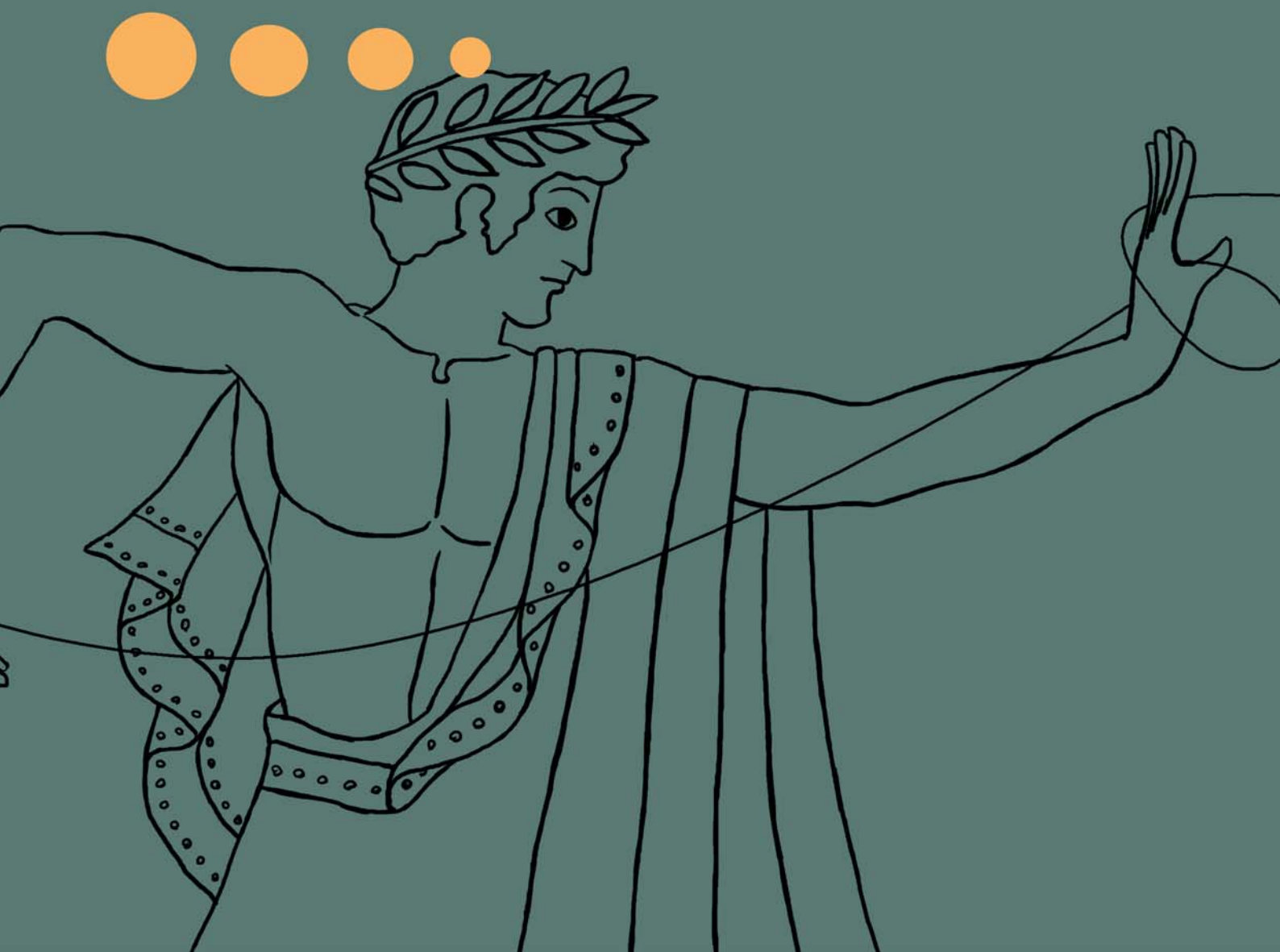


N°

54

ARCHAEOLOGICAL TEXTILES REVIEW



2012 issue

Archaeological Textiles Review

ATR is published by the Society
Friends of ATN, hosted by DNRF
CTR.

Editorial Board:
Eva Andersson Strand
Carol A. Christiansen
Margarita Gleba
Susanna Harris
Ulla Mannering

The scientific committee:
John Peter Wild, UK
Lise Bender Jørgensen, Norway
Elisabeth Wincott Hekett, Ireland
Johanna Banck-Burgess, Germany
Ad hoc members

Cover: Sidsel Frisch

Layout:
Sidsel Frisch
Camilla Luise Dahl

Print: Grafisk
University of Copenhagen

Subscription information:
To become a member of the society
Friends of the Archaeological
Textiles Newsletter and receive
ATR, as well as for institutional
subscription please visit:

www.atnfriends.com

ISSN 2245-7135

Contents

Editorial

1

Articles

- Textiles on Egyptian Mirrors: Pragmatics or Religion?** 2
Karen Price and Margarita Gleba
- Ginderup - Textiles and Dress from the Bronze Age
Gleaned from an Excavation Photograph** 14
Sophie Bergerbrant, Sølvi Helen Fossøy
and Lise Bender Jørgensen
- Textiles and Identity seen through
Etruscan Tomb Paintings** 19
Liv Caroe
- Mathematical Image Analysis on Historical Textiles** 30
Kristian Ryder Thomsen and Mathias Londin Larsen
- Shimmering Cloth, Like the River by this Path** 39
Ben Cartwright
- The Embellished Dress in Hunter-gatherer Societies** 44
Lars Larsson
- Un fragment de toile en coton découvert dans le
frigidarium d'une villa gallo-romaine
à Damblain (Vosges, France)** 52
Nathalie Schluck, Christophe Rose, Didier Le Thiec
and Karine Boulanger
- ṯúg | NÍG.SAG.LAL.SAL | : - A headband
written using a logogram** 57
Richard Firth
- Techniques inattendues dans un fragment textile en
coton, du site d'El Deir, Oasis de Kharga,
Désert Occidental Egyptien** 62
Fleur Letellier-Willemin and Fabienne Médard
- A 17th Century Woman's Cap from
Haarby Church, Denmark** 72
Camilla Luise Dahl and Esther Grølsted
- How to Pleat a Shirt in the 15th Century** 79
Beatrix Nutz and Harald Stadler
- Discovery of a New Tablet Weaving Technique
from the Iron Age** 92
Lise Ræder Knudsen and Karina Grömer



Reviews

Textile Production Workshop Kerstin Droß-Krüpe	98
Wool Economy in the Ancient Near East and the Aegean: from the Beginnings of Sheep Husbandry to Institutional Textile Industry Eva Andersson Strand	99

Resources

Recent publications, websites, and dissertations	100
---	-----

News

New projects	104
Obituaries	105

Editorial

Archaeological Textile Newsletter has now changed its name to Archaeological Textile Review. This emphasises the development towards a high profile scientific journal and is based on the recommendation of an external evaluation. Archaeological Textiles Review Issue 54 is also the first annual issue. Publishing two issues per year was no longer sustainable and we hope the readers will like the new format of “two in one”.

This issue includes 12 articles with a geographical distribution reaching from Mesopotamia and Egypt to Northern Europe, and a chronological distribution spanning from Stone Age to the 17th century AD. Different sources including mirrors, tomb paintings, texts and of course textiles are analysed and various methodological aspects such as tool contexts and image analysis are considered. Several of the articles are by students presenting the research they have conducted at the BA, MA and PhD level. Once again it is evident that archaeological textile studies are a wide-reaching and diverse field of research that generate interest among the younger generation. In 2012 the first two ATN issues printed in Copenhagen, 46 and 47, were made accessible online on our webpage. In 2013 the next two issues, 48 and 49, will also be published online. We hope the ATN/ATR readers appreciate this service. Printed back issues can still be purchased together with the annual membership on the homepage:

<http://www.atnfriends.com>.

In 2012 the society received funding from The Danish Council for Independent Research, Humanities (FKK) for publication of ATR 2012 Issue 54, 2013 Issue 55 and 2014 Issue 56, and for the digitizing of old issues (1-45). We thank the Danish Government for this generous support. Please make sure to renew your membership at the beginning of the year. Your subscription is important because ATR needs at least 200 subscribers to receive funds from governmental sources. In spite of the faithful support from old and new subscribers we still have not reached this critical mass – so please spread the word and advertise at any given occasion. Flyers that can be brought to meetings and conferences can be downloaded on the webpage.

The editors encourage the contributors to submit their articles throughout the year to spread the editing workload as the peer review system requires more time in the editorial process. The deadline for contributions for ATR 2013 Issue 55 is the 1st of June. The new and more detailed guidelines are also now posted on the webpage – close adherence to them will greatly speed up the editing and review process, please follow them closely.

The last annual meeting was held in September and the minutes can be read on our webpage.

The editors



Karen Price and Margarita Gleba

Textiles on Egyptian Mirrors: Pragmatics or Religion?

Introduction

The Petrie Museum of Egyptian Archaeology at the University College London houses an impressive range of objects that showcase ancient Egyptian daily life as well as those thought necessary for the afterlife. Plentiful among these objects are mirrors. Found in burials, a handful of mirrors at the Petrie Museum fascinatingly bring evidence of another funerary artifact: textiles. When disposed in a burial in contact with metals, textiles can be preserved in their organic state or become mineralized, a process during which their organic structure is replaced by an inorganic one consisting of metal salts. Six mirrors from the Petrie Museum display such textiles, raising important questions: Why were textiles and mirrors placed together in burials? Is this survival incidental or are textiles on these mirrors representative of a wider Early Intermediate and Middle Kingdom phenomenon? Did ancient Egyptians create cases made of textiles to cover mirrors deposited in burials? If so, did their mortuary practices require the covering of mirrors for a religious purpose or was it simply a practical matter of protecting the reflective surface? This article will address these questions by investigating ancient Egyptian textiles, mirrors and the possible significance of their association.

Mineralization Process

Fiber mineralization occurs as a post-depositional process. In certain burial environments the presence of metals (in this case copper and its alloys) facilitates a chemical reaction that allows the dispersal of metal ions (Chen *et al.* 1998, 1016). These ions are able to infiltrate fiber that is undergoing degradation by microorganisms. This corrosive process is toxic to the

micro-organisms and thus at times is able to decrease the amount of damage that these organisms would normally cause to the textile. Textile mineralization can preserve the external structure of the fiber in what is known as a negative cast, or as a positive cast with the metal ions penetrating throughout the entirety of the structure (Gillard *et al.* 1994, 133). The positive casts most often occur as a result of contact with copper and its alloys, of which the mirrors in the present study are made.

Materials and Methods

Six copper or copper alloy mirrors with organic or mineralized textiles were analyzed at the Petrie Museum of Egyptian Archaeology for this study presented in the Catalogue below. Microscopic analysis was carried out and micro-photographs taken using digital DinoLite microscope, noting when possible the following technical parameters: the location of mineralized textiles on the mirrors and their size, weave type, thread count, thread diameter and twist direction, and any special features. Diameter measurements were carried out on at least three yarns in each case and since they often varied substantially, a range is given in each instance (cf. Kemp and Vogelsang-Eastwood 2001, 65). As none of the textiles have preserved borders, it was not possible to identify warp and weft, but since in most pharaonic linen textiles warp is usually denser than weft (Kemp and Vogelsang-Eastwood 2001, 99-107), the denser system is listed as the first system in Table 1. In one case, fibre identification was carried out using Scanning Electron Microscope at the Wolfson Archeological Science Laboratories at the Institute of Archaeology, University College London.

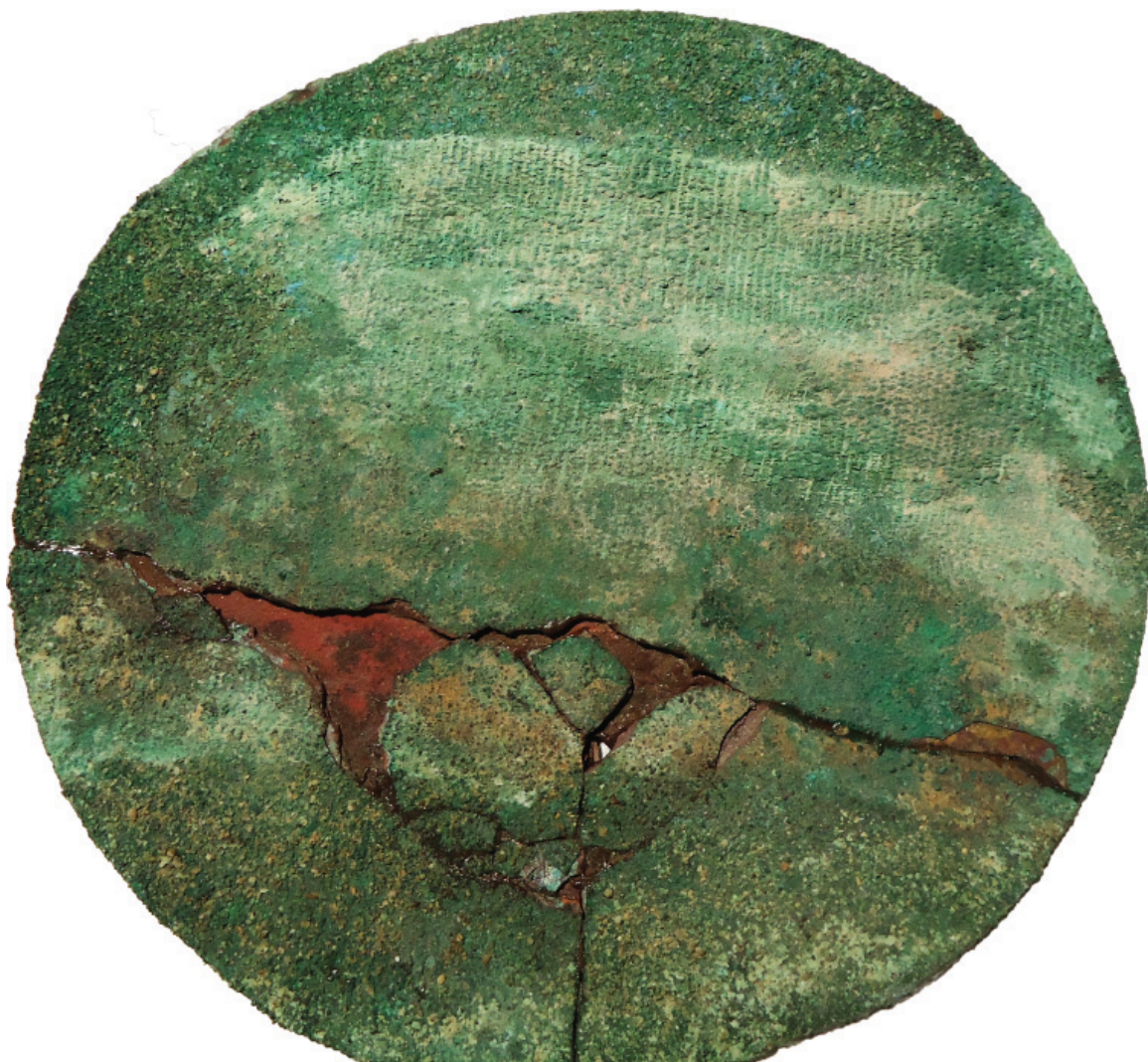


Fig. 1. Mirror 1 (UC58772), unknown date and context (Photo: K. Price, with permission of The Petrie Museum of Egyptian Archaeology, UCL).

Catalogue

Mirror 1 (Fig. 1)

Accession Number: UC58772

Date: Unknown

Context: Unknown

Mirror description: circular bronze mirror; tang missing; broken into several fragments and recomposed; size 14.5x15.3 cm.

Textile description: mineralized textile traces present on upper and central part of one face, measuring approximately 12x6 cm (Fig. 2)

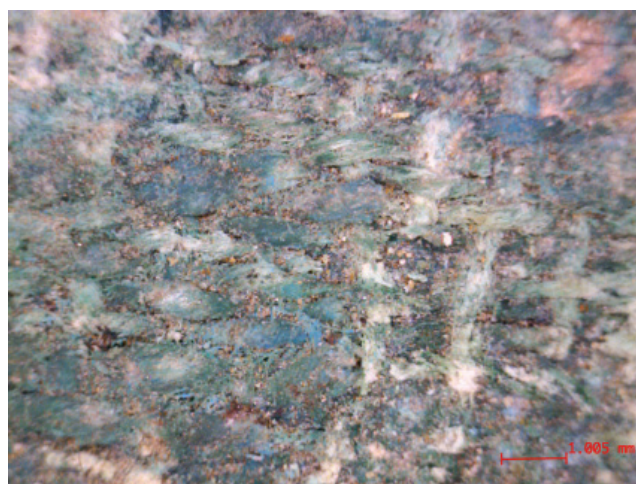


Fig. 2. Detail of textile on Mirror 1 (Photo: authors, with permission of The Petrie Museum of Egyptian Archaeology, UCL).

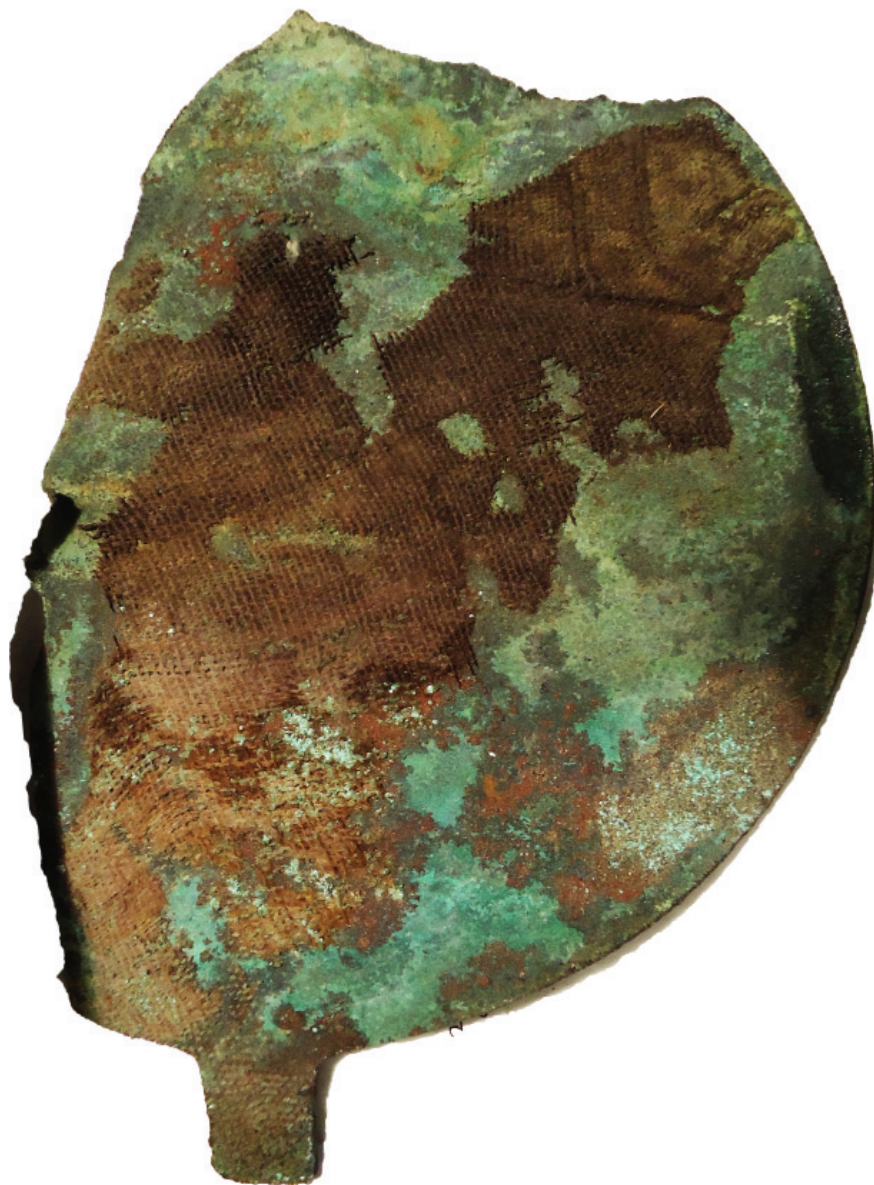


Fig. 3. Mirror 2 (UC18094), Dynasty 11, Abydos tomb 291 (Photo: K. Price, with permission of The Petrie Museum of Egyptian Archaeology, UCL).

Mirror 2 (Fig. 3)

Accession number: UC18094

Date: Dynasty 11, Middle Kingdom (2060-1991 BC)

Context: Abydos Tomb 291

Mirror description: circular bronze mirror with rectangular tang, broken vertically before or during deposition; size 17x11 cm.

Textile description: dark brown cloth preserved in patches on one face of the mirror with only small areas of mineralized textile (Fig. 4). A dark brown color of the textile may be due to degradation (Kemp and

Vogelsang-Eastwood 2001, 16). What appear to be 3 seams (two parallel with one perpendicular to them) are present in the upper right area (Fig. 5). The sewing thread in at least two of the seams is Z2s (cf. Kemp and Vogelsang-Eastwood 2001, 60). The upper two seams are similar to the “type 1 seam” found among the Amarna textiles (Kemp and Vogelsang-Eastwood 2001, 172, 178). This seam entails rolling under the edge of each piece of cloth and then attaching the two pieces together with stitching.

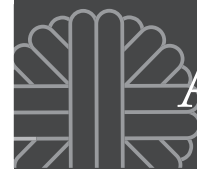


Fig. 4. Detail of textile on Mirror 2 (Photo: authors, with permission of The Petrie Museum of Egyptian Archaeology, UCL).



Fig. 5. Detail of textile on Mirror 2 showing possible seams (Photo: authors, with permission of The Petrie Museum of Egyptian Archaeology, UCL).



Fig. 6. Mirror 3 (UC26069), Dynasty 12, Qua (Photo: K. Price, with permission of The Petrie Museum of Egyptian Archaeology, UCL).

Mirror 3 (Fig. 6)

Accession number: UC26069

Date: Dynasty 12, Middle Kingdom (1991-1782 BC)

Context: Qua

Mirror description: circular bronze mirror with triangular tang; size 9x9.7 cm.

Textile description: mineralized traces of two different fabrics on both faces of the mirror, wrapping around on top right and bottom left corners (Fig. 7).



Fig. 7. Detail of textile on Mirror 3 (Photo: authors, with permission of The Petrie Museum of Egyptian Archaeology, UCL).



Fig. 8. Mirror 4 (UC43125), Dynasty 11, Abydos (Photo: K. Price, with permission of The Petrie Museum of Egyptian Archaeology, UCL).



Fig. 9. Detail of textile on Mirror 4 (Photo: authors, with permission of The Petrie Museum of Egyptian Archaeology, UCL).

Mirror 4 (Fig. 8)

Accession Number: UC43125

Date: Dynasty 11, Middle Kingdom (2060-1991 BC)

Context: Abydos, west of Shumeh el Zebib

Mirror description: Circular bronze mirror with rectangular tang; size 13x13.7 cm

Textile description: Six patches of tabby weave textiles remain while most were scraped off (Fig. 9); textile present on both faces of the mirror.



Fig. 10. Mirror 5 (UC43073), Dynasty 12?, Abydos tomb 275 (Photo: K. Price, with permission of The Petrie Museum of Egyptian Archaeology, UCL).



Fig. 11. Detail of textile on Mirror 5 (Photo: authors, with permission of The Petrie Museum of Egyptian Archaeology, UCL).

Mirror 5 (Fig. 10)
Accession Number: UC43073
Date: Dynasty 12?, Middle Kingdom (1991-1782 BC; Hall 1986, 5)
Context: Abydos, Tomb 275 Sq. Memeith
Mirror description: Circular bronze mirror, tang missing; size 13.5x12.9 cm
Textile description: mineralized textile patches adhering to both faces (Fig. 11)



Fig. 12. Mirror 6 (UC18094), Dynasty 9, Qua, Badari tomb 4979 (Photo: K. Price, with permission of The Petrie Museum of Egyptian Archaeology, UCL).



Mirror 6 (Fig. 12)

Accession Number: UC18094

Date: Dynasty 9, First Intermediate Period (2181-2040 BC; Hall 1986, 5)

Context: Qua, Badari tomb 4979, Tomb of Women.

Mirror description: heavy circular copper mirror with square tang preserving remains of wooden handle; size 15.x15.5 cm; conserved – covered with consolidant.

Textile description: mineralized textile traces on both faces, wrapping around the edge and preserving overlapping folds (Fig. 13).

Fig. 13. Detail of textile on Mirror 6 (Photo: authors, with permission of The Petrie Museum of Egyptian Archaeology, UCL).

Results

Technical characteristics of the textiles adhering to the mirrors are described in Table 1.

Four of the mirrors (3-6) have mineralized textiles on both the front and back of the mirror with one mirror (4) presenting evidence of the removal of textile remains in the past as a conservation treatment. Two mirrors (5, 6) have evidence of the original textile wrapping around the mirror from front to back, one of which shows overlapping folds of fabric (6).

Textiles on the six mirrors at the Petrie Museum are all tabbies with quality ranging from 10 to 28 threads/cm in System 1 and from 7 to 16 threads/cm in System 2 or between 28/16 and 10/7 threads/cm. This is a relatively narrow range and fits well within the normal range published for the vast quantity of textiles excavated at the Workmen's Village at Amarna and other sites for which the data is available (Kemp and Vogelsang-Eastwood 2001, 107). The twist is either s/s or S2s/s, although in some cases it was not possible to define the thread twist with certainty due to heavy mineralization. This also fits well with the results presented by Kemp and Vogelsang-Eastwood for the Amarna material (2001, 59-60). In some cases, splices are clearly visible (Fig. 14). Yarn diameter ranges between 0.24 and 0.66 in System 1 and between 0.29 and 1.02 in System 2, varying between fine and very coarse according to the classification by Kemp and Vogelsang-Eastwood (2001, 64). The finer yarn diameters in System 2 correspond to higher thread counts. The diameters vary considerably within each textile and within each thread system. Twist angle, mostly corresponding to medium, is also similar to the Amarna material (Kemp and Vogelsang-Eastwood 2001, 64).

The raw material of all textiles is most likely flax. A sample of loose thread from Mirror 2 was analyzed using Scanning Electron Microscopy (SEM), confirming that the fibre is flax, *Linum* sp. (Fig. 15), which is the predominant fibre used in pharaonic Egypt (Kemp and Vogelsang-Eastwood 2001, 25-34, 53). Diameter of 15 fibres measured ranges between 7.9 and 22.9 microns, with an average of 15 microns.



Fig. 14. Detail of textile on Mirror 5 showing a splice (Photo: authors, with permission of The Petrie Museum of Egyptian Archaeology, UCL).

Discussion

In addition to the Petrie Museum mirrors, at least four other Egyptian mirrors were found to bear proof of textile presence: three in the Boston Museum of Fine Arts: no. 21.10559 from Naga el-Deir 453b dated to Dynasty 12 (1991-1783 BC; Lilyquist 1979, fig. 53; *Museum of Fine Arts, Boston Online Collection 21.10559*); no. 13.3571 from Sheikh Farag dated to Dynasty 12-16 (1980-1630 BC; *Museum of Fine Arts, Boston Online Collection 13.3571*); no. 15-2-63 from Nubia (Sudan) of Kerma culture (2500-1520 BC; Lilyquist 1979, fig. 69; *Museum of Fine Arts, Boston Online Collection 15-2-63*); and one mirror in the Metropolitan Museum of Art: no 29.2.2 from unknown context dated to Middle-Late Kingdom (Lilyquist 1979, fig. 45).

However, it is possible, as with Mirror 4 and the mirror 21.10559 in the Museum of Fine Arts in Boston, which since being photographed has been unwrapped, that mineralized textile remains have been removed from many other artifacts during cleaning and conservation process (compare Lilyquist 1979, fig. 53 and *Museum of Fine Arts, Boston Online Collection 21.10559*). Indeed, Lilyquist (1979, 63) notes that: "impressions for remains of cloth are found on the surface of disks of every period". Although the mirrors from known contexts investigated for this study date from the Ninth Dynasty of the First Intermediate period (2181-2040 2025 BC) to the Twelfth Dynasty of the Middle Kingdom (204025-1782 BC), archaeological evidence

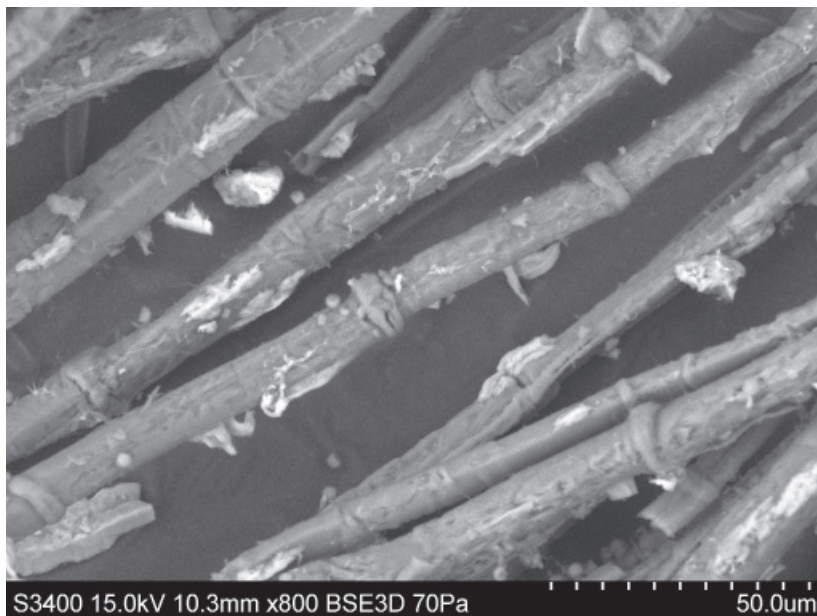


Fig. 15. SEM micrograph of flax fibres from Mirror 2 (Photo: M. Gleba).

attests to the presence of textiles on mirrors dating back to the Archaic or Early Dynastic Period (3050-2613 BC; Lilyquist 1979, 4). Therefore, it would appear that the relationship between textiles and mirrors, and their likely intentional placement together lasted for a very long time in Egyptian culture.

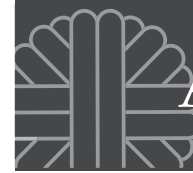
There are various reasons as to why mirrors would need to have been covered in textiles for burial. The simplest explanation is a practical one: the protection of the reflective surface. In fact, actual mirror cases have been found in excavations, the most famous being the gold and silver ankh-shaped case from the tomb of King Tutankhamun (see *e.g.* Desroches-Noblecourt 1989, 188). Mirror cases could also be made of materials such as bronze and wood (Wallis Budge 1987, 262). Egyptian iconography includes representations of mirror cases made out of animal hide typically depicted white with black patches, or plaited rush represented as checked squares or cross-hatching, reminiscent of basketry (Lilyquist 1979, 63, 65).

Most relevant to this study are cloth mirror cases. When discussing the presence of textile remains on mirrors, Lilyquist (1979, 63) surmises: "Impressions for remains of cloth are found on the surface of disks of every period, and it is a logical assumption that cloth was the basic protection for reflective disks throughout ancient Egypt". "Plain cases" are noted in representations with an outer row of stitching (Lilyquist 1979, 63). Although their material is difficult to ascertain, it is possible that they were made of

woven cloth with two pieces sewn together. While it is difficult to tell if the textiles on the Petrie Museum mirrors were once such cloth mirror cases, at least one of the mirrors preserves traces of two different textiles on its two faces, suggesting that a case may have been sewn together from fragments of different fabrics. On the other hand, three of the six mirrors at the Petrie Museum (Mirrors 4-6) and some mirrors from other museum collections appear to have been wrapped in a textile, possibly a strip of cloth, from front to back. The mirror 21.10559 at the Museum of Fine Arts, Boston was wrapped with a fringed cloth made of reed fiber (Lilyquist 1979, 65).

It seems to have been a common practice to reuse textiles in burials in ancient Egypt. Although the preparation of tombs was considered an intensive and prestigious activity (de Moor 2009), the use of recycled garments for the afterlife does not appear to have had a low-class stigma. This is well expressed in the last words of the relatives inscribed in a New Kingdom tomb: "he who had so much fine linen, and so gladly put it on, sleeps now in the cast-off garments of yesterday" (Erman 1907, 137). Most mummy bandages were actually made of reused fabrics (Ikram and Dodson 1998, 153). It can be surmised that textiles associated with mirrors, possibly used to wrap them, may have been such reused fabrics as well.

Although not found in burials, textile remains from the Workmen's Village at Amarna also included recycled strips of cloth. These strips had signs of being deliberately torn and cut from another, larger piece



of cloth and would have been used as a substitute for ropes, lamp wicks, bandages, and inserts used to strengthen the folds and seams of fabric (Kemp and Vogelsang-Eastwood 2001, 222-223). Small pouches made from recycled cloth are also known at Amarna (Kemp and Vogelsang-Eastwood 2001, 230-232). These pouches appear to have been made by gathering together the corners of a rectangular piece of cloth around an object and then tying them together with a string (e.g. fig. 6.66a-f in Kemp and Vogelsang-Eastwood 2001, 231-232).

Another example of the intentional wrapping of a mirror in loose cloth is seen in the case of Mirror 2. This mirror has a mineralized textile that is present not only on the surface of the mirror but also on its tang, the protruding appendage at the bottom of the mirror which would have been inserted into a handle. As the tang was usually covered by the handle and thus already protected, evidence for the wrapping of tang may point towards burial without a handle. However, it is also possible that the entire mirror with tang was wrapped in a textile before being reinserted back into the handle, which would suggest that mirrors were wrapped for reasons other than simple surface protection.

An alternative or perhaps additional motive for wrapping or covering mirrors in burials may have been due to cosmological power ascribed to these reflective surfaces. In Egypt, mirrors were associated

with the revitalization of the deceased, conserving his/her appearance and possibly even acting as a depository for the soul (Lilyquist 1979, 98-99). At least in the Middle Kingdom, the uncased mirrors are usually positioned towards the head in tombs while those in cases are more frequently found near the feet (Lilyquist 1979, 76) and Lilyquist (1979, 99) suggests that in the former case "the readiness of the mirror for use must be significant". Perhaps some mirrors were encased to prevent them from being readily available for use and to deter the (dangerous?) agency of its reflective surface. Conceivably, through encasement in cloth (or other material), the power of mirrors would be restricted in burial, perhaps so that they did not act on their own accord or were not misused.

In this respect, of special interest is King Tutankhamun's ankh-shape mirror case. Its shape may actually be a play-on-words representing the mirror's power as ankh meant both 'mirror' and 'life' in ancient Egypt (Ross 2008, 91). As 'mirror' and 'life' were conveyed with the same word, mirrors could thus be used in burials to transfer life to the deceased (Bird 1986, 189). It has also been suggested that mirrors acted as depositories for the soul (Lilyquist 1979, 99; Graves-Brown 2010, 167).

In fact, cross-cultural comparisons certainly indicate that mirrors across time and space had important cosmological significance. Thus, Chinese burial practices reveal beliefs in the power of reflective

Number	Date	Context	Weave	Thread count	Thread twist	Thread diameter	Twist angle
UC58772	unknown	unknown	tabby	20-21/9	s(S2s?)/s	0.43-0.56/ 0.68-0.82	medium/medium
UC18094	Dynasty 11	Abydos	tabby	20-22/10	S2s/s	0.27-0.57/ 0.37-0.52	medium/medium
UC26069	Dynasty 12	Qua	open tabby	10-11/7	S2s?/s	0.34-0.62/ 0.57-1.02	?
			tabby	20-22/11	s/s?	0.24-0.35/ 0.32-0.37	?
UC43125	Dynasty 11	Abydos	tabby	28/16	s/s	0.28-0.36/ 0.29-0.37	medium/low
UC43073	Dynasty 12?	Abydos	tabby	24/10	s/s	0.39-0.53/ 0.40-0.50	medium/medium
UC18094	Dynasty 9	Qua	tabby	20/7	s/s?	0.60-0.66(splice 1.22)/0.47-0.68	medium/?

Table 1. Technical characteristics of the textiles on Petrie Museum mirrors.



surfaces. Although later in date, Chinese mirrors from the Winthrop collection at the Harvard University Art Museums, dating from the Zhou Dynasty's Spring and Autumn Period (771-476 BC) to the Tang Dynasty (AD 618-906) preserve mineralized textile traces (Costello 2005, 1, 10). These mirrors, placed on or next to the deceased, were necessary in burial to ward off evil spirits, as they became visible in their reflective surface (Costello 2005, 2; Ho 2005, 91-92). Since their placement with textiles has not been investigated systematically, it is possible that the impressions might be the result of contact with the deceased's clothing, yet the association of mirrors with textiles is curious.

The need to restrict the power of mirrors is also seen with a small number of mirrors found in Etruscan burials in Italy. Nancy de Grummond (2009, 171) states: "the act of breaking or covering a mirror is commonly accompanied by strong feelings, probably because of the widespread perception that a mirror contains within itself another world that is no longer accessible if the mirror, a kind of pathway to that world, is closed down". This pathway appears similar to "scrying", or seeing into other worlds through reflective surfaces as described by Graves-Brown (2010, 167). The manner in which this pathway was closed in late 4th and early 3rd century BC mirrors found in Etruscan burials was through the canceling of mirrors by "suthinizing" (inscribing the mirror with 'suθina' meaning 'for the tomb', usually on its reflective side), and/or the ritual mutilation of mirrors by folding, gouging or hammering (de Grummond 2009, 172-175). Some of the mirrors bear traces of textiles. It may be that by wrapping an object the same objective was achieved. Although seemingly destroyed, Etruscan mirrors appear to have been defaced with restraint, perhaps a way in which to decrease the power of the mirror but not ruin it (de Grummond 2009, 176-177). Similarly, on the above-mentioned Chinese mirrors inscriptions were utilized to draw supernatural attention to the burial in order to assist the deceased and keep away malevolent spirits (Bulling and Drew 1971-72, 44). Ancient Egyptian mirrors do not show evidence of a similar practice, although at times they were inscribed (see Lilyquist 1979, figs. 5-19 for drawings of inscribed mirrors). These inscriptions usually listed the names of the male and female owners of the mirror.

It is plausible to assume that ancient Egyptians believed that the power of the mirror needed to be controlled during burial. As with cased mirrors placed on the eastern side in coffins, a method for doing this may have been to cover the reflective surface. Textiles constituted an easy way to accomplish this.

Conclusion

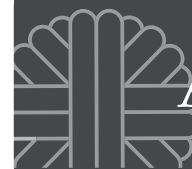
The six mirrors analyzed at the Petrie Museum of Egyptian Archaeology, combined with others located in other museum collections, provide evidence that mirrors in pharaonic Egypt were intentionally covered with textiles when placed in burials. This phenomenon, combined with the fact that many mirrors may have been cleaned before or after entering museum collections, during which process textile traces would have been removed from their surfaces, more than hints at a wider burial practice that involved the covering of these reflective surfaces. It is still unclear as to why this was done. Although the explicit evidence that appears in Etruscan and Chinese burials for the need to mutilate or inscribe the mirror to call upon or reject supernatural forces is not present in the case of Egyptian mirrors, it is possible that mirrors were covered for similar reasons. This may have been done with a gold ankh-shaped mirror case, wood, metal, hide, rush, cloth cases or simply recycled textiles, donated to the burial for use in the afterlife. While further research of textiles on Egyptian mirrors is necessary in order to fully understand their function in burials, it is likely that mirrors were purposely covered with textiles probably for more than pragmatic reasons, and that these textiles aided the controlling of their supernatural power within mortuary contexts. Even when minute, textile traces on ancient objects not only provide new information about these objects but also lead us to ask new questions about their significance in the past.

Acknowledgments

We would like to thank Stephen Quirke and Susanna Pancaldo of the UCL Petrie Museum of Egyptian Archaeology for providing the access to the mirrors and permitting the sampling of thread fragments from mirror UC43075 for SEM analysis. We also thank Jana Jones for reviewing the paper and providing useful comments and corrections.

Bibliography

- Bird, J. (1986) An inscribed mirror in Athens. *Journal of Egyptian Archaeology* 72, 187-189.
- Bulling, G. and Drew, I. (1971-72) The dating of Chinese Bronze Mirrors. *Archives of Asian Art* 25, 36-57.
- Chen, H. (1998) Preservation of Archaeological Textiles through Fibre Mineralization. *Journal of Archaeological Science* 25, 1015-1021.
- Costello, S. (2005) An Investigation of Early Chinese Bronze Mirrors at the Harvard University Art



- Museums. Unpublished paper for ANAG-PIC Student Papers presented at the 2005 Annual Student Conference hosted by the Buffalo State College, Art Conservation Department.
- De Grummond, N. (2009) On Mutilated Mirrors. In M. Gleba and H. Becker (eds.), *Votives, Places and Rituals in Etruscan Religion*, 171-182. Leiden and Boston.
- De Moor, A. (2009) *3500 years of textile art: the collection in HeadquARTers*. Tiel.
- Desroches-Noblecourt, C. (1989) *Tutenkhamen. Life and Death of a Pharaoh*. New York.
- Digital Egypt* (2001) Mirrors. Retrieved 1 December 2011 from World Wide Web: <http://www.digitalegypt.ucl.ac.uk/metal/mirrors.html>
- Donadoni Roveri, A. (2001) *The Art of Weaving*. Milan.
- Dunham, D. (1941) Two Recent Installations in the Egyptian Galleries. *Bulletin of the Museum of Fine Arts* 39/231, 7-10.
- Edwards, I. (1937) A Toilet Scene on a Funerary Stela of the Middle Kingdom. *The Journal of Egyptian Archaeology* 23/ 2, 165.
- Erman, A. (1907) *A Handbook of Egyptian Religion*. London.
- Gillard, E., Hardman, S., Thomas, R. and Watkinson, D. (1994) The Mineralization of Fibres in Burial Environments. *Studies in Conservation* 39/2, 132-140.
- Graves-Brown, C. (2010) *Dancing for Hathor: Women in Ancient Egypt*. London and New York.
- Hall, R. (1986) *Egyptian Textiles*. Buckinghamshire.
- Ho, C. (2005) Chinese mirrors - Magic and Faith: Reflections on Chinese Mirrors in the Tenth to the Fourteenth Century. *Cleveland Studies in the History of Art* 9, 90-97.
- Ikram, S. and Dodson, A. (1998) *The Mummy in Ancient Egypt. Equipping the Dead for Eternity*. London and New York.
- Kemp, B. and Vogelsang-Eastwood, G. (2001) *The Ancient Textile Industry at Amarna*. London.
- Lilyquist, C. (1979) *Ancient Egyptian Mirrors from the Earliest Times through the Middle Kingdom*. Munich.
- Luskes, M. (1994) *Illustrated dictionary of the Gods and Symbols of Ancient Egypt*. London.
- Museum of Fine Arts, Boston Online Collection* 15-2-63. Harvard University- Boston Museum of Fine Arts Expedition. Retrieved from World Wide Web: <http://www.mfa.org/collections/object/mirror-333451>
- Museum of Fine Arts, Boston Online Collection* 21.10559. Harvard University- Boston Museum of Fine Arts Expedition. Retrieved from World Wide Web: <http://www.mfa.org/collections/object/mirror-144674>
- Museum of Fine Arts, Boston Online Collection* 13.3571. Harvard University- Boston Museum of Fine Arts Expedition. Retrieved from World Wide Web: <http://www.mfa.org/search/collections?keyword=13.3571>
- Petrie Museum Catalogue*. Petrie Museum. Retrieved on 15 March 2011 from World Wide Web: <http://petriecat.museums.ucl.ac.uk>
- Pinch, G. (2006) *Magic in Ancient Egypt*. 2nd ed. London.
- Ross, M., ed. (2008) *From the banks of the Euphrates: studies in honor of Alice Louise Slotsky*. Winona Lake, IN.
- Taylor, J. and Strudwick, N. (2005) *Mummies: Death and the Afterlife in Ancient Egypt: Treasures from the British Museum* (exh. cat.). Santa Ana.
- Wallis Budge, W. (1987) *The Mummy: A handbook of Egyptian funerary archaeology*. 3rd ed. London and New York.
- Wilkinson, R. (1994) *Symbol and Magic in Egyptian Art*. London.
- Corresponding Author: m.gleba@ucl.ac.uk



Sophie Bergerbrant, Sølvi Helen Fossøy and Lise Bender Jørgensen

Ginderup – Textiles and Dress from the Bronze Age Gleaned from an Excavation Photograph

Introduction

In general, actual remains of archaeological textiles are the source for data such as weave, spin direction, yarn diameter or thread count, even though impressions on pottery or metal may sometimes serve this purpose. In this paper the information derives from high quality excavation photographs. Unfortunately, despite good intentions, the textiles themselves were destroyed during post-excitation processes.

