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Editorial

The second issue of *Archaeological Textiles Review* in its new guise is as varied as ever in terms of its geographical and chronological scope, ranging from the Chalcolithic and Roman textiles of the Southern Levant (Sukenik et al.; Ben Yehuda), to Bronze Age finds from China (Cardon et al.; exhibition review *Buried Past in Desert*; symposium review *Wool on the Silk Road*), to colour in Latvian Iron Age textiles (Pigozne), to costume in the Northern Caucasus (Orfinskaya), and to 15th-century tapestry tools (Nutz and Ottino). From a more methodological perspective, there is more on the mechanics of spindles (Verhecken) and on wardrobe studies based on written sources (Dross-Krüpe and Wagner). A healthy crop of recent PhDs awarded for dissertations and numerous new postdoctoral projects funded by the EU and national councils and foundations on textile topics indicates the vitality of the field. With that in mind we are introducing a new feature, which will provide extended summaries of recent PhD dissertations.

2013 was a busy year for the archaeological textiles field, with many important conferences, exhibitions and publications. The DressID project culminated with an exhibition in Hildesheim (see summary by Michael Tellenbach and ATN 51), accompanied by a catalogue summarising the main strands of the project (see new publications). A major volume on the Hallstatt textiles (see new publications) is an outcome of the CinBA project (see ATN 52 and summary forthcoming in the next ATR). Another major volume presents the results of the several years of research into the purple silk and gold textiles from the Late Antique sarcophagi in Trier (see new publications).

Next year promises to be just as full with e.g. *Purpureae Vestes V* (March 2014, Barcelona, Spain),

Traditional Textile Craft - An Intangible Cultural Heritage (March 2014, Amman, Jordan), *NESAT XII* (May 2014, Hallstatt, Austria), *Textile Terminologies - from the Orient to the Mediterranean and Europe 1000 BC-AD 1000* (June 2014, Copenhagen, Denmark) and the *Early Textiles Study Group* (October 2014, London, UK) conferences taking place.

You can keep up with the events and news in textile archaeology on the Friends of ATR Facebook page:

<https://www.facebook.com/pages/Friends-of-Archaeological-Textiles-Review>.

It is encouraging to see that we have over 380 followers, so please spread the word and also send us your news and announcements.

In 2014, Margarita Gleba and Susanna Harris will be stepping down as editors of ATR and two new editors will be appointed at the next Annual General Meeting which will be held in Hallstatt, Austria during the NESAT XII symposium. The last Annual General Meeting was held in July 2013 at CTR in Copenhagen and the minutes can be read on our webpage.

Issues 46-51 are now available online on our webpage, and many readers have already used this free download possibility, but back issues are still provided in print though the homepage as long as there is a demand for this. Please make sure to renew your membership at the beginning of the year.

Please keep sending us articles, reviews and news. We encourage the contributors to submit their articles throughout the year to spread the editing workload. The next deadline for contributions to ATR 2014 Issue 56 is the 1st of July.

The Editors



Nahum Ben-Yehuda

Union Yarn and Union Fabric in Talmudic Literature from the Roman Era

Introduction

Modern era fabrics and the garments or textile products manufactured from them are often bi-component or multi-component fiber blends, e.g. cotton, polyester, and spandex - in various ratios. The selection of these fiber blends emanates from various considerations, such as factors of production cost, consumer demand and product performance. These mixture-fabrics may be produced by two methods:

1) Union yarn – wherein the different fibers are blended together and in turn spun. A variation – union plied yarn wherein several spun yarns, each consisting of one different textile material, are plied together, and in turn woven or knitted – is out of the scope of the current paper. 2) Union fabric – wherein two different yarns, each consisting of a single type of fiber, are woven or knitted together.

This is a *longue durée* phenomenon. Historically, mixture-fabrics have been documented and their preserved remains found. The Edict of Diocletian mentions various garments of half-silk (Laufer 1971, 150-152). Nevertheless, detailed descriptions of these garments' respective construction are lacking. Archaeological materials of this category in hand include those that originate from Roman era Palmyra in Syria, and from various locales in the Byzantine and Medieval periods. This paper will focus on the literary evidence for these fabrics from the Roman period, as presented in Talmudic literature.

The Talmudic sages (ca. 150-450 CE¹) demonstrate remarkable familiarity with textiles and their manufacturing processes. A wide gamut of fibers is recorded, i.e. sheep wool, goat hair, camel hair, rabbit hair, linen, hemp, various silks, and sea silk (*bisso marino*). For example, the following *halakha* (Talmudic law) lists the fibers that were in minor use:

One who takes outside on Shabbat [one of the following fibers]: grape wool [cotton], *kalakh* wool, camel wool, rabbit wool, wool from a sea creature, or any other [fiber] which is to be spun... (Tosefta Shabbat 9:3, literal translation of the Hebrew text's terminology).

The production of union yarn both spun and plied, of various fiber blends and ratios is described in this literature, as are various permutations of union fabrics. The aforementioned secular considerations for these products do not apply in Talmudic literature. Instead, legal ("halakhic") contexts are the principle impetus for the description of contemporaneous textiles.

It is important to emphasize that the exact dating of Talmudic sources is a complex task. Although estimated dates of final redaction for the various works indeed provide a relative *terminus ante quem* ("date before which") in the 3rd to 5th centuries CE, nevertheless these works embody many layers of historic excerpts offering a much earlier *terminus post quem* ("date after which"). This entire period may encompass 500 years or more. In the current paper, we will adhere to the *terminus post quem* (TPQ), this being the firmest ground.

This paper will elaborate upon the composition and structure of these mixture-fabrics as the sages describe them, and their respective halakhic connotations.

The two halakhic contexts in which Talmudic literature describes textiles of this type are: 1) the laws of forbidden mixtures (or: diverse kinds), and 2) eruptive affections (explained below) of garments. The familiar King James Version Bible translation of the latter: "A plague of leprosy... in a garment" (Leviticus 13:47, *passim*) is misleading, and has been rejected by contemporary scholars (Rabinowitz 2007, 650). Obviously, Hansen's disease is irrelevant



in this context (Milgrom 1991, 809 translates as “mold disease”). The current paper has adopted the terminology of the Jewish Publication Society Bible translation – “eruptive affection,” and applied it in turn to the Talmudic sources.

Both of these halakhic contexts are of Biblical origin (Iron Age), and the sages of the Talmud (Roman Era) relate to them from their own contemporary viewpoint, reflecting current textile technological capabilities and practices. According to *halakha*, the Biblical law of forbidden mixtures and its Rabbinically-decreed additions (or: safeguards) are binding and practiced in every era. Eruptive affections of garments may not have been a contemporary phenomenon in the sages’ time. Nevertheless, they are dealt with by them as if they were. Half-silk garments are mentioned in the various Talmudic genres - *halakha*, exegetics, and homiletics (*midrash aggada*). In this paper, the term wool – with no added descriptive modifier (e.g. camel, rabbit etc.) – indicates sheep wool. Flax and linen, in our context, are interchangeable terms.

Palmyra

Both union yarns and union fabric components were identified in some of the textiles retrieved from Palmyra (Schmidt-Colinet et al. 2000, *passim*). These textiles are relatively similar both geographically and chronologically to those mentioned in the Talmudic literature, and often provide correlative physical evidence. Union yarns of the following compositions are documented: wool-cashmere (probably from Mongolia; Schmidt-Colinet et al. 2000, 10), and cotton-flax (Schmidt-Colinet et al. 2000, 13). Both of these mixtures preserve the uniform animal fiber or vegetable fiber composition of the yarn. Similar, in this aspect, yarn blends are found in Mishna *Kil’ ayim*² (*infra*), i.e. wool-camel hair, and flax-hemp. In contrast, Rashi suggests the existence of a flax-wool union yarn. Union fabrics of the following structures and materials are documented at Palmyra:

- Warp: cultured silk (*Bombyx mori*), weft: cashmere or wool, cotton or flax.
- Warp: tussah silk, weft: cotton.
- Warp: flax, weft: wool.

These may be balanced weaves, warp-faced or weft-faced (Schmidt-Colinet et al. 2000, 10-13, *passim*). Many similar characteristics of material and structure in union fabrics are found in Talmudic literature.

The presence of both cultured silk from China and tussah silk (probably from India) in Palmyrene textiles, adds corroboration to their presence in the Land of Israel at that time, arriving via the overseas silk route. Although Asiatic camel hair was not identified (Schmidt-Colinet et al. 2000, 11), the fact

that cashmere goat hair appears lends credibility to the proposition that Bactrian camel hair may very well have been imported from the East, via the overland route. These issues will be discussed below in their respective halakhic contexts.

Kil’ ayim – The Law of Diverse Kinds

The Biblical sources for this prohibition are as follows:

A garment, which is a combination of two kinds of material - *sha’atnez*³, shall not be placed upon you (Leviticus 19:19).

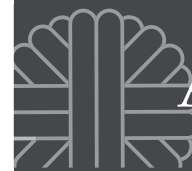
You shall not don *sha’atnez* - a combination of wool and flax (Deuteronomy 22:11).

Talmudic literature provides additional parameters and detail. It is possible to ‘neutralize’ one of the components of the forbidden combination, either wool or flax, by blending it at the fiber stage with a non-forbidden material. The ratio of 51% (or more) non-forbidden material to 49% (or less) forbidden material renders the resulting yarn exempt from this prohibition, and from susceptibility to eruptive affection (see below).

Wool and flax exclusively are subject to the [Biblical] prohibition of diverse kinds, and wool and flax are exclusively susceptible to eruptive affection.... Camel wool and sheep wool which have been blended together [before spinning] – if the majority is from the camels it is permitted [to be combined with flax]. If the majority is from the sheep, then it is forbidden to be combined with flax. If they are of equal quantities, then it is forbidden to be combined with flax. Likewise, [this ruling applies] to blends of flax and hemp [fibers] (Mishna *Kil’ ayim* 9:1).

Regarding camel wool, as specified in the Mishna, the indigenous camel of the Land of Israel is the one-humped Dromedary. Dromedary hair is relatively coarse in contrast to indigenous Awassi sheep wool. In color, Awassi is usually white and Dromedary varies from cream to dark brown. It can be assumed that this local, readily available material would naturally be used for this blend. Nevertheless, the softer and finer Asiatic two-humped Bactrian camel hair may also have been available via the overland silk route (*cf.* Palmyra above), thus producing a finer quality union yarn. Bactrian camel hair is also available in a variety of shades.

