAT XII symposium was organized by the Natural History Museum Vienna from 21st to 24th May 2014 in Hallstatt, Austria. The venue of the 12th Symposium was chosen on account of the archaeological heritage of Hallstatt as well as the flora and fauna of the whole region, which is designated in the UNESCO World Heritage list.

The conference volume contains 35 scientific papers grouped into seven chapters. The first chapters introduce Austrian textile research and prehistoric textile finds from Europe, such as recent analysis of the earliest wool finds and early Scandinavian textile design. The main corpus of articles deals with textiles and clothing covering a time span from early medieval to the early modern period, their archaeological research, experiments and art historical context. Five papers focus on tools and textile production, object-based research as well as experimental archaeology and investigation of written sources. The chapter "Specific analyses" embraces interdisciplinary research including dyestuff analysis, isotopic tracing and a drawing system for archaeological textile finds from graves.

The book, therefore, provides a wealth of information on recent research being undertaken into archaeological textiles from sites in Central and Northern Europe.

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