In 1933 Johannes Brøndsted from the National Museum of Denmark excavated a ploughed out burial mound in Ginderup, Heltborg parish, Thy, Denmark. The central burial, grave A, proved to be a stone cist. It contained a great quantity of organic material, too fragile to recover, but this was at least recorded in drawings, reports and photographs (Brøndsted NM Archive). The interior of the stone cist was 1.7 m long and 0.25-0.45 m wide. The grave contained some skeletal remains and a neck-ring, a fibula, a double button, two arm-rings and one finger-ring (Aner and Kersten 2001, 198; Brøndsted NM Archive). The artefacts help date the grave to Montelius period III, i.e. 1300-1100 BC. The grave goods indicate that the deceased was a woman.

After initial recording and photographing at the site, the grave was removed *en bloc*. First the grave was covered by a layer of sand, followed by tissue paper. Plaster was then poured on top. Then, all of the side stones of the cist were removed and all four sides were covered by plaster. A wooden box was built around this, and the entire block was taken to the museum to be excavated in the conservation

laboratory (Brøndsted NM Archive). The Ginderup grave is briefly mentioned by H.C. Broholm and M. Hald (1935, 286) in their study of Bronze Age clothing, which tells us that they were aware of the find, but only the possibility of it containing a corded skirt was stated. A report from the excavation of the block has not been found by the authors. Despite the fact that large textile fragments can be seen in the excavation photographs, not a single textile fragment survived. Fortunately, two very high quality photographs were taken before the plaster treatment began. Much information can be gained about the textiles from these photographs, particularly when combined with the available measurements of the artefacts.

Blanket

The entire inner space of the grave was originally more or less covered by textiles (Brøndsted NM Archive). Not all of these textile fragments are visible in the photographs (Fig. 1). It is however clear that the deceased was covered by a large textile woven in tabby. Close examination of the photographs shows that the fabric was made with s-twisted yarn in one direction and z in the other (however, it is impossible to determine warp and weft direction) and the thread count was 3.5/4.5 threads/cm, the threads being c. 1.2 mm thick. This can most clearly be seen in the larger piece of textile that survived in the waist area of the deceased. As all visible pieces of woven fabric have the same visual appearance, it is likely that all the tabby woven textiles derive from the same fabric.

As far as we know, all of the well-known oak-log

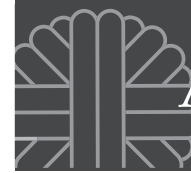
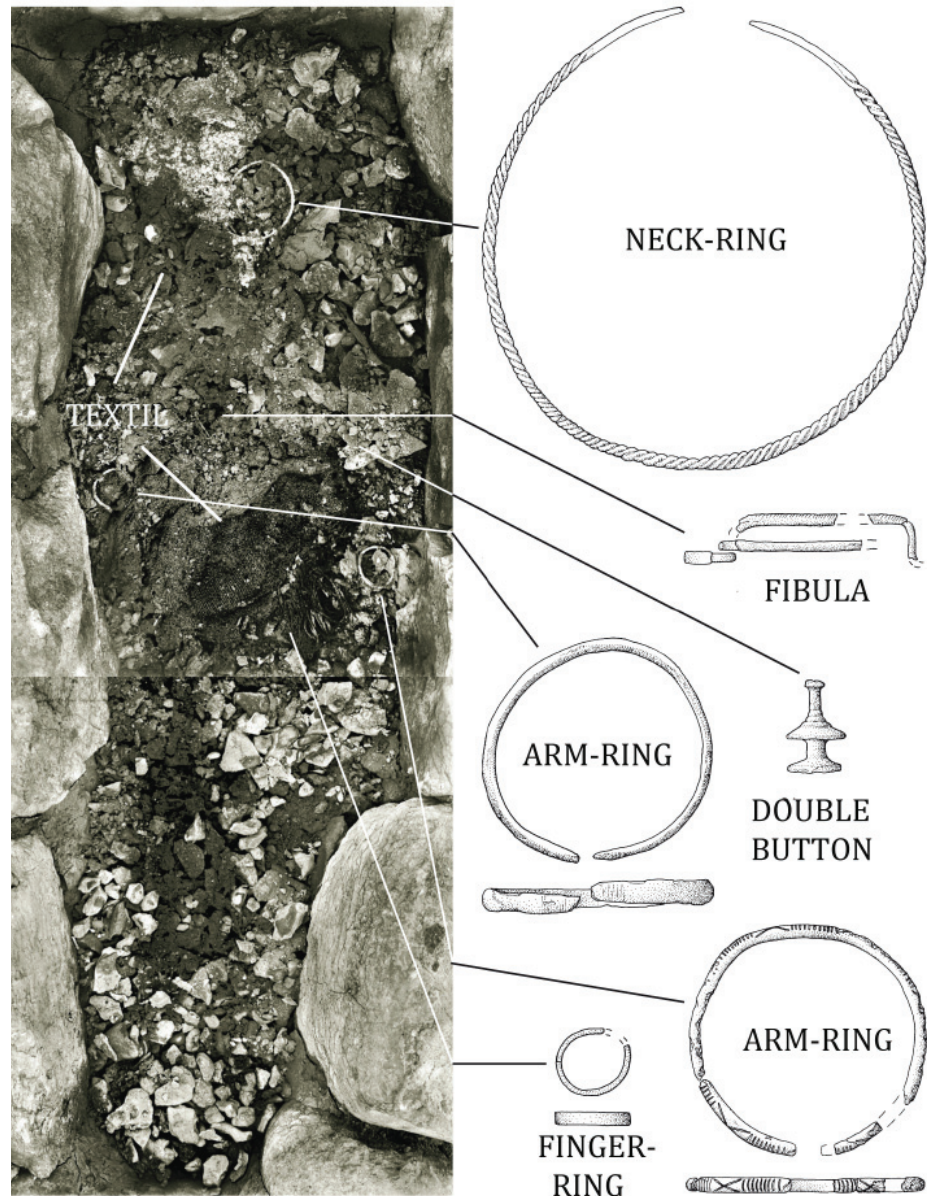


Fig. 1. The Ginderup burial, based on the photographs in the National Museum of Denmark and illustration from Aner and Kersten 1973 (After Bergerbrant et al. 2012, © Skalk).



coffin burials with complete garments had a textile placed on top of the deceased. In the four male graves, i.e. Muldbjerg burial, Borum Eshøj graves A and B, and Trindhøj, the cloak had been used as a cover, and in the case of Muldbjerg the deceased was also covered by a 2.15 x 1.2 m blanket under the cloak (Boye 1896, 35, 54, 57, 91). The female burial of Egtved was also covered with a large piece of woven cloth, determined by Broholm and Hald (1940, 82) to have been a blanket (Thomsen 1929, 175-176). In the case of Skrydstrup, the deceased was covered by two large folded textiles, A and B (Broholm and Hald 1939, 21, 49-51). The female burial of Borum Eshøj grave C had been found by farmers, the coffin turned over and the garments removed before the contents could be documented (Boye 1896, 51). According to the description obtained from the perpetrators, this body had also been covered by woven fabric (Broholm and Hald 1935, 276). In two other oak coffins, Store Kongehøi A and B, the deceased had also been covered by cloth that unfortunately could not be salvaged (Boye 1896, 81-3). The cremation grave from Hvidegård was likewise covered by a woven cloth (Aner and Kersten 1973, 143-45). The textile covering

of the Ginderup grave is made of *s/z* yarn like most of the other examples, except one of the blankets from Skrydstrup and the cloak from Borum Eshøj grave A (Tables 1 and 2). Generally the thread count varies between c. 3/3 threads/cm (Egtved) and c. 4/6 threads/cm (Hvidegård).

Corded skirt

Even more interestingly, remains of another item of clothing can be glimpsed under the large tabby woven textile visible in the photographs. These are cords, deriving from a corded skirt like the well-known example from the Egtved oak-log coffin and fragmented remains of similar skirts from several other Bronze Age sites in Denmark (Broholm and



Blankets	Twist warp	Twist weft	Thread count warp (per cm)	Thread count weft (per cm)	Reference
Borum Eshøj grave C	s	z	4.6	3.1	Broholm and Hald 1935, 276
Egtved	s	z	2.8-4.2	2.6-3.2	Broholm and Hald 1935, 281f
Muldbjerg	s	z	4.2	3.4	Broholm and Hald 1935, 224
Skrydstrup blanket A	s	s	4.4-4.7	3.0-3.2	Broholm and Hald 1939, 49
Skrydstrup blanket B	s	z	4.1-4.5	4	Broholm and Hald 1939, 49f
Trindhøj	s	z	4.3-5.4	2.9-4.2	Broholm and Hald 1935, 240ff
Hvidegård	s	z	4	6	Bender Jørgensen 1986, 189

Table 1. Technical characteristics of blankets recovered from various oak-log coffins and the cremation grave of Hvidegård in Denmark.

Cloaks	Twist warp	Twist weft	Thread count warp (per cm)	Thread count weft (per cm)	Reference
Borum Eshøj grave A	s	s	3-4.5	2.1-3.5	Broholm and Hald 1935, 255
Borum Eshøj grave B	s	z	3.6-4.6	2.2-3.2	Broholm and Hald 1935, 264
Muldbjerg	s	z	3.7	2.7-2.8	Broholm and Hald 1935, 216
Trindhøj	s	z	4	3	Broholm and Hald 1935, 232

Table 2. Technical characteristics of cloaks recovered from various oak-log coffins in Denmark.

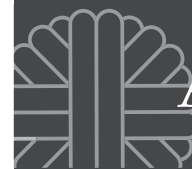


Fig. 2. Illustration of cords from Ginderup burial (Drawing: S. H. Fossøy).

Hald 1935, 286f; Bergerbrant 2005; Fossøy and Bergerbrant in press). However, the Ginderup cords are made differently from all other known corded skirts from the Danish Bronze Age. Most skirts have cords constructed as cabled plied threads, S2Z2s or Z2S2z, and two skirts have cords made from 2-ply threads, Z2s or S2z (Fossøy and Bergerbrant in press). The Ginderup cords, however, are Z3s, plied of three single threads (Fig. 2). In total, more than 20 cords, 3 mm thick, the longest c. 12 cm, can be identified on the western side of the burial, i.e. by the left hand of the deceased. As one cannot see the top of the skirt it is hard to say how different this corded skirt is from the other known fully or partly preserved corded skirts. The photographs do, however, indicate that the lower part of the skirt is made in a manner similar to that of the fully preserved Egtved skirt, i.e. the cords end in a thread ring made from the end of the cord. A thin thread has been twisted tightly around the ring to make it thicker and to keep it together. A string is threaded through the rings, above the rings two twined threads can be seen. Together, these keep the skirt in place. There are indications that the Ginderup skirt might be shorter than the Egtved skirt (Fig. 3), as the cords on the photograph end higher up the leg than in the Egtved burial, but this is difficult to determine due to the lack of information.

Conclusion

This study demonstrates that it is indeed possible to glean important information about prehistoric textiles, even if the textiles themselves are not preserved, if good excavation photographs are available. It emphasises the value of taking good quality photographs of

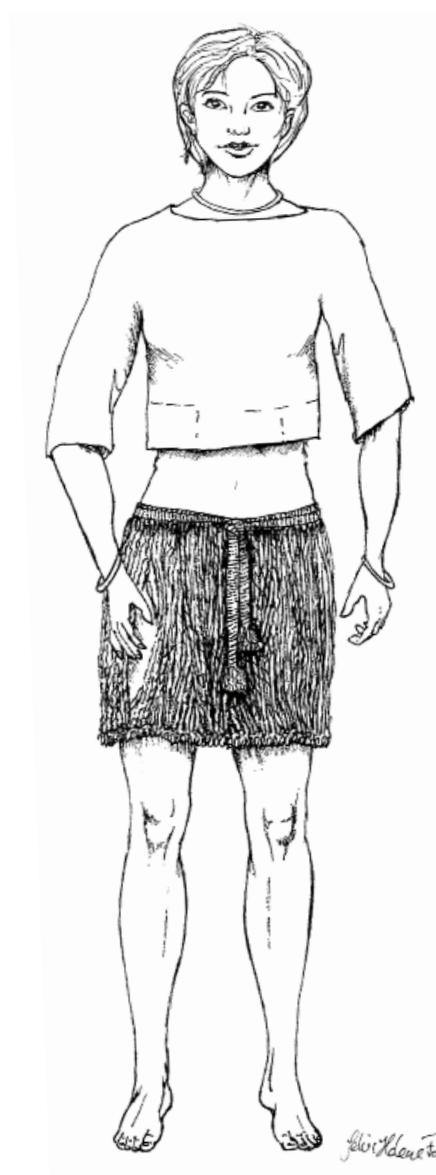


Fig. 3. Reconstruction of Ginderup costume (Drawing: S. H. Fossøy).



organic materials before removing them from the excavation site. Today, with modern equipment, this is easy to do and should be routine practice. An archive search for photographs from old excavations where textiles were found (but not preserved) can also produce good results, as has been shown here. The photographs taken during the excavation of the burial in Ginderup in 1933 have presented us with a previously unrecorded type of corded skirt, preserving information that might otherwise have slipped into obscurity.

Acknowledgements

This paper is based on work conducted within the HERA-funded project Creativity and Craft Production in the Middle and Late Bronze Age Europe (CinBA). Thanks are due to Helga Schütze of the National Museum in Denmark who facilitated our search for the photographs and the excavation report, and to the National Museum for giving us permission to publish the photographs.

Bibliography

Aner, E. and Kersten, K. (1973) *Die Funde der älteren Bronzezeit des nordischen Kreises in Dänemark, Schleswig-Holstein und Niedersachsen*, Volume 1. Neumünster.

Aner, E. and Kersten, K. (2001) *Die Funde der älteren Bronzezeit des nordischen Kreises in Dänemark, Schleswig-Holstein und Niedersachsen*, Volume 11. Neumünster.

Bender Jørgensen, L. (1986) *Forhistoriske tekstiler i Skandinavien/Prehistoric Scandinavian Textiles*. Nordiske Fortidsminder Serie B, Bd. 9. København.

Bergerbrant, S. (2005) Female interaction during the early and middle Bronze Age Europe, with special focus on bronze tubes. I: Hjørungdal, T. (ed.), *Gender locales and local genders in Archaeology*. BAR Int. series 1425. Oxford. 13-23.

Bergerbrant, S., Fossøy, S. H. and Bender Jørgensen, L. (2012) Snoreskørt. *SKALK* 2012(2), 7-19.

Boye, V. (1896) *Fund af Egekister fra Bronzealderen i Danmark* (reprint 1986). Wormianum.

Broholm, H.C. and Hald, M. (1935) *Danske bronzealders dragter*. Nordiske Fortidsminder Bd. II(5-6), 215-347. København.

Broholm, H.C. and Hald, M. (1939) *Skrydstrupfundet*. Nordiske Fortidsminder Bd. III(2), 9-115. København.

Broholm, H.C. and Hald, M. (1940) *Costumes of the Bronze Age in Denmark*. København.

Fossøy, S.H. and Bergerbrant, S. (in press) Creativity and Corded Skirts from Bronze Age Scandinavia. *Textile: The Journal of Cloth and Culture*, 11:1.

Thomsen, T. (1929) *Egekistefundet fra Egtved, fra den ældre Bronzealder*. Nordiske Fortidsminder Bd. II(4), 165-214. København.

Unpublished sources

Brøndsted NM Archive. Brøndsted, J. NM 52/33 & 22/34, Excavation report in the National Museum of Denmark archive. The photographs are Nos. 7944 and 7945.

Corresponding author: sophie.bergerbrant@ntnu.no



Liv Caroe

Textiles and Identity seen through Etruscan Tomb Paintings

Introduction

The subject of this article is the textiles depicted in Etruscan tomb painting, investigated recently for a BA project. They have been illustrated in great detail, posing a question whether this reflects a special meaning and status of textiles in Etruscan society? While it is usually the significance of the iconography of the tomb paintings that is discussed, it is also important to look at the depicted textiles because they may reflect social and economic conditions besides status, fashion and identity. In other words, the textiles can tell us about the standards and norms of the past and in that way provide us with a greater understanding of the society. This is particularly relevant because, except for a few inscriptions, contemporary literary Etruscan sources are lacking, so our knowledge about the Etruscans and their habits is based on what we know from Greek and Roman historians and writers, as well as archaeological and iconographic sources. The latter provide pictorial representations of textile production and technology (Gleba 2008, 29-30), while the tomb paintings give us examples of the finished products. Therefore, the iconography of the Etruscan tomb paintings is a useful instrument for studying textiles. Combined with other archaeological material they can provide us with new information. The aim of this paper is thus to examine the types and function of the textiles depicted in Etruscan tomb paintings, as well as to observe their change through time. I also want to explore if differences or changes in patterns and use of color are visible within different periods. Finally I want to investigate if there was any particular identity connected to certain textiles based on their patterns and colors.

Background

Etruria, usually referred to by Greek and Roman writers as Tyrrhenia, refers to a region in Central Italy which in its heyday was bordered by the Arno River to the north and the Apennines and the Tiber River to the south. To the west the region was bordered by the Tyrrhenian Sea. The Etruscans called themselves Rasna or Rasenna. Today the region is located in that area which covers Tuscany, and part of Latium, Emilia-Romagna and Umbria. Etruscan civilization developed from the beginning of the 1st millennium BC. The Early Iron Age settlements consisted of a small number of huts, but eventually they grew into larger urban centres with high social stratification. The monumental, chamber tombs of the 7th century BC (the Orientalising period) contained a huge amount of rich grave goods in precious materials, indicating that the upper class had adapted a common aristocratic culture belonging to the elite throughout the Mediterranean region. The Etruscans organized themselves into independent city states, each of which would control a larger territory. One of the most important and prominent Etruscan cities was Tarquinia, Tarchuna in Etruscan. The modern town formerly known as Corneto is located on a plateau c. 75 km north-west of Rome, some 6 km away from the Tyrrhenian coastline. In 1922 the town reverted to its ancient name, Tarquinia. The modern town is the medieval successor of the ancient city, which was located on a limestone plateau north of the current town, called Piano della Civita (Bonghi Jovino 2010, 161-180). The ancient city occupied a system of plateaus, hillocks and valleys flanking the river Marta (Leighton 2004, 32). According to some written sources, Tarchon, a mythological hero was probably the founder of Tarquinia. With a surface



Kat. A	himation	chiton	tebenna	loincloth	toga	mantle	hairband
Tomb 1	X						
Tomb 2	X						
Tomb 3	X	X		X			
Tomb 4	X	X	X				
Tomb 5	X		X				
Tomb 6	X	X		X		X	
Tomb 7	X			X			
Tomb 8	X						X
Tomb 9	X						
Tomb 10	X				X		

Kat. B	himation	chiton	tebenna	backmantle	hoodmantle	short tunic	tutulus	hairband
Tomb 1		X		X			X	X?
Tomb 2		X			X		X	
Tomb 3		X			X		X	
Tomb 4	X	X						
Tomb 5		X	X	X		X		
Tomb 6	X	X		X		X	X	
Tomb 7	X	X		X				
Tomb 8	X	X						X
Tomb 9	X	X						X ?
Tomb 10	X	X						

Kat. C	blankets	cover	cushions	ribbons	awning	baldachine
Tomb 1			X	X	X	
Tomb 2				X		
Tomb 3				X		
Tomb 4	X	X	X		X	
Tomb 5	X	X	X	X		
Tomb 6	X	X	X		X	X
Tomb 7	X	X	X	X		
Tomb 8	X	X	X		X	
Tomb 9					X	
Tomb 10	X		X			

Table 1. Textiles.

A) men

B) women

C) utilitarian textiles



area of some 133 hectares, Tarquinia was one of the largest cities in Etruria. Tarquinia became an important trade centre with the emporium at Gravisca, which was founded in the 6th century BC as the harbour of Tarquinia (Barker and Rasmussen 1998, 167). It was marked by the cosmopolitan atmosphere formed by the artists, craftsmen and merchants coming from Greece, Minor Asia and the Near East. A number of Greek sanctuaries have been excavated of which the earliest have been dedicated to Aphrodite. Tarquinia came into conflict with Rome on several occasions and was finally defeated definitively in the 3rd century BC.

Tomb Paintings

The city is famous and known for its painted chamber tombs. The tomb paintings span nearly four centuries, dating from the first quarter of the 6th century BC to the end of the 3rd century BC. The main cemetery of Tarquinia is the Monterozzi located on a ridge south-west of the ancient city. It contains mostly rock-cut chamber tombs dating from the 6th century BC. Roughly 80 % of all known examples are found here. Tarquinia was the most important site for Etruscan tomb painting. Besides Tarquinia, a number of tomb paintings are recorded in other Etruscan cities: 14 in Chiusi, 11 in Cerveteri, 3 in Vulci, 3 in the environs of Orvieto, 2 each in Veii, Blera, Sarteano, Magliano Toscano and Populonia and 1 each in Bomarzo, Cosa, Grotte San Stefano, Orte, San Giuliano and Tuscania (Steingraber 2006, 308-311). The oldest tomb paintings from the 7th century BC are found in Veii and Cerveteri. Roughly 6000 known chamber tombs have been located in Tarquinia and only 2.5% of these are painted. The chamber tombs tend to imitate houses and mostly have a single chamber, although two-, three- or four-chamber tombs with a cruciform ground plan are also known. In some cases, the chamber tomb tends to imitate a tent or pavilion with the painted ceiling imitating a textile. The floor plans of the rooms are mostly rectangular and the dimensions vary from 4 to 260 m² (Steingraber 2006, 15-16).

The paintings were executed on a foundation of plaster. In the early tomb paintings the layer was very thin but later on the foundation became roughly 2 cm thick. The initial preparatory drawing would be incised on the wall before painting was applied. In Archaic wall paintings (c. 6th century BC), the incising and the application of the colour were carried out while the plaster was still wet. The pigments used for colouring derived either from minerals or plants. It has been established that white was made of chalk, reds from oxide of iron, blue from lapis lazuli and black from charcoal. During the first half of the 7th century BC only black, white and red were used and

sometimes yellow was added. Later blue and green were introduced and by mixing and/or diluting these colours a varied and nuanced scale of tones was obtained. This is particularly seen during the Archaic period, since the palette became more restricted from the 4th century BC onwards (Pallottino 1952, 18-19). It is likely that leading artists would design the work but unfortunately no information about painters, artists and workshops exist, so they remain unknown to us, despite the research that has helped to identify the hands of several artists. The great majority of Tarquinia's tomb paintings were executed in the decades between 530 and 490 BC (Steingraber 2006, 16, 29).

Methods

My study is based on examination and registration of tomb paintings from ten tombs at Tarquinia, Monterozzi, dating roughly from 520 to 325 BC. The wide chronological dating enables me to follow developments over a period of 200 years allowing to observe change through time. Besides chronology, accessibility (only few of the painted tombs are publically accessible) and their present condition (many paintings have completely deteriorated since their discovery) have been important criteria for choosing these specific tombs. In each tomb only the registration of the back, left and right walls was done, since in most cases the paintings of the entrance walls have deteriorated. The dating for the tombs is based on Steingraber 2006 (pp. 308-309), revised since the original publication of his catalogue (Steingraber 1986). The tombs have been numbered consecutively. The ten tombs chosen are as follows:

Tomb 1: Tomb of the Lionesses (Tomba delle Leonesse), 520 BC, Steingraber no. 77.

Tomb 2: Tomb of the Baron (Tomba del Barone), 510/500 BC, Steingraber no. 44.

Tomb 3: Tomb Carderelli (Tomba Cardarelli), 510/500 BC, Steingraber no. 53.

Tomb 4: Tomb of the Leopards (Tomba dei Leopardi), 480 BC, Steingraber no. 81.

Tomb 5: Tomb of the Triclinium (Tomba del Triclinio) 470 BC, Steingraber no. 121.

Tomb 6: Tomb of the Funerary Bed (Tomba del Letto Funebre), 460 BC, Steingraber no. 82.

Tomb 7: Tomb 5513 (Tomba 5513), 450 BC, Steingraber no. 162.

Tomb 8: Tomb of the Ship (Tomba della Nave), 450-425 BC, Steingraber no. 91.

Tomb 9: Tomb of the Warrior (Tomba del Guerriero), 400-350 BC, Steingraber no. 73.

Tomb 10: Tomb of the Shields (Tomba degli Scudi), 350-325 BC, Steingraber no. 109.

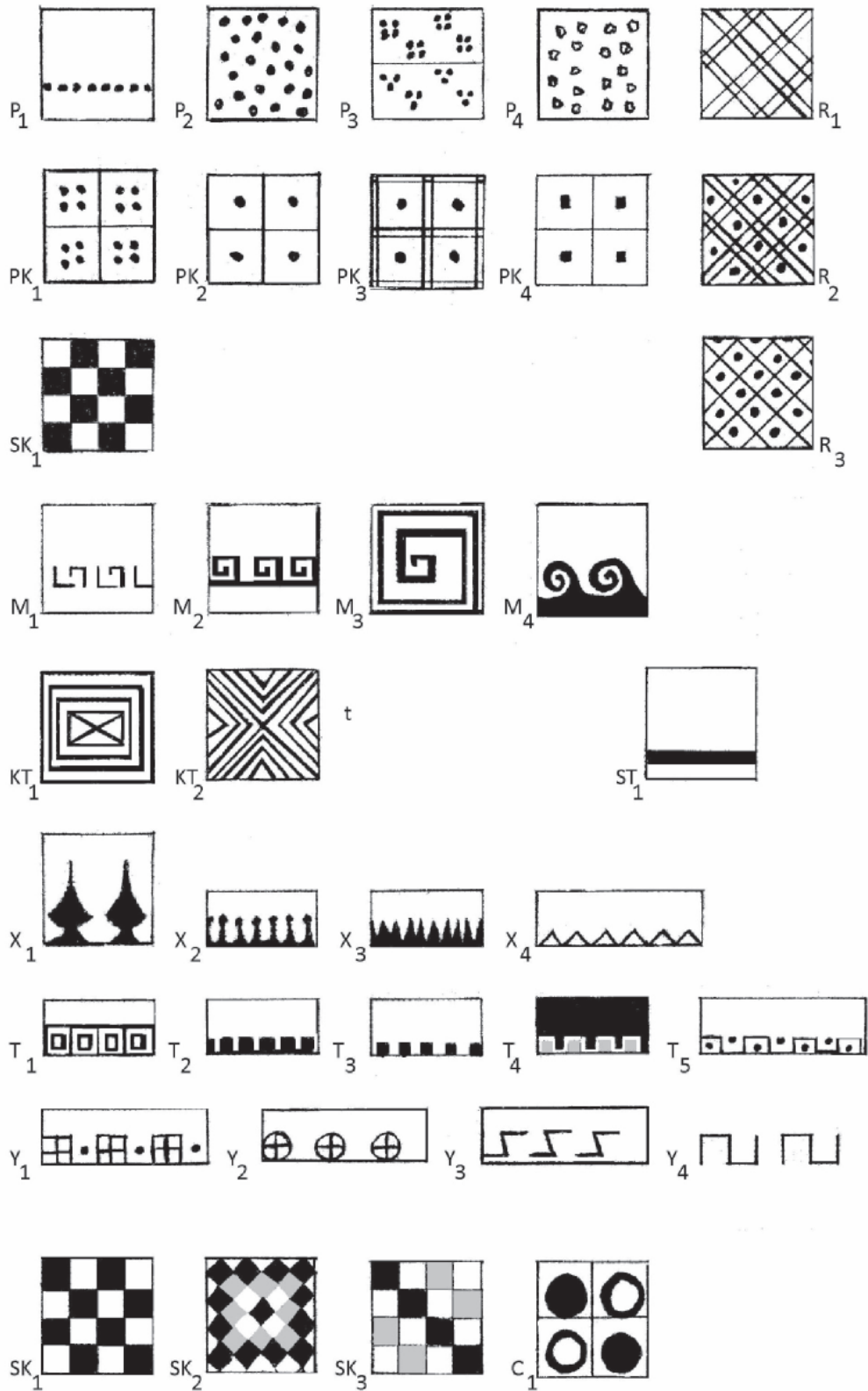


Fig. 1. Patterns in analysed tomb paintings (Drawing by the author).



In addition to the direct observations, I have consulted publications of the individual tombs for my study (Moretti 1966; Steingraber 1986; Moltesen and Weber-Lehmann 1992). I have divided the textiles into two categories: clothing textiles and utilitarian textiles. The clothing textiles are further divided into male and female, with further subdivisions for patterns and colours.

Analysis

The results of my investigation are summarised in Tables 1-3. Mutually they show connections between individual textiles, their patterns and colours. In addition, the patterns have been classified so that each pattern is given its own 'code', respectively a letter and a number (Fig. 1), which not only simplified the registration of the patterns, but also illustrates their variety. In the case of colours, nuances and shades have not been taken into consideration, as the colours change from tomb to tomb depending on the pigment, e.g. from a red-brown to dark red. Differences could also be a result of the state of preservation of specific tomb. Thus, the varieties of colours red and white are only registered as red and white in Table 3. Table 1 illustrates both clothing and utilitarian textiles depicted in the analysed tombs. Garments used by both men and women include the himation, chiton and the tebenna (Fig. 2). In Tomb 8 a hair-band is used by both male and female banqueters. Garments specific to men are the loincloth (Tomb 3), the toga (Tomb 10) and a 'warrior-mantle' seen in Tomb 6. Steingraber refers to a male dancer wearing both mantle and weapons as an armed dancer and a dancing warrior (Steingraber 2006, 141,193). Otherwise the back-mantle (Fig. 2.1) is used by women in four tombs (Tombs 1, 5, 6, 7) and the hood-mantle (Fig. 2.2) in two (Tombs 5 and 6). The female headgear tutulus is seen in three tombs (Tombs 1, 2, 3) and possibly in Tomb 6.

Clothing textiles, function

Male clothing textiles

The most common male garment depicted in the analysed tombs is a himation. In the vast majority of tombs it is used by the banqueters. Often banquet includes music and dance and the himation is also worn by musicians and dancers (Tombs 1, 3, 4, 5, 8, 9). In some cases, it is only wrapped around the lower part of the body as seen worn by musicians, servants and participants of processions (Tombs 1, 4, 6). Furthermore, it is also used by the banqueters in Tomb 1. The function of the himation does not change over time (Tombs 1-10). In Tombs 4 and 5 a change in style is noted. The depiction of the himation is more flowing and billowing.

The chiton is used in only three tombs (Tombs 3, 4, 6). In Tomb 6 it is used without a himation by two young men holding a horse. Chiton is no longer depicted in Tombs 7-10, suggestion it was no longer in use/fashion. The Etruscan mantle, tebenna (Fig. 2.1) is worn by a participant of a procession and a dancer in Tombs 4 and 5 respectively. The loincloth is worn by participants in funeral games. The toga is used by two musicians in Tomb 10. In one tomb hair-bands are used by men instead of the more common wreath.

Female clothing textiles

In female dress, the himation is always used over a chiton and is worn by banquet participants and, in a single case, in a procession (Tomb 10). Only in Tomb 6 it is draped over a chiton like a skirt around the lower part of the body. The chiton is worn under a hood-mantle in Tombs 2 and 3 and used by female dancers (Tomb 1, 3, 4, 5, 6) and by a single flute player in Tomb 3. Worn by servants and maids, it is used without any other garments as seen in Tombs 3 and 10. In Tomb 1, the chiton is used by itself by one of the dancers while it is worn with another garment by female dancers in other tombs. In Tomb 3, the dancer wears a hood-mantle, while in Tombs 1, 5 and 7 the dancers wear a back-mantle. In Tomb 4 a tebenna (Fig. 2.3) is worn by several of the female dancers but the garment is draped differently on each one, which may have both a practical purpose in their dance as well as a ritual one. One of the female dancers in Tomb 1 wears a tutulus; in Tombs 2 and 3 it is worn under a hood-mantle. Hair-band is only used in Tomb 8 by the male and the female banqueters. The hair-band does not look like a wreath or a diadem which usually adorns the hair of dancers in other tombs.

Women's use of the himation continues throughout the period examined and its function remain unchanged. The chiton changes its character and style in Tomb 5 where it appears more flowing and billowing on the dancing women compared to the dancers in Tomb 1. The chiton continues to be worn at a banquet. The tebenna, the hood-mantle and the short tunic (Fig. 2.3) which primarily seem to be used in connection with dance cease to be depicted in later tombs. The reason for this could be that the subject matter changes and female dancers are no longer depicted. This tendency is obvious in Tombs 8, 9, and 10 where only male dancers are shown.

The use of the hood-mantle also discontinues, although it is only depicted in Tombs 2 and 3. On the bell-shaped tintinnabulum from Bologna (Gleba 2008, 30, Fig. 8), all the women depicted wear the mantle pulled over the head and as they belong to the elite, it could signify a certain degree of status. It could also



Fig. 2.1. Tomb 5513 (reworked and adapted by author from Moltesen & Weber- Lehmann 1992, 37, fig. 1.23).

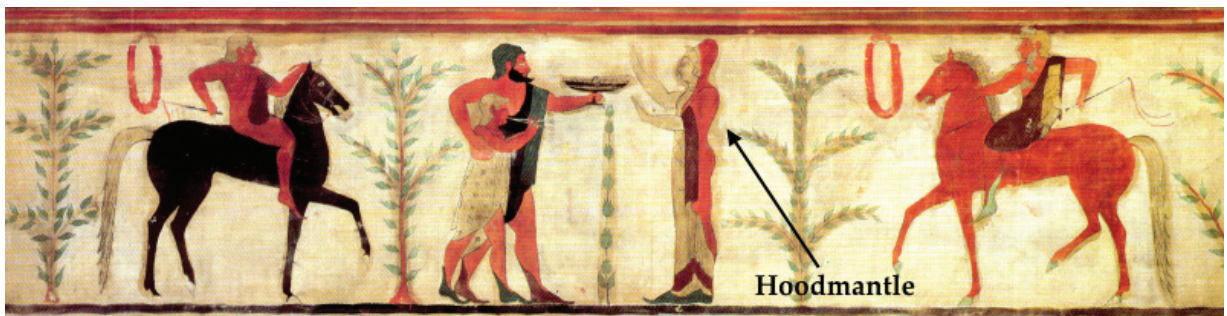


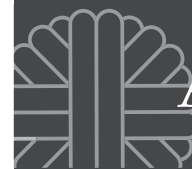
Fig. 2.2. Tomb of the Baron (reworked and adapted by author from Moltesen & Weber- Lehmann 1992, 70, fig. 1.63).



Fig. 2.3. Tomb of the Triclinium (reworked and adapted by author from Moltesen & Weber- Lehmann 1992, 37, fig. 1.24).



Fig. 2.4. Tomb of the Leopards (reworked and adapted by author from Moltesen & Weber- Lehmann 1992, 32, fig. 1.14).



Kat. A									
Tomb 1	P1	M4	ST1	X3					
Tomb 2	P3								
Tomb 3	P1	PK2	R3						
Tomb 4	P3	ST1							
Tomb 5	P1	ST1	X3						
Tomb 6	P1	ST1		ST1					
Tomb 7	P1	P2	P3	ST1					
Tomb 8	P1	M2	ST1	T3	X3				
Tomb 9	P1	ST1							
Tomb 10									

Kat. B									
Tomb 1	P3	ST1	T4						
Tomb 2									
Tomb 3	P1	P2	ST1	X4					
Tomb 4	ST1								
Tomb 5	P2	P3	ST1	X3	X4				
Tomb 6	P3	ST1							
Tomb 7	P2	P3	P4	ST1?					
Tomb 8	P1	P4	ST1	X3					
Tomb 9	P1	ST1							
Tomb 10	P1	ST1	T3	X1	X2	X3			

Kat. C									
Tomb 1	P1	P3	P3						SK1
Tomb 2									
Tomb 3									
Tomb 4	R1								SK3
Tomb 5	PK1	ST1	X3						SK3
Tomb 6	P3	PK4	Y1	Y2	Y3	Y4			SK2
Tomb 7	P1	PK3	T4?	T5					
Tomb 8	P1	SK1	ST1	X3					SK3?
Tomb 9									C1
Tomb 10	SK1	M1	M2	M3	KT1	KT2	T1	T3	T4

Table 2. Patterns.

A) men

B) women

C) utilitarian textiles.

(The codes in bold to the right refer to the patterns of the awnings).



be a symbol connected to death and in the specific tombs symbolise the deceased woman. In the Tomb of Hunting and Fishing (Tomba della Caccia e Pesca; (Steingraber 1986, no. 50) a female banqueter is also depicted with her mantle pulled up over her head.

Patterns

Table 2 shows that in seven tombs the patterns (Fig.1) used with most frequency on clothing textiles are P1 and ST1 (Tombs 1, 3, 5, 6, 7, 8, 9). P3 and X3 are both used in three tombs. In Tomb 2 only a single pattern P3 is used on a himation. In Tombs 1 and 8 several different patterns are depicted respectively M4, M2 and T3. Likewise Tomb 3 offers a unique use of patterns, PK2 and R3, depicted on the clothing textiles. In Tomb 10, a lack of pattern on male garments is registered, it is rather unusual. In a few cases there appears to be a differentiation in the use of pattern shown on male and female garments. Patterns M4 (Tomb 1) and M2 (Tomb 8) only appear on men, while patterns T4 (Tomb 1) and X4 (Tomb 5) are only shown on women. Otherwise, it seems that the same patterns are used for male and female garments. Pattern ST1 is the most common, with P1 (Tombs 1, 3, 8, 9, 10) and P3 (Tombs 1, 2, 4, 5, 6, 7) also being frequent. In tomb 10 a new repertoire of patterns shown on women, X1 and X2, seems to be introduced.

Colours

Table 3 shows that in male clothing, both red and white are the most registered colours. Black, brown and blue are used relatively regularly throughout the period examined. The colour green is used in Tomb 1, 2, 4, 6 and 7. The only colour not registered for men is orange. On the other hand it is used by women as Tombs 1, 3 and 5. Blue and green are used less in for female clothing than for male and colour black is only registered in two tombs (Tombs 1, 3) Otherwise, the use of red, white and brown are nearly the same in female and male clothing.

Discussion

Tables 1-3 demonstrate that there was no sharp division in the use of textiles between the two sexes, but instead a common use of certain garments, patterns and colours is in evidence. Himation and chiton are the garments most frequently used by both sexes. The typical Etruscan garments including tebenna, hood-mantle, back-mantle, tutulus and short tunic seem to disappear over time and are no longer depicted after the middle of the 5th century BC. It could be the result of a change in fashion, or influence of Greek style (Haynes 2000, 132). In later period, the expansion of Roman civilization probably also affected the fashion.

The commonest patterns are P1, P3, ST1 and X3, with P2 and T3 following. In terms of colours, red and white are the most used colours both in male and female garments, with brown, green and blue following. Orange is the only colour seen only on women.

Utilitarian textiles

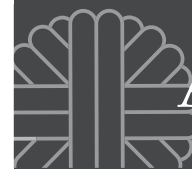
Category C mostly includes blankets, covers, cushions and ribbons. Blankets (Fig. 2.4) and cushions are depicted most frequently as they are associated with banqueting scenes which are depicted in Tombs 1, 4, 5, 6, 7, 8, 9, and 10. Tomb 9 shows a banquet scene but registration of blankets and cushions in that specific tomb are omitted as they do not appear clearly. Couch covers (Fig. 2.4) are depicted in five tombs (Tombs 4, 5, 6, 7, 8) as are ribbons (Tombs 1, 2, 3, 5, 7). Awning is depicted in Tombs 1, 4, 5, 6, 8, and 9, hence appearing throughout the period considered here. A baldachin is only seen in Tomb 6.

Function

In category C the use of blankets is primarily connected to banqueting where they are used to cover couches and their function continues throughout the period under consideration. In Tomb 6 the blankets are also used as bedcovers. The combination of blankets and covers (Fig. 2.4) is used on couches in five tombs. This practice ceases after the end of the 5th century BC. Unfortunately in Tomb 9 it has not been possible to register if the combination of blanket and a cover was used. In Tomb 10 blankets used without covers are seen on the couch. Cushions are usually used at the banquet by reclining participants to support the left arm and their function continues throughout the period. In Tomb 6 the cushions are piled on the bed. Ribbons are depicted in five tombs. Their use is mostly connected to banqueting and dancing scenes. They are also depicted in Tomb 2 which is interpreted as a parting scene. The ribbons are draped on trees and on walls. In Tomb 5 a ribbon is also used by a dancing woman (Fig. 2). The ribbon changes character and appearance as it looks like a piece of cloth in Tomb 1 where it is carefully draped and hanged on the wall, while in Tomb 3 the ribbons look like narrow bands. After the middle of the 5th century BC they are no longer depicted. When the banqueting appears to take place outside, an awning is registered.