In some instances, the sages expand Biblical prohibitions. These are referred to as Rabbinic decrees,



and offer safeguards which distance the observant from the danger of transgressing the original Biblical prohibition. One of these appears in our context:

The *Shir 'ayim* and the *Kalakh* are not subject to the Biblical prohibition [of the law of diverse kinds], but are forbidden [by Rabbinic decree] because they present a misleading impression (Mishna Kil 'ayim 9:2).

These materials - *Shir 'ayim* and *Kalakh* - are **not** *sericum* (cf. Sifra Tazria' 5:13:1, *infra*) which can be identified as silk (*Bombyx mori*), but rather sea silk (*bisso marino*), as identified by Maimonides (cf. Tosefta Shabbat 9:3 "wool from a sea creature"). Sea silk is yellow-gold in color and might well be mistaken for flax. In addition, wild silks also offer a similarity to wool and/or flax both in their off-white to beige colors and in their variegated texture – due to being spun, as opposed to *Bombyx mori*, which is white, shiny, and smooth – a reeled continuous filament. Furthermore, *shirayim*, *sericum*, and *kalakh* appear together in a parallel source (Sifra Tazria' 5:13:1), indicating that they are not the same material. These wild silks may include tussah (or tasar), muga, and eri from India or China (Fig. 1), and may well have arrived in the Land of Israel in the 3rd century CE via the overseas silk route (Albaladejo Vivero 2013; cf. Palmyra above).

Shir 'ayim and *Kalakh* are kinds of silk and look as if they are wool and flax, being that one of them is soft like flax and the other is hard and

hairy like wool. (Maimonides – Commentary to the Mishna *ad loc.*). In coastal towns, there is a kind of wool which grows on undersea rocks. Its appearance is that of gold and it is very soft. It is called *Kalakh* and is forbidden to combine with flax because of the misleading impression, as it is similar to wool. Therefore, *Shir'ayim* and *Kalakh* are forbidden because of their misleading appearance (Maimonides – *Mishneh Tora, Hilkhhot Kil 'ayim* 10:1).

Maimonides' description of wool as "hard and hairy", as opposed to the "soft" flax requires explanation. In modern conditions we are generally accustomed to the opposite. Evidently the local medieval Spanish or Egyptian breeds of sheep produced coarse carpet wool, which could be described as hard and hairy, as opposed to pulled-early fine-fiber flax, in turn well-retted and beetled – which can subsequently be smooth and soft. Indeed, the indigenous Land of Israel Awassi sheep, which Ryder (1983, 130, 228) classifies as the probable descendant of Roman-era fat-tailed breed, produce medium diameter wool with the above characteristics.

The Biblical prohibition of combining these diverse kinds has its specific regulations regarding textile-production procedure, as follows:

The prohibition of diverse kinds [a combination of wool and flax] applies only to spun and woven material, as is written: "You shall not don '*sha'atnez*' - a combination of wool and



Fig. 1. Eri, Tasar, Muga and *Bombyx* silk cocoons (Photo: Richard Pieglar, used with permission).



flax" (Deuteronomy 22:11). [This Biblical *hapax legomenon* is subsequently interpreted as an acronym [*notarikon*.] [*'Sha'atnez'* indicates] a material which is *shūa'*, *tavūy* and *nūz* (Mishna *Kil 'ayim* 9:8).

The definition of the above three terms is subject to difference of opinion among Talmudic exegetes and halakhic decisors. Rashi, in his commentary to Babylonian Talmud *Nidda* 61b, defines the above acronym-derived terms as follows: *shūa'*–combed, *tavūy* – spun, *nūz* – woven. According to Rashi's opinion, in order to be forbidden by Biblical law, the combination of these two diverse kinds, i.e. wool and flax, must be in all three stages of production. This is union yarn. Being already blended at the fiber stage, there is no distinct textile component identity, neither of the flax nor of the wool.

In contrast, the Tosafist Rabbenu Tam's opinion (*ad loc.*) is that *nūz* (indeed a *hapax*) means plied, not woven. Therefore, when the flax and wool are combed, spun and plied separately, and these two separate yarns (wool and flax) are woven together, the resulting union fabric is forbidden by Biblical law. In other words, when the flax and wool components each have attained their distinct textile identity, as a plied yarn before being combined, the woven fabric is subsequently considered a Biblically forbidden mixture. Rabbinic decree further forbids combinations of wool and flax made by any means, including felting or sewing (*Arba 'a Turim, Yoreh De 'a*, ch. 300).



Fig. 2. Tussah warp - Awassi weft (Photo: Nahum Ben-Yehuda).

Experimental Archaeology

Experimental archaeology was implemented in order to concretize the Rabbinic decree prohibiting the combination of various fibers with wool and/or flax due to their misleading appearance, as indicated in Mishna *Kilayim* 9:2. The goal was to gauge the degree of similarity between these fibers, in parameters of color and texture. An additional goal was to aid in the corroboration of these fibers' actual identities. A balanced-weave tabby union fabric was woven using a tussah silk warp, and alternating weft sections of dry-spun flax, wet-spun flax, hemp, tussah, and Awassi wool. Preliminary results indicate that the section combining Awassi wool and tussah (Fig. 2) is indeed misleading to the nonprofessional, as the cream-colored semi-rough tussah resembles flax, and misleadingly appears as the Biblically prohibited wool-flax combination.

In another experiment, yarns of various mixtures were prepared – in accordance with Mishna *Kil 'ayim* 9:1. Awassi sheep (Fig. 3) fleece was obtained from a local flock, at April shearing time. Dromedary camel hair (Fig. 4) was obtained from a local herd, at the July molting season. Mr. David Mallin, of Cashmere Fibres International Bradford UK, kindly provided de-haired Bactrian camel roving. These fibers were further processed and spun by Mrs. Toni Friedman of Moshav Nir Etzion. Three different single-fiber yarns were produced (Figs. 5a-d): 100% Awassi, 100% Dromedary, and 100% Bactrian. And two union yarns: 2/3 Dromedary + 1/3 Awassi, and 2/3 Bactrian + 1/3 Awassi. This blend over-fulfills the halakhic demands of the aforementioned Mishna, which requires "a [simple] majority of camel wool", and halakhically permits the combination of these union yarns with flax, and correspondingly renders them **insusceptible** to eruptive affection. Difficulties were experienced in several processes: In de-hairing the Dromedary in order to obtain clean noils, and in blending and spinning together the two fibers of different lengths. Nevertheless, the results are usable yarns.

Nega 'im – The Eruptive Affection of Garments

The Biblical phenomenon, eruptive affection of garments, appears in Leviticus chapter 13. Talmudic literature in turn offers detailed *halakhot*, including ramifications in our context of union yarn and union fabric:



Fig. 3. Awassi sheep before shearing - Kibbutz Ein Harod Ihud (Photo: Nahum Ben-Yehuda).



Fig. 4. Combing off Dromedary hair. Negev Camel Ranch, Mamshit (Photo: Nahum Ben-Yehuda).

When an eruptive affection (*nega' sara'at*)⁴ occurs in a cloth of wool or linen fabric, or in the warp or in the weft of the linen or the wool... if the affection (*nega*) in the cloth or the skin, or in the warp or the woof, or in any article of skin, is intense green (or: yellow) or intense red, it is an eruptive affection... Such is the procedure for eruptive affections of cloth, woolen or linen, or in warp or in woof... for pronouncing it pure or impure (Leviticus 13:47-48, 59).

Talmudic literature addresses five specific aspects of this topic.

1) Textile materials which are susceptible to this phenomenon. In contrast, many of the **insusceptible** fibers are listed:

“And the garment” – Is it possible that this refers to a garment made of any of the following materials: *shirayim*, *sericum*, *kalakh*, grape wool [cotton], camel wool, rabbit wool, or goat feathers (*sic* = hair)? [No, because] Scripture states: “In a garment of wool or in a garment of flax” (Sifra Tazria' 5:13:1).

2) Halakhic standings of various blends of susceptible and **insusceptible** materials. This ruling is identical to the parameters indicated for the law of diverse kinds:

Camel wool and sheep wool which one blended together [before spinning], if the majority is from the camels, then they [the warp or weft yarn spun from this blend, or the garment woven from it] are **insusceptible** to [the] impurity [of eruptive affection]. If the majority is from the sheep, then they are susceptible to [the] impurity [of eruptive affection]. If they are of equal quantities, then they are susceptible to [the] impurity [of eruptive affection]. Likewise, [this ruling applies] to blends of flax and hemp [fibers] (Mishna *Nega'im* 11:2).

3) The effect of coloring (or dyeing) upon the susceptibility of otherwise relevant materials. This aspect is an exclusive characteristic of the *halakhot* of eruptive affections:

Hides and clothing which are dyed (or colored) [by any means] are **insusceptible** to [the] impurity [of eruptive affection]... Rabbi Shimon says, “Those materials which are colored in their natural state [e.g. brown or black sheep wool] are susceptible, and those that have been dyed by man are **insusceptible**” (Mishna *Nega'im* 11:3).

Is it possible that [garments] will be susceptible to [the] impurity [of eruptive affection] whether



Fig. 5a. Awassi Yarn - 100%
(Photo: Nahum Ben-Yehuda).



Fig. 5b. Dromedary yarn - 100%
(Photo: Nahum Ben-Yehuda).

they are colored (dyed) or non-colored (non-dyed)? [No, because] Scripture states: "In a garment of wool or in a garment of flax". Just as flax is used in garments as it was created (non-dyed) [This is based upon the precept that flax was used exclusively in a non-dyed state. It was, however, used both bleached and unbleached], so [in this case] wool – only as it was created (non-dyed). [These two fibers are mentioned adjacent to one another in Scripture in order to parallel this characteristic.] (Sifra *Tazria* 5:13:3). [Is it possible] that I will exclude from [susceptibility wool] which was dyed by man, but will not exclude that which is colored in its natural state? [No, both will be excluded] because Scripture states: "Of flax or of wool". Just as flax is white, so [in this case,] wool only when it is white. [As above, these two fibers are mentioned adjacent to one another in order to parallel this characteristic.] (Sifra *Tazria* 5:13:4).

4) How colored components in various weaving structures, i.e. bi-colored fabrics in balanced, warp-faced, and weft-faced structures, affect garment susceptibility. The colored (dyed) materials referred to in the following *halakhot* are characteristically wool, as flax was used exclusively in a non-dyed state (see above):

A garment – the warp of which is colored [an insusceptible condition] and the weft of which is white [a susceptible condition], or *vice versa* – the halakhic status [of the garment] is according to the appearance [*i.e.* whether the white or color is apparent as in a weft-faced or warp-

faced cloth] (Mishna *Nega'im* 11:4).

A garment – whose warp is colored [an insusceptible condition] and whose weft is white [a susceptible condition] or *vice versa* – the halakhic status is determined by the weft [This indicates a weft-faced weave. As a result, dyed warp renders the garment susceptible, while dyed weft renders it **insusceptible**]. In the case of pillows and bolsters – it is determined by the warp [This indicates a warp-faced cloth.] Both of these follow the rule of "appearance" (Tosefta *Nega'im* 5:4).

Worthy of notice is the more detailed information conveyed in the Tosefta, which is based upon the principle of appearance as established in the previous Mishna. While the Mishna does not indicate which types of weaves are common, the Tosefta reflects interesting data in the framework of bi-colored dyed/white fabrics, i.e. they are generally (or exclusively?) weft-faced. In contrast, pillow and bolster cases are generally (or exclusively?) warp-faced. The halakhic status of a balanced bi-color dyed/white weave is not indicated in these excerpts; although a probable extrapolation would be that it is **insusceptible**, being that a contiguous white surface, such as the faced structures, is required to enable susceptibility.

5) The influence that **insusceptible** textile components in the fabric have on its halakhic standing:

A garment – whose warp is *sericum* and whose weft is wool, or *vice versa* – both of these [cases] are insusceptible to [the] impurity [of eruptive affection] (Tosefta *Nega'im* 5:5).



Fig. 5c. Bactrian yarn - 100%
(Photo: Nahum Ben-Yehuda).



Fig. 5d. Bactrian 2/3 + Awassi 1/3
(Photo: Nahum Ben-Yehuda).

This halakhic ruling encompasses both balanced weaves and *sericum*-faced or even wool-faced weaves, and is not dependent on appearance. Here is an obvious discrepancy between the bi-color undyed/dyed case in which the appearance of the fabric determines the halakhic standing and the bi-component sericum/wool case in which, under any circumstances, the garment is unsusceptible. The shortcoming of dyed wool in this halakhic context (susceptibility) is only its appearance, not its base material. Once that appearance is concealed, the base material – wool – still serves as a viable component, therefore creating a susceptible garment. In contrast, *sericum* (or any other unsusceptible fiber) even when concealed, is not considered a component of the fabric, and is legally nonexistent. As a result, one of the essential components of this fabric is lacking and it therefore is **insusceptible**:

A garment which has flax warp and hemp weft, or vice versa, is not susceptible to the impurity of eruptive affection. The same is true of a garment whose warp or weft is flax or wool, and the other component is goat hair or any of the other fibers [aside from wool and flax] – it is not susceptible (Maimonides, *Mishneh Tora*, *Hilkhot Tum'at Zara* at 13:3).

It is notable that Maimonides deletes (or only alludes to) the Tosefta's sole example – *sericum* + wool – and only offers others, which are not mentioned in Tosefta but nevertheless meet the appropriate criteria. It is dubious to suggest that the sericum + wool combination was uncommon in early 13th century CE Egypt, where Maimonides composed this

work. Nevertheless, the Tosefta's exclusive use of this *sericum* + wool example does tend to indicate that the phenomenon was familiar at that time in the Land of Israel.

Half Silks - Diocletian and Midrash Aggada

Subserica or *semisericum* (half-silk) and *holoserica* (pure silk) are mentioned in several contexts in the Diocletian's Price Edict. *Subserica* is a mixed-fiber fabric, consisting of silk and an additional fiber. They are listed there as garments: neckbands (7:49-50), shirts (9:10, 18), and dalmatics (9:12-16). In addition, they appear in relation to wages for those engaging with them: tailors (7:49-50), embroiderers (20:1-2), silk workers (20:9-11) and fullers (22:8-15). No details are provided regarding the construction of these fabrics, neither is the identity of the supplemental component in *subserica* nor its function as warp or weft. The Edict consistently demonstrates the relationship between the cost of a *holoserica* garment which is higher than the cost of the *subserica* version. In parallel, the fee for services rendered by various artisans is higher for *holoserica* than it is for *subserica*. Miko Flohr (in personal correspondence) postulates that this does not necessarily reflect a more difficult or time-consuming process, but rather a relatively greater liability for damages which may be caused to the more expensive material. Here we observe, that in this case the mixture-fabric is inferior to the single-fiber material. The addition of, perhaps, wool or linen to the pure silk decreases production costs at the expense of reduced quality.

The very same comparison, between the less expensive and less prestigious *semisericum* and the more prestigious *holosericum* is echoed in Talmudic literature:



Rabbi Yirmia Ben El 'azar says: "In the future, the Holy One Blessed be He will renew [in the sense of enhance] the brightness (or: glory) of the righteous ones' faces, as it is written: [Judges 5:31] 'And those who love Him [God] will be as the sun rising in might!' And just as he renews their faces, he will renew their garments. Today – *semisericum*, tomorrow – *'olosericum*" (Midrash Qohelet (Ecclesiastes) Rabba 1:9).

In addition this fabric is mentioned in the Jerusalem Talmud in an exegetic context. The prophet Isaiah (Iron Age) admonishes the "Daughters of Zion" for their vanity (or: arrogance), and warns that the Lord will punish them by "stripping off their finery". Subsequently, the prophet lists those items of dress and ornamentation that will be stripped off (Isaiah 3:16-23). Today, some of the articles in this list are difficult to identify. The Jerusalem Talmud presents a detailed list in which each article is identified. Here, the Biblical text's intentions have been contemporized and compatible items of dress, familiar to 5th century CE sages, are presented. One of these is half-silk:

"...v'HaHaritim." ⁵ (Isaiah 3:22) – These are decorated belts and decorated *'oloserica* (Jerusalem Talmud Shabbat 6:8:2).

It is difficult to ascertain why these specific two decorated items were selected as identification for the Biblical item. Evidently, they were contemporaneous expressions of vanity. The specific garment or ornament made of *'oloserica* is not mentioned by name, indicating that the material itself was the focal point, or that the garment was referred to by the name of its material.

Conclusions

In this paper, we have presented and analyzed Talmudic literary sources regarding union yarn and union fabric. Certain parallels from the Palmyra textiles and the Diocletian's Price Edict have been identified and compared to the Talmudic ones. Preliminary experimental reconstruction has been performed in accordance with these sources, and additional experiments are planned. Further research will encompass the union-plied yarns mentioned in this literature.

Notes

1. The calendar era "CE" (Common Era) is the accepted culturally-neutral alternative to "AD" and refers to identical years.
2. " ' " (= Modifier letter right half ring) indicates the Hebrew consonant *Aleph* – a glottal stop.
3. " ' " (= Modifier letter left half ring) indicates the Hebrew consonant *Ayin* – a voiced pharyngeal fricative.
4. "Š" indicates the Hebrew consonant *Šaddi* – an emphatic "S".
5. "H" indicates the Hebrew consonant *Het* – a voiceless uvular fricative, pronounced as the Spanish "J" in "Juan".

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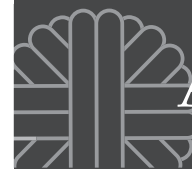
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Author: pishtani@gmail.com



Ieva Pigozne

Use of Colours in the Latvian Archaeological Textiles

Abstract

The article contains a report of a research project on the colours used in the archaeological textiles of the 3rd-14th centuries AD in the areas of Latvia inhabited by the Baltic population. It concludes that dark blue was the most popular colour of the garments found in the burials of the wealthy Baltic people. Blue and brown single yarns have been detected in the analysed fabrics, and blue, red, and yellow plied yarns have been distinguished in the decorations of the dress. Red and yellow were more frequently observed in female dress. Such a colour scheme seems to have been quite popular in the Baltic-inhabited areas of the Latvian territory in the 3rd-14th centuries AD.

Keywords: *Baltic, Latvia, archaeological textiles, colour, blue, brown, red, yellow.*

Introduction

This article represents one part of the author's doctoral thesis that analyses the use of colours in Latvian textiles from the 3rd-14th centuries AD. This article can also be looked upon as a continuation of the previously published introduction to Latvian archaeological textiles (Davidson and Pigozne 2010).

Context

Results presented here are from a research project that was carried out at the National History Museum of Latvia in 2008 and 2009. All the collected data on the use of colours come from the textiles that are stored at the National History Museum of Latvia in Riga, Archives of the Archaeology Department, where majority of all the Latvian archaeological collections are kept. The analysed textiles come from burials, some stray finds, most of which are from burial grounds, and one hoard.

The total number of textile fragments that are to be found in the Latvian archaeological material is unknown. Mostly this is because the majority of archaeologists in Latvia have not been particularly interested in researching textiles. Textiles are such fragile artefacts that many of the excavated fragments have never been given an accession number and have often not been mentioned in the documentation of excavations. Another complication involves cleaning,

conservation and storage of the textile fragments once they have already arrived at the museum. Restricted budgets, other priorities and sometimes lack of knowledge (especially in the Soviet times) have led to a situation that many of the textile remains have never been cleaned, are not properly conserved and stored, so further degradation takes place.

Having said that, it is important to emphasize that Latvia possesses a great number of well-preserved archaeological textile remains, primarily due to two reasons: the type of soil favouring textile preservation, especially in the eastern part of the country, and the tradition of the 7th-13th century to use bronze jewellery and bronze decorations woven directly into woolen fabrics. Bronze functions as a preservative and so many textile remains have survived remarkably well.

A couple of other general aspects have to be mentioned with regard to textile finds in Latvia. If the buried person has many belongings in the burial, particularly pieces of bronze jewellery, it is more likely that textile fragments have survived. This leads to a disproportionably large number of textiles from the graves of the wealthier people and practically no record of the clothing remains of the poor. Moreover, as the bronze decorations that have been woven into the woolen fabrics are mostly used in particular garments, fragments of these garments constitute



the majority of the textile finds. Therefore the largest quantity of the better preserved textile remains that can be linked to specific garments are as follows: women's shawls (*villaine*) and head ornaments (*vainags*), men's capes, arm bands and leg wraps. There is no convincing proof of any textile fragments having belonged to women's skirts or men's trousers. This is mostly because the placement of the preserving bronze jewellery and decorations have normally been in the area between the deceased person's head and hips. Accordingly, textile remains are usually from this part of the burial. At the same time, analysing the colour of the women's shawls that constitute the largest number of the archaeological textile material, would repeatedly lead to the same result of blue. The same can be said regarding men's arm bands that were decorated with bronze rings. Similarly women's head decorations usually show the use of a red ground. This is why more samples of other garments have been chosen for the analysis, e.g. textile fragments that might have belonged to men's coats and caps. A number of textile fragments that can not be identified as parts of particular garments have been analysed for the same reason.