Patterns

On the utilitarian textiles, patterns P1 and P3 (Table 2) are the commonest, although they are only registered in four tombs. Pattern ST1 which is the commonest pattern in clothing textiles is less frequently used in category C (Tombs 5, 8). Patterns PK1, PK3 and



Kat. A	black	brown	red	orange	green	blue	white
Tomb 1	X		X		X	X	X
Tomb 2	X	X	X		X		X
Tomb 3	X	X	X				X
Tomb 4			X		X	X	X
Tomb 5			X			X	X
Tomb 6		X	X		X	X	X
Tomb 7	X		X		X	X	X
Tomb 8		X	X			X	X
Tomb 9	X	X	X			X	X
Tomb 10	X	X					X

Kat. B	black	brown	red	orange	green	blue	white
Tomb 1	X	X	X	X		X	X
Tomb 2		X	X		X		X
Tomb 3	X	X	X	X			X
Tomb 4			X			X	X
Tomb 5			X	X		X	X
Tomb 6			X		X		X
Tomb 7			X		X		X
Tomb 8			X				X
Tomb 9		X	X			X	X
Tomb 10		X					X

Kat. C	black	brown	red	orange	green	blue	white
Tomb 1	X		X	X		X	X
Tomb 2			X				X
Tomb 3		X	X				
Tomb 4		X	X		X	X	X
Tomb 5		X	X		X	X	X
Tomb 6		X	X		X		X
Tomb 7	X		X			X	X
Tomb 8		X	X			X	X
Tomb 9	X		X				X
Tomb 10	X		X		X		X

Table 3. Colors.

A) men

B) women

C) utilitarian textiles.



PK4 appear once in different tombs (Tombs 5, 6, 7). X3 is depicted in two tombs (Tombs 5, 8). Tomb 6 introduces new patterns Y1, Y2, Y3 and Y4. Tomb 10 also shows new designs and at the same time is also the tomb where most patterns are used. The pattern-code indicating awning is emphasized with black in Table 2. It shows that the most popular patterns in this category are SK1, SK2 and SK3. In Tomb 8 it is difficult to establish whether it is SK2 or SK3 which is depicted. But it is a checked pattern where more than two colours are used for the design.

Colours

In category C the same tendency is seen as in categories A and B where red and white are the most frequently depicted colours (although white is mostly a background, used for covers with colored pattern). Next come brown and blue which are used in five tombs evenly distributed throughout the period. Green and black are only used in four tombs. Green is depicted in Tombs 4, 5, 6 and 10. Black is depicted in Tomb 1 and occurs again in Tombs 7, 9 and 10. Orange is only used in Tomb 1.

Discussion

Among the utilitarian textiles, blankets and cushions are most common items depicted in all ten tombs. Ribbons are depicted in five tombs (Tombs 1, 2, 3, 5, 7). Besides having a practical function as either a decorative object or a marker for an outdoor banquet setting, they could have also a ritual significance. A ribbon (Fig. 2) is used in a dancing scene in Tomb 5 by a female dancer. Other ribbons are hung in the trees or they are wrapped around the tree trunks in various ways. The ribbon or rather a cloth seen in Tomb 1 is carefully tied as a knot and hung on the wall, which may have a ritual significance. Among the patterns, the commonest besides P1 and P3 are the geometric patterns such as PK1, PK3 and PK4. They are only used on the covers. In tomb 10 a completely different style is used as the blankets and the cushions are decorated with diverse patterns and colours, which contrast with the very quiet choice of pattern and colours in clothing textiles. Finally, in Tomb 6 new designs are introduced Y1, Y2, Y3 and Y4. In category C, the colours red and white are the commonest.

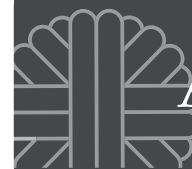
Interpretation and Conclusion

Based on my analysis it is possible to establish that in some cases a certain function and identity can be connected to the textiles and in other cases there is no division between gender and hierarchical order. The female dancers are dressed in the same chiton as the women attending the banquet. The young maid

is wearing the same long chiton with three-quarters-length sleeves as her mistress. Lack of hierarchical order is furthermore emphasized by the shoes/boots, which both the female banquet participant and the young maid are wearing in e.g. Tomb 10.

The textiles are depicted in nuanced ways, which enables us to see the variation in the types of textiles produced. We know from the archaeological record that both wool and flax were used for textile production in Etruria. Very small spindle whorls have been found indicating that it was possible to produce a very thin, fine yarn which in turn could be used to weave a fine, delicate cloth. In several of the tomb paintings the differences between the textiles are clearly depicted. In Tomb 1 for example, the female dancer on the left is dressed in an almost transparent chiton which contrasts with the heavy wool mantle she is wearing. The chitons worn by the women in this tomb are depicted as a transparent material clinging to their bodies. It is primarily the female attire which is depicted as being made of a delicate and transparent fabric. It is not only the material but also the cut and shape which mark the depicted textiles. It looks like some of the garments must have been cut and sewn in order to have that kind of shape. For instance the short tunic (Fig. 2.3) and the back-mantle (Fig. 2.1) depicted on dancers in Tomb 5 must have required some kind of fixture or else they would slip off while dancing. Sewing needles were found for example at the site at Poggio Civitate, Murlo, which appears to have been a significant textile-producing centre (Gleba 2008, 169). As mentioned above, there is no correlation between textiles, patterns and colours in this analysis, but it shows that certain patterns like P3 and P1 were depicted on both male and female garments, as well as on utilitarian textiles. In Tomb 1 for instance, pattern P3 is used on the female dancer's garment and also on a pillow used for by a male banqueter. Furthermore, it is depicted on a male flute player's himation as seen in Tombs 2 and 7. Pattern P3 is also seen used on a female banqueter's chiton in Tomb 7, and on a himation worn by a male banqueter and a male participant of procession in Tomb 4. The same goes for pattern P1. In Tomb 1, it is depicted both on a male musician's and a banqueter's himation. It is also depicted on a pillow used on the couch for banqueting. Furthermore, it is depicted on the dancing woman's chiton in Tomb 3, as well on a female banqueter's chiton in Tomb 7. The examples mentioned indicate that a pattern did not necessarily have a special function or identity linked to it. However, most of the functions are connected to banqueting, so certain patterns may have had a special meaning in connection to it.

The analysis also shows that specific patterns were



not connected to gender. There seems to be a general use of the patterns. Only in a few cases there seems to be a unique use of their designs, for instance, in Tomb 3 where geometric patterns as PK2 and R3 are used on the male clothing textiles or in Tomb 6 where completely new designs are introduced on the utilitarian textiles.

The checked pattern is primarily seen depicted on the ceilings reflecting awnings but with variations on a theme. It may have been associated with a special workshop which used it as a signature. It could also be used or connected with a funerary contest as Gleba mentions (Gleba 2008, 26). Investigation of the colours shows the same tendency as seen with the garments and patterns. The same colours have on the whole been used on both men and women. Just in a few cases a difference is seen. The colour orange is solely used by women and the colour black is only used by women in two tombs versus men's use of black in six tombs. Like the patterns, the colours may be associated with value as seen in the case of the colour purple. In the Tomb François at Vulci, Vel Saties is depicted in a purple mantle which also has a figural decoration, the purple indicating his status. In later times the Romans also used purple-decorated garments for instance, *toga picta*, as markers of status. Other colours may have also had special meaning.

So what signals did the Etruscan tomb paintings sent to the outside world in their use of textiles, patterns and colours? Most of the tomb paintings reflect banqueting, which is associated with the elite as the tomb paintings themselves do. Most likely it would have been possible to choose between a selection of scenes which would reflect family's specific choices and wishes. To what extent do the textiles reflect a reality then? Depictions of textile production on prestige objects such as the Verucchio Throne (Eles 2002, Tav. II-III, Tav. XXV-XXVI) and the Bologna tintinnabulum (Gleba 2008, 30, fig. 8) indicate that textile production was kept under the control of the élite. It is likely that the upper class families of Tarquinia have been involved in textile production and I think it is not accidental that the textiles have been in focus and depicted in such great details in the tomb paintings. Until more actual textiles are analysed, these textile depictions provide us with a glimpse of what Etruscan textiles would have looked like. While only ten tombs have been examined in this study, they demonstrate certain tendencies. A more extensive study of all tomb paintings in the future would be useful in order to draw more accurate conclusions.

Bibliography

Bonghi Jovino, M. (2010) The Tarquinian Project: A summary of 25 years of Excavation. *American Journal of Archaeology* 144(1), 161-180.

Eles, P. von (2002) *Guerriero e Sacerdote. Autorità e comunità nell' età del ferro a Verucchio. La Tomba del Trono*. Firenze.

Gleba, M. (2008) *Textile Production in Pre-Roman Italy*. Oxford.

Haynes, S. (2000) *Etruscan Civilization: A Cultural History*. London and Los Angeles.

Moltesen, M. and Weber-Lehmann, C. (1992) *Katalog der Etruskischen Grabmalerei*. Antike Welt, Sondernummer 23 Jahrgang. Mainz am Rhein: Philip von Zabern, 21-88.

Steingraber, S. (1986) *Etruscan Painting, Catalogue Raisonné of Etruscan Wall Paintings*. New York.

Steingraber, S. (2006) *Abundance of Life, Etruscan Wall Painting*. Verona and New York.

Stopponi, S. (2011) Campo della Fiera at Orvieto: new discoveries. In N. T. de Grummond and I. Edlund-Berry (eds), *The Archaeology of Sanctuaries and Ritual in Etruria*. JRA Supplementary series, 81. Portsmouth, RI, 16-44.

Corresponding author: livcaroe@gmail.com



Kristian Ryder Thomsen and Mathias Londin Larsen

Mathematical Image Analysis on Historical Textiles

Introduction to mathematical image analysis

Mathematical image analysis is the field of extracting useful information from images. This could be as simple as reading a barcode or as complex as automatic facial recognition. This is typically done by using mathematical models based on (e.g. multivariate) statistics and evaluated by computer algorithms. Mathematical image analysis is a non-destructive, efficient and precise examination method which makes it ideal for use on historical textiles.



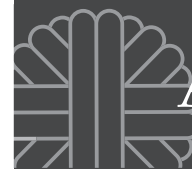
Fig. 1. The dress analysed in this study (Photo: Ulla Mannering, CTR).

Case Study

In a three week project course at the section for Image analysis and Computer Graphics, at DTU Informatics, Department of Informatics and Mathematical Modelling, the Technical University of Denmark, we have examined the possibilities to measure wear of textiles using mathematical image analysis. We have analysed images of a dress which we had borrowed from Danish National Research Foundation's Centre for Textile Research (CTR) at the University of Copenhagen (Fig. 1). The dress is a copy of a garment found in Moselund bog near Viborg in Denmark together with the body of a man (Østergård 2004, 135-140). The original costume is 14C-dated AD 1050-1155. The copy, which we have looked at, was made by the Danish hand weaver Anna Nørgård. It has been used at the Danish Viking Ship Museum in Roskilde by visiting children for about three years. When due to wear and tear it could no longer be used at the museum, it was given to CTR. During its use it has not been washed or cleaned otherwise. This means that the garment has only been subjected to mechanical wear similar to historical use.

The copy is made of an industrially produced 2/2 twill wool fabric. It has clear signs of wear, for instance it has multiple holes, threadbare areas and defects like detached threads in the otherwise homogeneous machine spun yarn.

To analyse the dress we have worked with multispectral image data of various places of the dress. Multispectral imaging is taking the "same image" multiple times with different wavelengths across electromagnetic spectrum. In our case the image has been taken 18-20 times in the spectrum across ultra violet, visible light and near infrared. Multispectral image data have been used because different materials have different reflective properties depending on the wavelength.



This is true for even very small local fluctuations in the material. Images taken with near infrared light have also been used because the colour pigments in the threads are invisible in this light, thereby exposing the pure thread and making it possible to measure thread thickness more accurately than with regular images.

Measuring of visible background by means of canonical discriminant analysis

A logical place to start when you want to characterize wear and tear in textiles only by means of image analysis is to measure and quantify how much background is visible through the fabric. This gives you basic information about the state of the textile with regard to holes and whether or not the textile has been worn thin. In an image all pixels have a value that represents its colour. The basic idea is to count how many pixels have "thread colour" and to get a value of the state of wear and tear in the textile by comparing this to the total number of pixels in the image. There is a complication however. A thread is not uniform single colour but a gradient of similar looking colours partly due to natural variation and partly due to physical aspects of the photography. In order to convert our image into a binary image containing only two colours we threshold the image after using a mathematical orthogonal transformation called normalized Canonical Discriminant Analysis, referred to as nCDA. It is beyond the scope of this article to explain nCDA in detail, however the basic principle is explained briefly (Aasbjerg Nielsen 1999, 8).

We have been working with multispectral image data meaning that the "same image" has been taken 18-20 times with different wavelengths across visible and infrared light. This gives us 19-21 sets of dimensional data. By defining what a pixel in a thread respective to the background looks like in this 19-21 dimensional space, nCDA can be used to make a linear combination of the 18-20 images that separates thread and background, so all pixels of thread get centred around the value 1 and all pixels of background get centred around the value -1. By thresholding this image at zero one gets a binary black and white image in which one can just count the number of black and white pixels respectively. Figures 2-4 illustrate an example of nCDA used in a rather extreme case of the wear and tear in the textile and demonstrate nCDA's capacity to distinguish between thread and background.

Automatic measuring of thread thickness by texture correlation

Visual inspection shows that the thread thickness varies a little throughout the textile. This variation can

be automatically measured from a single photograph using a mathematical method based on texture correlation as a function of offset in a Grey Level Co-occurrence Matrix, referred to as a GLCM (Carstensen 2002, 224). The textile consists of parallel threads, with a specific spacing, thereby making the textile periodic. The basic idea is to measure this periodicity. From this information one can with a high degree of precision compute backwards the average thread thickness in a local part of the image. This information can also be used to automatically evaluate yarn evenness, evaluate yarn fineness, calculate the textile's cover factor and thickness group, as well as warp and weft set.

In order to measure the periodicity in a textile's weave one first needs to calculate a GLCM of the image of the textile. A GLCM is a matrix (two dimensional table of numbers, like a Sudoku) giving a full representation of second order gray level statistics. Loosely speaking a GLCM is just a count of how many times a given pixel value co-occurs in a given distance in the image. In more mathematical terms, a GLCM is defined with respect to a given displacement h , and element (i,j) , denoted c_{ij} , as the number of times a point having gray level j occurs in position h relative to a point having gray level i . The meaning of this definition is more apparent if, as a concrete example, we compute the GLCM of a 4 colour image, with $h=(0,1)$, i.e. one step in the horizontal direction (Figure 5).

By computing the correlation in the GLCM one gets a single number. This number tells you to what extent the original image and the image with an offset h look like each other. By computing many GLCMs with increasing displacement and their corresponding correlation one can get a plot like the one seen in Figure 6. By computing either the average distance between the local maxima marked by green dots or the distance between the first two local maxima one knows the period of periodicity in the textile weave.

In Figure 7, a more intuitive illustration is made of the period in the textile's weave.

It also shows that the relationship between the individual threads is needed to compute the thread thickness.

In our project we did not find an automatic mathematical method for extracting these relationships directly from an image. However we believe it is possible with a little extra work.

By assuming the relation

$$r = 4b \quad y = \frac{b}{4}$$

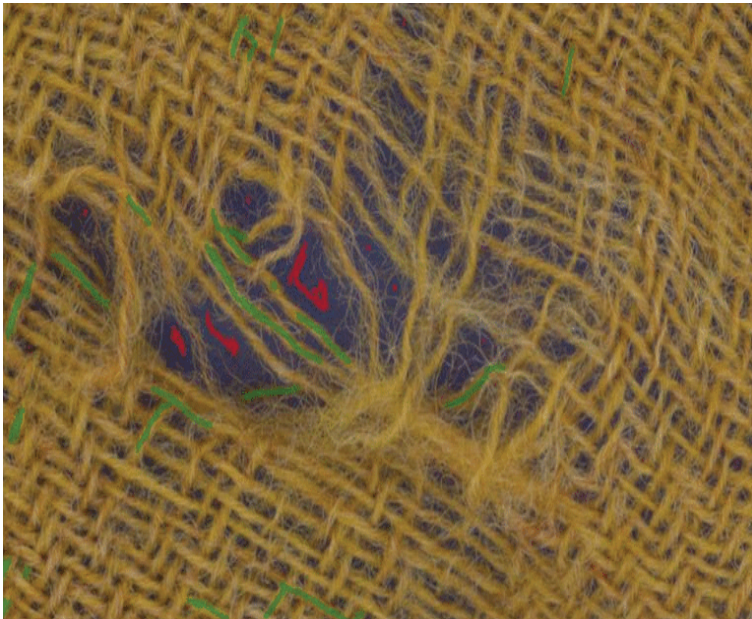


Fig. 2. A multispectral image viewed as one colour image. The red and green markings are manually painted onto the picture to define an example for the computer on what pixels constitute thread and what pixels are background (Photo: authors).

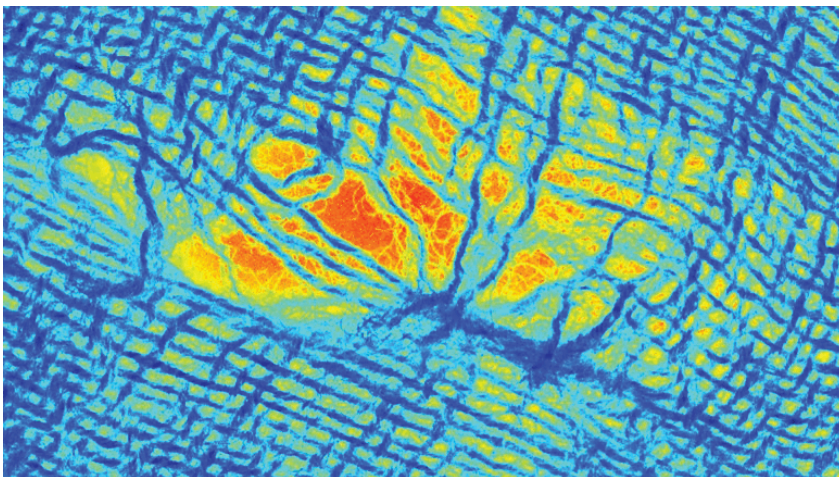


Fig. 3. Output of the nCDA analysis performed on the image seen in Fig. 2. All pixels belonging to a thread are blue and all pixels belonging to the background are orange. Pixels that are not clearly defined to contain either thread only or background only are coloured in a mixture of blue and orange (Photo: authors).



Fig. 4. Fig. 3 after a threshold. All pixels having a value below zero are coloured black and all pixels having a value above zero are coloured white. By simply counting the white pixels and comparing this number with the total number of pixels in the image one can get a percentage of how much background is visible through the fabric (Photo: authors).

One can express the thread thickness as follows:

$$\begin{aligned}
 r + 2b + y &= T \cdot p_b \\
 \Leftrightarrow 4b + 2b + \frac{b}{4} &= T \cdot p_b \\
 \Leftrightarrow b &= \frac{4}{25} T \cdot p_b
 \end{aligned}$$

Where T is either the average distance between all the green peaks or the distance between the first two green peaks in Figure 6 and P_b is the physical size of a pixel in millimetres. This information depends on the camera used to take the image and can be looked up in the specifications for camera.

Our machine-woven textile has a calculated thread thickness of $b = 0.23$ mm if $T = 20$ and $P_b = 0.0725$ mm. This corresponds with visual inspection.

Defect detection

By using mathematical image analysis we found three ways of performing defect detection. In the following we outline independent methods and results.

Defect detection by means of canonical discriminant analysis

The defects we are looking for are detached threads and small knots resulting from these (Fig. 8). These detached thread areas are much fluffier than the rest of the textile and absorb and reflect other wavelengths of light. Therefore, one may use multispectral image data, meaning taking the “same image” 18-20 times with different wavelengths across visible and infrared light. This gives us 19-21 sets of dimensional data. In this multidimensional data, defects and regular threads have very different characteristics, and defects can be easily detected by using a mathematical orthogonal transformation called normalized Canonical Discriminant Analysis, nCDA.

Since the fine structure of the textile is of no interest, we have first smoothed the image using a 21x21 mean filter, hereby replacing each pixel with the average of all 440 neighbouring pixels. This has the same effect on the image as a wet sponge would have on water-painted child’s drawing. This leaves only the coarse details in the image, making it easier to visually define exactly which parts of the image are to be considered as defects and which are not. We then literally paint on the image to make a selection of what is to be considered a defect and what is to be considered a regular weave section (Fig. 9).

From this information the computer performs nCDA

in the 19-21 dimensional image space and returns an image (linear combination of the 18-20 images) in which defects are centred around the value of -1 and coloured red and regular threads are centred around -1 and coloured blue (Fig. 10). A threshold value of > 0.36 has been experimentally determined as an optimum for separation between defects and regular threads in the nCDA output. By thresholding you get an image containing only two colours: one colour representing regular thread and one colour representing a defect as a direct result of a detached thread or simply the detached thread itself (Fig. 11). A defect can then be automatically detected by simply computing the average pixel value for a given area of the image. If this local average exceeds a user-specified limit, the area is known to contain a defect. The size of each area depends on the size of defect you like to detect and the limit depends on the weave. In our case, a limit of 0.7 gave reliable and consistent results.

Defect detection by means of the Laplacian pyramids

Defects have locally similar colour and smoothed texture, compared locally to textile without defects. This is illustrated in Figure 12. Try for instance to compare Region Of Interest (ROI) 4 and 5. You will see that in ROI 4 the textile weave is clearly visible, whereas in ROI 5 it is not. This property can be used mathematically to locate and detect textile defects. This is done with the use of what is known as a Laplacian pyramid (Carstensen 2002, 22).

In short terms, which will make much more sense in the following, if you extract a small part of the image roughly in the same size as the defects you want to

2	1	1	3	3	0	1	2	3
3	1	0	2	2	0	2	2	0
3	3	1	1	2	1	3	2	1
0	2	1	0	1	2	0	2	1
0	0	1	0	0	3	0	2	0

Fig. 5. Left: A 4 colour image. Right: The GLCM of the left image computed with a $h=(0,1)$, i.e. one step in the horizontal direction. This means that e.g. there are 3 pixels having the value one that has a neighbour value of zero if you take one step to the right in the image (Photo: authors).

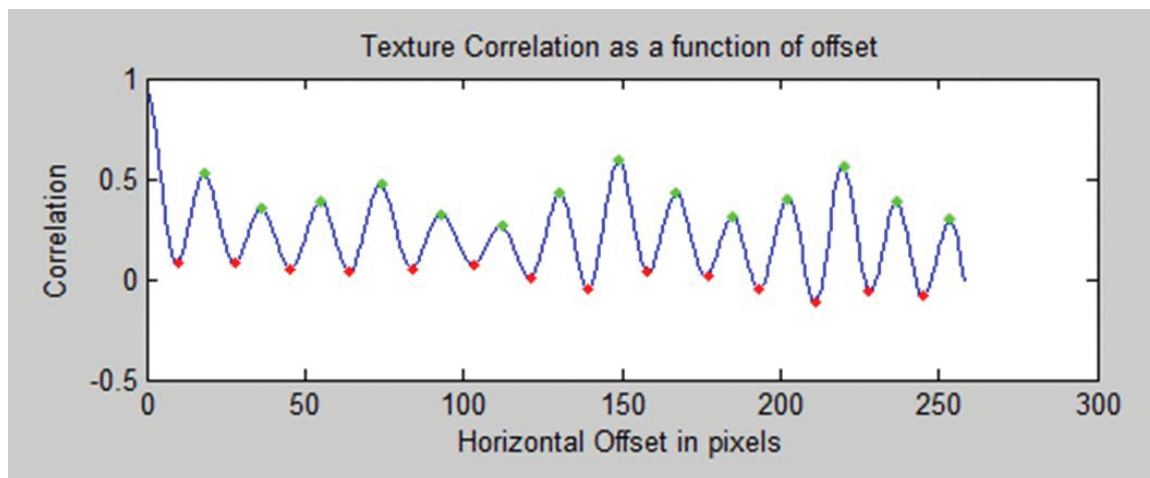


Fig. 6. Texture correlation as a function of offset. As the offset increases the correlation fluctuates periodically due to the natural periodicity in the textile weave. The period can be used to calculate the distance between two threads in the textile and the thread thickness (Photo: authors).

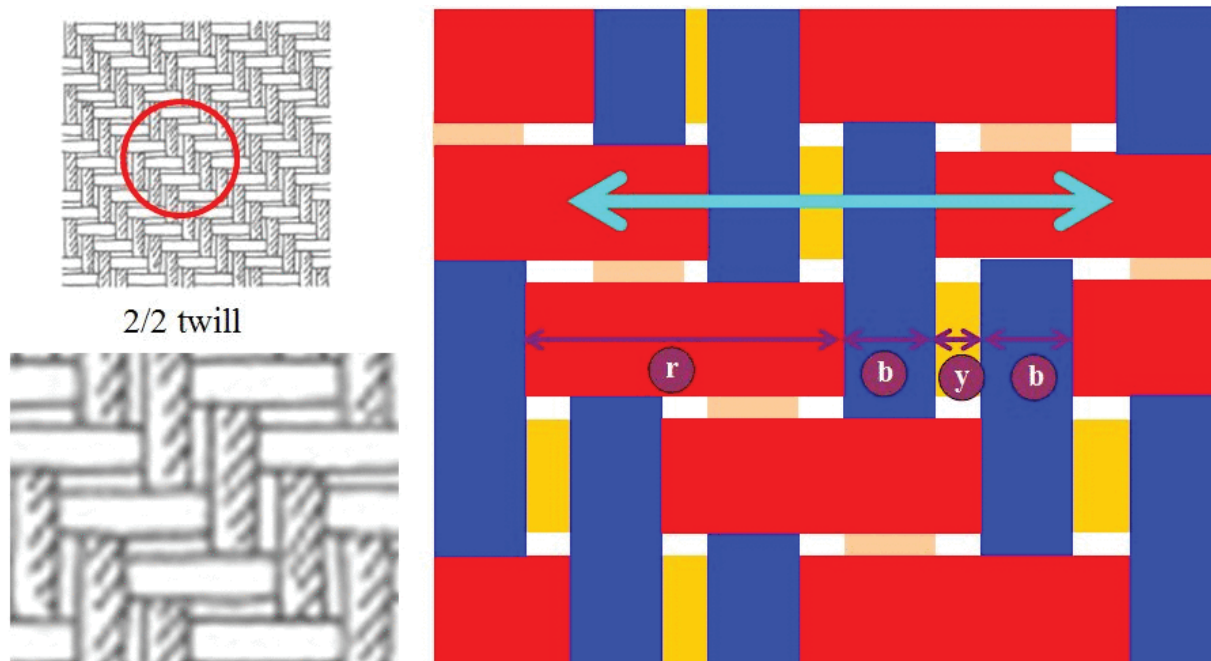


Fig. 7. A 2/2 twill weave. The period computed from Fig. 6 corresponds to the light blue arrow. Depending on the textile's orientation in the image the light blue arrow covers one piece of warp/weft thread, two weft/warp crossings and a little spacing between the weft/warp crossings. These sections are colour coded in red (r), blue (b) and yellow (y) respectively. The relationship between these variables depends on the weave and thread used. By defining the relationships between r, b and y, one can compute the average thread thickness of the entire image (Photo: authors).

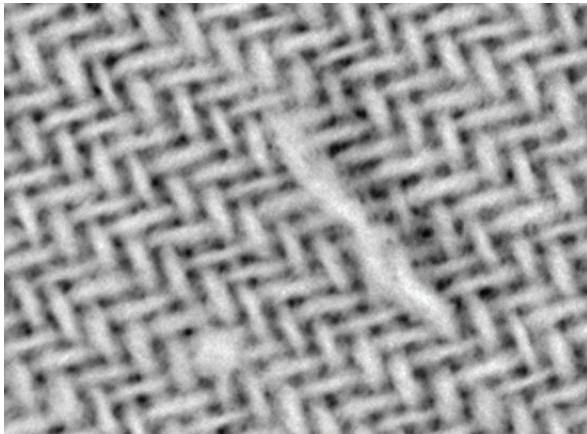


Fig. 8. Textile with a defect due to a detached thread and detached thread itself (Photo: authors).

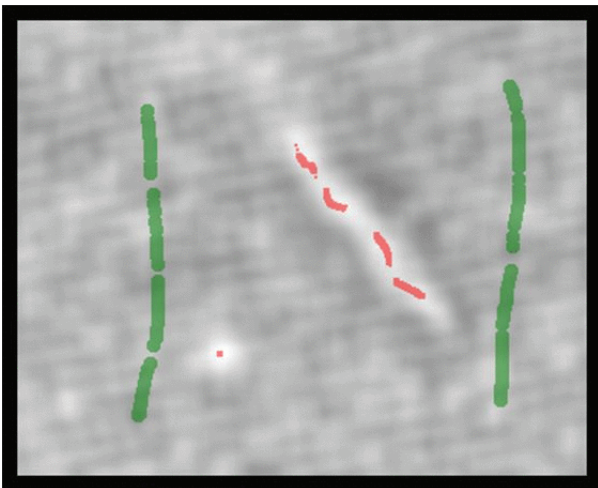


Fig. 9. Fig. 8 in a smoothed out version. The red and green markings are manually painted onto the picture to define an example for the computer on what pixels are regular thread and what pixels are defect (Photo: authors).

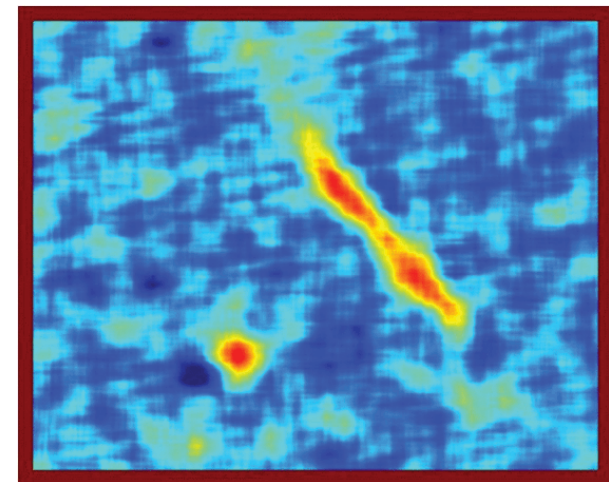
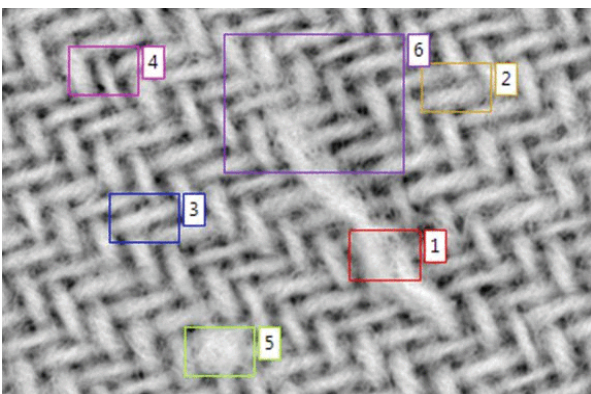


Fig. 10. Output of the nCDA analysis performed on the image seen in Fig. 9. All pixels belonging to a regular thread are blue and all pixels belonging to a defect are red. Pixels that are not clearly defined to contain either regular thread only or defect only are coloured in a mixture of blue and red (Photo: authors).

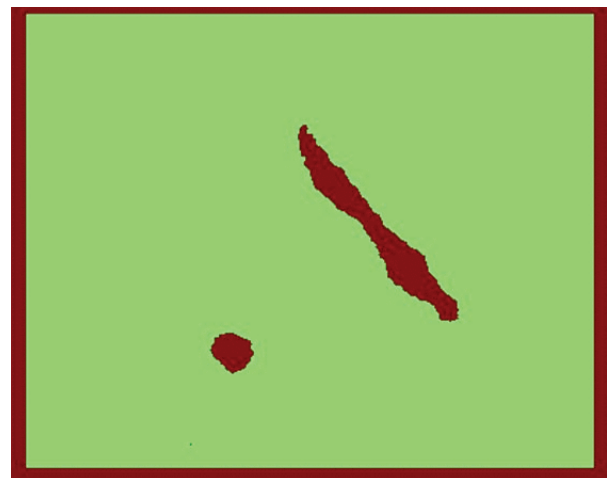


Fig. 11. Fig. 10 after a threshold. All pixels having a value below the threshold are coloured green and all pixels having a value above the threshold are coloured brown. By simply counting the brown pixels and comparing this number with the total number of pixels in the image one can get an indication of whether or not this image contains a defect (Photo: authors).

Fig. 12. Image taken at 780nm. ROI 1 and 5 contains defects. ROI 6 contains a partial defect (Photo: authors).

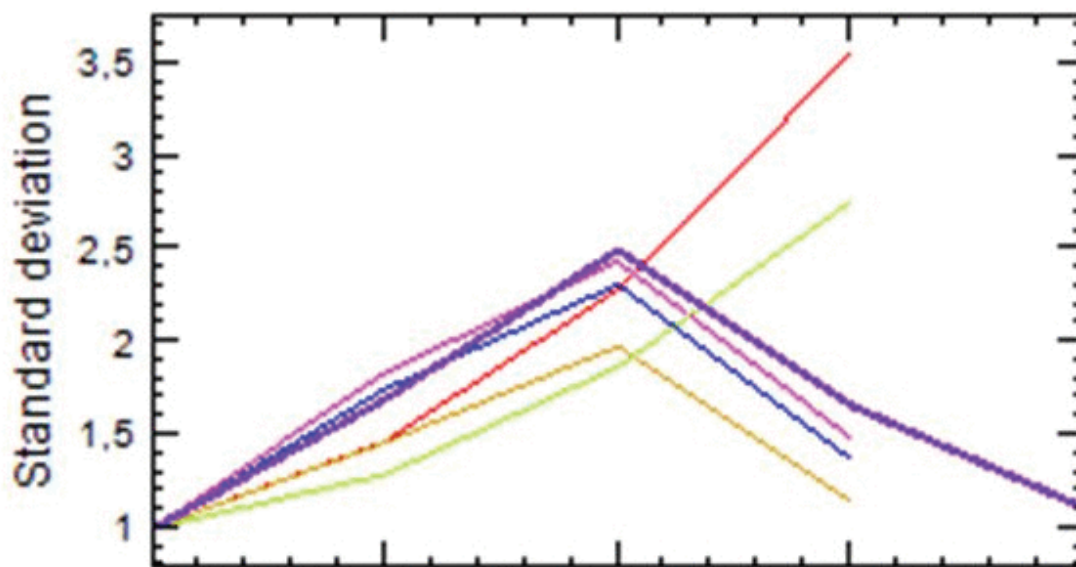


Fig. 13. The standard deviation as a function of scale (level) in a Laplacian pyramid. The curves corresponding to ROI 1 and 5 are peaking, indicating a defect. The curve corresponding to ROI 6 is not peaking, because ROI 6 is significantly larger than the partial defect it contains (Photo: authors).

detect, and plot the standard deviation as a function of scale in the Laplacian pyramid of the image part, you will see a peak in the plot, if and only if, your extracted image part contains a defect.

The images we work with one can mathematically think of as an array of pixels or pixel intensities. The pixel intensity is a number for instance between 1 and 100. This value describes the amount of light reflected at this given point in the image. The amount of light reflected depends on a number of physical properties of the material photographed. The pixel intensities for areas of thread are of course different from the pixel intensities for the space between two threads. This means that if you calculate the standard deviation of the pixel intensities for a region of the image not containing any defects, you get a large number. A region with a defect will not contain as much space between threads, therefore the standard deviation of the pixel intensities in this region will be a smaller number (in practice you need to pre-process your image first, in order to obtain this effect in a statistically stable way).

In order to pre-process your image you first make a Laplacian pyramid in the following way: Take your original image and delete every other pixel both vertically and horizontally. You now have an image a quarter of the original size. Continue doing so a few

times, each time making a new level in what is known as a simplified Gaussian pyramid. Mathematically reconstruct each level in the Gaussian pyramid, as well as possible, with the use of interpolation. Pixel-wise subtract each level in the simplified Gaussian pyramid from the interpolated one, and you now have a Laplacian pyramid.

Choosing the right size of the part to extract and compute standard deviation on is very important. If your extracted part is too small the defect detection algorithm will take too much computer time and thereby not be efficient. If the extracted part is too large, the actual defect will not cover a large enough area of the extracted part, and the defect will therefore not be detected. It is hence important to choose the size of part to extract corresponding to the defect you wish to detect.

The algorithm to follow using this version of defect detection is simply to extract a part of the original image and compute the standard deviation for this part in each of the first levels in a Laplacian pyramid. If the standard deviation increases as a function of the level in the Laplacian pyramid, this part of the original image contains a defect no smaller than roughly the size of the extracted image part.

Start by extracting a part in e.g. the top left corner, calculate if it contains a defect, and then simply move

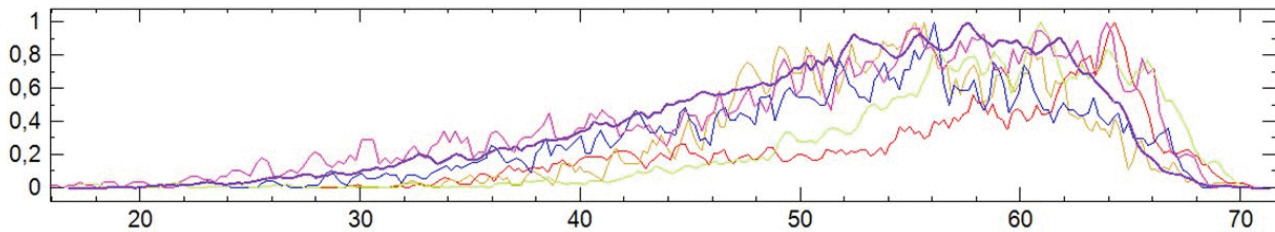


Fig. 14. Histograms for ROI's seen in figure 12 (Photo: authors).

the part to extract a little, calculate if this part of the original image contains a defect, and continue this way until you have checked the entire image. Results of the algorithm can be seen in Figure 13. Depending on the image size and available computer power checking an entire image should take in the neighbourhood of a second or two.

Defect detection by means of histogram analysis

Defects can also be detected with histogram analysis exploiting the same defect characteristic as in the previous section of this article. The fact that defects have different colour characteristics can be used to detect defects with the use of simple statistical tools. Figure 14 shows the histograms of ROI 1-6. It is clearly seen that these histograms are not identical. Therefore, one just needs a way to differentiate between the ones that represent a defect and the ones that do not. In order to do this, it is necessary to consider the average height of the histograms and the statistical terms skewness and kurtosis. Skewness is a measure of asymmetry of the probability distribution of a real-valued random variable. By considering the histograms as probability distributions, skewness can be used to measure the distribution of dark and light colours in each ROI. A large negative skewness means that the histogram is "tilted" to the right, and thereby indicates that the histogram's left tail is longer than the histogram's right tail. This also implies that most of the pixel values in the ROI are smaller than the mean and possibly the median.

Kurtosis is a measure of how outlier-prone a distribution is. This tells you something about how many values lie far away from the histogram's "centre of mass". If the histogram has a (Gaussian) bell-shaped form it would have a kurtosis of zero. A negative kurtosis indicates a (leptokurtic) shape more like a high thin sandcastle. A positive kurtosis indicates a (platykurtic) shape more like if the top part of the

sandcastle has collapsed and now lies around the base of the castle.

By computing skewness, kurtosis and average height of the histograms for ROI 1-5, a clear pattern emerges. ROI 1 and 5, which contains defects, have significantly higher values than the ROI's not containing any defect. From a defect detection point of view, a ROI is interesting if one more of the following conditions are fulfilled:

- The skewness of the ROI's histogram is larger than average.
- The ROI's histogram has a smaller average height than the average of all histograms for all ROIs.
- The kurtosis of the ROI's histogram is deviating significantly from the mean of all ROIs' kurtosis.

A ROI is defined to be containing a defect if two or more conditions are fulfilled.

By means of this method a defect is detected in ROI 1 and 5 seen in Figure 12.

Conclusion

Many archaeological and historic textiles have been used in contemporary reconstructions. The analysis of these fabrics shows a high degree of wear, but when doing reconstructions of these fabrics we use the data directly because we have no formulas for systematic analyses of wear that can characterize the change that happens with a piece of textile and its threads during use. It is therefore important to systematically analyze the wear, since it can refine the analysis of the archaeological or historic textiles, and the description of their wear. In our work we have found several ways to do systematic analysis of wear and tear in textiles. Using nCDA analysis we obtained a concrete value of the state of wear and tear in the textile. This provides basic information about the state of the textile with regard to holes and whether or not the textile has been worn thin, which may give information about the



social status of the owner. If the fabric is worn thin you can imagine that it is from a lower social status because one could not afford to buy a new garment when the old clothes were worn thin. The method also enables us to compare wear patterns of two textiles in relative terms.

Using texture analysis we have automated the measure of mean thread thickness. This has been done by measuring texture correlation in the horizontal direction. From this we have plotted the texture correlation as a function of offset. This illustrates the periodicity in the textile's weave. Based on the basic assumption about the aspect ratio between the warp and weft threads, it is possible to compute the average thread thickness of the entire image. This can be applied to measure both warp and weft thread thickness by simply rotating the image 90 degrees. As of now, an educated guess is needed to know the aspect ratio but it is possible to develop an automatic method to extract the information directly from the image.

In order to perform an automatic defect detection we have used three different methods. It is important to know that these methods can be used both to detect defects and to count the number of defects in a textile. Firstly, we used canonical discriminant analysis to automatically detect defects. This gives us an image containing only two colours. One colour represents the regular fabric and the other colour represents a defect as a direct result of a detached thread or the detached thread itself. A defect can then be automatically detected by simply computing the average pixel value for a given area of the image. If this local average exceeds a user-specified limit, the area is known to contain a defect. The size of each area depends on the size of defect to be detected and the limit depends on the weave. In our case, the limit of 0.7 gave reliable and stable results.

Secondly, we have worked with defect detection using a Laplacian pyramid. Laplacian pyramids have been used because defects have locally similar colour and smoothed texture, compared locally to area without defects. We have used this property to mathematically locate and detect textile defects.

Thirdly, we have detected defects with histogram analysis exploiting the same characteristics as in the second method. We have illustrated the histograms of six different regions of an image with defects. It could clearly be seen that the histograms were not identical. Therefore one just needed a way to differentiate between the ones representing a defect and the ones that did not. In order to do this, we considered the average height of the histograms and the statistical tools skewness and kurtosis. Based on these statistical

characteristics, a pattern emerged and it was possible to clearly detect defects.

All mathematical and image analysis methods used in this project can be adapted to other textiles and weaves. We have developed these methods for archaeological textiles, but they might also have an industrial application. Automatic counting of defects or thread spacing can for instance have applications in automatic quality control.

Acknowledgements

We thank our supervisor Jens Michael Carstensen, Department of Informatics and Mathematical Modelling, Technical University of Denmark and Ulla Mannerling, Centre for Textile Research for their advices.

Bibliography

Østergård, E. (2004) *Woven into the Earth. Textiles from Norse Greenland*. Aarhus.

Aasbjerg Nielsen, A. (1999) *Orthogonal Transformations*. Department of Informatics and Mathematical Modelling, Technical University of Denmark.

Carstensen, J. M. (2002) *Image Analysis, vision and computer graphics*. Department of Informatics and Mathematical Modelling, Technical University of Denmark.