Finally, it is necessary to address the problem that probably the great majority of the textiles that have been excavated from the burials might belong to festive/ceremonial dress and not everyday dress. Taking into account that most of the finds are from the burials of the wealthier people, there still are indications that the excavated garments had been used prior to the burial ceremony. There are at least two finds of unravelled and coarsely mended tablet-woven bands attached to the edges of women's shawls (Zarina 1970, 82, table 13, no. 4, 11). The mended parts correspond to the placement of fibula used for holding both ends of the shawl together. Another example shows that "buttonholes" were sometimes sewn in the tablet-woven bands to avoid unravelling of them when a fibula would hold a shawl together (Zarina 1970, 88). This suggests that the shawls were used many times during the lifetime. Another source of information regarding clothing not used in burials comes from the Tiras Bog hoard of textile fragments from at least 15 different garments of men's clothing (Zeiere 2008, 130). Several of these garments had been mended e.g. leg wraps. Accordingly, the appearance of the hoarded textiles, as well as the craft skills needed for producing them are similar to those garments found in the contemporaneous burials.

Earlier research and methods of detecting the colours

So far distinguishing colours has not been the main interest even to those archaeologists who have done

research on the archaeological textiles (for more information on general research on Latvian textiles, see Davidson and Pigozne 2010, 5-31). The first publication where colours were mentioned was by Ernsts Vale in 1928 (Wahle 1928, part 2). He noted that the colour of some 3rd-4th century AD textile fragments from Rucavas Mazkatuzi burial ground could possibly have been natural grey. Julijs Auskaps spotted wood blue colour of a shawl from Stamerienas Annasmuiza burial ground (Auskaps 1929, 32). Valdemars Ginters (Dzervitis and Ginters 1936, 26-54) described the archaeological evidence of textile remains and wrote that the main colours of the fabrics were blue, brown, and natural grey; the colours of the ornaments: blue, yellow, red, and green. However, Ginters admits that he never traced green, only assumed that it had to be there. Konstance Ozols published an article where she mentioned that the colours of the women's shawls might have been dark blue or dark brown, while the tablet-woven bands contained pairs of colours: red and blue, red and yellow, red and green, yellow and brown (Ozols 1939, 85). Of the researchers who have touched upon specifying colours, only Auskaps, Ginters and Ozols mentioned the methods that had been used for clarifying colours: microsublimation, spectroscopy, and chemical analysis. Hugo Riekstins described the colours of a man's arm band: it was made of blue fabric with red, yellow and blue fringes (Riekstins 1939, 72). Anna Zarina, the only Latvian textile researcher of the Soviet period, identified the colour of several textile fragments. She distinguished that fabrics had usually been dark blue, brown and yellowish brown. The most widespread colours of tablet-woven bands had been blue, red and yellow, and the ground of women's head ornaments had been red (Zarina 1970, 57-58, 72, tables 4, 6, 10-16, 21, 23, 26). Irita Zeiere analysed the textiles of Tiras Bog hoard and noticed that the cape found in the hoard had been dyed blue, the hood – yellowish brown, the leg wraps – brownish red, and the plaited yarn as well as the yarn used for sewing – red (Zeiere 2008, 130-134). After the re-establishment of independence of Latvia, financing of archaeological research has been very limited and after Latvia experienced the global financial crisis it has been close to non-existent. In the last 20 years, there has been one attempt to carry out chemical analysis of some textile fragments, however, the results were never published and their interpretation was disputable. Experimental research of how the colours of the textiles would be influenced by burying them in the local soil has never been carried out in Latvia.

My research is the first to concentrate particularly on the colour of the archaeological textiles and thus the first in this field. Sadly, the lack of financing made it



Fig. 1. A remarkably well preserved fragment of a woman's shawl from Galgauska, stray find, 12th century AD, National History Museum of Latvia RDM I 3666, Table 1 no. 187-191 (Photo: Ieva Pigozne).

impossible to carry out chemical analysis. However, the advantage that the researchers of Latvian textiles have is that sufficiently great number of samples is preserved in very good condition, often making it possible to distinguish their colours even with a naked eye (Fig. 1).

The methods of detecting colours which were examined and tested included a microscope and a spectroscope. In cooperation with Gatis Ikaunieks, application of an Ocean Optics USB4000 spectroscope was tried and the conclusion was that in detecting the colours of archaeological textiles this method was unproductive as all the results contained too much of "unidentifiable dark colour". Finally, the use of an optic microscope has proved to be the best of the available methods in distinguishing the colours. Magnification 120X turned out to be optimal to detect the colour of single fibres. Before starting to work with the archaeological textiles, ten samples of woolen yarns dyed in different colours, as well as samples of natural white and natural grey yarn were examined. In the process of clarifying colours it has been possible to find several samples of fibres in every colour in a very bright and well preserved condition. When poorly preserved fibres of the same sample were also analysed, types of fibre degradation and changes it had brought to the initial bright colour could therefore be identified.

In cases where in the same yarn some darker natural grey fibres could be detected, it was a sign that colour was not very degraded since natural grey fibres are present in most of the local natural white sheep wool of today as well. If the degradation of the fibres was too advanced, all the fibres looked the same - either thin, slightly yellow and transparent or very dark reddish brown. In these two cases, further detection

of the initial colour was impossible. However, if the fibres were better preserved, the general tendencies of colour changes were that fibres that had initially been dyed blue, presumably with woad (*Isatis tinctoria L.*), would turn darker, sometimes close to black, sometimes more green or more violet (Fig. 2). Yellow, red and brown colours had often lost colour and turned paler and greyer, sometimes lighter and more yellowish.

Samples representing the areas of the current day Latvian territory inhabited by the Balts have been selected for analysis (Fig. 3). Textile remains from the finno-ugric Liv-inhabited areas were not included in the research because they could not be used further in the project where data from the archaeological finds and Latvian folklore material were compared.

The results of the analysis of 233 fibre samples are summarised in Table 1. The following is a discussion of the use of every colour that has been detected in the course of the research.

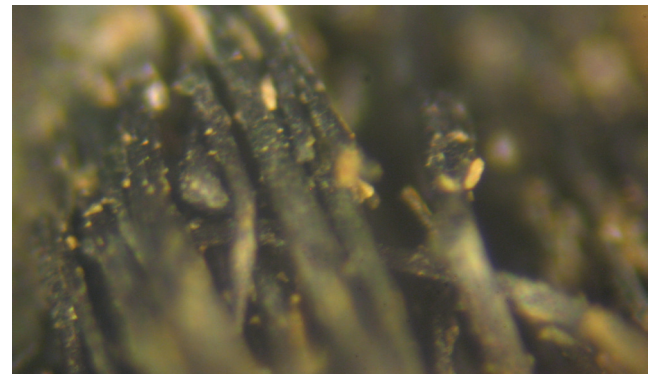
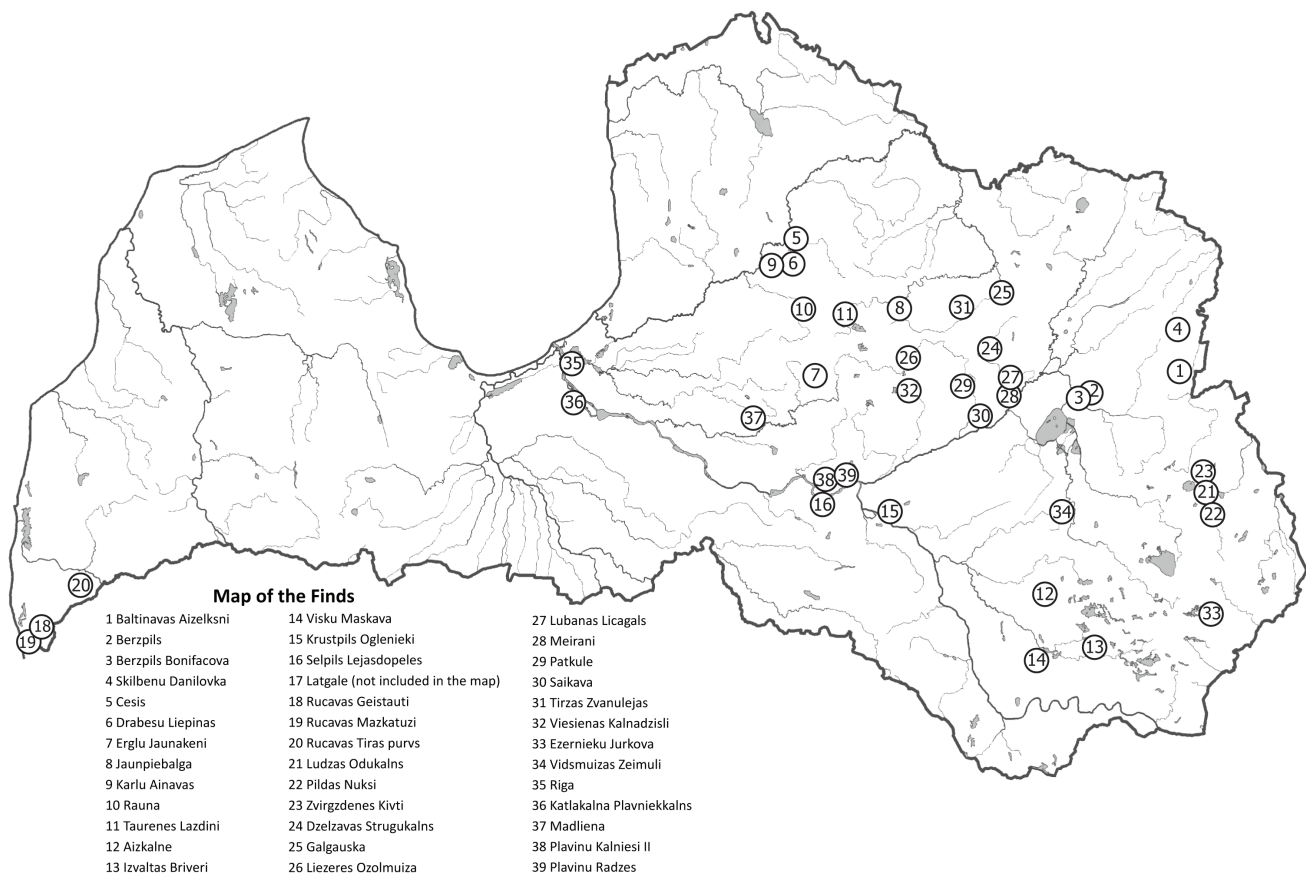


Fig. 2. Sample of relatively well preserved dark blue fibers that have become almost black; some signs of degradation can be observed (Photo: Ieva Pigozne).