Corresponding Authors:

Kristian Ryder Thomsen: s103253@student.dtu.dk

Mathias Londin Larsen: s103456@student.dtu.dk



Ben Cartwright

Shimmering Cloth, Like the River by this Path:

Bjørkum, Lærdal, and the Role of an Inland Production Site in the Viking Age

This article uses recent methodological advances (Andersson Strand forthcoming) combined with social theory to suggest that those textile tools referred to as 'insignificant lumps of stone' (Hoffmann 1964, 17) can be used to investigate production, not only of things, but at the human level. Using statistical analysis of loom weights and spindle whorls it is possible to suggest the optimal fabric and yarn types that were being produced at the 7th to 10th centuries AD site of Bjørkum, Lærdal, Norway. A variety of pit house finds, from slag to comb making debris, and beads, suggest a transient craft production. Given the context of the site, archaeological references, social approaches to making and ethnohistoric analogies, it has been possible to analyse fabric production, and its social significance, at a production site that sheds light on the social changes that were intertwined with the birth of the Viking Age in Norway.

In 2009, the Archaeology Unit from Bergen University Museum conducted what was thought to be a routine archaeological survey prior to a road building programme in the Lærdal valley, Sogn og Fjordane, Norway. The road was to follow the valley floor, running beside the river (so rich in fishing that the old kings of Norway held the rights). In an impressive upland environment of steep, rock faced and tree studded fjordal mountains, the course of an older route, past a medieval farm, that joined the West Coast to the Eastern, upland interior. Such was the richness of the discovery that the digging team who started out in short sleeves, the sun on their brown arms, were soon defrosting the site beneath plastic sheets nailed to wooden beams in order to create make-shift tents

as the high escarpments cast a day long shadow above the river, forcing the archaeologists into thick jackets and balaclavas (Ramstad 2011; Ramstad pers. comm.). What they unearthed was a late Iron Age and Viking Age site of considerable importance. An inland/upland production site, with between 13 and 15 pit houses containing a variety of textile implements from loom weights and spindle whorls, through to a bone hand-held distaff; and the rough-outs, and whole glass, amber and crystal beads which could have been used as the finished textiles. Using an analytical methodology largely inspired by recent work at the Danish National Research Foundation's Centre for Textile Research, Copenhagen (Andersson Strand forthcoming, Andersson Strand and Gebauer Thomson pers. comm. 2011; see also Mårtensson *et al.* 2009) it was possible to investigate the optimal fabric ranges the 27 (stone and soapstone, complete and datable) loom weights could have been used to produce, and to compare the results to the production ranges of the 19 (soapstone, stone and fired clay) contextually secure spindle whorls (see Andersson 2003). These results, of course, are partially dependant on the number of loom weights discovered. While not huge in number, when considering the amount of stone needed in warping a loom, the find of functional caches, and assuming one weight as being representative of an evenly weighted loom set up using many, the analysis can nevertheless be informative.

The picture that emerged was of a shifting pit house economy, in the early phases (late 7th to early 10th centuries AD), that was re-focused on the re-use of a rectangular 3 aisled house, Structure 1 (10th century



AD). Contemporary with these architectural shifts, seems to be a change in production. In the early phases of use the loom weights indicate that very high end textiles could have been produced (see Bender Jørgensen 1992, 138-140, 212-215, 263-264) These would have been readily recognised by the elites of the day, in tabby and twill weave, through to sturdier textiles, what we might call working fabric, which bares comparison with the specifications known for contemporary sailcloth (Cooke *et al.* 2002). This textile tradition, reinforced by finds of functional caches of loom weights in individual pit houses and matched in the spindle whorl assemblage, seems to run through the early phases, which can be divided into three based on the use, creation and digging out of new pit houses.

In the final phase, loom weights, including the so-called phallic stone found between the paired post holes of Structure 1, indicate a potential proliferation of woven thread at the heavier end; highlighting a range of new textile choices with a preference for thicker closed fabrics (of 40-70g woven thread tension-Cartwright forthcoming a), and an opening of the few cloth types that overlap with any of the earlier productions. Interestingly, noting Andersson's (2003, 143) assertion that a specialised production needs a specialised tool set, Structure 1 is the only context where a pair of lathe turned soapstone whorls seemed to have been produced to match each other.

These results cannot be considered in isolation and gain extra resonance within the context of the site. They add to what we can infer about the physical interaction

of weavers, spinners, yarn, loom and landscape, to the extent that we might refer to them as knotting the threads of mountain pathways through their actions and bodily movements at the loom. The workforce, communities of female weavers and spinners (see Cartwright forthcoming b, on this gendering of practice), were highly skilled, especially in the early phases. A difference made explicit with comparison to the surrounding sheiling sites, suggesting a unique functional niche.

Bjørkum itself, shares a market naming component with the famous Viking Age trading site of Birka, and the site lies below a known thing/ting meeting place as well as a Skeid (Ramstad 2011, 52, 53). Both functioned as meeting points, drawing the local populations, whether for the politics of the day or to watch annual events, such as the horse fights of the Skeid, as recorded in Saga accounts and later historic records (Stylgar 2011). This site of east meets west would have been an ideal point for the production of fine items (there is also slag at the site, suggesting metalwork, and possibly evidence for comb manufacture, Ramstad 2011, 49, 51), providing for the need of thing goes to look the part (we are told for example, that Skarp-Hedin was known at first sight at the Icelandic Althing, because he looked like a warrior; *Njal's Saga* 1960, 248), an argument potentially supported by the find of a trade weight in one of the pit houses. And we should remember the early potential for producing sail-cloth comparable material, in light of the role of cloth as a Viking Age unit of currency (Hoffmann 1964).



Fig. 1. 'Creating a Buzz': A Hand Carved 'Beehive' Shaped Whorl from Bjørkum with a 1 penny for scale. It is an interesting whorl type, reasonably rare, and gives a visual indication of the role whorls could have played as personal possessions (Photo: author).



What of the weavers themselves, what role did they play in this regionalised economy? I would argue that weaving acted as both a tangible (in thread) and intangible point of binding together. The seasonal nature of the site, - the form of the pit houses, possibly just pits for tented structures, and lack of formalised hearths (until the later phases), suggests a transient workforce. If it is argued that cloth production operated in a pre-planned cycle, yarn being specifically produced for specific cloth, then the pit houses of Bjørkum would have necessarily been linked to the landscape in material demands for flax and wool. The agricultural restrictions on when this would have been available, suggest a possible mid-summer schedule, between the first shearing/flax planting, and taking of the animals to pasture - the time of year when Skeids were traditionally held (Stylgar 2011), and the harvesting of the lush summer coats/flax harvesting and processing at the end of summer. All tasks that would have required inward looking community co-operation and the associated activities of social bonding (e.g. see Larson 2001; Stewart 2005; Lucas 2008).

One should consider the role of the loom in bringing different areas/groups together. The raw material has to be physically (walked out and) gathered from the landscape, pre-prepared, and eventually the product of the loom processed, in all likelihood, by communal groups. This is an area of research I am currently engaged in. There is an area of study that suggests the formation of habit is a creator of a 'way of seeing' (a pun on habit as both spatio/temporal movement and as an item of clothing. Elsewhere, I have taken this further to argue that clothes are an imposing factor in the imposition of bodily movement, habit and meaning) (Berger 1972, Felski 2000). This can in part be put down to the demands that the loom creates, a seasonal way of doing things that is required in the pre-planned nature of production. That the paths one takes through the landscape, literally give a point of view (Ingold 2000, 226), and as such are crucial factors in the creation of a world view in any given spatio-chronological context. I would argue it is the interface of weaver, material and loom that, in part, provides a temporal stimulus for these interactions.

If the weavers were drawn from the surrounding upland populations, Bjørkum may have functioned as an important community weaving site, a site of coming together, drawing practitioners from across the region. Similar arguments have been made for sites in Zealand, Denmark (Gebauer Thomsen pers. comm.; see also Gotfredsen *et al.* 2011, 213; Nørgård Jørgensen *et al.* 2011, 102-104), and within Norway (Brink 2011, 89-91), for example at Stedje farm (Mortensen 1998).

Pit houses sealed in the act of cloth production, would have become "cafés of women" (Naji 2009, 56), sites of competition, communication, education, discussion, resulting in the re-weaving of a sense of a region wide communal identity (which would surely have been a matter of some political importance to the burgeoning chiefdoms - as a form of self-making whose significance is seemingly highlighted in literary sources, and notably those linked to cosmological influence (for example, the relic poem *Darraðarljóð*; see also Gardela 2008, 50).

This influence, or what has been termed in recent anthropological literature *agency* (Gell 1998- used here as a causal affect born from an act of doing, notably the influence weavers generated through their skill), belies traditional assumptions about the domesticity of cloth production, and rather sees the *locus* of the loom as a centre of world weaving. This status is perhaps reflected in the procurement and transporting of soapstone rough-outs, lathe turned and inscribed soapstone, and fired clay whorls, to the site. If specific whorls were needed for specific productions, and given the skilled and time consuming nature of spinning yarn, then this must have occurred under the demands/ guidance of the spinners. Could the trade weight, remembering that women in 'Scandinavian' Russia have been excavated buried with scales, reinforce this picture of autonomy, and finally, given the re-structuring of the last phase of use, how would this have affected these strong women? It is likely, given the anthropological literature on the sense of, and oppositional slow change of practical traditions, that enforced change (perhaps related to a top down re-ordering of space and practice as seen at Bjørkum, not forgetting that there is an important medieval farm situated metres away) would probably be, to some extent, resisted.

This threat is possibly acknowledged in the memorialisation/curation of the importance of past productions at the site (the bodily acts of their predecessors and relations in social practice, and their importance in community binding, and spiritual re-weaving) in the find of a spindle whorl within a foundation deposit, a post hole packing fill in Hus A, as well as a whorl found in a fire-pit with a complicated relationship with Structure 1. These buildings ceased to be used at a time when sweeping changes were about to be made to the spatial organisation of cloth production in Northern Europe. And notably in connection to socio-political events in Norway and the Atlantic sphere. We might ask whether these whorls were placed there to commemorate the role of cloth production and its producers at the site, at a time when that very production was being forced to change?



Acknowledgements

Acknowledgements are due to: The AHRC for funding my PhD research, Morten Ramstad and the team in the University Museum, University of Bergen for all their kind assistance, all of the members of CTR (the Danish Research Foundation's Centre for Textile Research, the SAXO Institute, University of Copenhagen), including the visiting scholars for all their help and suggestions, James Barrett, McDonald Institute for Archaeological Research, University of Cambridge, and Eva Andersson Strand, CTR, for kindly giving their time to comment on the text.

Bibliography

Andersson, E. (2003) *Tools for Textile Production from Birka and Hedeby*. Birka Studies (8). Stockholm.

Andersson Strand, E. (forthcoming) From Tools to Textiles, Concluding Remarks. In Andersson Strand, E. and Nosch, M-L (eds). *Tools, Textiles and Contexts: Investigating Textile Production in the Aegean and Eastern Mediterranean Bronze Age*. Oxbow. Oxford

Bender Jørgensen, L. (1992) *North European Textiles until AD 1000*. Aarhus.

Berger, J. (1972) *Ways of Seeing*. London.

Brink, S. (2011) Comments on Inger Storli: 'Court Sites of Arctic Norway: Remains of Thing Sites and Representations of Political Consolidation Processes in the Northern Germanic World during the First Millennium AD?' *Norwegian Archaeological Review* 44(1), 89-91.

Cartwright, B. (forthcoming a) Making Cloth Beneath the Slopes: Spinning and Weaving at Bjørkum, Lærdal, Norway. In Ramstad (ed.), *Bjørkum- Utgravinger av en Vikigtidsplass I Lærdal. Bjørkum: The Excavations of a Viking Age Sit in Lærdal, Western Norway*. Bergen.

Cartwright, B. (forthcoming b). *Weaving the World: The Role of Spinning and Weaving in Identity Creation in Viking Age Atlantic Scotland, 600-1200 AD*. PhD Thesis. University of Cambridge.

Cooke, B., Christiansen, C. and Hammarlund, L. (2002) Viking Woollen Square-Sails and Fabric Cover Factor. *The International Journal of Nautical Archaeology* 32(2), 202-210.

Felski, R. (2000) The Invention of Everyday Life. *Cool Moves: A Journal of Culture/ Theory/ Politics*. Vol. 39, 15-31

Gardela, L. (2008) Into Viking Minds: Reinterpreting the staffs of Sorcery and Unravelling Seiðr. *Viking and Medieval Scandinavia* 4, 45-85.

Gell, A. (1998) *Art and Agency: An Anthropological Theory*. Oxford.

Gotfredsen, A. and Gebauer Thomson, L. (2011) Three Pit-Houses of the Magnate's Residence at Lake Tissø. In L. Boye (ed.), *The Iron Age on Zealand: Status and Perspectives*. Copenhagen.

Hoffmann, M. (1964) *The Warp-Weighted Loom: Studies in the History and Technology of an Ancient Implement*. Oslo.

Ingold, T. (2000) *The Perception of the Environment: Essays on Livelihood, Dwelling and Skill*. Oxford.

Larson, K. (2001) *The Woven Coverlets of Norway*. Seattle and London.

Lucas, G. (2008) Pálstóftir: A Viking Age Shieling in Iceland. *Norwegian Archaeological Review* 41(1), 87-100.

Magnusson, M. and Pálsson, H. (1960) *Njal's Saga*.

Mårtensson, L., Nosch, M-L. and Andersson Strand, E. (2009) Shape of things: Understanding a Loom Weight. *Oxford Journal of Archaeology* 28 (4), 373-398.

Mortensen, M. (1998) "When they speed the shuttle". The role of textile production in Viking age society as reflected in a pit house from Western Norway. In L. Bender Jørgensen and C. Rinaldo (eds), *Textiles in European Archaeology: Report from the 6th NESAT Symposium, 7-11th May 1996 in Borås*. GOTARC Series A, Vol. 1. Göteborg, 188-195.

Naji, M. (2009) Gender and Materiality in-the-Making: The Manufacture of Sirwan Femininities through Weaving in Southern Morocco. *Journal of Material Culture* 14 (1), 47-73.

Nørgård Jørgensen, A., Jørgensen, L. and Gebauer Thomsen, G. (2011) Assembly Sites for Cult, Markets, and Social Relations: Historic-ethnological Analogy between North Scandinavian Church Toens, Old Norse Assembly Sites and Pit House Sites of the Late Age and Viking Period. *Arkæologi I Slesvig. Sonderband "Det 61. Internationale Sachsensymposion 2010"* Haderslev, Danmark. Neumünster, 95-112.



Ramstad, M. (2011) *Bjørkum: An insight into the new economic and social structures in the early Viking Age*. Bergen.

Stewart, K. (2005) *Crofts and Crofting: Past, Present and Future*. Edinburgh.

Stylgar, F-A. (2011) *Horse Fights and Cow Fights in Norwegian Folk Tradition*. <http://arkeologi.blogspot.co.uk/2010/10/horse-fights-and-cow-fights-in.html>

Corresponding author: bhjc2@hermes.cam.ac.uk



Lars Larsson

The Embellished Dress in Hunter-gatherer Societies

Tooth ornaments from the graves at the cemeteries of Zvejnieki, northern Latvia

Introduction

Due to the good preservation of certain sites in southern Scandinavia we have a wide knowledge of the tools in bone, antler and wood from the Mesolithic (10,000–4000 BC). Remains of threads, ropes and nets have been found (Kernchen and Gramsch 1989). Even small pieces of textile, in needle-binding technique, have been found at a submerged site south-west of Funen (Denmark) dated to the late Mesolithic (Andersen 1987). However, remains that provide direct information about clothing are still missing. Judging by the considerable variation in the animals that were hunted – including mammals, birds and fish – there was a plentiful supply of skins for making parts of costumes, corresponding fully to the clothes worn for ordinary activities and on special occasions by members of hunter-gatherer societies in similar biotopes in both Asia and North America.

In contrast to clothes, however, if we deal with the embellished or ornamented dress the situation becomes quite different. The preservation of perforated teeth and bones found mainly in graves provides a basis for a better understanding.

In societies with hunting as an important economic contribution, pendants made of animal teeth are often common decorative objects. Tooth pendants are used to adorn the body and decorate clothing. The tooth pendants have a multifaceted meaning. The teeth as pendants are a kind of abstraction of the wild environment. By extracting the teeth from the animals and reshaping them, they are transferred into domestic surroundings. Here, carnivorous and herbivorous animals, and animals from marine and terrestrial environments, are mixed together in an artificial world completely ruled by humans. However,

they remain part of the wild world, and their special qualities might be transferred to the wearer. The use of teeth from particular animals may be generally taken to reflect norms and values accepted by individuals living in a shared physical and social environment. The close contacts between humans and animals in a range of everyday contexts could have translated into the selection of a particular animal as a totem (Worbs 1977; Gebauer 1988).

The relationship of the tooth decoration to individual garments has been examined occasionally (Kotova 2010). However, only a few previous studies of tooth pendants have considered social factors (d'Errico and Vanhaeren 2002; Vanhaeren and D'Errico 2002) and other factors, such as the ritual perspective.

During an individual's lifetime, the number and combination of pendants might change due to life-course transitions in age and gender roles, as well as developments in special competences, special social relationships, etc. Throughout life, the dress, adornments and gear would change, be replaced and in turn be complemented. This ought to shape the amount, species composition and wear patterns in the assemblage of pendants associated with the individual.

However, from the perspective of society, the ultimate form of loss of decorative clothing occurs when it is provided as a gift to a dead member of society. Even in that situation, regulations by the society and decisions of a more individual kind regulated what part of the decorative dress, and additional decorative parts, accompanied the buried person.

In a synchronic perspective, social relations tend to be structured by kinship-based affinities as well as other groupings based on age, gender or special

commitments (O'Shea and Zvelebil 1984). In the archaeology of hunter-gatherer societies, such features might be reconstructed based on the study of tooth pendants associated with burials. Further insight would be obtained if these combinations could be followed diachronically, shedding light on the survival of tradition and acceptance of innovations. Material suitable to study these social phenomena is rare. An excellent site for both synchronic and diachronic analyses is the cemetery at Zvejnieki, northern Latvia. The reasons for choosing the graves at Zvejnieki are plentiful. They were excavated in the late 1960s and early 1970s (Zargorskis 2004). The graves are well preserved and were carefully excavated. The large number of graves provides an excellent opportunity to compare ornaments from different age groups and both sexes. The cemetery was used for millennia, from about 7500 cal. BC to about 2600 cal. BC, providing possibilities for diachronic studies (Zagorska 2006). The taxonomic identification of all tooth pendants has been performed (Lõugas 2003, 2006). Thus, it is feasible to study the arrangements of teeth from different animals.

There are about 2400 mammal teeth – both with and without artificial modification – that have a position in the graves indicating a symbolic meaning. The range of species employed for pendants seems to be smaller during the early use of the cemetery, with wild boar, elk, red deer and aurochs most common (Eriksson and

Zagorska 2003, 6). A much wider spectrum is present in the later graves, which include brown bear, wolf, dog, badger, otter marten, fox seal, beaver, wild horse and human.

Artificial alterations of the teeth and use-wear

All available tooth pendants have been studied under a magnification of 10X. One goal has been to understand the techniques of pendant manufacture. Another goal has been to identify and classify whether and how use might have affected the pendants – a use-wear analysis. This type of analysis should give an indication of how the pendants were fastened, as well as how different sets of garments were handled and if pendants of different use-wear were combined.

Different modes of shaping the teeth for pendants have been identified: drilling, perforation by making depressions on opposite sides of the root, by cutting grooves and by grinding the root into a square shape (Fig. 1). A more detailed presentation of the analyses is published elsewhere (Larsson 2006; 2009).

Analysis of pendant manufacture techniques in graves dated directly by ^{14}C assays suggests that the types of tooth pendant modification can be partly seriated. In the oldest graves dated to about 7500 cal. BC, associated pendants display traces of the drilling technique. At about 5500 cal. BC, drilling was replaced by cutting depressions on opposite sides of the root.

The use-wear is due to several different and sometimes



Fig. 1. Two different techniques in alteration of the roots of teeth used as pendants, drilling (left) and carving of the perforation (right). The perforations show heavy use (Photo: Bengt Almgren, LUHM).



interacting factors. One is how the pendants were fastened to the dress, belt or other artefacts: whether they were individually sewn to the surface or were they assembled in smaller or larger groups. The amount of use-wear is also related to the intensity of use of the articles of dress. Different parts of the dress might have been used with varied intensity. Parts may also have been obtained on different occasions during the lifetime of the interred individual. According to osteological expertise, the density of the bone in the root of the tooth from different animals should not vary in order to provide different use-wear for different species.

The use-wear has been classified in two groups – light and heavy use-wear. With light use-wear there is clear use polish around the perforation or in the grooves or the notch. In the second group the use-wear is so intensive that most or all traces of manufacture have been lost, as in Figure 1. The fact that there are traces of wear at all on the teeth shows that they were relatively loosely attached to the clothes so that the groups made some noise as the wearer moved.

Graves with pendants

The structure of the adornments has been studied as well as the arrangements of different species that were used as pendants. A few examples are presented:

Grave 170 is one of the oldest graves in the cemetery, with a radiocarbon date to 8150 ± 80 BP (Ox-5969) 7454–6834 cal. BC. It contained a young adult male with a total of 125 pendants. There is a marked spatial distribution in the grave of pendants according to species. The largest number are from wild boar and are linked to the chest in vertical as well as horizontal lines and on regular clusters in two vertical rows along the pelvic region and the extremities (Fig. 2:A). The remaining pendants occur as smaller clusters, including a group of red deer pendants at the lower right side of the chest and a mixed group of wild boar and elk tooth pendants at the right upper chest. An apparent decorative set was arranged as a necklace consisting mainly of elk tooth pendants, with aurochs tooth beads located at the centre. A concentration of pendants at the feet includes elk, wild boar and red deer.

One has to keep in mind that the marking of different species makes the division of species very obvious. This was not possible to recognise unless at a very close approach to the person. However, the special arrangement of teeth from different species proves that it has a special meaning to the wearer and/or the person who made the arrangement of pendants. The most important concern was that people had knowledge about the arrangement, not that it was

visible to everyone. The symbolic meanings of the decoration were based upon concepts accepted by the society and did not need to be fully known and visible to people other than those who approved the outfit.

Most of the tooth pendants with identified use-wear are associated with the neck region of the buried individual (Fig. 2:B). Among the sets of wild boar tooth pendants, the wear varies from clusters including no use-wear to those in which all teeth display use-related polish. Because teeth within clusters of pendants tend to show similar amounts of wear (or lack thereof), the different groups of pendants may be interpreted to have been obtained at different stages during the individual's lifetime.

Out of all pendants examined, 38% exhibit use-wear. However, the proportion of worn pendants displays marked variation between different species. One third of the elk teeth, the two pendants from aurochs and just one of the teeth from red deer show use-wear. This difference in wear indicates that sets of ornaments were combined from other probably older sets.

Grave 121 contained a young female adult and is dated to 6145 ± 80 BP (Ua-19883) 5302–4854 cal. BC, which falls within the Early Neolithic according to Latvian chronological nomenclature.¹ The tooth pendant assemblage includes specimens from five species. However, the majority come from beaver teeth. Teeth from beaver are most common on the upper and left part of the woman's body, with teeth of wild boar more common on both sides of the trunk (Fig. 3:A). However, all sets of pendants include more than one species. Two major sets are found at the left chest area and between the femora. Both have a fan-like shape and include beaver, elk and a single tooth pendant of dog. The lower part of the skeleton is badly damaged. Virtually all of the teeth show signs of preparation, with carving being the dominating technique for achieving a perforation.

A rather high number of pendants exhibit use-wear – 39%. Within the pendant cluster located at the lower right arm, all teeth display use-wear. Among the fan-shaped sets, a high proportion of pendants also show signs of wear (Fig. 3:B). As with the other graves described, there is considerable variation among species in the percentage of worn pendants. The two otter teeth and the only example of a tooth from fox show heavy wear. However, 75% of teeth from wild boar, 42% of the teeth from dog, 27% of beaver and 25% of elk teeth exhibit light wear traces.

Pendants and pendant adornments in child graves

Of special interest is also how and when a new member of the society received his or her outfit and

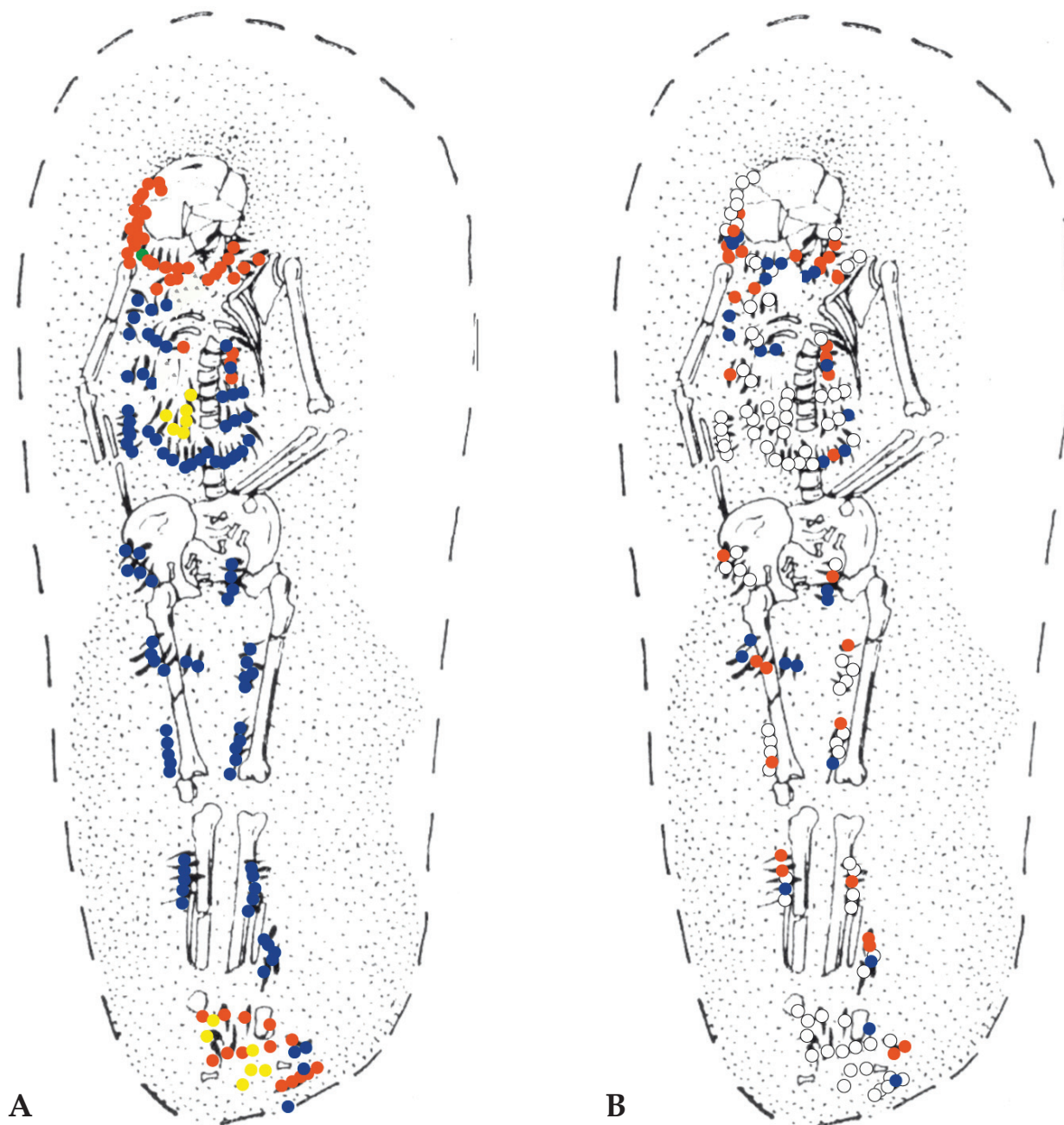


Fig. 2. Grave 170. A: the distribution of pendants according to species, blue: wild boar, red: elk, yellow: red deer and green: aurochs. B: unfilled circle: pendants with no wear, blue circle: pendants with light use wear and red circle: heavy use wear. Shading marks the area covered by red ochre (After Zagorski 1987 with additions).

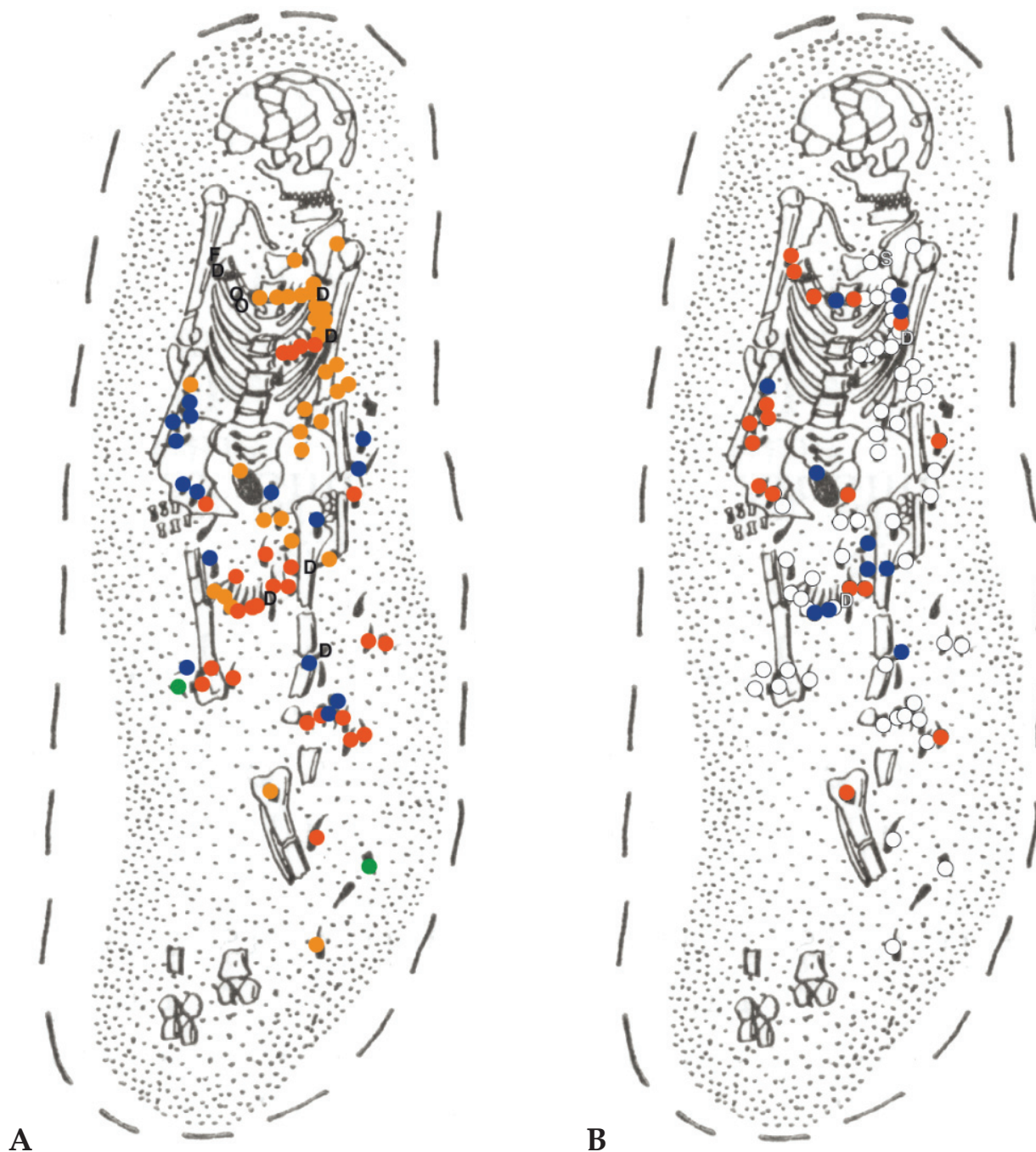


Fig. 3. Grave 121. A: the distribution of pendants according to species, blue: wild boar, red: elk, orange: beaver, D: dog and circle: aurochs. B: unfilled circle: pendants with no wear, blue circle: pendants with light use wear and red circle: heavy use wear. Shading marks the area covered by red ochre (After Zagorski 1987 with additions).

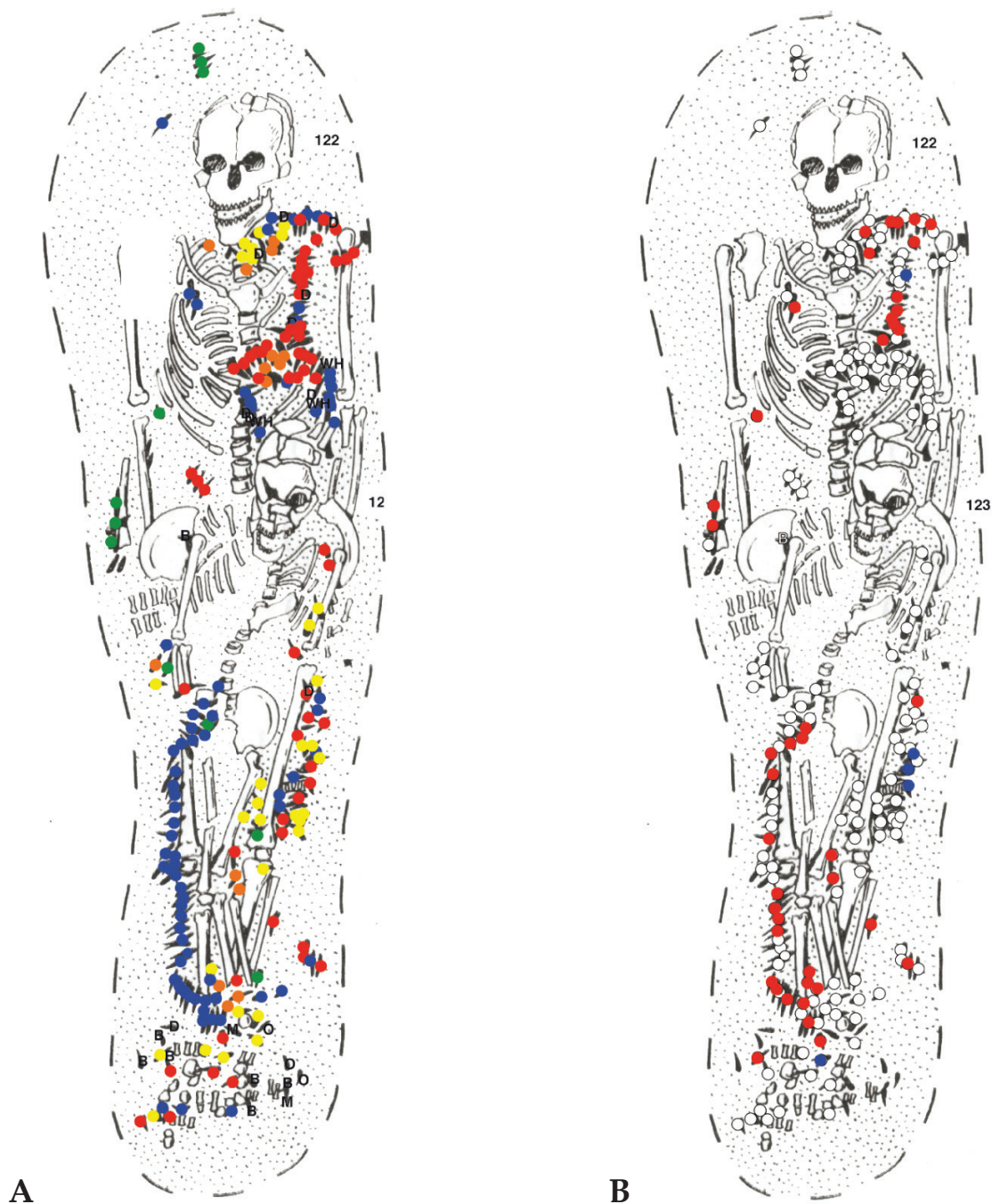


Fig. 4. Graves 122-123. A: the distribution of pendants according to species, blue: wild boar, red: elk, yellow: red deer, green: aurochs, orange: brown bear, B: badger, M: marten, O: otter and WH: wild horse. B: unfilled circle: pendants with no wear, blue circle: pendants with light use wear and red circle: heavy use wear. Shading marks the area covered by red ochre (After Zagorski 1987 with additions).



gear. Two contrasting scenarios are expected. The dress outfit and adornments are specially made for a child entering the society. Alternatively, the child inherits the outfit – or parts of it – from relatives or other members of the community. In the former situation the pendants are newly made, without much or any use-wear. This is the pattern the archaeologist would find if the child died and was buried with its dress. In the latter scenario one would expect to find pendants with use-wear among the pendants for the child. Moreover, because it is unlikely that children's pendants could have developed substantial use-wear themselves, worn teeth in juvenile burials likely represent gifts of used pendants.

As presented above, both patterns are present in child graves at Zvejnieki. In *Grave 43* a considerable percentage of the pendants exhibit use-wear. In *Grave 31* no pendant exhibits use-wear. In *Grave 122–123* there is a spatial distinction between pendants associated with the adult man and those with the child (Fig. 4). The adult pendant assemblage includes worn teeth. The child's assemblage includes no specimens with use-wear.

This variability could be explained by changes through time in cultural practices, both in furnishing a new member of society with clothing and adornment, and also in decorating the dead with pendants. Yet, one might expect that children's social roles changed rapidly with age so that in some cases, the child was presented with new dress or gear, and in other cases, the old items were given as gifts from relatives.

It should be noted that the distribution of wear traces on pendants in child burials can also shed light – in comparative perspective – on the social lives of adults. Most adult graves include pendants with wear. Yet, in a small number of graves, pendants associated with the interred are without wear. Women and men might have been given, or expected to furnish for themselves, a new dress with newly-made ornaments when they were integrated into new families or attained a new status among their own relatives. At death, the dress might even have been entirely newly made for use as a cloak for the dead. The old dress or parts of the dress could have been deposited in the grave besides the interred.

Other forms of dress decoration

It is not solely tooth beads that embellished dress. Several graves had finds of astragali from beavers. These small, almost square bones could occur in assemblages of up to 13 examples. Since they were mostly found along with tooth beads they are perceived as being a part of the embellished dress. Of particular interest are some finds of bird bones. In

Grave 164, that of an adult man, there were in total 42 wing bones of jay at the right arm, on the trunk, at the right knee and at the feet (Mannermaa 2006). It should be borne in mind that jay has a patch of blue-and-black barred feathers on the wing which is very distinct and must surely have been highly visible and a good decorative element in the dress.

Final comments

Through detailed study of the tooth pendants from Zvejnieki, an archaeologist can gain an interesting perspective on values, norms and structures constituting the Mesolithic and Neolithic societies that existed in what is now northern Latvia. When dealing with mortuary analyses of hunter-gatherer cemetery sites, exceptions seem to be something of a rule. Indeed, the analyses of the Zvejnieki material identify very few well-defined patterns concerning the manufacture and use of pendants. The observed variability might be interpreted as mirroring a society with an acceptance of a variety of attitudes or norms related to different families or a society with a most intriguing system of norms and therefore very difficult to decipher.

Knowledge about dress in the Mesolithic is virtually non-existent. The few depictions of humans that occur in the form of carvings on bone and antler show hatching on bodies, but it is uncertain whether this is supposed to represent clothes. Reconstructions of dress are either based on the Early Neolithic finds from the frozen man in Ötztal in South Tyrol (Spindler 2001) or on ethnographic information about hunter-gatherer societies in Siberia or North America (Larsson 1988). If it is postulated that the tooth beads found in graves, with the exception of those around the neck, were sewn on to garments, then the costume must have consisted not only of a sleeved jacket but also a skirt that was at least knee-length or some kind of leggings. Some women probably had a broad beaded belt around the hips. Variation in the animal species of the tooth beads at the feet suggests that shoes were decorated. The same also applies to the headdresses worn by certain bodies in the grave.

Notes

1. It should be remembered that there is a difference in terminology between Scandinavia and the Baltic region. In the latter, the introduction of pottery is regarded as the start of the Neolithic, which took place around 5600 BC. In southern Scandinavia it is the introduction of agriculture that marks the change around 4000 BC. In this part of Latvia the change took place around 2500 BC. The graves considered here thus belong to hunter-gatherer societies.

References

- Andersen, S. A. (1987) Tybrind Vig: A Submerged Ertebølle Settlement in Denmark. In J. M. Coles and A. J. Lawson (eds.), *European Wetlands in Prehistory*. Oxford, 253-280
- d'Ericco, F. and Vanhaeren, M. (2002) Criteria for Identifying Red Deer (*Cervus elaphus*) Age and Sex from Their Canines. Application to the Study of Upper Palaeolithic and Mesolithic Ornaments. *Journal of Archaeological Sciences* 29, 211-232.
- Eriksson, G. and Zagorska, I. (2003) Do dogs eat like humans? Marine stable isotope signals in dog teeth from inland Zvejnieki. In L. Larsson, H. Kindgren, K. Knutsson, D. Loeffler and A. Åkerlund (eds.), *Mesolithic on the Move. Papers presented at the Sixth International Conference on the Mesolithic in Europe, Stockholm 2000*. Oxford, 160-168.
- Gebauer, A. B. (1988) Stylistic analysis. A critical Review of Concepts, Models, and Applications. *Journal of Danish Archaeology* 6, 223-229.
- Kernchen, I. and Gramsch, B. (1989) Mesolithische Netz- und Seilreste von Friesack, Bezirk Potsdam, und ihre Konservierung. *Veröffentlichungen des Museum für Ur- und Frühgeschichte Potsdam* 23, 23-27.
- Kotova, N. (2010) Burial clothing in Neolithic cemeteries of the Ukrainian steppe. *Documenta Praehistorica XXXVII*, 167-177.
- Larsson, L. (1988) Ett fångstamhälle för 7000 år sedan, *Boplatser och gravar i Skateholm*. Lund.
- Larsson, L. (2006) A tooth for a tooth. Tooth ornaments from the graves at the cemeteries of Zvejnieki. In L. Larsson and I. Zagorska (eds.), *Back to the origin. New research in the Mesolithic-Neolithic Zvejnieki cemetery and environment, northern Latvia*. Acta Archaeologica Lundensia, Series in 8o, No. 52. Lund, 253-287.
- Larsson, L. (2009) Symbols around the body: tooth ornaments from the graves at the Zvejnieki cemeteries, northern Latvia. In S. McGartan, N. Schulting, G. Warren and P. Woodman (eds), *Mesolithic Horizons. Papers presented at the Seventh International Conference on the Mesolithic in Europe, Belfast 2005*. Oxbow, 664-670.
- Lõugas, L. (2003) *Report on archeozoological analyses from Zvejnieki archaeological complex, Latvia*. Unpublished report. Tallin.
- Lõugas, L. (2006) Animals as subsistence and bones as raw material for settlers of prehistoric Zvejnieki. In L. Larsson and I. Zagorska (eds.), *Back to the origin. New research in the Mesolithic-Neolithic Zvejnieki cemetery and environment, northern Latvia*. Acta Archaeologica Lundensia, Series in 8o, N°. 52. Lund, 75-89.
- Mannermaa, K. (2006) Bird remains in the human burials at Zvejnieki, Latvia. Introduction to bird finds and a proposal for interpretation. In L. Larsson and I. Zagorska (eds.), *Back to the origin. New research in the Mesolithic-Neolithic Zvejnieki cemetery and environment, northern Latvia*. Acta Archaeologica Lundensia, Series in 8o, N°. 52. Lund, 289-299.
- O'Shea, J. and Zvelebil, M. (1984) Oleneostrovski mogilnik: Reconstructing the Social and Economic Organization of Prehistoric Foragers in Northern Russia. *Journal of Anthropological Archaeology* 3, 1-140.
- Spindler, K. (2001) *The Man in the Ice: The Preserved Body of a Neolithic Man Reveals the Secrets of the Stone Age*. London.
- Vanhaeren, M. and d'Ericco, F. (2002) The Body Ornaments Associated with the Burial. IN J. Zilhão and E. Trinkaus (eds.), *Portrait of the Artist as a Child. The Gravettian Human Skeleton from the Abrigo do Lagar Velho and its Archaeological Context*. Trabalhos de Arqueologia 22. Lisboa, 154-186.
- Worbst, M. H. (1977) Stylistic behaviour and information exchange. In C. E. Cleland (ed.), *For the Director: Research Essay in Honour of James B. Griffith*. Museum of Anthropology Papers in Anthropology 61. Ann Arbor, 317-342.
- Zagorska, I. (2006) Radiocarbon chronology of the Zvejnieki burials. In L. Larsson and I. Zagorska (eds.), *Back to the origin. New research in the Mesolithic-Neolithic Zvejnieki cemetery and environment, northern Latvia*. Acta Archaeologica Lundensia, Series in 8o, N°. 52. Lund, 91-113.
- Zagorski, F. (1987) *Zvejnieku akmens laikmeta kapulauks*. Riga.
- Zagorskis, F. (2004) *Zvejnieki (Northern Latvia) Stone Age Cemetery*. Bar International Series 1292. Oxford.