Fig. 3. Map of the finds (Illustration: Ieva Pigozne and Ingus Freibergs).



Discussion

Blue

The most popular colour of the analysed textile remains is blue. It has been detected in 105 of the 233 samples examined. The use of it would have been even more widespread if a proportionally larger number of women's shawls had been analysed. The aim of this research, however, was to find out the use of all possible colours. This is why a larger number of textile fragments of other colours have deliberately been chosen for the analysis.

Seventy of the 105 occurrences of blue colour were detected in fabrics of the garments. In the female burials it was identified in 20 shawls (or textile fragments that most likely belonged to shawls). Six of the analysed shawls were decorated only with tablet-woven bands sewn to their edges and ends (Table 1 no. 16, 53, 73, 108 (Fig. 6), 182, 205) and one shawl that was decorated with tablet-woven bands and a line of embroidery (Table 1 no. 12). Eleven shawls were decorated with in-woven bronze rings and spirals (Table 1 no. 3, 9, 24, 30, 57, 65, 70, 176, 187 (Fig. 1), 192, 219). Two shawls

were plaid, made of blue wool and natural white linen (Table 1 no. 17, 116). All the analysed fabrics of the shawls were twills woven in single yarn. Blue colour was identified in 13 samples of fabric that could not be associated with a particular garment (Table 1 no. 11, 68, 69, 86, 99, 112, 113, 120, 157, 158, 159, 170, 186). These fragments do not have edges, attached bands or fibulae that would help indicate their function.

In male burials, blue has been detected in 29 samples of fabric: eight coats, seven coats or capes, one cape, three capes or burial covers, one cap, one leg wrap and eight pieces of fabric that could not be identified as having belonged to particular garments. Three of the analysed coat fragments were decorated with in-woven bronze rings (Table 1 no. 91, 94, 233). One of these samples contains a V-neck cut that was tucked and sewn with a plied red woolen yarn (Table 1 no. 94, 95). Another fibre sample of a coat contained a zigzag line of red yarn embroidery (Table 1 no. 143, 144). Fragments of a 14th century AD blue coat were preserved together with a button and an added leather strip (Table 1 no. 213, 214). One fragment of a blue coat



fabric had been found behind a leather belt together with a piece of linen, possibly a shirt (Table 1 no. 145). Seven of the analysed finds were classified as possible fragments of coats or capes. In two cases tablet-woven bands were attached to their edges (Table 1 no. 43, 136) and at least one bronze ring was woven into the second sample. Bronze spirals were added to one of the analysed pieces (Table 1 no. 88). A fibula was found in five of the analysed samples and thus could have served as a preservative of the fabric (Table 1 no. 43, 88, 98, 100, 105). One fragment of blue coat or cape was found under an owl-shaped fibula that is an indicator of a high social status (Table 1 no. 230). A fabric that was found close to a warrior's bracelet and with a fibula put into it was identified as a possible remain of a blue cape (Table 1 no. 97). Three fragments of blue fabric could have been either a coat or a burial cover (Table 1 no. 42, 154, 218). The first two of them were twills and only the third was a plain weave and was found adhering to the remains of a wooden coffin. One of the analysed samples belonged to a head covering, most likely a cap (Table 1 no. 41). Another was a fragment of a leg wrap (Table 1 no. 90). Eight of the analysed samples of blue fabric were not possible to specify as parts of particular garments (Table 1 no. 89, 93, 96, 102, 133, 147, 210, 212).

Six samples of blue fabric from stray finds have been analysed (Table 1 no. 45, 60, 72, 78, 140, 201), as well as one sample that was found in a burial of a baby (Table 1 no. 111). In addition, when discussing the use of blue fabrics, it has to be mentioned that one of the analysed fragments was a brown fabric with four lines of three blue threads woven into it (Table 1 no. 155, 156).

The use of the blue colour has been detected in all types of garments that have been found in archaeological excavation in the Latvian territory. Regrettably, there is no absolute proof of women's skirts and men's trousers either among the analysed fragments or in the archaeological material in general.

Thirty-five cases of the use of blue colour have been found in clothing decoration. In the female burials, blue colour has been detected in 14 tablet-woven bands that were either added to the edges of the shawls or could have been woven sashes. In all of these cases, blue was used together with other colours. In nine tablet-woven bands, blue yarn was used together with red and yellow (Table 1 no. 20, 55, 74, 117, 123, 188 (Fig. 1), 208, 217, 226), in five – together with red (Table 1 no. 5, 13, 26, 114, 124). Blue colour was also detected in five inkle-woven (warp-faced) ribbons. One of them was used as a head ornament (Table 1 no. 63); another could have been a sash (Table 1 no. 179). Three inkle-woven ribbons are of unclear usage. In two of these ribbons blue yarn was used together with red and

yellow (Table 1 no. 81, 130), in three others – together with red (Table 1 no. 63, 179, 204). Blue plied yarn has been detected in six fillings of the head ornaments (crowns) that were made of bronze rings and spirals that were threaded on yarn and sometimes also bast. In five cases, blue yarn was used together with red (Table 1 no. 34, 36, 84, 169 (Fig. 4), 171), in one case together with red and yellow (Table 1 no. 128). Blue and red yarn was also used in an inkle-woven ribbon that belonged to a head ornament (Table 1 no. 63, Fig. 4).

Blue colour was distinguished in a smaller number of dress decorations found in male burials, possibly also because there are fewer decorations on the textiles excavated in male burials. Two arm bands have been analysed. One of them was blue (Table 1 no. 149), the other was made as a blue and red inkle-woven band (Table 1 no. 178). Blue, red and yellow yarn was detected in one tablet-woven band (Table 1 no. 137). Three pieces of blue yarn were used for threading bronze spirals on them: in one case red was also used (Table 1 no. 39), in another yellow was used, too (Table 1 no. 152, 153). In the fringes of this spiral decoration, two slightly different shades of blue were used.

Among the stray finds, one use of blue has been detected in a tablet-woven band (Table 1 no. 46 (Fig. 7)) and in an inkle-woven ribbon (Table 1 no. 197), in both cases – together with red and yellow. Similarly, in both these cases the plied yarn that was used for sewing the bands to the fabric was also blue (Table 1 no. 49, 200).

Chronologically, the oldest finds where blue colour was traced were from Rucavas Geistauti burial ground that dates back to the 5th-6th centuries AD. These are textile fragments, probably shawls that were found in female burials (Table 1 no. 157, 158, 159). Two of the analysed samples that contained unidentifiable colour also come from this burial ground, and it is possible that they might have been blue as well (Table 1 no. 161, 162). Two samples are from the 8th century AD burials in Zvirgzdenes Kivti burial ground: remains of a shawl that was decorated with bronze rings (Table 1 no. 176) and an inkle-woven ribbon of blue and red, possibly an arm band (Table 1 no. 178). The majority of the analysed fabrics and decorations that were blue dated to the 10th-13th centuries AD. The latest of the analysed blue fabrics were a stray find from the 13th-14th century in Liezeres Ozolmuiza (Table 1 no. 201) and 14th-century coat fragments from Viesienas Kalnadzisli (Table 1 no. 213, 214).

Brown

Evidence of using brown colour has been detected in 21 of the 233 analysed textile samples. It has to



be emphasised that brown fabrics are the only ones that contain any colour other than blue. Therefore textile fragments that were supposed to be brown were selected for the study on purpose. This is why statistically the proportion of brown fabrics versus blue fabrics could be much higher in favour of the blue ones.

No certain use of brown has been identified in the textiles from female burials. It is most likely that two pieces of fabric that used to be covers of the burial could have been dyed brown. One of them is a fulled twill fragment that has been found at Rucavas Mazkatuzi (Table 1 no. 163). The other is a twill fabric that has been found over the neck rings, sometimes in two layers (Table 1 no. 222).

The other two uses of brown in the fabrics of female burials are not certain either. One of them is a herringbone twill fabric with selvages (Table 1 no. 38). This indicates that the fabric could have belonged to a skirt or a cape that might have been made of several pieces sewn together. It is also possible that these fragments are from a coat. Light brown colour was identified in a fabric from Madonas Strugulalns (Table 1 no. 181). The colour could be a result of dyeing but it is also possible that the initial colour of the fabric was naturally white that had turned into light brown while buried in the ground.

The majority of the brown fabrics - 15 samples - come from the male burials. Two of the identified brown fabrics have most likely belonged to coats (Table 1 no. 1, 209). It is possible that one of the analysed brown felted fabrics with a fibula in it is a fragment of a cape (Table 1 no. 2). It seems unlikely that textiles buried in the Rucavas Tiras bog hoard were burial covers. So a light brown twill fabric with one sewn edge and darker reddish brown stripes (of six warp threads) could have been a cape (Table 1 no. 165, 166). Tiras

bog hoard contained fragments of reddish brown leg wraps woven in herringbone twill and with lots of mending (Table 1 no. 167). One brown fragment of a plain weave from the same hoard was also analysed (Table 1 no. 164). It is not possible to tell what piece of clothing it initially belonged to. Except for one blue cape, other textile fragments of the hoard were brown fabrics that could have belonged to some 15 different garments. None of these fragments contained bronze rings or spirals. This suggests that brown clothing might have been more suitable for everyday wear and not considered very prestigious.

In four cases brown colour was detected in fabrics that might have belonged to capes or burial covers (Table 1 no. 21, 104, 146, 148). Two fabrics that come from unidentified garments contain brown (Table 1 no. 211) and reddish brown colour (Table 1 no. 175). Usage of brown colour in one cap has been detected (Table 1 no. 229). A practice whereby a spiral (or most likely multiple spirals) was sewn to a head covering with the help of a light brown yarn has been noted only once (Table 1 no. 231). There is a slight possibility that initially this yarn might have been naturally white. This is the only time when brown yarn has been used in the decorations of the dress and therefore can be looked upon as an exception.