Corresponding author: lars.larsson@ark.lu.se



Nathalie Schluck, Christophe Rose, Didier Le Thiec
et Karine Boulanger

Un fragment de toile en coton découvert dans le *frigidarium* d'une villa gallo-romaine à Damblain (Vosges, France)

En 2008-2009, une villa gallo-romaine située sur l'ancienne base aérienne de Damblain, dans les Vosges (France), a été mise au jour et étudiée par l'INRAP (Institut National de Recherches Archéologiques Préventives). Les archéologues y ont identifié une *pars urbana* et une *pars rustica*. C'est dans l'aile occidentale du bâtiment résidentiel de la *pars urbana*, dont les structures architecturales sont bien conservées, qu'un ensemble balnéaire a été dégagé. Au sein de ce secteur thermal, un fragment de textile a été découvert de manière fortuite, derrière un joint en mortier de tuileau du *frigidarium*. La pose de ce joint est datée vers la fin du II^{ème} siècle ou vers le début du III^{ème} siècle après J.-C..

Précisément, le fragment de textile a été découvert après retrait du joint en mortier de tuileau, joint isolant la partie inférieure de la paroi est du *frigidarium* : le textile était placé entre le joint en mortier de tuileau et la partie inférieure du mur, au niveau de la paroi n° 54 (Fig. 1-3). Il était donc situé derrière un joint très solide, lequel a pour fonction d'isoler la partie inférieure du *frigidarium* des infiltrations d'eau.

Fixé par de la poussière ou par des grains de calcite à la paroi inférieure du *frigidarium*, le fragment de textile est composé de fibres brunes claires, apparemment non teintées, localement noircies, en particulier au bout des fils. Il mesure environ 1 cm x 3,3 cm (Fig. 4-5). D'autres fils, mesurant quelques millimètres, étaient visibles au même emplacement, à quelques centimètres du fragment. Ces fils présentaient, à l'œil nu, les mêmes caractéristiques physiques et techniques que les fils du fragment analysé ci-après (Fig. 6).



Fig. 1. Vue d'ensemble de la paroi est avant retrait du joint (© INRAP).



Fig. 2. Paroi est, après retrait du joint (© INRAP).

Procédés analytiques : méthode, matériel analytique et échantillonnage

Le fragment de textile a été caractérisé au niveau technique et au niveau matériel : les techniques de tissage et de torsion des fils du textile et la nature de ces fils ont été analysées. Une loupe monoculaire Peak Short focus (8 x 20) a permis de déterminer la structure du tissu et des fils. Des observations au MEB ont mené à la caractérisation de la nature des fibres.

Les observations microscopiques ont été réalisées à l'INRA (Institut National de la Recherche en Agronomie), Centre de Nancy, avec un Microscope électronique à balayage (MEB) (ZEISS 1450 VP) en mode pression contrôlée (Fig. 7-12) – à différents grandissements et à 20 kV de tension d'accélération. L'emploi de ce MEB présente l'avantage d'une préparation simple des échantillons, sans métallisation de ces derniers.

Trois fils ont été prélevés à partir du textile même : deux fils (prélèvement n° 1 et n° 2) situés sur un axe théorique 0y, un fil situé sur un axe théorique 0x (prélèvement n° 3), la chaîne ne pouvant être distinguée de la trame. Deux coupes transversales ont été réalisées à partir des prélèvements n° 1 et n° 2 ; une vue longitudinale du prélèvement n° 3 a complété les observations réalisées à partir des coupes.

Pour ce qui concerne la vue longitudinale des fibres, le fil d'environ 2 mm a été fixé sur un ruban adhésif double-face. Pour ce qui concerne les coupes, les fils ont été insérés dans une plaque perforée Joliff (épaisseur : ca 0,4 mm; diamètre des perforations: ca 0,5 mm) avec l'aide de fils de polyester, puis les échantillons ont été également fixés sur un ruban adhésif double-face.

Résultats

Le fragment a pu être caractérisé de la manière suivante : il s'agit d'une toile très peu dense composée principalement de fibres de coton de torsion Z apparemment non teintées.

Analyse technique du fragment (Fig. 3-5)

Toile

0y : fils simple, torsion Z moyenne, 0,1 mm, brun clair. 4 fils sur 0,5 cm, soit 8 fils au cm.

0x : fils simple, torsion Z moyenne, 0,1 mm, brun clair. 11 fils au cm.

Analyse des fibres (Fig. 7-12)

Les coupes n° 1 et n° 2 ainsi que la vue longitudinale ont permis d'identifier principalement des fils de coton et une fibre péricyclique (lin ?).

Coton :

Vue longitudinale : fibres ayant l'aspect d'un ruban aux boursouflures latérales, torsions multiples des fibres sur elles-mêmes.

Coupe transversale : lumen ayant l'aspect d'une fente, paroi externe de la fibre rappelant le profil d'une fève de haricot.

Fibre péricyclique (lin ?) :

Vue longitudinale : paroi lisse marquée de flexions transversales.

Commentaire

Les fragments de textiles datés au plus tard de la première moitié du III^{ème} siècle ap. J.-C. principalement composés de coton et tissés à partir de fils de torsion Z sont rares en Europe. Pour la période romaine, des fragments en coton ont été découverts de manière ponctuelle sur le continent européen (Wild 1970, 18) tandis qu'ils sont plus fréquents en Egypte, en Nubie, au Soudan ou au Proche-Orient (Lorquin et Moulherat 2001-2002, 186-192). En particulier, six sites européens ont livré des fragments en coton (Wild *et al.* 2008, 145) tandis que certains sites égyptiens, soudanais et nubiens sont particulièrement fournis en fragments



Fig. 3. Paroi n° 54 après retrait : vue d'ensemble (© N. Schluck).



Fig. 4. Vue du fragment textile posé sur la paroi n° 54 (© N. Schluck).

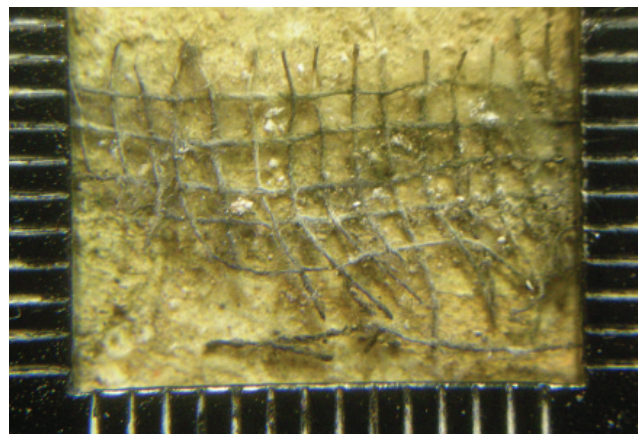


Fig. 5. Détail du fragment (© N. Schluck).

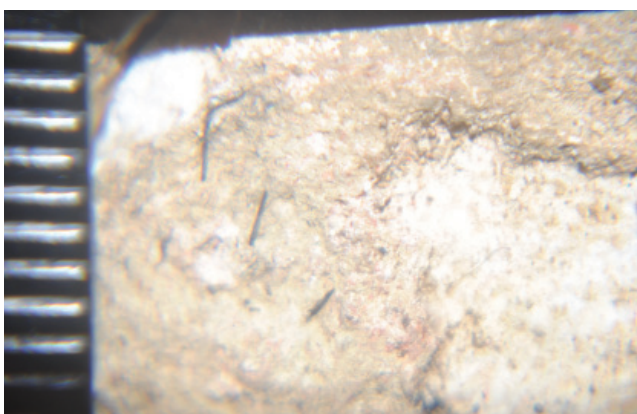


Fig. 6. Fils de même qualité que ceux du fragment situés à 1 cm de distance à gauche du fragment (© N. Schluck).

tissés à partir de fibres de coton (Wild *et al.* 2008, 145). Parmi eux, nombre de toiles sont présentes, la torsion des fils variant entre le sens S et le sens Z.

Dans ce contexte, le *Periplus Maris Erythraei*, utilisé en tant que source primaire, pourrait dessiner en partie une géographie du commerce du coton entre l'Inde et l'Égypte romaine (Casson 1989, 292-293 ; Wild 1997, 287-298 ; Lorquin et Moulherat, 2001-2002, 189). Rédigé en grec par un auteur inconnu, probablement au milieu du I^{er} siècle ap. J.-C., le *Périple* décrit les relations commerciales maritimes entreprises depuis l'Égypte jusqu'aux confins barbares de l'Empire, c'est-à-dire jusqu'à l'Inde, en passant, entre autres, par la côte somalienne et l'Arabie, *via* la mer Erythrée. Y sont cités des produits échangés au sein de cet espace commercial, produits parmi lesquels figurent des textiles dont du « coton » nommé *καρπάσος* (*Periplus Maris Erythraei*, 41 : 14.6) : l'interprétation de ce terme en tant que « fibre de coton » (Casson 1989, 77, 292)

conduit certains auteurs à esquisser des hypothèses sur le transit de cette fibre à partir de l'Inde, voire sur le transit des éventuels vêtements tissés à partir de cette fibre (Casson 1989, 292-293 ; Wild 1997, 291). L'on prendra néanmoins en considération trois données qui relativisent ces hypothèses : d'une part, l'on s'interroge aujourd'hui sur l'éventuelle culture du coton dans certaines oasis égyptiennes et palestiniennes (Wild *et al.* 2008, 144), d'autre part, certaines sources antiques attribuent « faussement certaines productions au pays de transit, non à celui d'origine (...) » (Schneider 2004, 285) au point qu'Éthiopie et Inde pourront se rencontrer dans l'imaginaire gréco-romain, voire se confondre, enfin des données d'ordre archéologique et littéraire placent l'origine et le développement de la culture du coton au Bélouchistan pakistanais dès la première moitié du VI^{ème} millénaire avant J.-C. tandis que la fibre semble avoir été cultivée en Mésopotamie et à Bahreïn plus tardivement (Tengberg et Moulherat 2008, 44-45), ce qui indiquerait que la culture de la fibre de coton dans le monde antique n'est pas exclusive à l'Inde.

Aussi, en l'état actuel des connaissances, dans une perspective de datation antique et en gardant toute réserve, la présence de coton et la torsion Z de la toile de Damblain suggèreraient que ce fragment consiste en un produit d'importation éventuellement indien ou peut-être égyptien si la seconde fibre observée consiste bien en du lin (Wild *et al.* 2008, 146 ; J. P. Wild, communication personnelle, 10/02/2012).

Il peut également s'agir d'un textile ré-employé dans un contexte gallo-romain. Parmi ces hypothèses, la fonction de ce fragment pose toujours problème.

On le voit, il est encore trop tôt pour attribuer une origine géographique et une fonction à ce petit fragment : cette tâche nous incombera ultérieurement. La toile de Damblain méritera comparaison avec



Fig. 7. Vue d'ensemble du fil (© INRA Nancy).

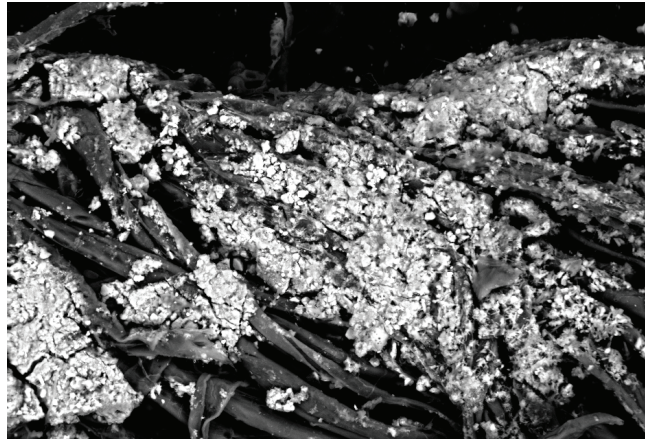


Fig. 8. Couche minérale à la surface du fil (© INRA Nancy).

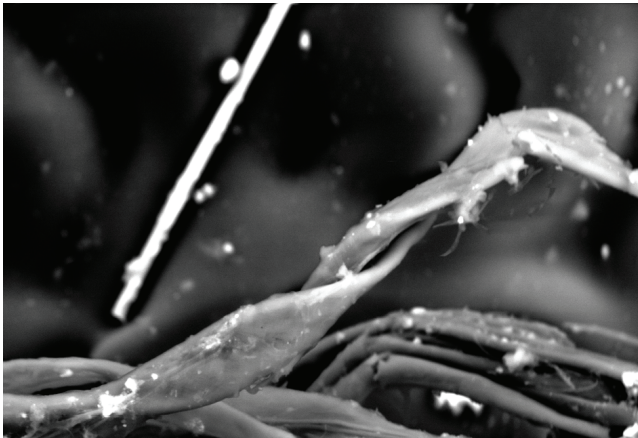


Fig. 9. Fibre de coton : torsions caractéristiques (© INRA Nancy).

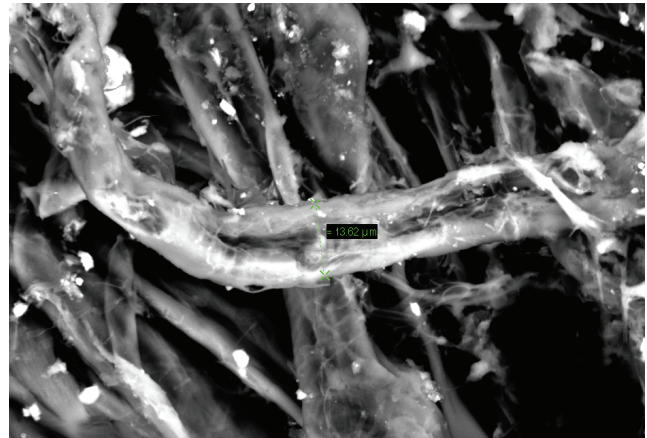


Fig. 10. Fibre de coton : boursoufflures latérales (© INRA Nancy).

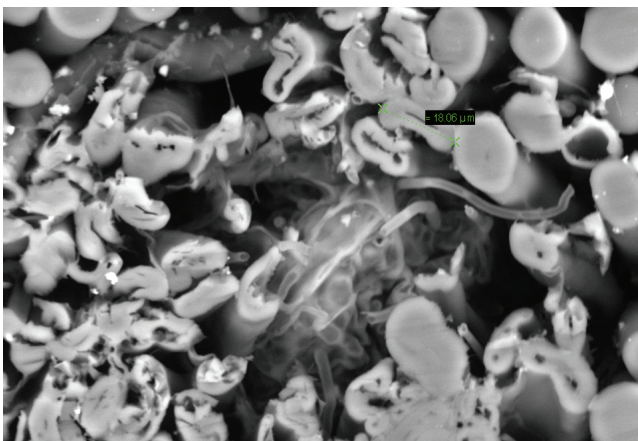


Fig. 11. Coupe : à gauche du cliché, fibres de coton en forme de fèves de haricot, lumen fin. Les fibres sans lumen, à droite du cliché, consistent en du polyester contemporain (cf. préparation des échantillons) (© INRA Nancy).



Fig. 12. Fibre pérycyclique parmi les fibres de coton (© INRA Nancy).



d'autres toiles à la structure très ouverte datées de la même période, mais également avec des toiles plus récentes. Dans un objectif comparatif, des textiles plus tardifs, datés jusqu'au XX^{ème} siècle, pourraient être pris en considération car les étoffes tissées à partir de coton sont introduites en Europe au moins dès le Bas Moyen-Age.

L'état de conservation du fragment reste remarquable. Une isolation du milieu climatique aura-t'il conduit à sa préservation ? Les traces noires observées à l'œil nu à la surface de certains fils, d'abord considérées comme des traces de carbonisation, consisteraient-elles en une couche isolante (résine, goudron, argile)? Les résidus observés au MEB indiquent la présence de constituants de l'argile (Plomb, Zinc, Magnésium, Cuivre, Fer, Titane), matériau imperméable : une argile, le joint en mortier de tuileau ainsi que la calcite observée à la surface de la toile auront pu isoler le textile du climat très humide du *frigidarium*.

Summary

A textile fragment has been discovered on the archaeological site of Damblain (Vosges), in France, by the Institut National de Recherches Archéologiques Préventives (INRAP). It was located in the *frigidarium* of a Gallo-Roman villa. This remarkably preserved fragment was found behind a mortar join made of broken tiles which was sealed at about the end of the 2nd century AD or at the beginning of the 3rd century AD. A technical and material analysis using the SEM at the Institut National de Recherche Agronomique (INRA), has proved it to be made of cotton fibres. The fibres are Z-spun; these Z-spun threads are woven to form an open tabby. Given the rarity of this fabric, at least in the occidental part of the Roman Empire, we are now trying to compare it with other tabbies in order to better understand its origin and its method of manufacture.

Remerciements

J.P. Wild, Université de Manchester et S. Wuelfert, Haute Ecole des Arts de Berne.

Bibliographie

Casson, L (1989) *The Periplus Maris Erythraei. Text with Introduction, Translation and Commentary*, Princeton.

Lorquin A. et Moulherat C. (2001-2002) *Corpus des vestiges de coton recensés pour l'Antiquité tardive en Syrie, Egypte, Nubie et Soudan in Aquitania*, XVIII, 186-192.

Schneider P. (2004) *L'Ethiopie et l'Inde : interférences et confusions aux extrémités du monde antique*, Rome.

Tengberg M. et Moulherat C. (2008) *Les « arbres à laine »*. *Origine et histoire du coton dans l'Ancien Monde in Les Nouvelles de l'Archéologie*, 42-46.

Wild J. P. (1970) *Textile Manufacture in the Northern Roman Provinces*, Cambridge.

Wild J. P. (1997) *Cotton in Roman Egypt: some problems of origin in Al-Rafidan*, Tokyo, vol. XVIII, 287-298.

Wild J. P., Wild F. C. et Clapham A. J. (2008) *Roman cotton revisited* in Alfaro C. et Karali L. (éds) : *Purpureae Vestes. II Symposium Internacional Sobre Textiles y Tintes del Mediterráneo en el mundo antiguo*, València, 143-147.

Corresponding author : nathalieschluck@hotmail.fr

Richard Firth

túg | NÍG.SAG.LAL.SAL | :

A headband written using a logogram

In general, during the period 2500-2000 BC, the same types of textiles were used throughout Mesopotamia and were identified using a common terminology. However, there are some examples where textile names predominantly appear on tablets from one location, although it is possible that the same types of textile were used elsewhere but identified using different names. túg|NÍG.SAG.LAL.SAL| is a headband and the word is found written on clay tablets from the Early Dynastic IIIb, Lagash II and Ur III periods. The word is very unusual because, although it was used at a number of different locations and identified using the same cuneiform signs, the order of the signs differed systematically according to the location. Thus, túg|NÍG.SAG.LAL.SAL| was used at Girsu, túg|NÍG.SAL.LAL.SAG| at Umma, and there is a third variation túg|NÍG.SAL.SAG.LAL| found on a tablet with unknown provenience (TLB 3, 168).¹ Thus, the 'word' can be regarded as a logogram because the order of the individual signs within the word can be varied whilst the word retains the same meaning (Steinkeller 1989, 276).

Waetzoldt (1972, 140 and 279; 1980-83, 200), Steinkeller (1989, 276-277) and Gelb, Steinkeller and Whiting (1991, 294) each give very brief notes on this type of headband. The objective here is to bring these earlier considerations together and develop them further, taking into account the much wider range of texts that are now available. Although there is a wealth of textiles listed in the tablets, these are under-represented in Sumerian dictionaries. This is probably because it is often difficult to determine enough information about textiles to distinguish one from another. The aim here is to provide sufficient detail for túg|NÍG.SAG.LAL.SAL| so that it can be properly included in future research.²

Waetzoldt (1972) transliterated the cuneiform signs as túg-nì-sag-lá-mí, however, Steinkeller (1989, 276-277)

and Gelb, Steinkeller and Whiting (1991, 294) render the word as túg|NÍG.SAG.LAL.SAL|, noting the parallel with chestband, níg-lal-gaba, and interpreting the sign, SAL, as 'fine' or 'female'.

Following Steinkeller (1989, 276-277) and accepting túg|NÍG.SAG.LAL.SAL| as the correct transliteration then, taken literally, it is a woollen textile (túg) which is something (níg) that binds (lal) the head (sag) that is thin or fine (sal). There is some ambiguity since the same cuneiform sign can be transliterated in different ways so, if the sign rendered as SAL was instead given as MUNUS, then it would imply female, rather than light or fine.

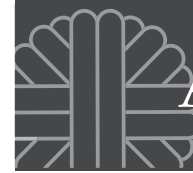
In terms of the physical characteristics of the textile, Waetzoldt (1980-1983) notes the tablet UNT 34, which gives two examples for the length of this textile, i.e. 0.6 m and 3.5 m. Another tablet (ITT 5, 6711) implies that the weight of the textile is 83¹/₃ g. It is evident that if a headband of length 3.5 m is wrapped around the head then the resulting headwear would be something akin to a turban. However, a headband of length 0.6m would only pass once around the head of a full size adult.

The weight of the textile is relatively light considering its length. Therefore, it would seem appropriate if SAL was interpreted as light or fine. On the other hand a significant proportion of these headbands are described as being of quality, nin. This is a female designation of textile quality, analogous to lugal (royal). Thus, at least in these cases, the túg|NÍG.SAG.LAL.SAL| were specifically intended for females, supporting the suggestion the sign, given as SAL, should instead be rendered as MUNUS ('female').

A further consideration is that SAL is frequently written as an adjunct to LAL, as túg|NÍG.SAG.



Tablet no.	Text	Context	Period
DP 31 (1.12)	NÍG.SAG.<LAL>.SAL	Girsu	EDIIIb
DP 32 (2.4')	1 NÍG.SAG.LAL.SAL	Girsu	EDIIIb
DP 75 (4.2)	1 NÍG.SAG.LAL.SAL siki	Girsu	EDIIIb
OrNS 42, 236 (2.5)	1 NÍG.SAG.LAL.SAL	Girsu	EDIIIb
RIME 1.9.9.1 (10.10)	1 NÍG.SAG.LAL.SAL	Girsu	EDIIIb
RTC 18	1 NÍG.SAG.LAL.SAL	Girsu	EDIIIb
ITT 4 <7322>	NÍG.SAG.LAL.SAL	Girsu	
RTC 198	1 ^{túg} NÍG.SAG.LAL.SAL nin	Girsu	GU.16.04
MVN 6, 504	1 ^{túg} NÍG.SAG.LAL.SAL nin	Girsu	GU.16.04
MVN 7, 152	5 ^{túg} NÍG.SAG.LAL.SAL nin	Girsu	Lagash II
MVN 7, 459	1 ^{túg} NÍG.SAG.'LAL.SAL' [...]	Girsu	UN.i.01
ITT 5, 6711	2 ^{túg} NÍG.SAG.LAL.SAL ús sag ¹⁰ ki-lá-bi 1/3{ša} 3 ^{túg} NÍG.SAG.LAL.SAL ús ki-lá-bi 1/2 ma-na	Girsu	Š.08
RTC 281	[x] ^{túg} NÍG.SAG.LAL.SAL sag ¹⁰	Girsu	Š.08
RA 65, 20 7	2 ^{túg} NÍG.SAG.LAL.SAL sag ¹⁰	Girsu	Š.08.10
MVN 7, 394	[...] 2 ^{túg} NÍG.SAG.LAL.SAL sag ¹⁰ [...] 1 ^{túg} NÍG.SAG.LAL.SAL ús sag ¹⁰ 3 ^{túg} NÍG.SAG.LAL.SAL ús 5 ^{túg} NÍG.SAG.LAL.SAL sag ¹⁰ 1 ^{túg} NÍG.SAG.LAL.SAL ús sag ¹⁰ 1 ^{túg} NÍG.SAG.LAL.SAL ús sag ¹⁰	Girsu	Š.09.04
MVN 7, 405	1 ^{túg} NÍG.SAG.LAL.SAL ús	Girsu	Š.09.08
SAKF 123	1 ^{túg} NÍG.SAG.LAL.SAL [...]		Š.40
TUT 129 (1.8)	[... ^{túg} NÍG].SAG.LAL.SAL níg-PI-eb	Girsu	AS.01
HLC 84 (pl. 48)	1 ^{túg} NÍG.SAG.LAL.SAL [?]	Girsu	AS.07.04
DAS 311	nin-ušur ₄ ama-tuku ₅ ^{túg} NÍG.SAG.LAL.SAL	Girsu	AS.08.06
MCS 5, 31 AOTc 229	nin-ušur ₄ ama-tuku ₅ ^{túg} NÍG.SAG.LAL.SAL	Girsu	AS.08.06
Princeton 2, 247	1 ^{túg} <NÍG>.SAG.LAL.SAL	Girsu	AS.09.12
UNT 103	5 ^{túg} NÍG.SAG.LAL.SAL	Girsu	IS.04.09
ITT 5, 6855	1 ^{túg} NÍG.SAG.LAL.SAL nin	Girsu	Ur III



Tablet no.	Text	Context	Period
MVN 6, 519	túg NÍG.SAG.LAL.SAL nin lá-ia 4 túg NÍG.SAG.LAL.[...] lá-ia 6 3-kam ús túg NÍG.SAG.LAL.SAL nin lá-ia 4 lá-ia 15 túg NÍG.SAG.LAL.SAL nin lá-ia 30 túg NÍG.SAG.LAL.SAL 3-kam ús	Girsu	Ur III
TUT 126 (3.21)	8 túg NÍG.SAG.LAL.SAL sumun	Girsu	Ur III
UNT 16 (rev.1.4') ¹	2 túg NÍG.SAG.LAL.SAL níg-IGI-eb	Girsu	Ur III
UNT 34 (2.6) ² (2.20)	1 túg NÍG.SAG.LAL.SAL siki? 1 kùš 6 šu-si 1 túg NÍG.SAG.LAL.SAL ús nin 7 kùš	Girsu	Ur III
HSS 4, 6 (4.3) (rev.2.20)	túgbar-du15 NÍG.SAG.LAL.SAL nin 26 túg NÍG.SAG.LAL.SAL ù túgbar-si níg-se11- se11 nin	Girsu	Ur III
RTC 304 (2.6)	5 túg <NÍG>.SAG.LAL.SAL du sumun	Girsu	Ur III

1. The words níg-PI-eb and níg-IGI-eb appear following túg|NÍG.SAG.LAL.SAL| on TUT 129 and UNT 16. Since PI and IGI are similar signs, then it is likely that these represent the same word (níg-PI-eb is also found qualifying textiles on MVN 5, 155 and TUT 126).
2. There is a problem with the reading of the sign given above as siki on UNT 34: I.7, I.11 and II.6. Waetzoldt (1972, 234) reads the sign as KWU 898+AŠ (sic). The transliteration in the cdli database renders this sign as dara₄, however, there are no other examples of Ur III textiles described as dara₄ (red) in the cdli database. Thus siki (wool) is used here both because it is a reasonable interpretation of the sign and it is a plausible reading in this context.

Table 1: túg|NÍG.SAG.LAL.SAL| on tablets from Girsu.

LALxSAL|. Following Waetzoldt (1972, 279), it is judged unnecessary to draw a distinction between túg|NÍG.SAG.LAL.SAL| and túg|NÍG.SAG.LALxSAL|. However, the use of SAL as an adjunct to LAL would seem to favour its interpretation as a light or fine textile that is bound (around the head).

Tablet ITT 5, 6855 gives the amount of effort required to make a túg|NÍG.SAG.LAL.SAL| and the time required for fulling. However, there is a difficulty here arising from the similarity between the signs diš (i.e. 1) and géš (i.e. 60). On the basis simply of the drawing of this tablet, the reading of lines II.4-6 would be
1(diš) túg|NÍG.SAG.LAL.SAL| nin
á géme-bi 3(diš)
ʾá¹ lú azlag₂-bi 6(diš)

The lengths of time are usually quoted in days, however, from a practical perspective, the amount of time required for the textile women (géme) to spin the wool and weave the textile would far exceed three days. This is particularly the case since the sign, nin,

denotes that this is a very high quality textile, probably implying that it was made with very thin thread. For this reason, Waetzoldt (1972, 140) reads line II.5 as: á géme-bi 3(géš) (i.e. 3 x 60 = 180). On this basis, it is suggested that the time required by the textile women to make the túg|NÍG.SAG.LAL.SAL| nin is 180 days and the time required by the fullers (lú azlag₂) is six days. Whilst this is plausible, it relies heavily on an interpretation of a cryptic text and clearly it would be preferable if the inscription were more explicit.

Tables 1, 2 and 3 list the tablets including the word túg|NÍG.SAG.LAL.SAL| and its variations. As already noted, in terms of the data available, the use of the word túg|NÍG.SAG.LAL.SAL| appears to have been restricted to Girsu whereas túg|NÍG.SAL.LAL.SAG| was used at Umma. Waetzoldt (1983) noted this correlation based on a relatively small number of examples. The Tables below show that it remains valid even though a substantially larger number of tablets have been considered.



Tablet no.	Text	Context	Period
Nisaba 11, 25 (1.17 & 20)	3 túg NÍG.SAL.LAL.SAG 3-kam ús 1 túg NÍG.SAL.LAL.SAG du	Umma	Š.34
SAT 2, 190 (2.13)	1 túg NÍG.SAL.LAL.SAG a-rá 1-kam	Umma	Š.38
TCL 5, 6055	1 túg NÍG.SAL.LAL.SAG du	Umma	AS.03.04
UTI 3, 1855	5 túg NÍG.SAL.LAL.SAG níg-dára	Umma	AS.05
AnOr 1, 46	16 túg NÍG.SAL.LAL.SAG 14 túg NÍG.SAL.LAL.SAG [...] 5 túg NÍG.SAL.LAL.SAG du sumun 4 túg NÍG.SAL.LAL.SAG du 3 túg sumun 2 túg NÍG.SAL.LAL.SAG [...] 16 túg NÍG.SAL.LAL.SAG ga- [...]	Umma	AS.06
MS 2011 (rev.2.16')	2 túg NÍG.SAL.LAL.SAG du	Umma?	AS.07
BM 110313 ¹	6 túg NÍG.SAL.LAL.SAG	Umma	AS.09.11
AAICAB 1/1, pl. 43-44, 1911-240	8 túg NÍG.SAL.LAL.SAG 1 túg NÍG.SAL.LAL.SAG	Umma	ŠS.05
AAICAB 1/1, pl. 35, 1911-227	1 túg NÍG.SAL.LAL.SAG dam ² ba-ka [ŠU+LAGAB] 1 túg NÍG.SAL.LAL.SAG	Umma	IS.03.01
Rochester 146	'túg' NÍG.SAL.LAL.SAG	Umma	Ur III
BPOA 1, 435	1 túg NÍG.SAL.LAL.SAG	Umma	Ur III
Sale Documents 88	túg NÍG.SAL.LAL.SAG	Umma	Ur III

1. Pomponio 2010, 190.

Table 2: túg|NÍG.SAL.LAL.SAG| on tablets from Umma.

Tablet no.	Text	Context	Period
TLB 3, 168	1 túg NÍG.SAL.SAG.LAL 3 túg NÍG. SAL.SAG.[LAL] 1 túg NÍG. SAL.SAG.LAL		Ur III

Table 3: túg|NÍG. SAL.SAG.LAL| on a tablet with unknown provenience.



During the Early Dynastic IIIb period, the name of this headdress is given as |NÍG.SAG.LAL.SAL| without the textile determinative, túg, used in later periods. Strictly, this leaves open the possibility that, during this period, the headdress could have been made from either wool or linen, although in one case (DP 75) it is specified that it was made from wool (siki).

During the Lagash II period, the túg|NÍG.SAG.LAL.SAL| listed are qualified by nin (lady) and the usage of this quality designation continues into the Ur III period. It is particularly interesting to note MVN 6, 519 where we find both

túg|NÍG.SAG.LAL.SAL| nin

túg|NÍG.SAG.LAL.SAL| 3-kam ús

where 3-kam ús denotes that the textile is of third quality. Thus, it is clear that nin is indicating the textile quality, i.e. first class quality, suitable for a lady (cf. šàr, also rendered as lugal, which can be used to denote first class quality, or royal quality; see the discussion by Waetzoldt 1972, 47-48).

Similarly, on tablets ITT 5 6711, RA 65 20 7 and MVN 7 394, túg|NÍG.SAG.LAL.SAL| is qualified by the word sag₁₀ (also rendered as sig₅ or saga) which is also a term describing quality. Thus, sag₁₀ is good quality and ús sag₁₀ is the following quality, i.e. second class quality (Waetzoldt 1972, 47). On RTC 304, the textile is described as being of ordinary quality (du). There are also qualifying terms, old (sumun) and rag (níg-dára).

It is worth noting that the lower quality examples are found on the later texts, from the Ur III period. Further, at Girsu, the qualities of many of these textiles is relatively high, whereas at Umma there are more examples of túg|NÍG.SAG.LAL.SAG| of an ordinary quality.

The aim of this paper has been to consider the Mesopotamian headband known as túg|NÍG.SAG.LAL.SAG| and to build on the previous, relatively brief notes, together with new transliterations of tablets, to give detailed consideration to this textile. It has been demonstrated that there is sufficient information about this textile to warrant its inclusion in Sumerian dictionaries.

Notes

1. The choice of format of the word, túg|NÍG.SAG.LAL.SAL|, and the abbreviations used in this paper in references to texts are based on The Cuneiform Digital Library Initiative (<http://cdli.ucla.edu/>).
2. Currently túg|NÍG.SAG.LAL.SAL| does not appear in *ePSD* (Electronic Pennsylvania Sumerian Dictionary, <http://psd.museum.upenn.edu>). It appears in Halloran's Sumerian Lexicon (2006, 202) as (túg)nig₂-sag-la₂-MI₂; nig₂-sag-la₂xMI₂, veil for women ('thing' + 'to hang' + 'female'). However, this textile is clearly not a veil since it is shown in the main text that it can be up to 3.5 m long.
3. Where the information is available, dates are given using the initials of the ruler (Gudea in Lagash II; Ur-Nammu, Šulgi, Šu-Suen, Amar-Suen, Ibbi-Suen in Ur III), the year of reign and the month.

References

- Gelb I. J., Steinkeller P., and Whiting R. M. Jr. (1991) *Earliest Land Tenure Systems in the Near East: Ancient Kudurrus*. Oriental Institute Publications 104, Chicago.
- Halloran, J. A. (2006) *Sumerian Lexicon: A Dictionary Guide to the Ancient Sumerian Language*. Los Angeles.
- Pomponio, F. (2012) New Texts Regarding the Neo-Sumerian Textiles. In C. Michel and M.-L. Nosch (eds), *Textile Terminologies in the Ancient Near East and Mediterranean from the Third to the First Millennia BC*. Oxford, 186-200.
- Steinkeller, P. (1989) *Sale Documents of the Ur III Period*. Stuttgart.
- Waetzoldt, H. (1972) *Untersuchungen zur Neusumerischen Textilindustrie*, Studi Economici e Tecnologici I, Rome (= UNT).
- Waetzoldt, H. (1980-83) Kopfbedeckung A. Philologisch, *Reallexikon der Assyriologie* 6, Berlin, 18-31.

Corresponding author: firth827@btinternet.com



Fleur Letellier-Willemin et Fabienne Médard

Techniques inattendues dans un fragment textile en coton, du site d'El Deir, Oasis de Kharga, Désert Occidental Egyptien

Dans l'*Archaeological Textiles Newsletter* numéro 43, des cordelettes de coton de la nécropole Sud du site d'el Deir avaient été décrites ; en grande quantité, elles maintenaient les linceuls des momies chrétiennes (Letellier-Willemin et Moulhérat 2006). Le coton semblait être utilisé presque exclusivement sous cette forme et pour cet emploi funéraire. Depuis, l'étude textile du Deir (qui est toujours en cours), a permis de mettre en évidence la présence de coton dans toutes les nécropoles du site, parmi lesquelles quatre traditionnelles et une chrétienne, datées d'environ 700 BC à 700 AD. Les nécropoles traditionnelles ont été partiellement réutilisées au fil des siècles, dont une au moins jusqu'au III^e siècle AD. Elle fut très vraisemblablement utilisée en même temps que la nécropole chrétienne. Comparée aux milliers de fragments provenant des cinq nécropoles, la pièce de coton de la tombe P5, datée du II^e siècle AD, est unique de par l'emploi particulier de cette fibre. Elle offre l'opportunité d'une nouvelle approche du coton, dans l'oasis de Kharga qui forme, avec Dakhla la Grande Oasis, une région aux caractéristiques bien spécifiques et différentes de la vallée (Fig. 1).

Le contexte archéologique

Le coton du Deir

A ce jour, le coton provient exclusivement du contexte textile funéraire du site. Une vingtaine de textiles en coton a été mis en évidence, parmi les milliers de fragments des cinq nécropoles et de l'atelier

d'embaumeur ; sans oublier les cordelettes décrites précédemment. Il s'agit majoritairement de fragments non teints en toile de coton, aux chaînes et trames de torsion S, et de quelques fils de coton Z2S utilisés en couture dans des textiles tissés en lin. Il existe aussi quelques rares toiles mixtes, en coton et lin, dans les nécropoles traditionnelles, ou en coton et laines (mouton, chameau ou chèvre) dans la nécropole chrétienne.

La tombe P5 du Piton aux chiens

C'est cette tombe qui a livré le fragment sujet de cet article. Elle fait partie des cinq tombes d'une nécropole traditionnelle, particulière par sa situation et son aspect, appelée le «Piton aux chiens» (Fig. 2). Les tombes sont creusées dans un piton rocheux, d'autant plus imposant qu'il s'érige seul dans la plaine, isolé de deux autres nécropoles traditionnelles. La tombe P5, dont l'architecture soulève toujours de nombreuses questions, est orientée plein sud. On y accède par une courte descenderie creusée dans la roche. Fermée par un bloc de calcaire blanc taillé avec soin, elle abritait des restes humains perturbés, adultes et enfants, ainsi qu'une grande quantité de textiles très fragmentés et dispersés. Elle fut réutilisée comme nécropole pour plusieurs centaines de momies de chien, dont certaines très bien conservées. La tombe P5 a donc une double histoire. Il est important de signaler qu'il n'a pas été retrouvé de coton parmi les textiles des momies de chiens. Leur décor, typiquement daté de l'époque

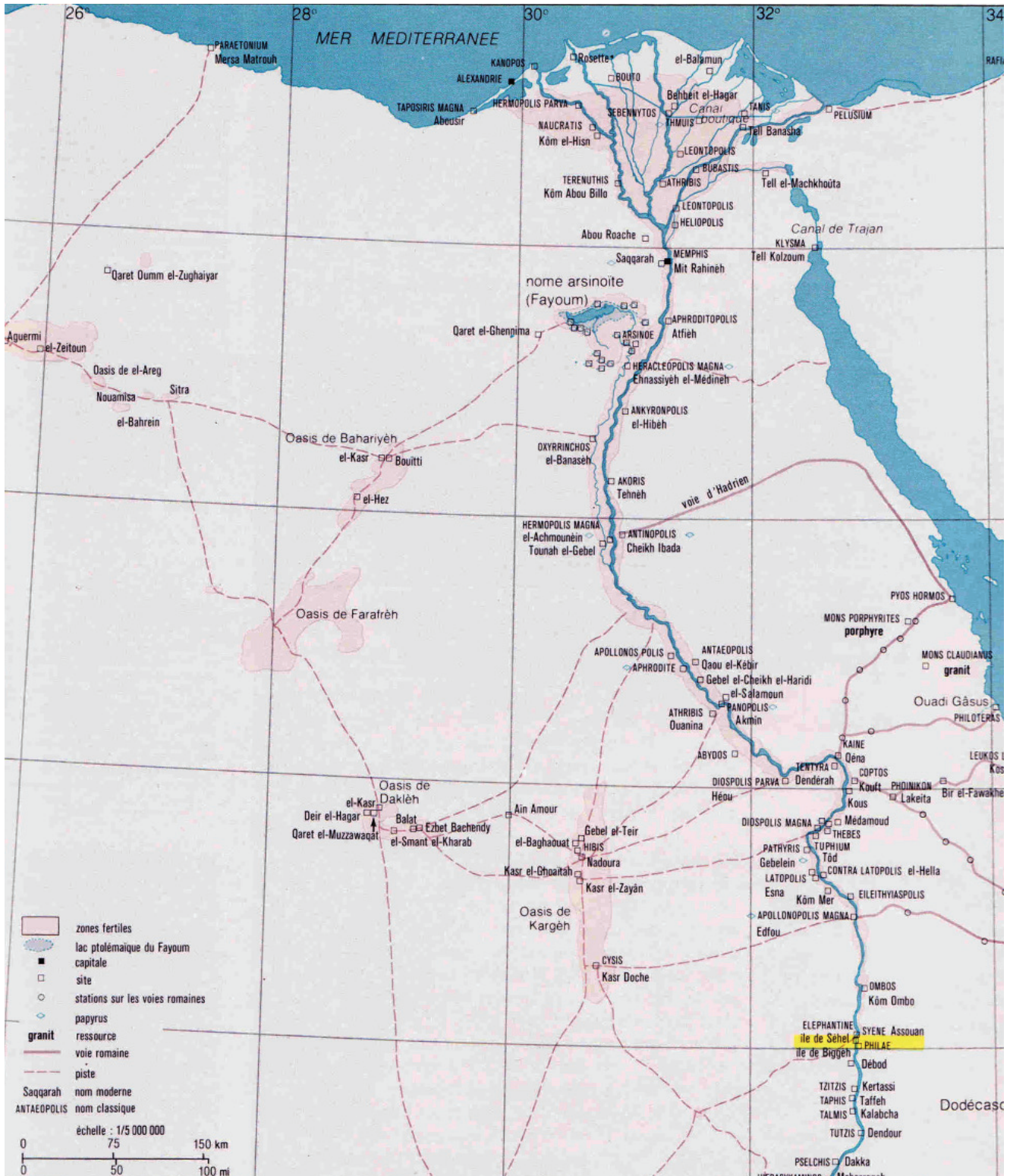


Fig. 1. D'après la carte de L'Égypte à l'époque gréco-romaine (© Lovell Johns d'après *Atlas de l'Égypte Ancienne*, J. Malek and J. Baines, p.53. Texte français: Fernand Nathan S.A. Paris 1981).