There are two samples of brown fabric that are stray finds. One of them was a plain weave (Table 1 no. 221); the other was a twill with four lines of three blue threads woven in (Table 1 no. 155-156). Regrettably, it is not possible to determine what garment these pieces might have belonged to. Only two cases of striped fabrics have been detected and analysed in this research project, and it seems that stripes have not been a widespread way of decorating the fabrics.

It has to be emphasised that brown, brownish, reddish brown, greenish brown, and greyish brown colours



Fig. 4. A fragment of a woman's head ornament made of bronze rings and spirals threaded on plied yarns from Ludzas Odukulns burial ground, 11th century AD, National History Museum of Latvia RDM IV 119a,b, Table 1 no. 168-169 (Photo: Ieva Pigozne).



have been noted only in woven fabrics. As mentioned before, the only exception was the yarn used for sewing a spiral to a fur cap. Brown has not been detected in any other decorations and ornaments. Another observation is that bronze rings and spirals have not been woven into any brown fabrics. This again suggests that brown garments might have been considered less valuable than the blue ones.

Chronologically, the oldest find where brown colour was detected is a felted twill fragment that could have been a female cape or burial cover. It is dated to the 3rd-4th century AD and was excavated at Rucavas Mazkatuzi (Table 1 no. 163). The next in line is a brown wool fabric from a female burial in Katlakalna Plavniekkalns dated to the 5th-6th century AD (Table 1 no. 222). The next are male garments from the Rucavas Tiras bog hoard that is dated with the 9th century AD (Table 1 no. 164-167). The rest of the analysed fabrics can be dated to the 10th-13th centuries. The latest analysed sample is a coarse plain weave fragment (Table 1 no. 221) from recent excavations in the inner courtyard of Riga castle. It was found in the layer dated to the 13th-14th centuries. Most likely this sample does not represent the dress of the local people. It was however selected for analysis because it was well preserved.

Red

None of the analysed fabric samples turned out to be red. Red colour has only been distinguished in 76 ornaments and decorations of the garments. This makes red to be the most popular colour used for details. Due to lack of time in several cases the fabrics of the shawls were detected blue with a naked eye and not analysed further so that more decorative

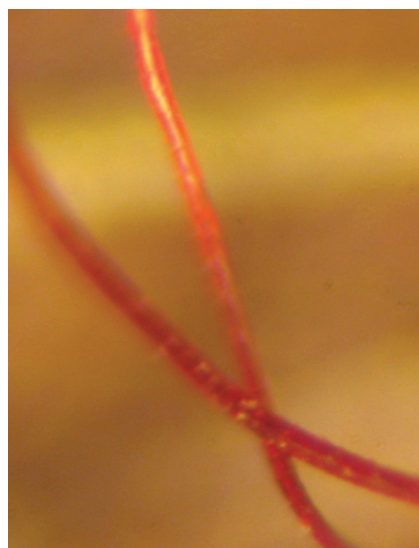


Fig. 5. Red fibres in the tablet-woven band of the shawl from Galgauska, 12th century AD, National History Museum of Latvia RDM I 3666, Table 1 no. 189 (Photo: Ieva Pigozne).

tablet woven-bands of the shawls could be studied. This is why more data on the blue fabrics together with the analysed bands and other decorations could proportionally be presented.

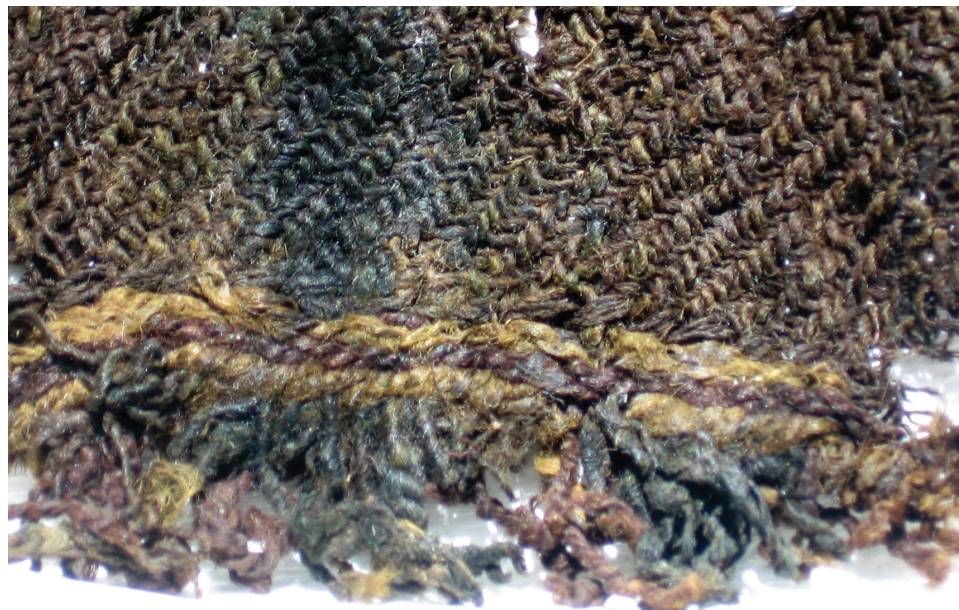
Red was more often used in the decorations of the female dress – in 55 of the analysed samples (Fig. 5). In 23 cases, these were tablet-woven bands. In these bands red yarn was most frequently used together with blue and yellow. Eight such bands were identified (Table 1 no. 19, 54, 59, 109, 119, 206, 216, 227). Four bands contained red used together with blue (Table 1 no. 4, 25, 115, 225) and another four where it was together with yellow (Table 1 no. 31, 59, 107, 184). In two of them (Table 1 no. 31, 107), the use of yellow is not certain, as initially this might have been blue that had degraded. There are two other interesting examples of bands where two different shades of red had been used: one was brighter, the other more gingery (Table 1 no. 75 and 76, 189 and 191 (Figs 1 and 5)). It is possible that differences existed already when the bands were woven. Finally, three tablet-woven bands where red was better preserved and therefore the only analysed colour are included in the research (Table 1 no. 8, 10, 67).

An observation was made that red was usually used as one of the colours of the woven ornament, while the edges of the bands were most often woven in blue yarn. If red was used for the edges of the ornamental line, blue usually followed it as the finishing line. Such bands were commonly sewn to the fabrics of the shawls with blue plied yarn. There are, however, two cases when red was used instead, thus creating a decorative stitch (Table 1 no. 7, 215-217).

A few of the shawls have tablet-woven bands that were made using only three or four tablets. These simple striped bands were sewn to the edges and the ends of the shawls. The most frequent colour scheme was: yellow, red, yellow, blue. A relatively well preserved example of such band was found in Krustpils Oglenieki burial ground (Table 1 no. 108-109, Fig. 6). Colour schemes of the bands made using only three tablets usually were: yellow, red, yellow, as on a band from Erglu Jaunakeni burial ground (Table 1 no. 58-59). Another scheme was red, blue, red, e.g. on a band from Drabesu Liepinas burial ground (Table 1 no. 25-26). In both the ornamented and the striped tablet-woven bands, blue yarn was usually used for the weft. There are, however, exceptions when red yarn is used instead and thus a line of red decorative dots is created on both edges of the band. One such band from Skilbenu Danilovka burial ground was included in the analyses (Table 1 no. 10).

The tradition was that the tablet-woven bands that were woven onto the ends of the shawls also had

Fig. 6. A fragment of a woman's shawl from Krustpils Oglenieki, burial no. 8, 12th century AD, National History Museum of Latvia VI 3: 79, Table 1 no. 108-109 (Photo: Ieva Pigozne).



inwoven fringes. Many of the finds have relatively well preserved bands and poorly preserved fringes. However, in some cases, fringes are still there and it is possible to notice that the colours used in the bands and fringes are mostly the same. One example of such fringes was analysed in this research project and two different tones of red colour were detected: bright red and darker brownish red (Table 1 no. 193, 194).

Red colour has been identified in six inkle-woven ribbons from female burials. In two of them red was the only colour (Table 1 no. 27, 28); in another two red was used together with blue (Table 1 no. 180, 203). In the last two, red yarn was used together with blue and yellow (Table 1 no. 83, 132). One ribbon (Table 1 no. 83) was sewn to the edge of a shawl. Another could have been a fragment of a sash (Table 1 no. 180). The initial function of the other four is unclear.

Five head ornaments that had been made of red inkle-woven ribbons or tablet-woven bands have been analysed. In all five cases, red was the only detected colour (Table 1 no. 6, 29, 110, 121, 224). One head ornament contains bronze spirals threaded on woolen yarn, bast twist wrapped in plied yarn, and a tassel of fringes with two cowries tied to it. Analyses of the fringes revealed the use of red plied yarn (Table 1 no. 220). Though cowry shells are not native to Europe, their use in Latvian women's necklaces and other ornaments was very popular. Another head ornament was made as a red tablet-woven band with inwoven bronze spiral ornament. Close to it, other fragments of red band, plaited yarn and yarn tassels were excavated. Use of red was identified in these fragments of the head ornament (Table 1 no. 22, 23). Yet another of

the analysed head ornaments was made of an inkle-woven ribbon with inwoven bronze spirals. Red and blue colours were detected in this ribbon (Table 1 no. 64). Red plied yarn was identified in all six of the analysed head ornaments that were made of bronze rings and spirals threaded on yarn. In five cases, red yarn was used together with blue (Table 1 no. 33, 35, 85, 168 (Fig. 4), 172) and once – together with blue and yellow (Table 1 no. 126). Two instances of red yarn have been found in the decorations that were made of bronze spirals attached to a garment. It is most likely that one of them belonged to a head ornament (Table 1 no. 223). The other is a decoration that was sewn to a fragment of blue fabric (Table 1 no. 87).

Embroidered lines of red plied yarn have been traced on three shawls. In two cases, one shade of red was identified (Table 1 no. 15, 66). In the third, however, there appeared repeating stretches of brighter red and darker brownish red embroidery (Table 1 no. 71).

Finally, a single yarn wound several times round a pin in a female burial at Rucavas Geistauti revealed the usage of red colour (Table 1 no. 160). It is difficult to tell what its function might have been, as it could have been applied for purely decorative, as well as magical – protective or harming – purposes.

Usage of red is much less frequent in male burials, as only 13 instances of red yarn have been identified during the project. In female burials, as in male dress, red colour was only used in decorations. One of the two analysed arm bands was made as an inkle-woven ribbon of blue and red yarn (Table 1 no. 177). No other inkle-woven ribbons have been identified in male burials. Analysis of four tablet-woven bands



shows that one such band was made of single red yarn (Table 1 no. 44). It was attached to a fabric to which a fibula was fastened. This band is the only one of all the analysed tablet-woven bands that revealed usage of single yarn. Three other analysed bands were excavated in a burial of a wealthy man in Selpils Lejasdopeles cemetery. Two of the bands were made of red and yellow yarn (Table 1 no. 134, 142). In one band, red was used together with blue and yellow (Table 1 no. 139). A fragment of a blue fabric that had embroidery of red yarn loops was excavated under the fibulae in the same burial. In addition, red plied yarn together with yellow and two different tones of blue yarn were detected in a tassel of fringes (Table 1 no. 150).

Red yarn used for threading bronze spirals of dress decorations has been detected in two male burials (Table 1 no. 40, 174). One embroidered line of twisted red yarn on a fabric has also been identified (Table 1 no. 144). One of the analysed samples was a twisted red yarn that had been used for sewing the edge of the V-neck cut of a man's blue wool coat that had been decorated with inwoven bronze rings. In this case the stitches of the red yarn must have had a decorative function (Table 1 no. 95). Similar red stitching has been noticed in a find from Priekulu Gugeris burial ground. Finally, three cases of red yarn that had been tied to jewellery have been detected in male burials (Table 1 no. 92, 101, 103). Two are from the same burial where red yarn was found tied to two fibulae. A smaller, most likely female ring is tied to one of the fibulas. It is possible that some decayed object was tied to the other, as well. It can be presumed that these represent an offering of female belongings in a male burial.

Red colour has been identified in eight decorations that belong to stray finds. In one tablet-woven band, red is used together with blue and yellow (Table 1 no. 47, Fig. 7), in another it is used together with yellow (Table 1 no. 62). Red, blue, and yellow yarn has been distinguished in an inkle-woven ribbon (Table 1 no. 198). Four cases of embroidered lines of red plied yarn have been noted. Three of them are applied to wool fabrics (Table 1 no. 50, 79, 196). The first is made of regularly repeating stretches of brighter red and darker brownish red. A remarkable find is an almost disintegrated linen fabric with embroidery of red plied yarn loops (Table 1 no. 80). This fragment might have been a part of the neck opening of a linen shirt and thus contains evidence of using red wool embroidery for linen garments. Finally, red yarn was identified in fringes attached to thick twill fabric where it was used together with another colour, likely yellow (Table 1 no. 51).

Chronologically, the oldest find where red colour was traced is from the Rucavas Geistatuti burial ground (Table 1 no. 160). It is red single yarn wound around the pin in a female burial of the 5th-6th century AD. The next two uses of red are detected in male burials: an 8th-century AD arm band from Zvirgzdenes Kivti burial ground (Table 1 no. 177), and a 9th-century AD decoration made of red yarn and bronze spirals excavated in Drabesu Liepinas burial ground (Table 1 no. 40). The rest of the samples can be dated to the 10th-13th centuries AD.

Yellow

Distinguishing yellow with the help of an optic microscope is sometimes problematic as disintegrated colour of degraded fibres can seem to be yellowish. This is why only those usages of yellow that were convincing enough are presented in this paper. It is important to emphasise that yellow has been identified rather rarely. Twenty-one of the 233 analysed samples revealed yellow colour. Three more cases are not certain. Like red, yellow colour can be observed only in plied yarn used to decorate dress. Moreover, yellow was always used together with red and/or blue.

Sixteen uses of yellow have been detected in female burials, 13 of them – in tablet-woven bands. In six of the bands, yellow was used together with blue and red (Table 1 no. 18, 56, 118, 207, 215, 228). In four cases, yellow was used together with red. However, in only two of them it is absolutely certain that this was yellow colour (Table 1 no. 58, 183). The other two bands could have been made of red and yellow or blue yarn (Table 1 no. 32, 106). There are two more tablet-woven bands where yellow was used together not only with blue but also with two different shades of red: bright red and gingery red (Table 1 no. 77, 190; Fig. 1). There is only one band where yellow was only used together with blue (Table 1 no. 122). In female burials, yellow has been detected in two inkle-woven ribbons where it was used together with red and blue (Table 1 no. 82, 131). Finally, yellow, red, and blue plied yarns were detected in the threading of one head ornament made of bronze rings and spirals (Table 1 no. 127).

There is only one male burial where usage of yellow yarn has been proven. This is a burial of a wealthy man from Selpils Lejasdopeles burial ground, dated to the 11th century AD. Yellow yarn has been noted in three tablet-woven bands from this burial. In one of them, yellow was used together with red and blue (Table 1 no. 138), in the other two – together with red (Table 1 no. 135, 141). The third band was sewn to a piece of fabric that was wrapped around pieces of female jewellery and placed next to the feet of the deceased

(Snore 1997, 72). In the same burial, yellow has also been found in the yarns that were used for threading bronze spirals of a decoration (Table 1 no. 151), where yellow was used together with red and two different shades of blue: intense dark blue and greenish blue. Yellow colour used in textile decorations has been detected in four stray finds. In one tablet-woven band, yellow was used together with red and blue (Table 1 no. 48, Fig. 7), in another band – together with red (Table 1 no. 61). Yellow, red, and blue yarns have been noted in one inkle-woven ribbon (Table 1 no. 199). One sample of (most likely) yellow being used in the fringes added to a thick twill fabric has been detected (Table 1 no. 52).

It can be concluded that yellow seems to be a characteristic colour of female dress. In the process of selecting samples for the analyses, yellow colour was deliberately searched for in textiles from male burials, although with little success. It is possible that people buried in Selpils Lejasdopeles burial ground were more fond of yellow than others. This can be suggested as one third of all the samples of yellow yarn used for the analysis came from this particular burial ground. Chronologically, yellow has been detected in textiles that belong to the narrowest range of time, as most of them are dated to the 11th-13th centuries AD. The latest sample of yellow is from a stray find of an inkle-woven band dating back to the 13th-14th century (Table 1 no. 199).

Final remarks

Although Ginters (Dzervitis and Ginters 1936, 26-54) and Ozols (Ozols 1939, 85) considered that green had been used in the textiles of the 8th-12th centuries AD, no convincing proof of green yarn has been found so far. It has been possible to observe two different shades of blue used in the same textile fragment (Table 1 no. 45 and 46; 152 and 153). In these cases, more intense

dark blue has been used together with greenish blue. No colours other than those discussed in this paper were distinguished in the analysed textiles.

Blue and brown single yarns have been detected in the analysed fabrics, while blue, red, and yellow plied yarns have been distinguished in the decorations of the dress. Red and yellow were more frequently observed in female dress. Such a colour scheme seems to have been popular in the Baltic-inhabited areas of the Latvian territory in the 3rd-14th centuries AD. However, further research of the colours, by means of identification of the dye compounds present in the fibres using chemical analyses, could provide more precise information about the colour and also elucidate issue of fading or degradation.

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Fig. 7. A reconstructed tablet-woven band from Drabesu Liepinas burial ground, Table 1 no. 46-48 (Reconstruction and photo: Ieva Pigozne).



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Author: pigozne@inbox.lv

Table 1. Colours in the Latvian archaeological wool textiles.

No.	(Number of the site according to Fig. 3), site, burial number, gender of the buried person, collection and accession number of the artefact, dating	Description of the find; possible function	Colours as seen in the microscope	Assumed initial colour
<i>Abrene region</i>				
1	(1) Baltinavas Aizelksni, grave 1, male, A 7449:17, 12th-13th cent.	Fragment of a twill fabric. Possibly from a coat.	In the fabric – brown, some hairs – dark.	Brown
2	(1) Baltinavas Aizelksni, grave 1, male, A 7449:19, 12th-13th cent.	Fragment of a felted twill fabric, a fubula put into it. Possibly from a cape.	In the fabric – dark brown, normally preserved fibres.	Brown
3	(2) Berzpils, stray find, female, A8044:17, 12th cent.	Fragment of a shawl – a twill fabric, inwoven bronze rings, a tablet-woven band attached to the edge.	In the fabric – dark blue-black, some hairs – brownish or greenish.	Blue
4			In the tablet-woven band – reddish brown.	Red
5			In the tablet-woven band – blue-black.	Blue
6	(3) Berzpils Bonifacova, stray find, female, RDM IV 41, 10th-13th cent.	Head ornament made of a plain weave fabric, very small spirals sewn to it.	In the head ornament – red, some hairs – of a cooler red tone.	Red
7		Fragment of a shawl, inwoven bronze rings. A tablet-woven band is sewn to the fabric with the help of a plied yarn.	In the yarn of the sewing – gingery, some hairs – bright red (slightly orange).	Red
8		A tablet-woven band, made of plied yarns.	In the tablet-woven band – gingery, some hairs bright red (cooler red tone than that of the sewing).	Red



No.	(Number of the site according to Fig. 3), site, burial number, gender of the buried person, collection and accession number of the artefact, dating	Description of the find; possible function	Colours as seen in the microscope	Assumed initial colour
9	(4) Skilbenu Danilovka, group II, barrow 1, grave 2, female, VI no accession number, 12th-13th cent.	Twill fragment of a shawl, inwoven bronze rings, a tablet-woven band, blue weft, the band is sewn to the fabric with the help of a blue yarn, a fibula put into the shawl.	In the fabric – bright woad blue, little greenish.	Blue
10			In the tablet-woven band – reddish orange, some hairs – yellowish orange, some – darker reddish brown.	Red
11			Fragment of a twill fabric.	In the fabric – dark blue-black.
12	(4) Skilbenu Danilovka, barrow 1, grave 2, female, VI no accession number, 12th-13th cent.	Fragments of two shawls: one tartan and one blue, not decorated. The second shawl has two lines of embroidery ~5 mm before the tabled-woven band which fringes that is attached to the end of the shawl.	In the fabric of undecorated shawl – dark blue.	Blue
13			In the tablet-woven band on the end of the shawl – blue.	Blue
14			In the tablet-woven band on the end of the shawl – reddish.	Red
15			In the embroidery – red.	Red
16	(4) Skilbenu Danilovka, group II, barrow 3, grave 2 (?), female (disturbed), VI no accession number, 12th cent.	Fragment of a twill fabric (shawl?).	In the fabric – dark blue-black.	Blue
17			Fragment of a twill tartan fragment of a shawl.	In the fabric – dark blue-black.
<i>Cesis region</i>				
18	(5) Cesis, female, A 185, 12th-13th cent.	Fragment of a shawl, inwoven bronze rings, a tablet-woven band attached to it.	In the tablet-woven band – brownish yellow.	Yellow
19			In the tablet-woven band – reddish.	Red
20			In the tablet-woven band – blue-black.	Blue
21	(6) Drabesu Liepinas, grave 1, male, VI 155: no accession number, 11th cent.	A fragment of a twill fabric, found over the belt and the warrior's bracelet.	In the fabric – dark reddish-brown, some hairs almost black, some – colour of rust.	Brown (or blue)
22	(6) Drabesu Liepinas, grave 24, female, VI 155:138, 12th cent.	Head ornament made of a tablet-woven band, inwoven tiny spirals that make a zigzag ornament.	In the tablet-woven band – some of the hairs – light orange, some – pale red, some – pale brownish red, disintegration of the fibres can be observed.	Red
23	(6) Drabesu Liepinas, grave 24, female, VI 155:179, 12th cent.	Fragments of tablet-woven bands, plaited yarn, yarn tassels, found close to the head ornament.	In the band and the plaited yarn – part of the hairs – brighter red than in the head ornament.	Red