Fig. 2. Site d'El Deir, le Piton aux chiens où se situe la tombe P5.



Fig. 3. Le textile étudié, dans son état de découverte (clichés: F. Letellier-Willemin).

romaine, repose sur l'emploi de bandelettes de plusieurs teintes travaillées selon des motifs différents. La tombe P5 ayant été pillée à maintes reprises, seuls quelques fragments de poterie permettent de la dater du II^e siècle AD, selon Pascale Ballet (communication orale, janvier 2012). Globalement, les textiles mis au jour sont des toiles de lin non teintes pour la plupart de bonne ou très bonne qualité comparée aux autres textiles du site. Citons à titre d'exemple, un long fragment de bandelette non teint. Une réduction élevée et la présence des deux lisières latérales montrent qu'elle a été tissée pour les funérailles, fait rare dans les nécropoles traditionnelles, traduisant vraisemblablement la momification d'un personnage de haut rang. Cette tombe a également livré quatre fragments tissés avec une chaîne en lin et une trame en coton, ainsi qu'une pièce en coton cousue sur un textile en lin, pour le rapiécer. Notons enfin qu'il existait quelques rares et minuscules fragments de cartonnage sur des toiles en coton.

Description technique

Le fragment mesure 39 cm de large et 30 cm de long (si l'on accepte, comme repère, que les franges sont des franges de chaîne) (Fig. 3). Non teint, sa couleur «beige moyen» provient des produits d'embaumement ; il présente une tâche plus marquée sur une petite partie (sa couleur «marron», ni marronnée-rouge, ni noire, constitue une indication concernant les produits employés) (Fig. 4). Il possède des franges de chaîne et une lisière. Il s'agit d'une armure toile, composée de trois tissages différents, créant un décor particulier.

Les fils

Ils ont un diamètre d'environ 0,5 mm en chaîne comme en trame, parfois légèrement plus fins en chaîne et plus épais en trame. Ils sont de torsion S, d'environ 45° pour la trame, de 45° à 80° (et plus) pour la chaîne (Fig. 5 et 6).



Fig. 4. Couleur originelle du coton, conservée sur une très petite partie (clichés: F. Letellier-Willemin).

Les franges

Elles mesurent environ 2 cm et sont de torsion S (Fig. 7). Elles sont constituées de 8 fils (sur la figure 7), regroupés par quatre. Au départ de la frange, chaque groupe de quatre fils forme une cordelette de torsion Z. Ces deux cordelettes en Z sont ensuite réunies par une forte torsion S avant d'être nouées à leur extrémité. Certaines franges ont 6 fils, d'autres 10. Cette variabilité est fréquente parmi les centaines d'exemplaires frangés du site, quelle que soit la qualité des franges. La frange de lisière incomplète est composée de 8 fils.

Première partie du tissage

Les franges n'étant pas renforcées à leur départ, le tissage se présente d'emblée comme un Gros de Tours (Fig. 8), selon la définition du CIETA. Sur 2,5 cm, ce tissage est globalement régulier, mais on observe une zone de tassement plus élevée près de la lisière. Il existe deux noeuds de raccord de trame, ce qui est habituel. La réduction en chaîne est de 8 fils au cm, celle de trame (10 fils x 2) donc de 20 fils au cm.

Deuxième partie du tissage

L'absence de trame sur environ 0,5 cm crée un effet de jour, d'un aspect bien particulier compte tenu de la forte torsion des fils de chaîne (Fig. 9). Cette absence de trame semble se poursuivre sur trois coups. En l'absence de la deuxième lisière, il est impossible de dire si un des fils de trame, du Gros de Tours précédent, est pris dans cette lisière pour la suite du tissage, ou si les deux fils de trame sont stoppés ensemble.

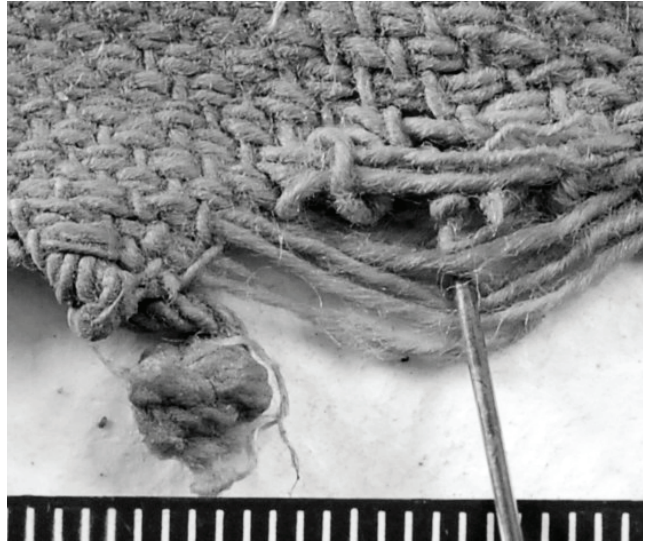


Fig. 5. Détail des trames (clichés: F. Letellier-Willemin).

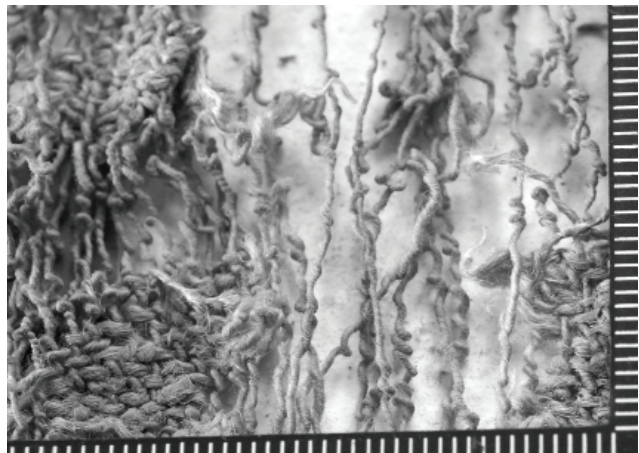


Fig. 6. Détail des chaînes (clichés: F. Letellier-Willemin).

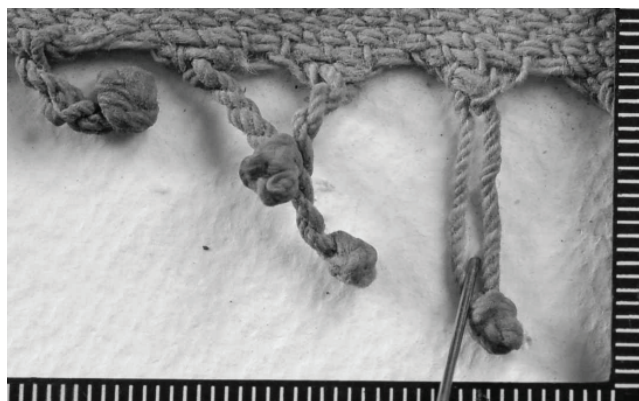


Fig. 7. Certaines franges détaillées (clichés: F. Letellier-Willemin).

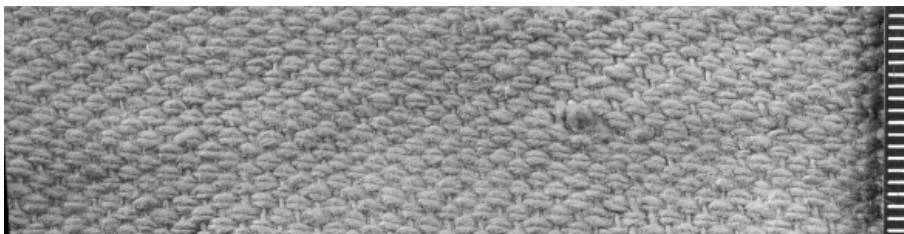


Fig. 8. Le Gros de Tours (clichés: F. Letellier-Willemin).

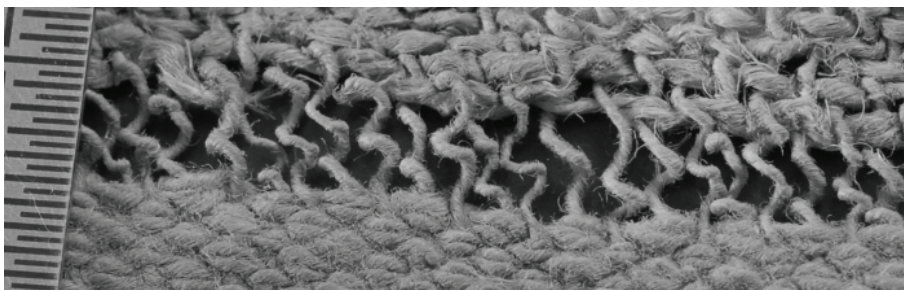


Fig. 9. Les jours, par absence de trame (clichés: F. Letellier-Willemin).

Troisième partie du tissage

Il forme une toile simple, sur 21 cm environ, dont la particularité tient à la très haute torsion des fils de chaîne, comparée à celle des fils de trame, ainsi qu'à une différence certaine de réduction entre les deux. La réduction est de 12 fils par cm en chaîne et de 8 fils en trame (Fig. 10). Cette différence engendre un effet irrégulier, contraire aux références de tissage «classique» égyptien. Par ailleurs, cet aspect contraste avec la régularité du Gros de Tours de la première partie. Il existe une courte erreur de liage où deux fils de chaîne contigus travaillent ensemble au lieu d'être séparés. Il s'agit donc d'un tissage d'aspect «crêpe», serré du fait de la différence de réduction et de la finesse des fils, mais différent des «crêpes» en laine que nous connaissons, dont la contexture est «carrée» (selon le CIETA), et la réduction plus faible, ce qui confère à la réalisation un aspect léger.

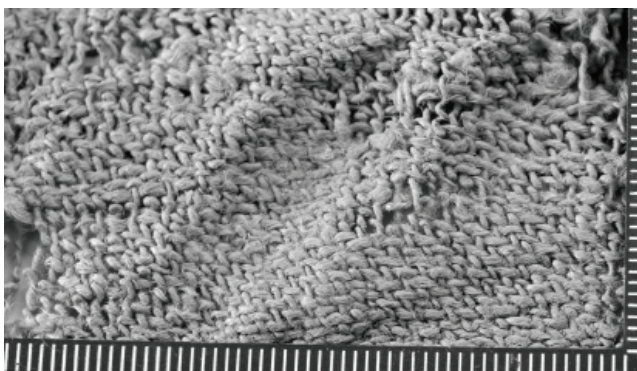


Fig. 10. La toile «crêpe» (clichés: F. Letellier-Willemin).

La lisière

Elle mesure 0,5 cm. Elle est constituée de 8 fils de chaîne regroupés par quatre, formant ainsi deux cordelettes de torsion Z (Fig. 11). Elles sont liées alternativement par les coups de trames. Les trois chaînes, à la suite de la lisière, sont doublées (composée chacune de deux fils non assemblés), sur toute la hauteur du fragment.

Le métier à tisser

Le modèle utilisé ici est un métier vertical à poids, permettant de réaliser certaines des particularités observées.

Comparaison technique avec les exemplaires textiles du Deir, tissés en lin pour les nécropoles traditionnelles et en laine pour la nécropole chrétienne

Les fils

A ce jour, les fils en lin, en laine ou en coton sont toujours de torsion S au Deir. Pour le lin, le diamètre des fils de chaîne (confirmés par la présence d'une lisière) est inférieur à celui des trames; très fins, ils mesurent entre 0,3 et 0,5 mm. La forte torsion des fils est fréquemment mise en évidence sur les fragments en lin, mais il s'agit toujours de fils isolés. Pour le lin, traditionnellement, une grande qualité textile se traduit par une réduction élevée, un tissage régulier, homogène, constitué de fils de même diamètre et de même torsion. Ce qui est fréquemment le cas au Deir. Il en est de même pour la laine. Seuls les effets reposent sur des fils différents, fortement tordus, en chaîne et en trame, pour créer un aspect «crêpe», comme cela a été constaté sur trois écharpes en laine (Letellier-Willemin 2009). Or le fragment de P5 possède des fils

de chaîne fortement tordus, des fils de trame de torsion moyenne, des fils de chaîne au diamètre inférieur à celui des trames, des réductions faibles en chaîne et en trame, mais plus importantes en chaîne.

Les franges et les jours et les lisières

Les franges en coton sont travaillées comme celles décorant les textiles en lin du Deir. Comme ici, les franges en lin ne sont pas systématiquement renforcées à leur départ par le passage de trames à fils multiples, par ailleurs très fréquentes dans le lin. Il n'a pas été retrouvé, à ce jour, de franges en laine.

Les jours apparaissent rarement dans les textiles en lin des nécropoles traditionnelles. Ceux attestés sont formés du regroupement des fils de chaîne à l'aide d'une ou de plusieurs trames, teintées ou non. Par contre, ils sont très fréquents dans les linceuls en lin chrétiens du Deir où ils sont créés par une absence de trame sur une certaine hauteur. C'est précisément ce que nous retrouvons dans ce fragment en coton.

La lisière de coton est travaillée comme la lisière des tissus de laine. Les lisières en lin sont toujours simples, formées par une plus haute réduction des fils de chaîne.

Le tissage

Le Gros de Tours est relativement fréquent sur des fragments en lin et dans toutes les nécropoles traditionnelles du Deir (Gros de Tours confirmés par l'existence d'une lisière).

La toile d'aspect crêpe a été mise en évidence dans la nécropole chrétienne, dans trois écharpes de tête en laines teintées. Elle existe également au Proche Orient dans quelques rares textiles (Granger-Taylor 2006, 121 et 127-128 ; Samir 2006, 192). Mais dans ces écharpes, la réduction chaîne et trame est faible et identique, ce qui confère aux textiles un aspect volontairement léger et homogène ; tel n'est pas le cas ici où il semble que l'effet recherché soit au contraire, d'une part un fort contraste entre le Gros de Tours régulier et le crêpe, et

d'autre part un aspect irrégulier volontaire du crêpe, aspect inattendu, répétons-le, selon les traditions égyptiennes.

Très peu d'erreurs de tissage existent dans ce fragment, ce qui est un gage de qualité.

Les métiers potentiellement utilisés au Deir seront évoqués dans la synthèse de l'étude des textiles du Deir, avec en grande partie, l'étude des erreurs rencontrées.

En résumé nous sommes en présence d'un textile présentant certains critères de qualité, adjoints à des caractéristiques nouvelles, inattendues, si on les compare aux fortes traditions textiles du lin et de la laine.

Comparaisons avec des textiles issus d'autres sites

A Kharga, deux exemplaires en coton sont recensés venant des nombreux textiles d'al-Bagawat la grande nécropole chrétienne près d'Hibis, sans plus de précision (Kajitani 2006, 97). Lors du survey du nord de l'oasis par Salima Ikram et Corinna Rossi, quelques fragments en coton ont été trouvés en surface (Jones 2006, 27-30). A Dakhla, des textiles en coton ont été mis en évidence (Bowen, communication personnelle, Leiden 2012), et sont en cours d'étude (Livingstone, communication personnelle 2012) ; ils proviennent d'habitats et de contextes funéraires. Mais leur tissage n'a rien de comparable avec celui du fragment de la tombe P5 du Deir.

Pour les autres sites d'Égypte, l'étude comparative est à entreprendre. A notre connaissance, il n'existe pas de tissage équivalent dans le désert oriental, ni sur la côte de la Mer Rouge (Cardon 2003, 622-625 ; 2011, 341-342 ; Bender Jørgensen 2006, 165-168; Wild, communication personnelle, 2012), ni sur les sites nubiens proches de la Haute Égypte (Adams 2006, 200-205 ; Wild, communication personnelle, 2012).



Fig. 11. La lisière, construite comme une lisière en laine (clichés: F. Letellier-Willemin).

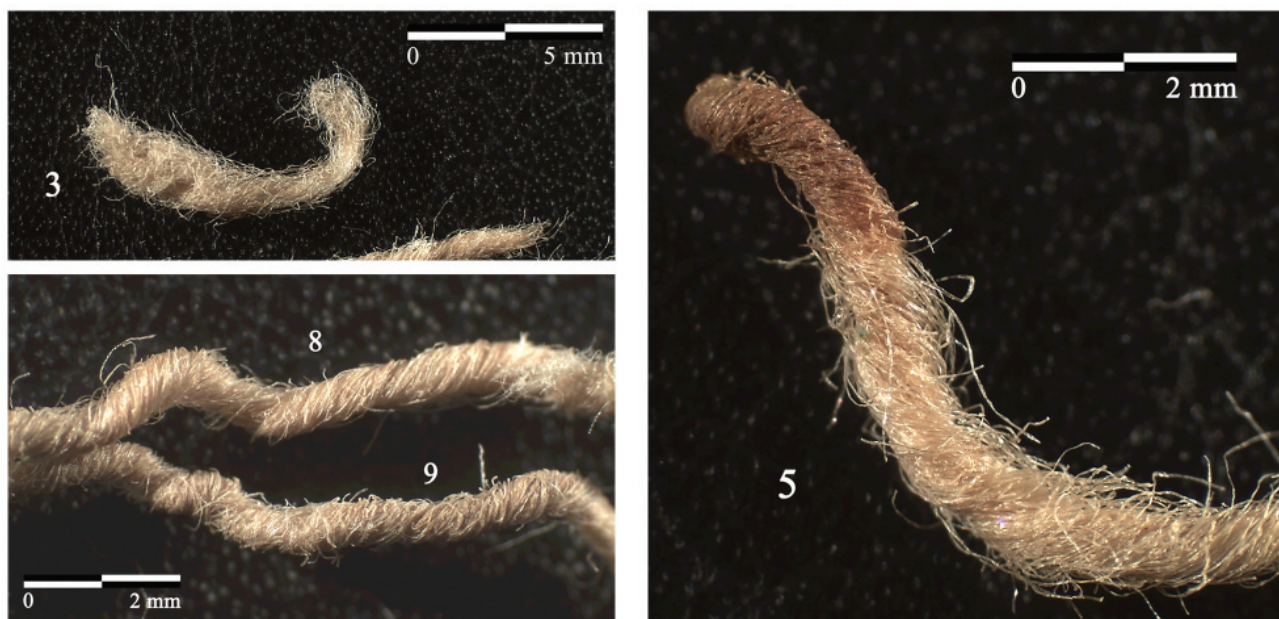


Fig. 12. El Deir (Egypte), tombe P5, Le Piton aux Chiens. Détail des fils sélectionnés pour une analyse (clichés: F. Médard).

Il est bien évident que ces recherches comparatives doivent être poursuivies, en incluant les textiles du Proche et du Moyen Orient, de la Lybie, du pourtour méditerranéen, et autant que possible, sur tous les sites où sont connus des exemplaires en coton. Nous n'en sommes qu'au début, et nous faisons appel à tous les lecteurs.

Analyse des fibres

Compte tenu du peu d'informations dont nous disposons sur le coton archéologique en Egypte et plus particulièrement dans l'oasis, compte tenu de la particularité du vestige en question, nous avons souhaité l'étudier le plus précisément possible. L'attention a notamment été retenue par la forte torsion des fils qui donne un aspect crêpe au tissage et rappelle ce même aspect des tissus en fibres de laine, mieux connus dans la nécropole chrétienne du Deir.

Sélection des échantillons

Plusieurs fragments de fils sont prélevés sur le tissu aux endroits correspondant respectivement à la partie tissée en armure toile (aspect crêpe) et à celle tissée en gros de Tours occupant la lisière de départ ou de fin d'ouvrage (selon le sens de fabrication). Parmi les onze fragments à disposition, nous en sélectionnons quatre, associées par paire à chaque armure de tissage identifiée (Fig. 12). Les éléments 3 et 5 correspondent à la partie tissée en Gros de Tours et les éléments 8 et 9 à celle tissée en armure toile.

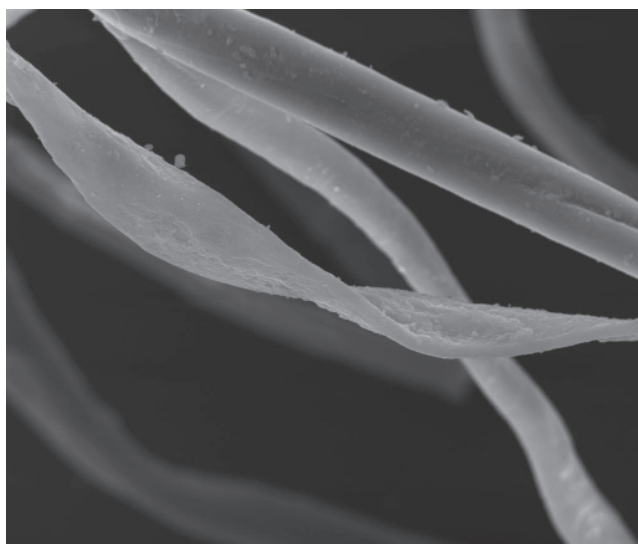


Fig. 13a. El Deir (Egypte), tombe P5, Le Piton aux Chiens; échantillon n°3. Vue longitudinale d'une fibre de coton. Grossissement x 1500 (clichés: S. Knopf /IS2M/CNRS).

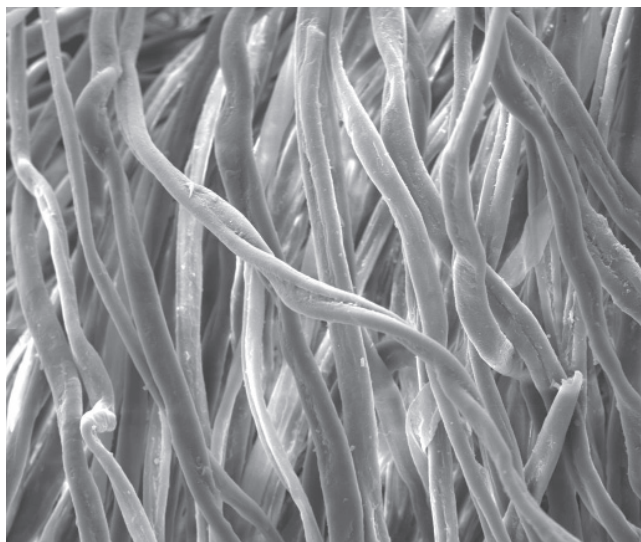


Fig. 13b. El Deir (Egypte), tombe P5, Le Piton aux Chiens; échantillon n°5. Vue longitudinale de plusieurs fibres de coton. Grossissement x 500 (clichés: S. Knopf /IS2M/CNRS).

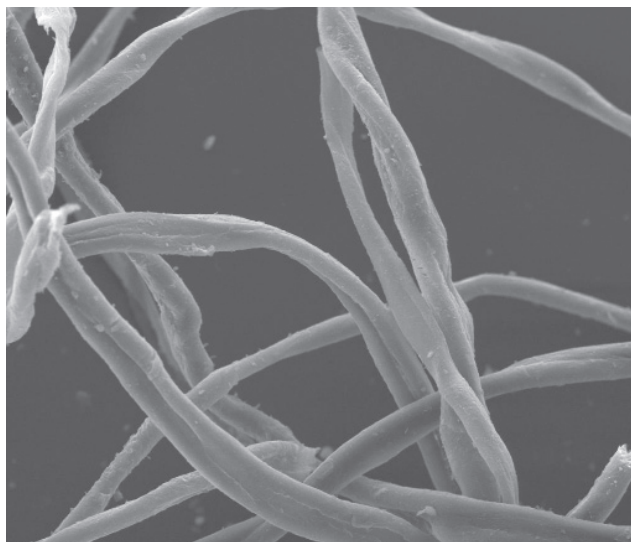


Fig. 14a. El Deir (Egypte), tombe P5, Le Piton aux Chiens; échantillon n°8. Vue longitudinale de plusieurs fibres de coton. Grossissement x 778 (clichés: S. Knopf /IS2M/CNRS).

Matériel d'observation et procédure d'analyse

Les observations microscopiques sont effectuées à l'Institut de Sciences des Matériaux de Mulhouse (IS2M) en collaboration avec Stephan Knopf (CNRS). Cet aspect de l'analyse nécessite l'utilisation d'un microscope électronique à balayage (MEB) environnemental FEI modèle Quanta 400. Résolution: 3.5 nm en haut vide et environ 5 nm en modes low vacum et environnemental. Système d'analyse EDX Oxford Instruments modèle Inca X-Act. Éléments détectables: tous à partir du bore.

Pour chaque échantillon, quelques mm de fils sont préparés afin d'être observés au microscope. La matière est métallisée pour en rendre la surface conductrice et améliorer sa lisibilité. Les fibres sont examinées en vue longitudinale et, lorsque la disposition le permet, en coupe transversale.

Examen au microscope

Lisière tissée en Gros de Tours: fils n° 3 et 5..

Lisière tissée en armure toile: fils n° 8 et 9.

Qu'il s'agisse de la partie du tissu réalisée en Gros de Tours ou de celle travaillée pour obtenir un aspect crêpe, tous les fils utilisés sont en fibres de coton (*Gossypium* sp.). Formées de deux bourrelets contigus, elles se caractérisent par une section plus ou moins ovoïde. En vue longitudinale, elles se présentent sous la forme de rubans vrillés. Le matériel, en parfait état de conservation, ne présente ni cassure, ni usure, ni pollutions incrustées dans les fibres.

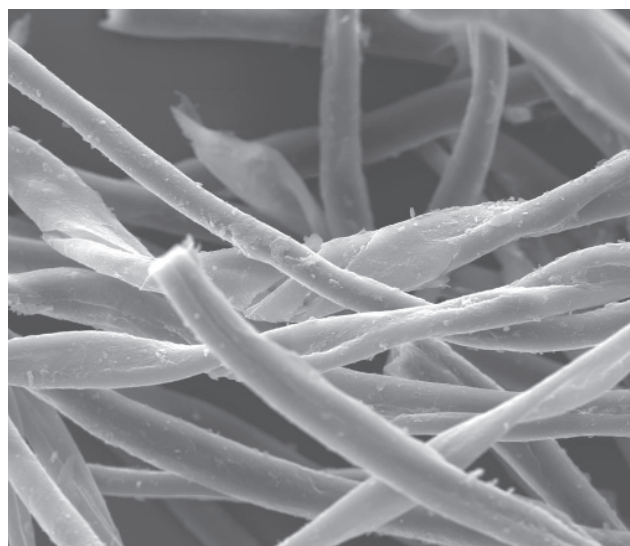


Fig. 14b. El Deir (Egypte), tombe P5, Le Piton aux Chiens; échantillon n°6. Ensemble de fibres de coton. Grossissement x 1000 (clichés: S. Knopf / IS2M/CNRS).



On soulignera ici la difficulté à se prononcer plus précisément sur l'espèce de coton employée. Il en existe effectivement plusieurs, issues de contrées différentes et dont les origines sont mal connues. Les espèces primitives ne se laissent pas différencier sur la base d'observations microscopiques (Tengberg et Moulhérat 2008).

Conclusion

Le textile en coton de la tombe traditionnelle P5 apporte de nouvelles précisions sur l'emploi de cette fibre, et ouvre par conséquent la voie à de nouvelles approches.

L'étude technique permet de conclure à une intrication textile fondée sur les modèles traditionnels égyptiens et sur quelques nouveautés. Traditionnellement au Deir, et en Egypte en général, les étoffes en lin et en laine tendent à la plus grande homogénéité possible. Dans les textiles en lin, le décor est créé «classiquement» par de simples effets techniques qui prennent tout leur relief dans un textile très homogène. Les couleurs y sont peu fréquentes. La lisière de ce textile est aussi traitée classiquement comme une lisière en laine; et ses fils sur-tordus existent aussi dans des textiles en laine. De plus, et nous pensons que c'est un point essentiel, sa couleur naturelle très claire répond à l'un des critères traditionnels de qualité en Egypte.

Par conséquent, les critères classiques égyptiens sont respectés en grande partie et sont même majoritaires. La nouveauté, frappante, est la création volontaire d'un aspect textile irrégulier et inhomogène: une caractéristique impensable traditionnellement. Et l'usage dans un même textile en coton, d'un tissage Gros de Tours, peu fréquent en lin, et d'un tissage «crêpe», peu fréquent en laine.

Les caractéristiques textiles égyptiennes traditionnelles dominant, nous pouvons émettre l'hypothèse d'un tissage égyptien. Mais une possible influence étrangère doit être envisagée.

Les analyses au MEB révèlent de belles fibres, longues, propres, comme neuves. Cela est-il suffisant pour évoquer une production locale (*in situ* ou proche de l'oasis) des fibres ou du tissage? On sait que les conditions nécessaires à sa culture sont réunies dans l'oasis à cette époque.

Qu'en est-il de la datation du fragment de la tombe P5? La tombe serait du II^e siècle AD environ, or les écharpes «crêpes» en laine du Deir sont datées aux environs du IV^e siècle AD. Au Deir quelques uns des rares exemplaires en coton, proviennent de la nécropole Nord-Est datée de l'époque perse, époque très présente dans l'oasis comme en témoigne le temple d'Hibis contenant le cartouche de Darius, et les fouilles du sud de l'oasis; mais la possibilité d'une

réutilisation ne doit pas être négligée. Les nombreux textiles provenant du temple d'Isis de Qasr Ibrim (construit sous le règne de Taharqa), sont tous en coton, et datés du I^{er} siècle au milieu du IV^e siècle AD (Wild, communication personnelle).

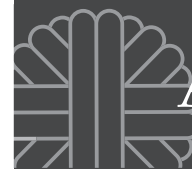
Nous ne ferons pas ici référence aux textes (Gradel et al., in press). Le but de cette présentation est d'appeler aux connaissances textiles des lecteurs. La datation des fibres en coton du Deir est essentielle. Mais nous sommes confrontés à un problème contemporain d'une autre nature.

Ce modeste fragment en coton de la tombe P5 nous questionne un peu plus précisément sur l'histoire du coton dans l'oasis et par conséquent sur son économie. Est-ce que le coton était cultivé dans l'oasis et dans quelle quantité? Les conditions requises pour sa culture étaient présentes, beaucoup d'eau et une atmosphère sèche. Mais il entraînait en concurrence avec les autres cultures, telles que le lin. De ce fait, il bouleversait certains monopoles. Il devait par conséquent être rentable. Sa culture potentielle entre ainsi dans le cadre de l'ANR 09-Jcjc-0142, Oasis Project, El-Deir Archaeological Mission, Université de Limoges, France, dirigée par Gaëlle Tallet.

Summary

In Late Antiquity the oases of Kharga and Dahkla formed a single entity, the Great Oasis. Kharga is located at the crossing of the caravan roads coming from the northern oases, Nubia and the Nile Valley. One of the major sites of the north of Kharga, El Deir, was equipped with an imposing fortress at the time of Diocletian, which shows its strategic interest. El Deir most probably depended on the capital of the north Hibis. The site was very rich in water and exploited vast fertile land tenures. According to the texts and archaeological material, the oasis had been prosperous since the Persian time.

The textiles we have studied from this site come from five cemeteries including four traditional cemeteries and one Christian cemetery. The cotton textile described in this paper was found in a traditional tomb dated to the 2nd century AD. Linen, however, was the fibre of preference in funerary contexts until the end of Late Antiquity. Was the cotton a local product, either spun or woven locally? What is the Egyptian part of this work and are there possible foreign influences?



Remerciements

Nous tenons à remercier très chaleureusement Françoise Dunand, directrice de la première mission du Deir, qui nous permet de travailler sur le matériel textile, et John Peter Wild pour sa disponibilité toujours bienveillante. Je renouvelle à Gaëlle Tallet toute ma reconnaissance et toute ma gratitude pour avoir donné une place à part entière aux textiles en tant qu'objets archéologiques.

Bibliographie

Adams, N. K. (2006) Ideologies in Conflict: The Textiles from the Isis temple at Qasr Ibrim. In S. Schrenk (ed.), *Textiles in situ, Their Find Spots in Egypt and Neighbouring Countries in the First Millenium CE, Riggisberg Berichte 13*. Abegg, publication Abegg-Stiftung, 197-210.

Bender Jørgensen, L. (2006) The Late Roman Fort at Abù Shàar, Egypt: Textiles in Their Archaeological Context. In S. Schrenk (ed.), *Textiles in Situ, Their Find Spots in Egypt and Neighbouring Countries in the First Millenium CE, Riggisberg Berichte 13*. Abegg, publication Abegg-Stiftung, 161-174.

Cardon D. (2003) Chiffons dans le désert : Textiles des dépotoirs de Maximianon et Krokodilô. In H. Cuvigny (ed.), *La route de Myos Hormos, L'armée romaine dans le désert Oriental d'Égypte, Praesidia du désert de Bérénice, I, Fouille de L'Ifao 48/2*. Le Caire, 622-625.

Cardon, D., Granger-Taylor, H. et Nowik, W. (2011) What did they look like? Fragments of clothing found at Didymoi: Case studies. In H. Cuvigny (ed.), *Didymoi, Une garnison romaine dans le désert Oriental d'Égypte, Praesidia du désert de Bérénice IV, I- Les fouilles et le matériel, Fouilles de L'Ifao 64, Chapitre XII*. Le Caire, 341-342.

Gradel, C., Letellier-Willemin, F. et Tallet, G. (in press) « Une laine bien plus douce et belle que celle des moutons » à El-Deir (oasis de Kharga, Égypte) : le coton au cœur de l'économie oasisienne à l'époque romaine.

Granger-Taylor, H. (2006) Textiles from Kirbet Qazone and the Cave of Letters, Two Burial Sites Near the Dead Sea. In S. Schrenk (ed.), *Textiles in Situ, Their Find Spots in Egypt and Neighbouring Countries in the First Millenium CE, Riggisberg Berichte 13*. Abegg, publication Abegg-Stiftung, 113-134.

Jones, J. et Oldfield, R. (2006) A Kind of Wool is Made by the Egyptians from a Tree? *ATN 43*, 27-30.

Kajitani, N. (2006) Textiles and Their Context in the Third-to-Fourth Century CE. Cemetery of al-Bagawat. In S. Schrenk (ed.), *Textiles in Situ, Their Find Spots in Egypt and Neighbouring Countries in the First Millenium CE, Riggisberg Berichte 13*. Abegg, publication Abegg-Stiftung, 95-112.

Letellier-Willemin, F. et Moulhéat, C. (2006) Découverte de Coton dans une Nécropole du Site d'El Deir, Oasis de Kharga, Désert Occidental Égyptien. *ATN 43*, 20-26.

Letellier-Willemin, F. (2009) Accessories from the Christian Cemetery of El Deir in the Egyptian Oasis of Kharga, Western Desert. In A. De Moor and C. Fluck (ed.), *Dress accessories of the 1st millennium AD from Egypt, Proceedings of the 6th conference of the research group "Textiles from the Nile valley", Antwerp, 2-3 October 2009*. Tiel: Lannoo, 97-109.

Malek, J. et Baines, J. (1981) *Atlas de l'Égypte Ancienne*. Paris.

Shamir, O. (2006) Textiles and Their Find Spots: Finds from Along the Spice Route Joining Petra and Gaza. In S. Schrenk (ed.), *Textiles in Situ, Their Find Spots in Egypt and Neighbouring Countries in the First Millenium CE, Riggisberg Berichte 13*. Abegg, publication Abegg-Stiftung, 185-196.

Tengberg, M. et Moulhéat, C. (2008) Les arbres à laine. Origine et histoire du coton dans l'Ancien Monde. In *Les Nouvelles de l'Archéologie N°114, Archéologie des textiles et teintures végétales, Actes de la table ronde Archéobotanique 2006, Compiègne, 28-30 juin 2006*, 42-46.

Corresponding author: f.letellier.willemin@free.fr



Camilla Luise Dahl and Esther Grølsted

A 17th Century Woman's Cap from Haarby Church, Denmark

Haarby church in Baag shire is the largest village church in the island of Funen in Denmark (Fig. 1). In the 16th and 17th century the church functioned as family church for members of some of the finest noble families in Funen including the Lykke, Bille, Rosenkrantz, Oxe and Rud families.

Much of the church inventory, still in the church today, is a testament of the generous donations from these noble families, such as the chalice and disk donated by Anders Bille's widow Sophie Rosenkrantz in 1661.

Haarby Church was subject to extensive restorations in 1856 and 1938. The last major restoration took place in 1975-76. In 1938 restoration work was left incomplete due to lack of funding, but in 1943 the work was resumed and four very damaged old coffins in the church vault were examined.

The arms of Lykke and Urne were displayed on the coffin lids. Two of the coffins belonged to Jacob Bille (1531-1652) and Erik Bille (1529-1656). Another coffin had a plaque with the name of Pernille Lykke. The last had no name and is an anonymous male, presumably of noble descent. All four coffins were adult size, approximately 175-180 cm in length. On the occasion of their examination, a number of well-preserved textiles were removed from the coffins: three men's caps, one with an under-cap, and a woman's cap together with shroud and pillow cases.

Since the excavation the Haarby textiles have been stored in the National Museum in Copenhagen, and, in 1965, they were issued museum numbers 821 to 831/1965 and kept in the department of the Early Modern Collection (3. Afd. Nyere Tids Samling). In 2008, the textiles were once again taken out of their storage box and examined by the current authors together with Irene Skals, conservator at the National Museum of Denmark.

The main focus was the female cap found on the body of the noble woman Pernille Lykke. Noble women's caps can be found across Denmark in written and visual sources, however, Pernille Lykke's cap is so far the only known extant example of a 17th century women's cap found in Denmark. Thus the little cap offers a unique insight into the cut and construction of period caps.

Pernille Lykke

Pernille Lykke was the daughter of Peder Lykke of Skovsbo (d. 1563) and Lisbeth Johansdatter Urne of Klingstrup (d. 1584). The couple belonged to the wealthy Funen nobility. Peder Lykke and his wife had eight children, of whom Pernille was the youngest. Pernille Lykke never married and left no issue to inherit from her, perhaps for the same reason she gave generous donations to churches and for charitable works in the last years of her life. Pernille Lykke's precise age at death is not known, her year of birth not being recorded. The earliest we hear of her is in 1599, when her name appears in a dispute about some property. On this occasion she is recorded to be an adult (Blomberg 1941).

In the 1610s, Pernille Lykke funded the so-called Sjøleboder (small living spaces) in Møntestræde in Odense. The half-timbered building meant for the poor still exists today and can be found in its original place. According to Pernille Lykke's own account, the building was divided into small "apartments" to house three honest and deserving poor women and two orphaned boys who were to go to school. The women were allowed to stay in the house until their death while the boys could stay for only three years (Engelstoft 1880, 228-230; Ladewig Petersen 1984, 405). The last to be heard of Pernille Lykke's activities is in



Fig. 1. Location of Haarby church in Baag shire on the island of Funen (Drawing: authors).

1627. In 1634 Pernille Lykke's brother is registered as the owner of her estate Højsgård situated in Haarby, at which time she must have been either dead or dying and her brother taken over the estate (Engeltoft 1880, 229).

A more precise time of her death we find, however, in the diary of Hans Mikkelsen, the Bishop of Funen diocese. His diary covering the years 1626-1641 has an entry in 1634, mentioning that on the 11th December that year he gave a funeral sermon for the noble maiden Pernille Lykke. She probably died sometime around the late fall of 1634 (Biskop Hans Mikkelsens dagbøger 1626-1641, 116). As Pernille's father died in 1563, she must have been at least 71 years old in 1634. Pernille Lykke must have been an old woman when she died.

Pernille Lykke's cap

Pernille Lykke's cap consists of one piece of fitted silk satin which was pointed at the ears and the middle of the forehead (Figs. 2-3). The colour is a little faded reddish brown. No dye analysis has been made.

The cap has a silk lining of a light brown colour. The cap is edged with a narrow ribbon interwoven with metal thread. The same type of ribbon is stitched on both sides of the cap's centre seam, from the 'forehead point' to the gathered top of the cap's silk satin; the length is 14 cm. The gathered top is made by four rows of threads, drawn together to 4 cm, creating 25 tiny meticulous pleats.

The lining is tacked to the cap. At the back, the outer fabric and lining is sewed together with point stitch. A casing creates a channel for a narrow silk string. Along the front edge, the cap is sewn together with the lining by overcast stitching and covered by the above mentioned ribbon; 2 mm long portion of the ribbon is folded to the wrong side. The ribbon goes from ear to ear and measures 48 cm, the cap measures from the forehead point to the back 44 cm. The depth of the cap is 21 cm.

Textile analysis of the cap had previously been carried out by Irene Skals from The National Museum of Denmark. The fabric is silk, woven in a 8-binding satin, with 223 threads/cm in the warp and 32 threads/



Fig. 2. Woman's cap from the coffin of Pernille Lykke in Haarby Church, now in the National Museum of Denmark (Photos: authors with permission of The National Museum of Denmark).



cm in the weft. The lining is silk as well. It is a good-quality densely woven silk fabric in tabby weave with 140 threads/cm in the warp and 49 threads/cm in the weft. The narrow ribbon which edges the cap is 6 mm wide. The warp consists of silk thread S2z and gold thread s-spun around a core of yellow silk. The warp has 28 threads/cm. The weft is pure silk S2s with 9 threads/cm.

Pernille Lykke's cap was probably originally worn together with some sort of 'under-parts' such as an under-cap or forehead cloth of linen. None, however, was found in her coffin. Furthermore, in general no linen had survived in the coffins in Haarby. Similar caps have not been found or been preserved in Denmark. Looking further west to the British Isles, one-piece caps are well-known in the Elizabethan period. (Arnold 2008, 47, 103-104) A number of preserved examples of caps with a similar cut and shape as Pernille Lykke's can be found in this period and from around the same time as Pernille Lykke died (Dahl & Grølsted 2009, 20-21)

So-called one-piece caps have not been the object of as much research as the two- and three-pieced caps in Denmark. This may be due to the fact that only very few such caps are known compared to the many caps of the later types that have been preserved and re-used

in rural Danish costume. However, it must be noted that Danish islands such as Amager, Falster (South part of the island) and Samsø all included one-piece caps in their 'folk costume' and they were used well into the 19th century (Andersen 1960).

The English caps follow the fashions of Britain: often with all-over embroidery in coloured silk (Arthur 1995; Arnold 2008). The Danish caps were, at least according to period portraits, rarely embroidered but decorated with passementerie, metal studs, pearls and occasionally gems (Dahl 2008, 24-26, 39-47).

A supposedly English cap of fine white linen embroidered with coloured silk is presently in the Museum of Fine Arts, Boston. The cap dated c. 1610-20 is in one piece like Pernille Lykke's cap, with curved cut-out templates and on the top of the head gathered in a row of small neatly made pleats sewn together with green silk. At the back of the head it has a narrow drawstring hem pulled together with a silk ribbon. In contrast to Pernille Lykke's cap, the Boston cap is not edged with ribbons but embroidered along the edges (Arnold 2008, 47, 103). Similarly another linen cap of unknown origin is preserved in the Ontario Museum in Canada and is decorated with whitework embroidery and dated to the first decades of the 17th century (Arnold 2008, 47, 104).

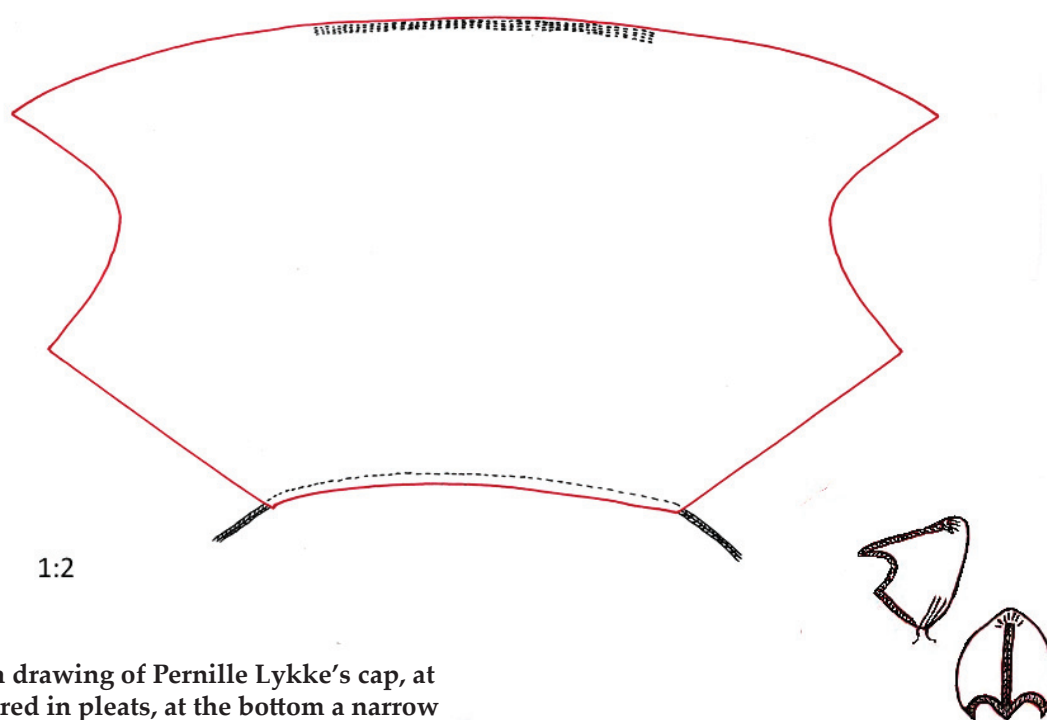


Fig. 3. Pattern drawing of Pernille Lykke's cap, at the top gathered in pleats, at the bottom a narrow drawstring hem (Drawing: Esther Grølsted).



Fig. 4. Joan, Scottish wife of citizen in Elsinore Wilhelm Graa. Epitaph (memorial painting) in Elsinore St. Mary Church, c. 1620 (Photo: Erik Fjordside).

White linen caps of this type can be found in artwork in Northern Europe, particularly in England and Scotland. The type of cap with a seam line on top of the head is otherwise not very common in portraits of Danish townswomen but are occasionally found, primarily if not exclusively, in depictions of foreign women (Fig. 4). Although Pernille Lykke's cap is of a similar cut, the fabric and decoration differ from those of townswomen portrayed in painting.

Ladies' caps in the period of Pernille Lykke's death

At the time of Pernille Lykke's death in 1634, both married and unmarried women wore head coverings. Although married ladies at the court had replaced the earlier obligatory cap with various fashionable hairdos and unmarried maidens traditionally were allowed to wear "open hair", caps remained the most common headwear for the 17th century women whether married or unmarried.

From the middle of the 16th century, helmet-like tight caps had been the height of fashion, but by the end of the century the caps were becoming taller, with a more pronounced rising back and curving at the front around the templates (Dahl 2008, 28-30). Usually a linen under-cap or forehead cloth was worn underneath the cap. The front was looped into two template buckles following the shape of the upper

caps with under-wiring or starch.

Examples of these types of women's caps can be found in contemporary Danish sculptures and paintings. An example is the sandstone sculpture of Lady Dorthe Juul, wife of the nobleman Jørgen Kaas. The sculpture that once was part of a funerary memorial of the couple in Glesborg Church, Djursland is now kept in the Randers Museum.

Lady Dorthe Juul is wearing the fashionable dress of the period – tight doublet and barrel-shaped skirt (farthingale). On her head she is wearing a tight-fitting cap, deep cut at the templates; along the selvedges the cap is decorated with borders with an abundance of studs and pearls. At the back of the head, the cap is gathered together, forming soft round folds.

Like Pernille Lykke's cap, it is decorated down the middle of the crown with a cross-shaped decoration – presumably covering a seamline (Fig. 5).

A similar cap can be found in the funerary monument of Jørgen Skeel and his two wives Kirsten Lunge (d. 1609) and Jytte Brok (d. 1640). The effigy was build around the time of Jørgen Skeel's death in 1631 and finished in 1633 (Fig. 6).

Caps of various kinds worn by noble women are also mentioned in contemporary written accounts. The noble maiden Ingeborg Rosenkrantz, like Pernille, died as an unmarried woman. At her death in 1636,



Fig. 5. Dorthe Juul, wife of Jørgen Kaas, sandstone sculpture formerly in Glesborg Church, Djursland, now in Randers Kulturhistoriske Museum. Jørgen Kaas died in 1619, Dorthe Juul in 1634. The sculpture is from around the time of Dorthe Juul's death (Photo: Camilla Luise Dahl with permission of Randers Museum).

she left behind a large number of movables and other possessions including elegant dresses and several silk caps. Five were of fine silk and one is described as a coloured with feule de mort (dead leaves) silk atlas cap (Arvelod i Ingeborg Rosenkrantz's Løsøre, 62-63). In addition to caps, she had a number of linen under-caps and forehead cloths - both embroidered and plain, as well as with lace.

Pernille Lykke's cap seems in many ways typical of its time - the style with the cut-out and shaped templates was a fashionable style popular around the time of her death and appears in period paintings and sculptures. The silk cap was thus most likely not a special burial item made to dress her in the coffin but more likely one of her own caps reused as burial clothes.

Its date is likely within a few years of her death in 1634, as nothing seems to suggest this was an old cap and it was not worn out or mended.

It is not a very elaborate piece of headwear, although it is made of silk and decorated with goldwork passementerie, suggesting that it was a simple elegant cap more suitable for everyday wear rather than for special occasions - it was a cap suitable for an old and unmarried noble maiden.



Fig. 6. The two wives of the Danish nobleman Jørgen Skeel, Lady Kirsten Lunge and Lady Jytte Brok. Effigy in Aarhus Cathedral, finished 1633 (Photograph: Erik Fjordside).



Aknowledgements

The authors would like to thank Irene Skals at the National Museum of Denmark for providing information and results of her analysis of the cap. We would also like to thank Dorothy Jones for bringing the diaries of Hans Mikkelsen to our knowledge.

Bibliography

Andersen, E. (1960) *Danske bønders klædedragt*. Carit Andersens Forlag, København.

Arnold, J. (2008) *Patterns of Fashion 4: The Cut and Construction of Linen Shirts, Smocks, Neckwear, Headwear and Accessories for Men and Women c. 1540-1660*. London.

Arthur, L. (1995) *Embroidery 1600-1700: At the Burrell Collection*. London.

Arvelod i Ingeborg Rosenkrantz's Løsøre, tilfalden hendes Broder Holger Rosenkrantz 1638. Nye Danske Magazin, 6 bd, 1. hft, årg. 1836.

Biskop Hans Mikkelsens dagbøger 1626-41. By A. Riising & M. Seidelin. Udgivet af Selskabet for Historisk Samfund for Fyns Stift, Odense 1991.

Blomberg, A. F. (1941) *Træk af den den fynske adels historie 1536-1660*. Foredrag ved Dansk Historisk

Fællesforenings årsmøde. URL: <http://www.historie.syd-fyn.dk/steder/adel.htm>

Dahl, C. L. (2008) Huffer till theris hoffueder: Sen-renæssancens kvindehuer, ca. 1560-1630. *Dragtjournalen* 2 (3), 21-52.

Dahl, C. L. & E. Grølsted (2009) Et kistefund fra 1600-årene i Haarby kirke. *Dragtjournalen*, 3, 5, 2009, 19-33.

Engelstoft, C. T. (1880) *Odense Bys Historie*. Odense.

Frøsig, H. (1971) Stand og mode. In: *Folk skaber klæ'r – klæ'r skaber folk*. Copenhagen: Nationalmuseet, 86-107.

Ladewig Petersen, E. (1984) De fede år: Odense 1559-1660. In: *Odense bys historie*, Bd. 2. Odense.

Szygenda, L. (1991) From Tudor Coifs to the Twentieth Century British Embroideries. In E. Benn (ed.), *Treasures from the Embroiderer's Guild Collection*. Devon: David & Charles.

Corresponding Author: camillaluisse.dahl@yahoo.com



Beatrix Nutz and Harald Stadler

How to Pleat a Shirt in the 15th Century

Introduction

In the course of extensive renovation work in 2008 at Lengberg Castle, Nikolsdorf, East Tyrol, archaeological surveys became necessary in several parts of the building. These were carried out under the direction of Harald Stadler from the Institute of Archeology, Department of Medieval and Post-Medieval Archaeology, University of Innsbruck. In the south western room on the 2nd floor of the south wing of the castle, a vault filled with waste was located and documented. The filling consisted of dry material in different layers, including organic matter such as branches and straw but also processed wood, leather (especially shoes) and more than 2700 textile fragments, not counting yarns, cords and ropes. The architectural history of the castle (evidence of alterations can be found in the travel diary of Paolo Santonino), the architectural study of Martin Mittermaier and Walter Hauser, Office for the Preservation of Historical Monuments Tyrol, and the archaeological features date the finds to the 15th century. The material was probably dumped in the vault when a second storey was added to the building by order of Virgil von Graben who was a burggrave at Lengberg in the name of the Archbishops of Salzburg. According to Paolo Santonino, the castle chapel, then also situated in the south wing of the castle on the first floor, was consecrated on October 13th, 1485 by Pietro Carlo, Bishop of Caorle. Assuming the reconstruction was finished by the time the chapel was consecrated the finds from the vault predate the year 1485. Five radiocarbon dates from the textiles, analyzed at the ETH Zurich, now confirm the dating.

It is extremely rare to find this huge amount of organic objects, especially textiles, in an archaeological dig and this find can only be compared to the amount found in the Muehlberg Ensemble in Germany (Rast-Eicher and Tidow 2005, 83) and the Sittingbourne Cache

in England (Eastop 2007, 66). The textiles were only preserved thanks to the very dry conditions in the vault and now provide an almost unique opportunity to study 15th century sewing techniques in detail.

Seventeen textile fragments were identified as parts of linen shirts, fourteen of which feature either partially or totally pleated areas. Two sleeves with textile buttons and button holes (Fig. 1), two sleeves with button holes (Fig. 7 and 9), one sleeve with a textile button (Fig. 18), one neckline (Fig. 2) and five fragments being either sleeve or collar are pleated on their entire width. Two shirts are pleated partially on the front, one of them with a preserved textile button (Fig. 3). One sleeveless shirt is pleated at the shoulder (Fig. 4).

The analysis of the textiles, basically consisting of a visual analysis of the sewing techniques and reflected-light microscopy of the threads, yielded three different types of pleats and four methods to attach the trimming strips (narrow wrist- or neckbands).

Pleat Type 1 and 2

These two pleat types are similar, the pleats are rounded and either folded to one side (Type 1) or straight (Type 2) (Fig. 6 bottom right), but there are variations in the sewing of the trimming strip (Type A, B and C – Fig. 6). The pleats of Type 1 can be either folded to the left or to the right side indicated on Table 2, column 5 “Trimming strip and pleat type” (l for left and r for right).

Pleat Type 3

Among the shirt fragments from Lengberg Castle this pleat type was only observed once and was applied to a shirt made of slightly finer linen than the rest of the finds (find no. 121). It shows closely spaced, pointed, straight pleats that use a lot of fabric (see description of Trimming strip Type D below and Fig. 8 bottom left).

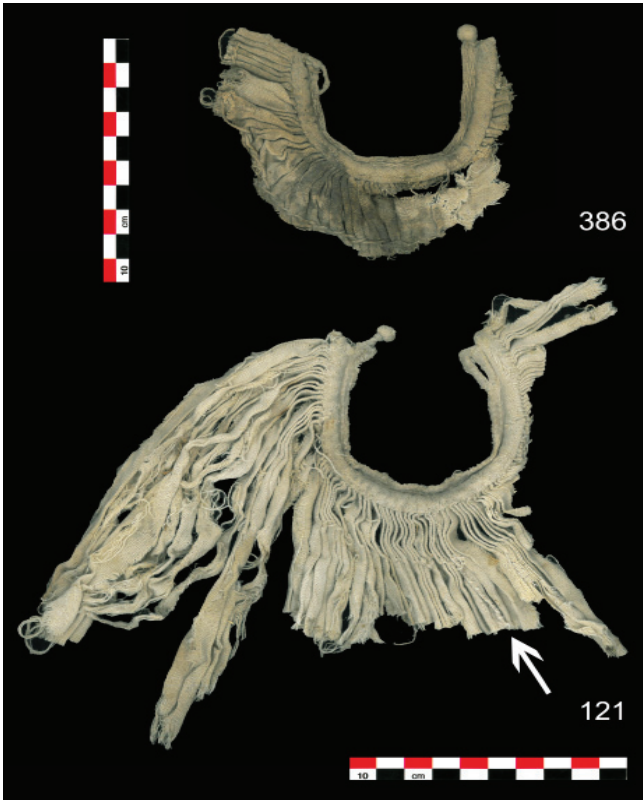


Fig. 1. (top left) Shirt sleeves with preserved textile button and button hole - inside. Find no. 386, Pleat Type C1r and Find no. 121, Pleat Type D (Photo: B. Nutz).

Fig. 2. (bottom left) Shirt collar / neckline. Find no. 01.24 - inside, Pleat Type B1r (Photo: B. Nutz).

Fig. 3. (top right) Fragment of a shirt or undergarment with partially pleated neckline in the front and preserved textile button - inside, Find no. 522.04. Pleat Type B1r (Photo: B. Nutz).



Sewing the pleats

As the last few millimeters of most pleats are now covered by the wrist- or neckband it cannot be said for certain how the pleats themselves were made. A small fragment with missing trimming strip (find no. 273.14) suggests that the fabric was folded at regular intervals, maybe temporarily fixated with pins, and the pleats were then stitched down with stem stitches right at the edge of the cloth (Fig. 5). The pleats on find number 121 (Pleat Type 3, Fig. 1 and 8) were probably made in a very similar way, but having a sharp ridge they were most likely additionally treated with slick-stones and kept in place with some kind of starch. The sharp ridge also caused the cloth to break along the edges as the linen dried up over time.

Trimming strip Type A

This type of trimming strip is found only once on a sleeve fragment with rounded, straight pleats (Fig. 6 and Tab. 2, find no. 430.02). The trimming strip is equally broad on both sides, first one edge is folded in, and then sewn onto the pleats with a running stitch, the fold fastened with whip stitches, then folded over the edge of the pleats and the border then folded in once more and sewn onto the other side of the pleats again with whip stitches.

Trimming strip Type B

With seven textile fragments featuring the type B trimming strip it is the most common method of applying a strip of cloth to the pleats amongst the shirt finds from Lengberg. It is used for wrist- as well as neckbands and made similar to type A, but much



Fig. 4. Shirt fragment of a sleeveless shirt or blouse pleated at the shoulder - outside. Find no. 559. Right: Detail with pleats - inside). Pleat Type B11 (Photo: B. Nutz).

narrower on the outside. The strip is folded in at the edge, sewn onto the pleats, folded over the pleats, once more folded in and sewn onto the other side both with whip stitches. Above the whip stitches back stitches run through the front and back layer of the trimming strip with the fabric of the pleats in between.

Fig. 5. Pleated fragment of sleeve or neckline, trimming strip missing. Find no. 273.14. Pleat Type ?1r.

Right: Reconstruction of the pleating with possible pins and pleat fixation with stem stitches (Photo: B. Nutz).

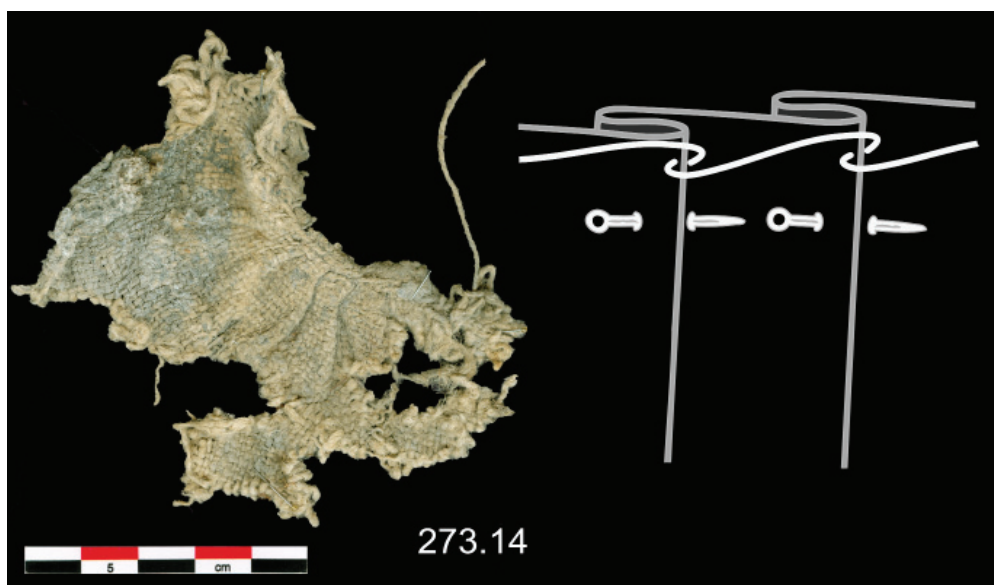




Fig. 6. Trimming strip and pleats Type A, B and C (Graphic: B. Nutz).

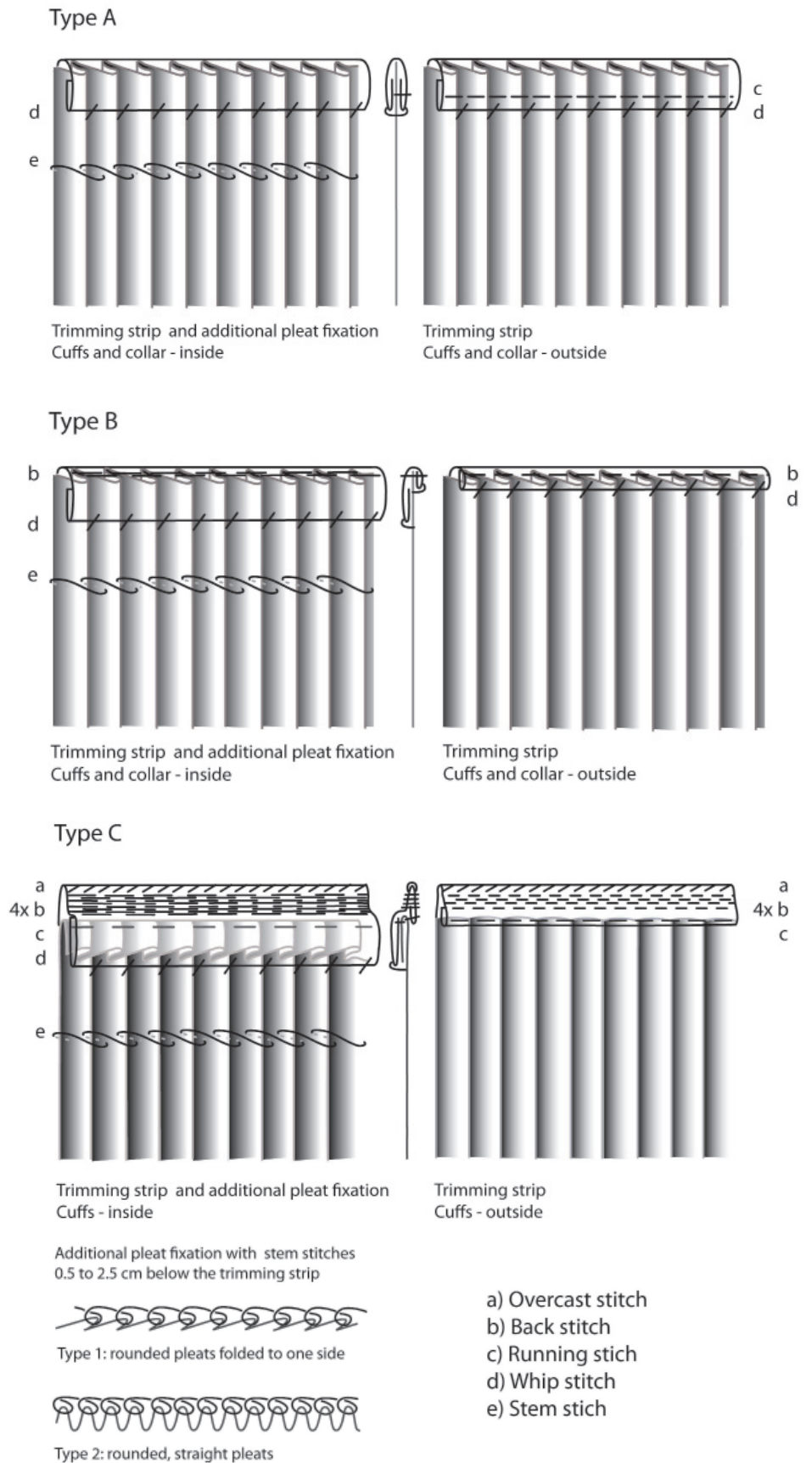
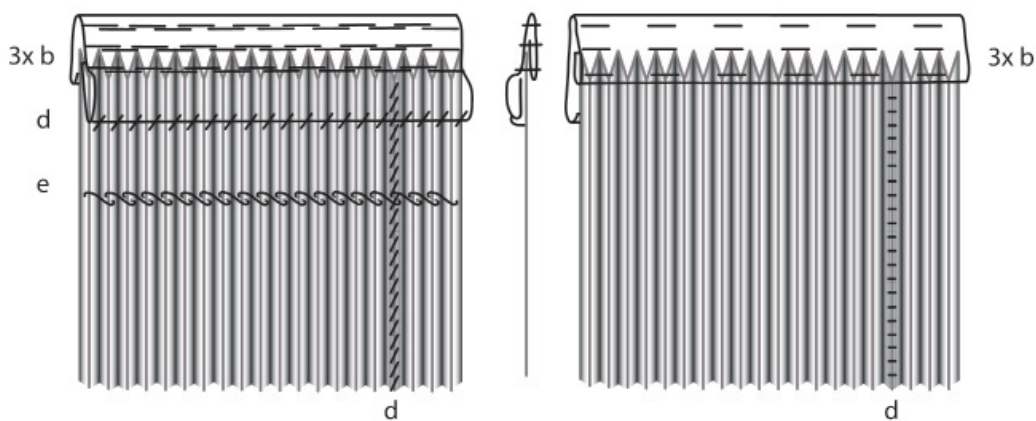




Fig. 7. Sleeve fragment with wristband (trimming strip) and button hole - inside. Find no. 430.02. Pleat Type A2 (Photo: B. Nutz).



Fig. 9. Sleeve fragment with wristband (trimming strip) and button hole - inside. Find no. 01.23. Pleat Type B1r. Dashed line indicating the run of the additional pleat fixation (Photo: B. Nutz).



Trimming strip and additional pleat fixation
Cuffs - inside

Trimming strip
Cuffs - outside

Additional pleat fixation with stem stitches
2.0 cm below the trimming strip

b) Back stitch
d) Whip stitch
e) Stem stitch

Fig. 8. Trimming strip and pleats Type D (Graphic: B. Nutz).



Type 3: closely spaced, pointed, straight pleats



Fig. 10. Neckband of linen shirt from Tyrol Castle, South-Tyrol – outside (above) and inside view (bottom). Pleats without additional pleat fixation (Photo: B. Nutz).

Trimming strip Type C

Two sleeve fragments show a trimming strip of the type C. At first sight they appear to be from the same shirt but a closer examination shows them having been made from fabrics with different thread count suggesting two separate shirts: Find no. 386 is a sleeve fragment with a preserved textile button and button hole (Fig. 11) and a thread count of 17-21 threads/cm. Find no. 164.04 - also with a preserved button - is made from a coarser fabric of 12-14 threads/cm. Of course, one cannot rule out the possibility that more than one type of cloth was used in the tailoring of a single shirt. As can be seen at a slightly damaged area on find no. 386 which allows a look at the inside of the trimming strip, the fabric with the pleats was folded in after the pleating. The trimming strip was then sewn onto the pleats with a running stitch, folded in, the fold fixed with whip stitches, folded over the pleats, folded in

again and sewn onto the other side of the pleats with whip stitches. As the strip is not folded directly at the folded edge of the pleats but with some fabric to spare the two sides of the protruding strip were then sewn together with four rows of back stitches and the edge then fixed in place with an overcast stitch. This provides for an appearance resembling embroidery.

Trimming strip Type D

The trimming strip type D only occurs once together with pleat type 3 on a sleeve fragment, find no. 121 (Fig. 1), with preserved textile button and button hole (Fig. 11). It is made of fine linen with a thread count of 18-19 threads/cm. Not all the pleats are preserved but with an average pleat count of 6.5 pleats/cm and a width of 19 cm it had approximately 123.5 pleats. With the average height of a pleat of 0.7 cm, leading to 1.4 cm of fabric per pleat, linen cloth with a width



of 172.9 cm was needed for the sleeve. To achieve that width two panels of cloth, one with a width of 91 cm, the other with 81.9 cm, were sewn together selvage to selvage with overcast stitch (Fig. 1, find no. 121, white arrow). The trimming strip was folded in, sewn onto the pleats with whip stitches, folded over the edge of the pleats with fabric to spare, folded in and sewn onto the other side with back stitches, the stitches piercing through all four layers of cloth (three layers of the trimming strip and one layer of pleats). The two sides of the protruding fabric then were sewn together with two additional rows of back stitches.

This shirt fragment was radiocarbon-dated at the Swiss Federal Institute of Technology (Table 1).

Based on the above mentioned presumption that the floorboards above the vault were in place by the time the chapel on the floor beneath was consecrated the shirt was in use sometime between 1440 and 1485.

Additional pleat fixation or smocking

All pleats have an additional pleat fixation 0.5 to 2.5 cm below the trimming strip carried out in stem stitches. Whether the stem stitches used for pinning down the pleats were done before or after the application of the trimming strip cannot be determined. Neither can it be said for certain whether the stem stitches were visible on the outside or inside of the shirt. Traditional shirts of the Modern Era sometimes show additional pleat fixation on the outside which is carried out as smocking thus decorating the shirt. However, two factors speak against the pleat fixation on the Lengberg shirts showing on the outside. Firstly, the seams, most of which are half fell seams, would then show more prominently on the outside. Secondly, some of the stem stitch rows are fairly irregular in their distance to the trimming strip (Fig. 9) and are therefore not very 'decorative'.

As these shirt fragments from Lengberg Castle are the only ones so far from the 15th century in Tyrol, it cannot be said with certainty if this additional pleat fixation was common in the area. On a shirt dating to the 16th/17th century (Tomedi 1998, 159) from Tyrol Castle, South-Tyrol, this fixation is missing (Fig. 10). Similarly, fragments of two pleated shirt sleeves from Muehlberg, Kempten, Bavaria, dating to the end of the 15th to early 16th century, do not have the additional smocking or pleat fixation, according to the published catalogue, one of these is decorated with bobbin lace (Rast-Eicher and

Tidow 2011, 429-430). But it can be found on a shirt dating to 1567: on this shirt - once belonging to the Swedish diplomat Nils Svantesson Sture - the gathers or pleats of the sleeve-ends are held together on the inside above the wristband by a single line of stitching (Arnold 2008, 21).

The stitches

With the exception of the stem stitches that were used for sewing the pleats and their additional fixation all stitches used in the sewing of the trimming strip and the sleeves can be encountered on other, contemporary, textile finds and are considered to be more or less common practice during the Middle Ages (Kania 2010, 86-101). All linen fabrics are woven with z-spun yarn and the sewing thread is invariably s-plyed 2-ply-yarn. Running stitch, whip stitch and back stitches were used to sew the trimming strips onto the pleats. In running stitch the sewing thread runs straight through the fabric, for whip stitches it passes over the fabric, in back stitch it doubles back on itself. The latter were also used for sewing together the protruding fabric of some of the trimming strips above the pleats. A distinction has been made between whip stitch and overcast stitch. Both stitches are basically sewn in the same way but the term overcast stitch is used to indicate whip stitches applied to the edge of a fabric, hem or trimming strip. The stem stitch consists of a long, slightly slanting, stitch forward on one side and a shorter one backward on the other side of the fabric.

Single threads were used for sewing all seams and hems as well as for most stem stitches. Only on two



Fig. 11. Textile buttons and button holes from shirt no. 121 and 386 (Photo: B. Nutz).



Fig. 12. Self-portrait of Albrecht Dürer from 1493 wearing a pleated shirt with the neckline and front visible and the pleated sleeves peeking through slits in his gown (Photo: The Yorch Project: Gesellschaft für Bildarchivierung GmbH).

sleeve fragments (finds no. 01.23 and 808.02) the stem stitches used for the additional pleat fixation were sewn with two ply-yarns. Both ply-yarns were either threaded through the eye of the needle at the same time, or a single thread was doubled by being hung equally long on both sides of the eye. This is indicated by both sewing threads passing between the same warp and weft threads or through the same holes caused by the needle in the fabric.

Linen Shirts of the 15th and early 16th century

Men and women of the period are often depicted wearing various types of pleated shirts, mostly beneath the outer garment, the pleated neckline and front visible and/or the sleeves peeking through

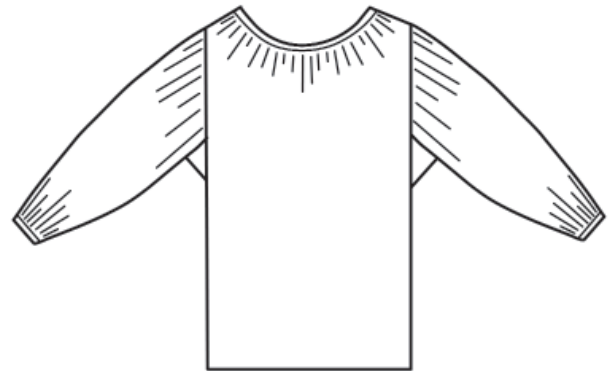


Fig. 13. Sketch drawing of a shirt from Lengberg Castle (Graphic: B. Nutz).

slits in the sleeves of the dress or gown (Fig. 12). That these shirts were not only worn by adults but also by children cannot only be seen on some of the contemporary images but is also confirmed by one of the sleeve fragments from Lengberg where the cuff has a girth of merely 14.5 cm (find no. 386, Fig. 1 - top) indicating the very slender wrist of its wearer.

Of course not all the shirts depicted in paintings were cut in the same manner than the shirts from Lengberg and none of the pictures are detailed enough to determine if one of them had an additional pleat fixation but they provide us with a good image of the appearance of shirts in general at the time.

An impression on how some of the shirts from Lengberg may have looked like is given with a sketch drawing (Fig. 13) where the neckline from find no. 01.24 (Fig. 2) and the sleeve fragments have been combined to reconstruct one shirt. Besides the sometimes elaborated pleats they were probably of a rather simple cut without many decorative elements such as embroidery or lace.

Conclusion

The excavation of a vault filled with waste dating to the 15th century yielded more than 2700 textile fragments, among them pieces of several pleated linen shirts. These finds now allow a detailed investigation and reconstruction of late medieval Tyrolean pleating methods. Three different pleat types (rounded straight, rounded folded to one side and closely spaced, pointed, straight pleats) and four wrist- or neckband-types could be determined. All pleats or gathers are additionally held together on the inside



by a line of stem stitches 0.5 to 2.5 cm above the band or trimming strip.

With fourteen fragments of pleated shirts this is probably the largest collection of 15th century linen shirts to be found from one find spot to date. The pleat and trimming strip varieties do not only offer insight into late medieval sewing and pleating techniques but also provide a rare opportunity to research the transition in fashion and textile techniques from medieval times to the Renaissance period. We must bear in mind that Lengberg Castle is situated close to today's Italian border and on modern day roads it is a mere 245 km from Lengberg to Venice. Therefore the influence of the Early Italian Renaissance on the textile production of Tyrol is not to be underestimated, especially as the silk fabrics also found in Lengberg were most likely imported from Italian silk production centers such as Venice or Florence.

As to the additional pleat fixation by means of stem stitches that are found on all pleated shirts from Lengberg further research and comparisons with other finds from surrounding areas, whether of an

earlier date, contemporary or of a later date, will be necessary. Hopefully this will help determine where this method of pleating was initially developed or if it was indigenous to the area and then spread from there. To assume that the shirts were not made by some local tailor but imported finished is unlikely. Contemporary account books from other Tyrolean noble families such as the Lords of Vilanders always mention the money spent on cloth and the tailor's payment but do not refer to the purchase of finished textile products (Goller 2007). Medieval dress used to be custom made, especially for the nobility.

That at least some of the shirts were once worn by the castle lords and the members of their family and not by some servant may be expected when looking at find no. 121. This heavily pleated shirt with its fine linen and the extensive use of cloth, probably being of the latest fashion, must have been quite expensive in the making. The still existing button-hole and textile button enables a measurement of the girth of the cuff of 17,5 cm. Whether this shirt was worn by a man or woman cannot be determined but the rather small

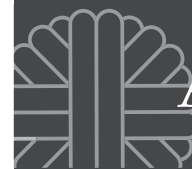
Lab Nr.	Sample Code and Description	Material	C14 age BP	DeltaC13 (‰)
ETH-45156	121 pleated shirt sleeve	linen	375 ± 25	-27,1 ± 1,1
<p><u>Calibrated C14 ages (Calendar time intervals) using OxCalv3.10</u> INFORM : References - Atmospheric data from Reimer et al (2009); OxCal v3.10 Bronk Ramsey (2005)</p> <p>ETH-45156 : 375±25BP 68.2% probability 1450AD (53.4%) 1520AD 1600AD (14.8%) 1620AD 95.4% probability 1440AD (62.4%) 1530AD 1550AD (33.0%) 1640AD</p>				

Table. 1. 14C-dating, – results from the Swiss Federal Institute of Technology, Zurich.



Table 2. Types A, B, C and D = trimming strip type; Type 1, 2 and 3 pleat types; r = pleats folded to the right / l = pleats folded to the left.

Find No.	Yarn: warp/weft	Warp/weft identified	Threads/cm warp/weft	Trimming strip and pleat style	Garment	Graphic
430.02	z/z	no	12-14/10-11	A2	Sleeve fragment with wristband (trimming strip) and button hole.	Fig. 7
01.24	z/z	no	14/11	B1r	Shirt neckline with neckband (trimming strip).	Fig. 2
559	z/z	yes	18/18	B1l	Shirt fragment of a sleeveless shirt or blouse pleated at the shoulder. Front left side.	Fig. 4
522.04	z/z	no	10-11/7	B1r	Fragment of a shirt or undergarment with partially pleated neckline in the front and preserved textile button.	Fig. 3
01.23	z/z	no	18/15	B1r	Sleeve fragment with wristband (trimming strip) and button hole.	Fig. 9
343.23	z/z	no	18/14	B2	Fragment of a sleeve or neckline with wrist- or neckband (trimming strip).	Fig. 14
803.02	z/z	no	9/8	B2	Fragment of a sleeve or neckline with wrist- or neckband (trimming strip).	Fig. 15
343.02	z/z	no	9/8	B1l	Fragment of a sleeve or neckline with wrist- or neckband (trimming strip).	Fig. 16
624.02	z/z	no	8/7	B2 or C2	Fragment of a sleeve or neckline, wrist- or neckband (trimming strip) worn away.	Fig. 17



Find No.	Yarn: warp/weft	Warp/weft identified	Threads/cm warp/weft	Trimming strip and pleat style	Garment	Graphic
386	z/z	no	21/17	C1r	Sleeve fragment with wristband (trimming strip), textile button and button hole.	Fig. 1/ Fig. 11
164.04	z/z	no	14/14	C2	Sleeve fragment with wristband (trimming strip) and textile button.	Fig. 18
121	z/z	yes	18/19	D	Sleeve fragment with wristband (trimming strip), textile button and button hole.	Fig. 1/ Fig. 11
273.14	z/z	no	10/8	?1r	Pleated fragment of sleeve or neckline, trimming strip missing.	Fig. 5
01.11	z/z	yes	12/9-10	?1r	Fragment of a shirt with partially pleated neckline, trimming strip worn away.	Fig. 19

circumference suggests a female or juvenile wearer with a slender wrist, maybe the lady of the castle.

As some of the other shirts are made from coarser linen and have less pleats they may have belonged to lower ranking members of the household. Here too further investigation may help find connections between the type of textiles found in the castle and the social status of their former owner thus providing deeper insight into the structure of the society at the turning point from Late Medieval to Early Modern Times.

In the light of more than 2700 individual textile fragments from Lengberg much work is still left to be done but the now more or less completed research on the pleated linen shirts found in this castle offer an opportunity for future scholars to compare their finds and research results with the finds from Lengberg Castle.



Fig. 14. Find No. 343.23.



Fig. 15. Find No. 803.02.



Fig. 16. Find No. 343.02.



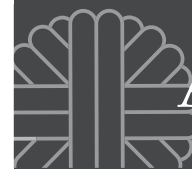
Fig. 17. Find No. 624.02.



Fig. 18. Find No. 164.04.



Fig. 19. Find No. 01.11.



Acknowledgments

The authors want to thank the Tyrolean Science Fund for their sponsorship of the scientific investigation and the Tyrolean Regional Government as owner of Lengberg Castle.

Bibliography

Arnold, J. (2008) *Cut and construction of linen shirts, smocks, neckwear, headwear and accessories for men and women c. 1540-1660*. London.

Eastop, D. (2007) Sound recording and text creation: oral history and the Deliberately Concealed Garments Project. In M. Hayward and E. Kramer (eds.), *Textiles and text: Re-establishing the links between archival and object-based research*; postprints; third annual conference, 26 - 28 July 2005. London, 65-70.

Goller, J. (2007) *Das Rechnungsbuch der Herren von Vilanders von 1415 - 1417* (Tiroler Landesarchiv, Handschrift 523). Auswertung und Transkription. Unpubl. Masters Thesis, Innsbruck.

Kania, K. (2010) *Kleidung im Mittelalter. Materialien - Konstruktion - Nähtechnik. Ein Handbuch*. Köln, Weimar, Wien.

Rast-Eicher, A. and Tidow, K. (2005) Die Textilien aus dem "Mühlberg-Ensemble". In I. Ericsson and R. Atzbach (eds.), *Depotfunde aus Gebäuden in Zentraleuropa: Concealed finds from buildings in Central Europe*. Berlin, 83-86.

Rast-Eicher, A. and Tidow, K. (2011) Mühlberg-Ensemble. Die Textilien. In R. Atzbach (ed.), *Die Ausgrabungen im Mühlberg-Ensemble Kempten (Allgäu): Metall, Holz und Textil*. Bonn, 285-351 and 428-497.

Tomedi, I. (1998) Ein Bauarbeiterhemd des 16./17. Jahrhunderts aus Schloss Tirol. In K. Spindler (ed.), *Das Geheimnis der Turris Parva: Spuren hochmittelalterlicher Vergangenheit in Schloss Tirol*. Landesmuseum Schloss Tirol, 04. April - 08. November 1998. Innsbruck, 145-159.

Corresponding Author: beatrice.nutz@uibk.ac.at



Lise Ræder Knudsen and Karina Grömer

Discovery of a New Tablet Weaving Technique from the Iron Age

Introduction

A new find from the salt-mine at Dürrnberg near Hallein in Austria (Grömer and Stöllner 2011, 105-109) supplements our knowledge about early tablet weaving techniques. The find is a separately woven woolen band, attached to a sleeve fragment (Fig. 1 and 2). It was found in 2009 in excavations by Dr. Thomas Stöllner of the Deutsches Bergbau-Museum Bochum, while exploring the Georgenberg site. Dendrochronology of wooden items from the findspot covers a time-span between the 5th and 3rd centuries BC. From the Dürrnberg saltmine more than 600 textiles are known (Stöllner 2005, Kurzynski 2002), most of them belonging to La Tène Period. Beside tabbies, 2:1 twills, and basket weaves, we know of eight examples of tablet weaving (Dürrnberg Textiles no. 554-1; 1180-1; 1303; 1888; 2041-1; 2196-1; 2575-2; 2577. Grömer and Stöllner 2011, 129-134). All of them are monochrome and woven with square tablets. They are made as narrow borders in simple warp twining and woven as an integrated part of larger weaves.

The new find from Dürrnberg No. 4470, is a special kind. The band was woven separately using tablets with four holes, threaded and turned in a specific way. The weaving created yellow Greek key or meander motifs on a background of greenish, blue and dark brown. Typological analysis of the pattern suggests a date at the end of the early La Tène period (i.e., the first half of the 3rd century BC; Grömer and Stöllner 2011, 109-111). The band was made with woolen warp threads of different shades (Table 1). SEM-analysis shows that paired horse hairs were used as weft (Fig. 3). The technique using hard plied fine wool threads as warp and stiff horse hair as weft is known from tablet-woven bands of the Hallstatt saltmine (Grömer 2005, 81) as well.

The weaving method of the Dürrnberg band

The weaving technique of the Dürrnberg band seems rather simple at first glance. The band is divided into two different pattern-woven sections with a warp-twined blue middle section of 4 tablets. The edges of the band are different from one another. One edge is a single warp-twined blue cord made with one tablet; on the other side the pattern weave ends with no solid edging. This edge is placed at the outer edge of the sleeve but it is uneven and seems not well suited for the wear the sleeve edge will be exposed to.

The salt in the mine has preserved the band incredibly well, but as the warp threads are very densely set, it is difficult to establish the amount of tablets used to produce it. Furthermore, the warps are made of plied yarns, making it more difficult to follow than single yarns. Unravelling the weaving was not allowed, so the only way to establish the original weaving method was trial and error.

A thorough microscopic study of the band was undertaken and macro photos were made. Then drawings of the thread course and hypotheses were made about the weaving method followed by practical attempts to make a reconstruction. Extensive experience and a thorough understanding of possible thread courses in tablet weaving are essential for this work (Ræder Knudsen and Mannering 2007; Ræder Knudsen 2012). The thread course of the Dürrnberg band defined standard tablet weaving methods. The problem is that there are three colours in each tablet in the pattern, but only two colours are in use in each square of the pattern. The wavy line is light coloured, and in one square the background is blue, while the background colour of the following square is brown. A colour change of this kind is not normally possible, because the undesired colour will come to the surface, when the tablets are twisted at certain times, no matter



Fig. 1. Dürrenberg, sleeve with attached tablet woven border, No. 4470. The dating of the border is probably first half of the 3rd century AD (Photo: A. Schumacher, © Deutsches Bergbau-Museum Bochum).



Fig. 2. Backside of the band with irregularities (Photo: A. Schumacher, © Deutsches Bergbau-Museum Bochum).

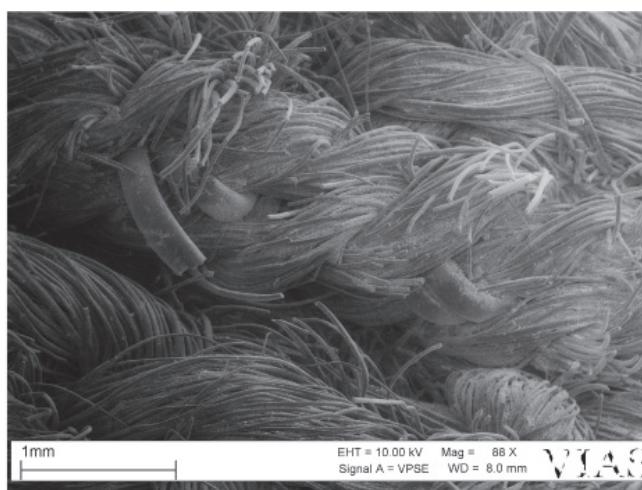
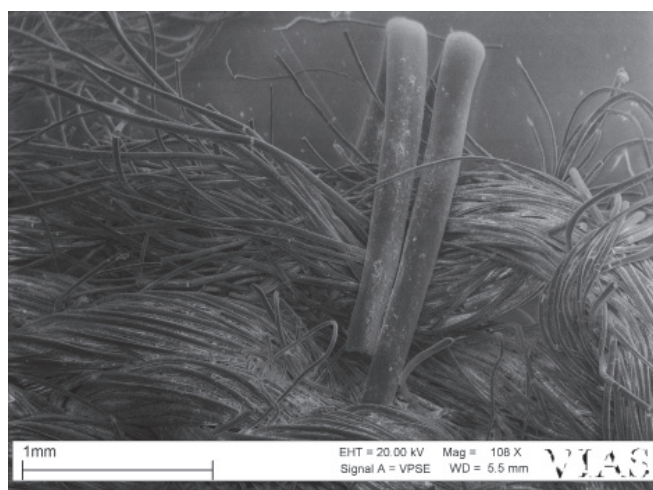


Fig. 3. SEM micrograph of the horse hair weft interacting with twined woolen warp threads (Photo: M. Mehofer, VIAS Vienna).

	warp					weft
	yellow (narrow)	yellow (wide)	dark blue	dark brown	greenish blue	
fibre	wool	wool	wool	wool	wool	horse hair
thread	plied yarn	plied yarn	plied yarn	plied yarn	plied yarn	paired
direction	S	Z	S	Z	S	not twisted
twist angle	30-40°	30°	30°	30-40°	30-40°	not twisted
thread thickness	0,2 mm	0,2-0,3 mm	0,2 mm	0,2 mm	0,2 mm	
thread count	92 threads with 1,8 cm (about 50 threads/cm)					8-10 weft/cm

Table. 1. Technical data of the tablet woven band (© Karina Grömer).



Fig. 4. Threading of tablets of the Dürrenberg band. Each column of elongated dots represents the colours threaded in one tablet, while the slope of the dot indicates the direction of the warp thread in each tablet. (Drawing: Lise Ræder Knudsen).

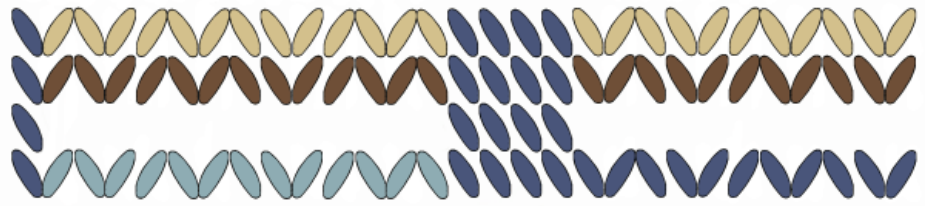
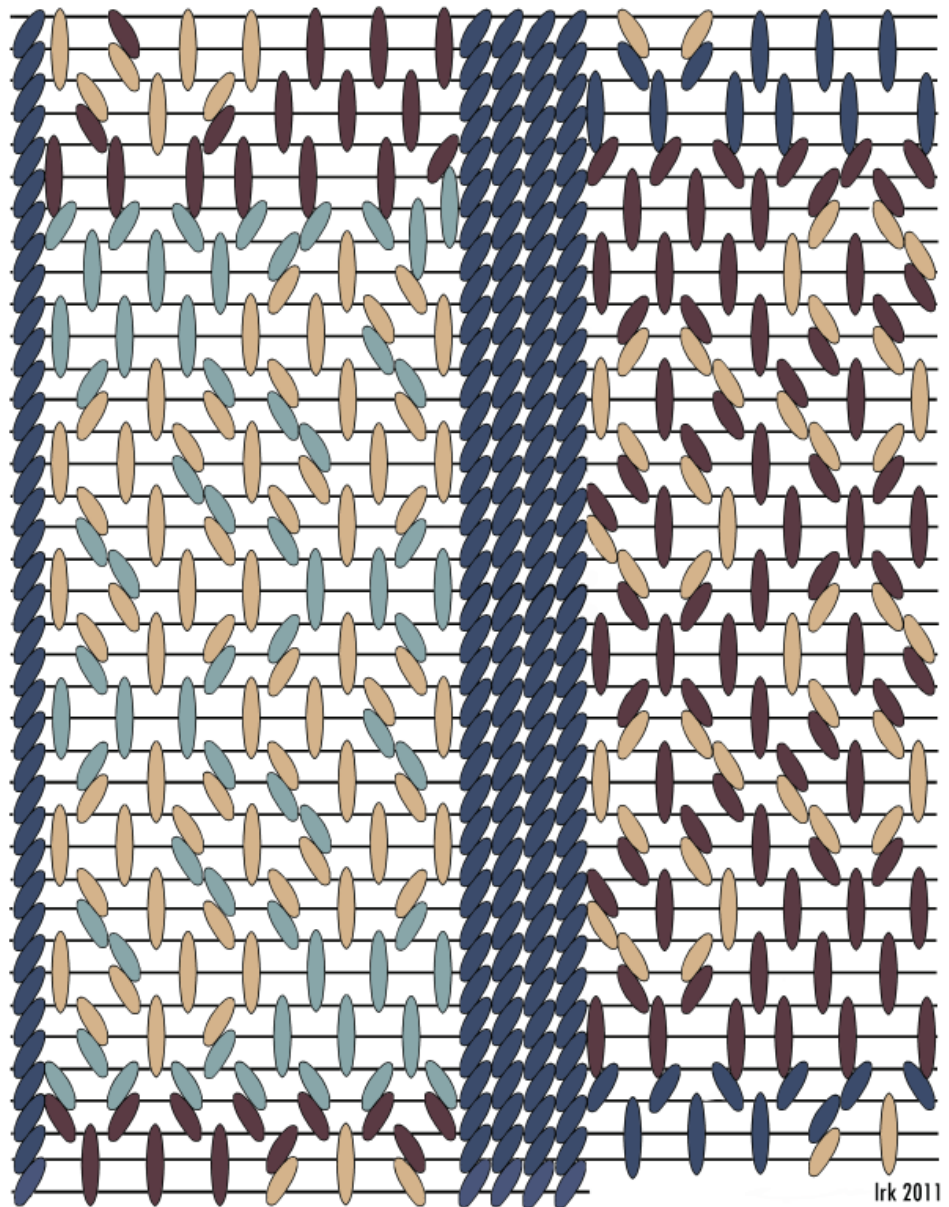


Fig. 5. Drawing of the pattern of the Dürrenberg band with focus on the thread course of each tablet. The black cross lines represent the weft while the elongated dots represent the points where the warp comes to the surface of the band (Drawing: Lise Ræder Knudsen).



Irk 2011

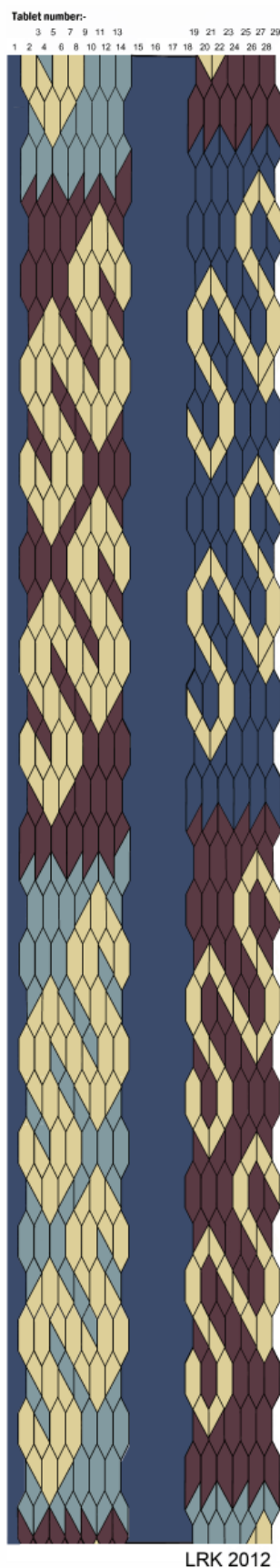
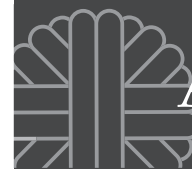


Fig. 6. Drawing of the pattern of the Dürrenberg band with focus on pattern (Drawing: Lise Ræder Knudsen).

if the tablets are triangular, square or another shape. But using experimental archaeology provided a new idea: what if the weaver had overruled the “laws” of tablet weaving and just avoided the undesired colour by pressing the threads of this colour below the weft with the shuttle? The practical weaving process showed that this was exactly the method used and furthermore, that it was very easy using this method (Fig. 4, 5 and 6).

Yet another problem arose when the background colour change was woven. As each tablet has three colours and an empty hole, it is not possible to change the background colour without changing the turning direction of the tablets. That is, when the colours follow each other in the tablet in this sequence: empty, brown, white, blue, and you want blue to take the place of brown in the turning sequence, this can only be obtained by changing the turning direction. When the turning direction is changed, the diagonal line which makes the wavy light pattern nice and even will change also, and the wavy pattern will become uneven and scattered. But this is not the case with the Dürrenberg band.

It was determined that a way to obtain the same pattern as in the original was to change the order that the single tablets followed each other in the bundle. As the tablets are not threaded from the same direction, the order that the colours come up, and the direction of the diagonal line of the light pattern of single tablets, are not the same. Thus it was possible to pick a tablet out of the bundle and place it differently. For instance, tablet number two and three could change place in the bundle. In this way, which is easier to show than to describe, it was possible to obtain a background colour change, as on the original border.

A reconstruction of the border was woven and the tiny errors of the original weaving and the reconstruction were compared (Fig. 7). In addition, pictures of the back sides were compared and the reconstruction and the original bands appeared very much alike. There might be other weaving methods which will produce a band like this as tablet weaving has an incredible amount of variations – but the technique found in this experiment produces a band with great resemblance to the original.

Technical details

The width of the band differs from 1.6 to 2.0 cm and the length is 25.5 cm.

The band was made using 29 four-hole tablets. At the edge towards the sleeve and in the middle section there are 1 and 4 tablets, respectively, each holding 4 blue threads. At the outer edge the band does not have edge tablets. In the two pattern sections there are 13

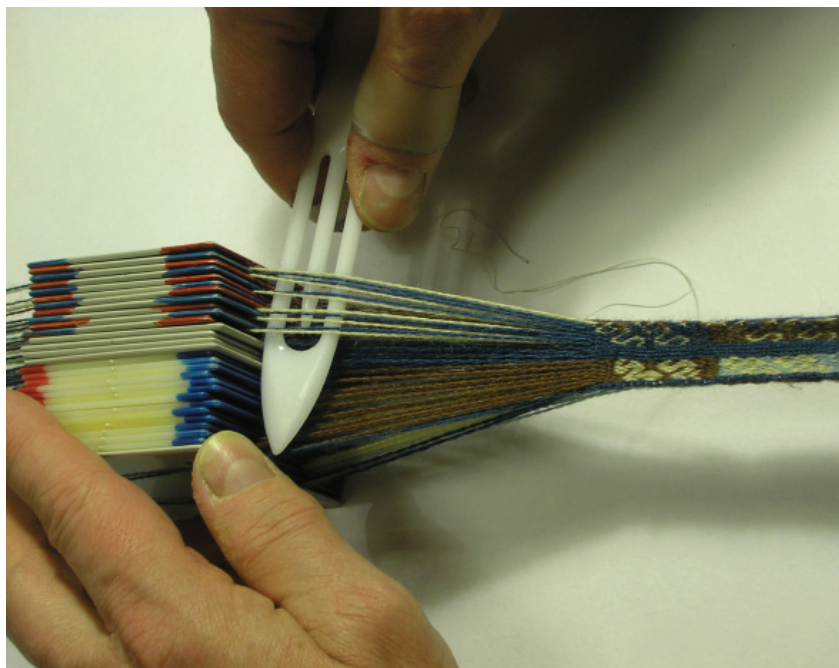


Fig. 7. Working on a reconstruction of the tablet woven band from Dürrenberg (Photo: Lise Ræder Knudsen ©).

and 11 tablets. The pattern of the 13-tablet section is a wavy line two tablets thick. The 11-tablet section has exactly the same pattern but with a thickness of only one tablet.

The tablet creating the single blue edge, and the four tablets forming the blue warp twined section in the middle are threaded from the same side, and the weaving method is straight forward quarter turns.

The two pattern sections are woven with individual turnings of groups of tablets and of single tablets. The turning sequence of the tablets is not very complicated and neither is the placing of the weft thread and avoiding the colour not in use. But threading the tablets and getting them in the right position for weaving is rather complicated. Furthermore, it is rather complicated to change the sequence of the tablets when a colour change is made.

This means that the weaver had many variables in focus and gave them equal attention to produce the pattern in this way. The pattern, especially in the background colour transition, has many small errors which are hardly visible to the naked eye. These errors are different at different places where the same pattern is repeated. This means that the weaver had a thorough understanding of the weaving system but had not memorized it or used a written pattern.

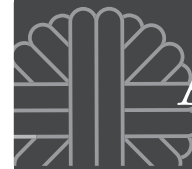
The pattern seems to continue right to the point where it was cut. This makes it likely that this sleeve border was part of a longer band.

Summary

The tablet woven band described was found in the Dürrenberg salt mine and belongs to the early group of patterned tablet borders from the Central European Iron Age. The band is sewn to the worn outer edge of a sleeve. As such, it was important that the band was stiff, and the use of horsehair as weft was a clever way to achieve this. The band was woven in a previously unknown method, producing colour changes in the background. Beyond the simple dynamics of tablet turning we are witness to extensive creativity and skill of the weaver in developing this clever method.

The development of this method and the production of this band must have taken much time and effort. All in all, it points to the fact that the band must have been produced in a society which had an excess of food and a general cultural surplus that encompassed the ability to appreciate the skills of the weaver and the results of the work effort.

Furthermore, the band was probably sewn onto a mine worker's sleeve edge at a later stage as reuse, which suggests that the border at the time of its disposal was not a highly important or valuable object.



References:

Grömer K. (2005) Tablet woven ribbons from the prehistoric Salt-mines at Hallstatt, Austria. In: P. Bichler, K. Grömer et al (Eds): *Hallstatt Textiles – Technical Analysis, Scientific Investigation and Experiment on Iron Age Textiles*. BAR Int. Series 1351, 2005, 81-90.

Grömer, K. und Stöllner, Th. (mit Beiträgen von Lise Raeder Knudsen und Helga Rösler-Mautendorfer), (2011) Ein abgerissener Ärmel aus dem Salzbergwerk Dürrnberg. Neue Erkenntnisse zur Brettchenwebtechnik in der Eisenzeit in Mitteleuropa. *Jahrb. RGZM* 56, 2009 (Mainz 2011), 105-157.

Kurzynski, K. v. (2002) Katalog der Textilfunde aus dem prähistorischen Salzbergbau am Dürrnberg bei Hallein. Ausgrabungskampagnen 1990 bis 2000. In: Stöllner, Th. (Ed.), *Textilkatalog* 1-23.

Ræder Knudsen, L and Mannering, U (2007) A Danish Early Germanic Iron Age Grave with Tablet Woven Cuffs. In: *North European Symposium for Archaeological Textiles* 9. Ennenda, 119-123.

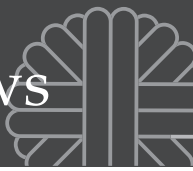
Ræder Knudsen, L. (2012) The Tablet-woven Borders of Verucchio. In: M. Gleba and U. Mannering (eds). *Textiles and Textile Production in Europe from Prehistory to AD 400*. Oxford, 254-263.

Stöllner, Th. (2005) More than Old Rags – Textiles from the Iron Age Salt-mine at the Dürrnberg. In: P. Bichler et al. (Eds.), *Hallstatt Textiles – Technical Analysis, Scientific Investigation and Experiments on Iron Age Textiles*. British Archaeological Reports S1351, Oxford 2005. 161-174.

Corresponding authors:

karina.groemer@nhm-wien.ac.at

lrk@konsv.dk



Kerstin Droß-Krüpe

Textile Production Workshop

21-24 August 2012, Sagnelandet Lejre
(Denmark)

For the second time researchers from all over the world were invited to Sagnelandet Lejre to gain hands-on experience in the field of ancient textile crafts. This stimulating four day workshop was organized by Ida Demant (Historical Archaeological Research and Communication Centre, Lejre, Denmark) and Eva Andersson Strand (The Danish National Research Foundation's Centre for Textile Research, Copenhagen University Denmark). Sixteen scholars from 10 countries in Europe, USA, Israel, Iran and China participated in this exciting workshop.

After a guided tour of the centre by General Manager Lars Holten the participants were divided into working groups according to their previous choice of subject areas: dyeing with plants (Instructor: Anne Højrup Batzer), fibre preparation and spinning (Instructor: Eva Andersson Strand), textile tool production (Instructors: Inger Hildebrandt and Jens Barnkob) and weaving on a warp-weighted loom (Instructor: Ida Demant). Under the guidance of the specialists in each subject, the participants spent two working days in their first working team before switching to a second area within textile production. The activities taught comprised: dyeing wool with different plant dyes (cochenille, madder, walnut, woad etc.) and mordants in wood fired boilers; processing flax stems from retted state to fibre; sorting, combing and preparing wool for spinning; hand spinning flax and wool; replicating textile tools in clay (spindle whorls, loom weights and spools), carving spindles from wood; setting up a warp-weighted loom, making a starting border, weaving a tabby textile.

Coming from a wide range of disciplines (prehistoric archaeology, classics, art history, conservation etc.) and also with very different levels of experience, the participants had practical introductions into aspects of ancient textile production and immediately started trying things out – learning from the instructors and from each other. The experience and knowledge gained were constant inspirations for new research questions, and led to lively discussions. Certainly this hands-on experience and the conversations with experienced textile craftspeople facilitated new perspectives on the research of each individual scholar.

In addition to the knowledge shared so willingly by the textile, pottery and woodworking craftspeople, the participants also benefited from a presentation from Martin Stoltze, breeder of Värmlands sheep.

These intense four days at Lejre were very fruitful and will surely provide a platform for new research ideas, making full use of the possibilities of experimental archaeology and reconsidering accepted knowledge. It remains to be hoped that this was not the last workshop of its kind!



Eva Andersson Strand

Wool Economy in the Ancient Near East and the Aegean: from the Beginnings of Sheep Husbandry to Institutional Textile Industry

7-10 November 2012,

Université Paris-Ouest Nanterre – France

Mesopotamia in the third millennium BCE has been called the birthplace of wool. This is because local socio-economic developments there led to increased production, and improvements in techniques for the manufacture of woollen threads and fabrics. In this region, large-scale factories began to produce fabrics and clothing in unprecedented quantities for the first time. The ESF SCH Exploratory Workshop analyzed the impact of this transformation, which radically altered the natural environment, the political landscape, and international trade networks, across the Near East to the Aegean. Its main focus was the economic aspects of wool production, using an interdisciplinary approach. The data provided by archaeology, archaeo-zoology, and epigraphy was brought together into a united historical perspective in 23 papers e.g. *From Weighing Wool to Weaving tools, Textile Manufacture at Ebla (Syria), Expansion of Sheep-Herding and the development of Wool production in Ancient Near East an Archaeo-zoological and Iconographical Approach, Wool trade in Anatolia during the Old Assyrian Period and Wool production and Economy at Ugarit*. The various papers explored

both the origins and beginnings of a wool economy in the Mediterranean and ancient Near East, and the stages leading up to large-scale reconstructed textile manufacture.

The workshop was convened by Cécile Michel (CNRS, ArScAn-HAROC, *Maison de l'Archéologie et de l'Ethnologie, Nanterre, France*), and by Catherine Breniquet (*Université Blaise Pascal-Clermont II, Clermont-Ferrand, France*) and supported by Centre National de la Recherche Scientifique (CNRS), France, the Danish National Research Foundation's Centre for Textile Research, Denmark, the Université Paris 1 Panthéon-Sorbonne, France and the Centre d'Histoire, Espaces et Cultures (CHEC).

The workshop papers will be published in the Oxbow Ancient Textile Series.



Recent publications

***Waterlogged Organic Artefacts. Guidelines on their Recovery, Analysis and Conservation*, by Angela Karsten, Karla Graham, Jennifer Jones, Quita Mould and Penelope Rogers**

These guidelines cover waterlogged organic artefacts, which range from minute fibre remains to complete items such as shoes, garments or containers. These guidelines are written for anyone working with archaeological waterlogged organic artefacts and cover all stages from project planning and initiation to archive deposition and curation. The overall aim is to ensure that the significance of waterlogged organic artefacts is appreciated, their research potential is fully realised and that they are integrated during the excavation and post-excavation phases. An overview of most waterlogged organic materials is given and good practice for the care of such artefacts is outlined. A bibliography and points of contact are provided for those who require more detailed information.

The guidelines can be downloaded for free from the English Heritage website:

<http://www.english-heritage.org.uk/publications/waterlogged-organic-artefacts/>

Textilien in der Archäologie. Materialien zur Bodendenkmalpflege im Rheinland 22 (Print Concept, 2011)

Jüngst geborgene Textilreste aus den römischen Bestattungen von Weilerswist und Rommerskirchen waren der Anlass, aktuelle Untersuchungen, Entwicklungen und Methoden der Textilforschung vorzustellen. Hierbei geben Beiträge zur Bergung, Sicherung und Konservierung eine Anleitung zum sachgerechten Umgang mit dieser fragilen Fundgruppe. Zahlreiche Beispiele von der römischen Kaiserzeit bis zur frühen Neuzeit illustrieren die Bandbreite archäologischer Textilfunde im Rheinland und vermitteln einen Überblick zum Stand der Restaurierungswissenschaft. Komplettiert wird der Band durch einen Ausblick auf aktuelle Projekte in der Textilforschung.

ISBN: 978-3-9811909-3-9

Price: € 21,00

Can be ordered from:

LVR-Amt für Bodendenkmalpflege im Rheinland,
Endenicher Str. 133, 53115 Bonn.

bodendenkmalpflege@lvr.de

***Daily Dress at Deir el-Medina, Words for Clothing*, by Jac. J. Janssen (Golden House Publications 2008)**

Using evidence from the papyri and ostraca from New Kingdom Deir el-Medina, as well as the meagre evidence of archaeology this volume attempts to provide more exact definitions for the range of words used to describe the everyday dress of the workers. Each entry includes the frequency of the words' usage, and analysis of its contexts and meaning.

ISBN-13: 978-1-906137-05-2

Price: £ 15.00

***Textile-making in central Tyrrhenian Italy from the final Bronze Age to the Republican Period*, by Sanna Lipkin. BAR International Series S2369 (Oxford: Archaeopress 2012)**

This is a study on textile production in central Tyrrhenian Italy from the final Bronze Age to the Republican period. Textile production is studied here through its technological, social and economic aspects. Textiles and their making were important parts of all fields of life in ancient Italy. Textiles and textile implements are found from settlement sites, burials, votive deposits and sanctuaries. The differences between the finds from different contexts through time point out the changes in material culture related to textile-making. The changes in the materials also indicate the change from household production of textiles to a workshop mode of production and specialisation, and later the development of slave involvement. Through the scope of this study one learns that textile production went through the introduction of many new technologies. This book presents new insights on the importance of textile-making in the ancient society and economy. The question of the importance of textile-making is approached

through different angles concerning age, gender, ethnicity, social status, profession and religion, and in so doing a new insight on the multifaceted identity of textile makers and their social status is built.

ISBN: 9781407309569

Price: £ 35.00

<http://www.archaeopress.com>

***KOSMOS. Jewellery, Adornment and Textiles in the Aegean Bronze Age*, edited by M.-L. Nosch and R. Laffineur. *Aegaeum* 31 (Liège: Université de Liège 2012)**

The subject of KOSMOS in the Aegean Bronze Age includes jewellery, costume, aesthetics, body adornment, colours, pigments, and textiles. The reason for this choice of subject was our wish to merge the textile research carried out currently at the Danish National Research Foundation's Centre for Textile Research, with the major research topic of Robert Laffineur, jewellery. This KOSMOS volume addresses the issues of textile production, costumes, dyes and pigments, colours, jewellery, aesthetics, body adornment, luxury and exotic items, gender and femininity/masculinity, as well as their social, religious, ideological, economic, technological, administrative and philological connections. In the Bronze Age, men, women and children would dress in garments, wear jewellery and adorn themselves to express their gender, age and status.

ISBN: 978-90-429-2665-3

Price: £ 140.00

<http://www2.ulg.ac.be/archgrec/publications.html>

***Russian Cloth Seals in Britain: A Guide to Identification, Usage and Anglo-Russian Trade in the 18th and 19th Centuries*, by John Sullivan (Oxford: Oxbow Books 2011)**

For many decades in the 18th and 19th centuries, Russia was the world's greatest exporter of flax and hemp and Great Britain its major customer. Most studies of flax and hemp and their associated industries have hitherto concentrated on the economic and historical events surrounding the rise and fall of these industries in Britain. This book is based on a large body of new material consisting of lead-alloy seals that were attached to bundles of flax and hemp exported from Russia and aims chiefly to describe the different seals that were used and to explain the reasons why they were employed. It offers a short history of their use, a guide to their identification and a catalogue of items recovered in Britain, opening up a valuable new source of material for analysing a different aspect of the history of commercial relations between Russia and Britain and providing assistance for finders and museum curators in identifying and deciphering these objects correctly. The text guides the reader through the different types of seal so far recorded using illustrations, transliterations of the Cyrillic texts found on the seals and explanatory tables, as well as a comprehensive catalogue. Analysis is conducted of the information found in the seals.

This information provides us with a picture of the manner in which the export of these products from Russia to Britain was handled and allows us to make comparisons over different periods of time and to analyse the different systems of quality control used. It also enables us to record the geographical distribution of Russian ports used for the export of flax and hemp to the UK, where the spread of their distribution tells us something of the redistribution of these imports and provides an understanding of the use to which their by-products were put as part of the agricultural practices of the 18th and 19th centuries.

ISBN-13: 978-1-84217-465-4

Price: GB £63.95

<http://www.oxbowbooks.com/bookinfo.cfm/ID/91609>

***Reading a Dynamic Canvas: Adornment in the Ancient Mediterranean World*, edited by Cynthia S. Colburn and Maura K. Heyn (Newcastle: Cambridge Scholars 2008)**

Personal adornment, as an extension of the body, is a crucial component in social interaction. The active process of adorning the body can shape embodied identities, such as social status, ethnicity, gender, and age. As a result of its dynamic and performative nature, the body can often convey meaning more powerfully and convincingly than verbal communication. Yet adornment is not easily read and does not necessarily reflect actual lived experience. Rather, bodily adornment, and the performances that accompany it, can be manipulated to conceal or exaggerate reality, thus speaking more to identity discourse. The interpretation of such discourse must be grounded in an understanding of the context-specific and negotiable nature of adornment. The essays in this volume, which are united by their focus on material and visual evidence, cover a broad chronological and geographical span, from the ancient Near East to Roman Britain, and bring together innovative scholarly work on adornment by an international group of art historians and archaeologists. This attention to the archaeological evidence makes the volume a valuable resource, as those working with material or visual culture face unique methodological and theoretical challenges to the study of adornment.

ISBN: 9781847184061

Price: £34.99

<http://www.c-s-p.org/flyers/Reading-a-Dynamic-Canvas--Adornment-in-the-Ancient-Mediterranean-World1-84718-406-5.html>



***Dressing the Dead in Classical Antiquity*, edited by Maureen Carroll and John Peter Wild, Stroud: Amberley Publishing.**

Naked we come into the world but we are extraordinarily unlucky if naked we leave it. It is a human reaction to cover the dead with textiles. This volume represents the results of new and ground-breaking research in the UK and abroad on clothing and textiles in the context of death and burial in Classical Antiquity, from the fifth century BC to the fifth century AD. The geographical scope encompasses the Mediterranean, as well as European, Asian, Egyptian and North African lands that were part of the Graeco-Roman world or that interacted with it in a variety of ways.

Investigations of funerary rituals thus far have focused on grave markers, burial ritual, grave goods, and skeletal material, while the roles of clothing and textiles in these rituals are less well understood. The topic is explored by studying a variety of different types of evidence: textiles in graves, such as shrouds and coverlets or the clothing in which the dead were dressed; clothing and textiles associated with death rituals, such as mourning dress; funerary portraits in sculpture and painting that depict the deceased dressed to convey messages about identities; and jewellery and dress accessories worn in death and included in the grave. The papers presented here offer tantalising glimpses of the role of clothing, textiles and bodily adornment as social markers, ostentatious displays, and expressions of identities in Classical Antiquity.

ISBN 9781445603001

Price: £25.00

<http://amberleybooks.com/catalog/search>

***Dress and Identity* edited by Mary Harlow. BAR S2356 2012: University of Birmingham IAA Interdisciplinary Series: Studies in Archaeology, History, Literature and Art 2.**

This collection of papers on 'Dress and Identity' arose from a seminar series held by the Institute of Archaeology and Antiquity, University of Birmingham in 2005. The present volume covers a wide chronological and geographical span: from archaic Greece to medieval Scotland by way of the Roman Empire and Anglo-Saxon England. The contributors come from a number of different academic disciplines: history, archaeology and classics. Contents: 1) Dress and Identity: an Introduction (Mary Harlow); 2) Costume as Text (Zvezdana Dode); 3) Veiling the Spartan Woman (Lloyd Llewellyn-Jones); 4) Dressing to Please Themselves: Clothing Choices for Roman Women (Mary Harlow); 5) The Archaeology of Adornment and the Toilet in Roman Britain and Gaul (Ellen Swift); 6) Dress and Cultural Identity in the Roman Empire (Ursula Rothe); 7) Investigating the Emperor's Toga: Privileging Images on Roman Coins (Ray Laurence); 8) Anglo-Saxon Woman: Fame, Anonymity, Identity and Clothing (Gale R. Owen-Crocker); 9) Representing Hierarchy and Homosociality: Vestments and Gender in Medieval Scotland (Penelope Dransart); 10) Cosmetics and Perfumes in the Roman World: A Glossary (Susan Stewart); 11) The Social Life of Museum Textiles: Some Comments on the Late Antique and Early Medieval Collection in the Ure Museum at the University of Reading (Anthea Harris).

ISBN 9781407309422

Price: £40.00

<http://www.archaeopress.com/ArchaeopressShop/Public/defaultAll.asp?QuickSearch=dress+and+identity>

Websites

An annotated bibliography of recent significant publications on indigo and related compounds C.J. Cooksey, *Biotechnic & Histochemistry* 2012, Early Online, 1-25:

<http://informahealthcare.com/doi/abs/10.3109/10520295.2012.698308>

This 25 page bibliography contains 188 entries and 9 figures and is an update of an earlier version of *Biotechnic and Histochemistry*, 2007, 82:2, 105-125

<http://dx.doi.org/10.1080/00958970701267235>

It contains mainly, but not exclusively, items published since 2007. The author can supply a copy to colleagues, upon their specific request, provided that no fee is charged and the article is used for research, teaching and private study purposes.

PhDs

Paula Mazare (“1 Decembrie 1918” University of Alba Iulia, Doctoral School of History, Romania) has been awarded a PhD for her thesis: *The craft of textile production at the Neolithic and Eneolithic communities in Transylvania* (Romania).



Margarita Gleba

New project:

PROduction and CONsumption: Textile Economy and Urbanisation in Mediterranean Europe 1000-500 BCE (PROCON) - 2013-2018

The past few years have witnessed a major dynamism in the field of archaeological textile research in Europe as demonstrated by numerous conferences and publications on the topic, as well as establishment of large-scale interdisciplinary collaborative programmes, such as the Centre for Textile Research (CTR) funded by the Danish National Research Foundation (2005-2015) and the pan-European project Clothing and Identities - New Perspectives on Textiles in the Roman Empire (DressID) funded by the European Union Education, Audiovisual and Culture Executive Agency (2007-2012). The necessary next step is to lead this growing field into answering some of the fundamental questions of archaeology, where evidence for textiles has hitherto been virtually unexplored. The European Research Council funded project PROCON aims to explore the role of textile production and consumption in the formation of early states, using the example of the Iron Age Mediterranean Europe. The overarching question to be answered is: To what extent did textile production and consumption define the development of productive and commercial activities of early urban Mediterranean societies in the Iron Age?

The aim of the project PROCON is to test the hypothesis that textile production and consumption was a significant driving force in the economy and in the creation and perception of wealth in Mediterranean Europe during the period of urbanisation and early urbanism in 1000-500 BCE. The focus will be 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 farm land, labour resources and

the development of urban lifestyle. This aim will be achieved by addressing 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 they changes over time in response of urban consumer demands?

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. This project takes developments in a specialist research field (textile archaeology) and applies them to modeling the dynamics behind the broader phenomenon of urbanisation in Europe. It 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. In terms of scale, project PROCON is concerned with broad patterns and adopts a Mediterranean-wide rather than a regional perspective, along with recent scholarship on 1st-millennium BCE Mediterranean. In doing so, the project explores similarities and differences between the different regions (Greece, Italy and Spain) as they followed their trajectories towards urbanisation.

The project will commence on 1 April 2013 and run for 5 years at the Institute of Archaeology, University College London, UK.

For information contact Margarita Gleba:
m.gleba@ucl.ac.uk



Frances Pritchard and John Peter Wild

Obituary, Thea Gabra Sanders (1933-2011)

ATR has the sad task of bringing readers the news of the death after a long period of illness of Thea Gabra Sanders (Edinburgh) on 13th June 2011. She was well known to those who attended meetings of the North European Symposium for Archaeological Textiles and the Early Textiles Study Group in the nineties, and she took on – with notable enthusiasm, energy and success – most of the organisation of the seventh symposium of NESAT in the National Museums of Scotland, Edinburgh, in May 1999. The lecture programme was full of interest and, thanks to Thea, the out-of-hours programme of activities was equally memorable: participants were each presented with a typical Scottish wool scarf on one fascinating visit to Burberrys, a leading woollen goods supplier on Princes Street! Her skill at winning financial support and help in kind from multiple donors was very evident.

Born and educated in The Netherlands, Thea settled in Scotland in 1962. She had already developed an active interest in craft weaving through the Edinburgh

Guild of Weavers, Spinners and Dyers when she came into contact with Michael Ryder in the early eighties. She worked in the Teaching and Research Centre of the Western General Hospital in Edinburgh where she had access to, and expertise in, the application of the Scanning Electron Microscope to fibre examination. Her micrographs underpinned Ryder's publication of the wools from the Mary Rose shipwreck (*Journal of Archaeological Science* 11, 1984, 337-343) and in the following year they published together in *Textile History* 16, 123-140 an article on the application of SEM microscopy to textile history. As had Brenda Lomas in Manchester and Rob Janaway in Bradford, they recognised and began to exploit the value of the Scanning Electron Microscope, a technique originating in the fifties, for textile fibre analysis – since when it has become a sine qua non in archaeological textile research.

For many years Thea ensured that textiles from archaeological sites in Scotland were recorded and when her illness struck she had just embarked on a re-examination of Viking-Age textiles from the region as a research associate at the National Museums of Scotland. It is sad that, despite the devotion of her husband Victor, she was not able to enjoy fully the fruits of her work in Edinburgh and her considerable contributions to textile archaeology.





John Peter Wild

Obituary, Bill Cooke (1943-2012)

The news that Dr W.D. (Bill) Cooke died on 10th August 2012 from a rare lung condition will come as a shock and severe blow to his many friends, colleagues and former pupils in the archaeological textile fraternity. Bill had created for himself over the past 25 years a special research niche: the characterisation and evaluation of archaeological textiles using the methodology of modern textile technology. In part, this arose from his own university department's long-established expertise and experience in the application of scanning electron microscopy to textile materials; but he extended it to the deployment of other technical apparatus, often one step back from the state-of-the-art, but superior to the latter in flexibility of use.

Bill's early career was in product management in the British textile industry, to which his PhD from the University of Manchester Institute of Science and Technology gave him entrée. In 1971 he returned to UMIST as Lecturer in Textiles, specialising in the teaching of knitting and knitted structures, but with a wider remit in the study of the properties and performance of textile fabrics.

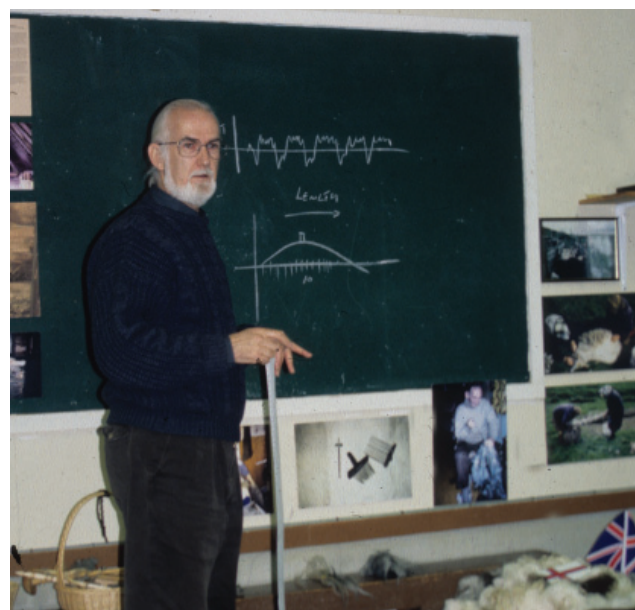
By the late 1980s he began to look for a fresh research challenge, and came down the road to the University's Department of Archaeology to root me out and explore the new possibilities which textile archaeology might offer. A glance at the well-preserved Roman wool textiles from Vindolanda inspired the thought that one could apply tests and ask questions of archaeological fabrics as if they were modern ones – and get some exciting answers. So it proved to be.

Bill and I set up the Manchester Ancient Textile Unit in 1989, as a (then unique) inter-disciplinary venture linking UMIST's Textile Department and the University of Manchester's Archaeology Department. It was designed as a vehicle for post-graduate teaching and research, and a platform for the launch of major research projects. Bill had an amazing ability to write applications which opened funding purses. Thanks to him, the Leverhulme Trust financed a three-year investigation (1992-1995) of the Vindolanda textiles

employing two post-doctoral research fellows, Colin Cork and Lucy Lu: it opened up new perspectives – and shut down a few, too. Software programmes for image analysis were beginning to be developed, and Colin grasped the opportunities enthusiastically.

Thereafter Bill made some significant contributions to the Nordic Viking wool sails project, based at Roskilde, and was a regular performer at meetings of the North-European Symposium for Archaeological Textiles. A string of pithy ground-breaking papers flowed from all this research activity.

Alongside his archaeological interests Bill ran a series of spin-off projects connected with his work in modern textiles, not least in the growing field of textile design. Though he formally took early retirement a decade ago, he remained active in research and fertile of new ideas, always willing to offer advice and inspiration. He has left a gap that will be impossible to fill.



General Information

Guidelines to Authors

The ATR aims to provide a source of information relating to all aspects of archaeological textiles. Archaeological textiles from both prehistoric and historic periods and from all parts of the world are covered in the ATR's range of interests.

1. Contributions can be in English, German or French.
2. Contribution may include accounts of work in progress. This general category includes research/activities related to archaeological textiles from recent excavations or in museums/galleries. Projects may encompass technology and analysis, experimental archaeology, documentation, exhibition, conservation and storage. These contributions can be in the form of notes or longer feature articles.
3. Contributions may include announcements and reviews of exhibitions, seminars, conferences, special courses and lectures, information relating to current projects and any queries concerning the study of archaeological textiles. Bibliographical information on new books and articles is particularly welcome.
4. Authors' guidelines can be found at www.atnfriends.com
5. All submissions are to be made in electronic text file format (preferably Microsoft Word) and are to be sent electronically or by mail (a CD-ROM).
6. Illustrations should be electronic (digital images or scanned copies at 600dpi resolution or higher). Preferred format is TIFF. Illustrations should be sent as separate files and not imbedded in text. Colour images are welcome.
7. All contributions are peer-reviewed by invited specialists.
8. The Editors reserve the right to suggest alterations in the wording of manuscripts sent for publication.

Please submit contributions by post to:

Archaeological Textiles Review
Centre for Textile Research
The Saxo Institute
University of Copenhagen
Denmark

Or by electronic mail to the corresponding editor:
Margarita Gleba: margarita@atnfriends.com

Or to editors:

Eva Andersson: eva@atnfriends.com
Ulla Mannering: ulla@atnfriends.com
Susanna Harris: susanna@atnfriends.com

Copyright

Copyright in text remains with the individual authors. Copyright in images remains with the originating source.

N.B. Back issues will with a three year delay be accessible in an electronic format on the ATR homepage. Therefore all copyrights have to be cleared for this medium.

Disclaimer

The views expressed by authors in articles printed in ATR are not necessarily those of the Editors and are the responsibility solely of the individual contributors.