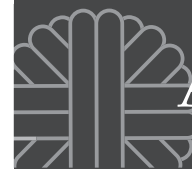
No.	(Number of the site according to Fig. 3), site, burial number, gender of the buried person, collection and accession number of the artefact, dating	Description of the find; possible function	Colours as seen in the microscope	Assumed initial colour
24	(6) Drabesu Liepinas, grave 37, female, VI 155:257, 12th cent.	Many fragments of a shawl, one fragment with inwoven bronze rings, twill fabric.	In the fabric – most hairs dark red-brown and dark purple; one fragment – possibly dark blue-black.	Blue (?)
25		A tablet-woven band of plied yarn (3 tablets).	In the edges of the tablet-woven band – reddish orange (dark).	Red
26			In the middle line of the tablet-woven band – possibly blue.	Blue (?)
27		Six fragments of inkle-woven (?) ribbon, made of single colour plied yarn.	In the ribbons – dark orange-brownish, disintegration can be observed – some hairs light yellowish, the thickest fibres – dark reddish-brown purple.	Red (?)
28	(6) Drabesu Liepinas, grave 37, female, VI 155:257, 12th cent.	Six fragments of 20 mm wide inkle-woven ribbon, made of plied yarn.	In the ribbons – part of the warp – dark cool red. Many areas of disintegrated fibres and unidentified colour.	Red
29	(6) Drabesu Liepinas, grave 72, female, VI 155:483, 12th cent.	Fragments of a head ornament, made of a 12 mm wide inkle-woven ribbon.	In the ribbon – reddish brown, some places – darker and paler. Possibly used to have a cool red shade. The whole ribbon is in single colour.	Red (?)
30	(6) Drabesu Liepinas, grave 79, female, VI 155:530, 11th cent.	Fragments of a shawl, inwoven bronze rings, a tablet-woven band attached to the fabric.	In the fabric – dark blue-black.	Blue
31			In the tablet-woven band – reddish, pale.	Red
32			In the tablet-woven band – yellowish, probably used to be yellow (or blue). Disintegration of the fibres can be observed.	Yellow (or blue)
33	(6) Drabesu Liepinas, grave 79, female, VI 155:533, 11th cent.	Head ornament, made of four lines of bronze rings and spirals threaded on coarse plied yarn.	In the filling of the ornament – reddish, the colour and its changes (darker, more yellow) can be well observed.	Red
34			In the filling of the ornament – dark bluish.	Blue
35	(6) Drabesu Liepinas, grave 79, female, VI 155:545, 11th cent.	Head ornament, made of bronze rings and spirals threaded on bast that was wrapped in plied yarn.	In the filling of the ornament – reddish.	Red
36			In the filling of the ornament – blue.	Blue



No.	(Number of the site according to Fig. 3), site, burial number, gender of the buried person, collection and accession number of the artefact, dating	Description of the find; possible function	Colours as seen in the microscope	Assumed initial colour
37	(6) Drabesu Liepinas, grave 85, male, VI 155:576, 11th cent.	Fragments of a cap, three tight lines of bronze spirals along the brim.	In the fabric – unidentifiable colour; disintegrated fibre. In some places – light yellowish; some hairs darker, some dark brown.	Un-identifiable
38	(6) Drabesu Liepinas, grave 95, female, VI 155:691, 11th cent.	Fragments of a herringbone twill fabric, one with a seam, two selvages.	In the fabric – light yellowish fibres, no darker hairs can be detected. In the middle of the yarn – orange-light brownish hairs. Probably used to be dyed light brown.	Brown (?)
39	(6) Drabesu Liepinas, grave 123, male, VI 155:830, 9th-beginning of the 10th cent.	Decoration of bronze spirals that are threaded on plied yarn.	In the filling of the spirals – dark blue, some hairs disintegrated.	Blue
40			In the filling of the spirals – reddish dark brown, some hairs disintegrated. One hair intense bright red.	Red
41	(6) Drabesu Liepinas, grave 123, male, VI 155: 835, 9th-beginning of the 10th cent.	Remains of a cap that used to be decorated with bronze spirals, only some plied yarns left.	In the fabric – dark blue, some hairs have lost colour or turned brown.	Blue
42	(6) Drabesu Liepinas, grave 138, male, VI 155: no accession number, 10th-11th cent.	Three small fragments of twill fabric. One of them found by a fibula, another – by a warrior's bracelet. Warp and weft yarns of different thickness.	In the fabric – various hairs: many bright yellow, some greenish or green, some reddish brown-black, one hair – light red. In another sample some hairs of the same yarn dark blue, some dark reddish brown. Probably the fabric used to be blue or blue and red (warp and weft of different colour).	Blue (or blue and red?)
43	(6) Drabesu Liepinas, grave 147, male, accession number of the horse-shoe fibula VI 155:931, 10th-12th cent.	Fragment of a fine twill fabric, a fine tablet-woven band (made of single yarn) attached to the fabric. A horse-shoe fibula put into the fabric.	In the fabric – many hairs yellowish, some dark, some dark blue. Probably the fabric was dark blue.	Blue
44			In the tablet-woven band – dark red hairs of a cooler tone.	Red



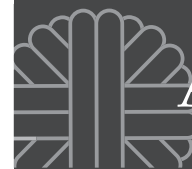
No.	(Number of the site according to Fig. 3), site, burial number, gender of the buried person, collection and accession number of the artefact, dating	Description of the find; possible function	Colours as seen in the microscope	Assumed initial colour
45	(6) Drabesu Liepinas, stray find (?), CMV 5603, 10th-12th cent.	Fragment of a coarse twill fabric with a tablet-woven band (of 8 tablets). The band sewn to the fabric with a plied yarn. Embroidered line of a plied yarn on the fabric, some ~3 mm from the band. Colours well preserved.	In the fabric – dark blue.	Blue
46			In the tablet-woven band – bluish, dark blue-green.	Blue
47			In the tablet-woven band – red, slightly gingery.	Red
48			In the tablet-woven band – bright golden yellow, parts of the band disintegrated.	Yellow
49			In the yarn of the sewing – blue.	Blue
50			In the yarn of the embroidery – stretches of dark cool red and stretches of yellowish gingery.	Red
51	(6) Drabesu Liepinas, stray find, VI 154: no accession number, 19th-12th cent.	Two fragments of a dense twill fabric. Fringes of two plied yarns and a knot in the end. The longest fringe 154 mm. Several inwoven bronze rings.	In the fringes – reddish (has turned darker).	Red
52			In the fringes – yellowish, used to be yellow (or blue).	Yellow or blue
53	(7) Erglu Jaunakeni, grave 22, female, VI 154: 596, 11th-12th cent.	Fragment of a twill fabric – an undecorated shawl. A tablet woven band (6 tablets: red, 3 yellow, red, blue) attached to the edge of the shawl.	In the fabric – dark bluish.	Blue
54			In the tablet-woven band – reddish brown-purple.	Red
55			In the tablet-woven band – dark bluish.	Blue
56			In the tablet-woven band – yellow.	Yellow
57	(7) Erglu Jaunakeni, grave 26, female, VI 154: 216, 11th-12th cent.	Fragments of a twill fabric – a shawl with inwoven bronze rings and spirals. A tablet-woven band (of 3 tablets: yellow, red, yellow) at the end of the shawl.	In the fabric – dark blue-black.	Blue
58			In the tablet-woven band – intense yellow.	Yellow
59			In the tablet-woven band – brownish red.	Red
60	(7) Erglu Jaunakeni, stray find, VI 154: 594, 11th-12th cent.	Fragment of a twill fabric, inwoven bronze rings. Tablet-woven bands (of 3 tablets: yellow, red, yellow) at the edges and the ends of the shawl (?).	In the fabric – dark blue.	Blue
61			In the tablet-woven band – bright yellow.	Yellow
62			In the tablet-woven band – darker reddish.	Red



No.	(Number of the site according to Fig. 3), site, burial number, gender of the buried person, collection and accession number of the artefact, dating	Description of the find; possible function	Colours as seen in the microscope	Assumed initial colour
63	(8) Jaunpiebalga, grave 1, female, VI 5:1, 13th cent.	A head ornament – an inkle-woven ribbon made of plied yarn, inwoven bronze spirals. In the edges – blue, in the middle line – red.	In the edges of the ribbon – greenish gray.	Blue
64			In the middle lines of the ribbon – intense red, slightly orange, possibly used to be light red (of slightly cool red tone). Some hairs yellow or dark.	Red
65	(9) Karlu Ainavas, female, A 9476: 3, 12th cent.	Fragment of the end of the shawl with a tablet-woven band (of ~6 tablets) and fringes. A line of embroidery of a plied yarn sewn on the fabric some 5 mm from the end.	In the fabric – blue, dark black-blue.	Blue
66			In the embroidery – some hairs orange, some reddish with bright red gloss, some pale light orange.	Red
67			In the tablet-woven band – reddish.	Red
68	(9) Karlu Ainavas, grave 4, female, A 3362, 12th cent.	Two fragments of plain weave fabric.	Dark greenish-black, some hairs brownish, where the color was lost – half of the hairs yellowish, half – pale blue.	Blue
69		Fragment of a twill fabric.	In the better preserved places of the fabric – dark blue-black, one hair bright blue. In the poorly preserved places – some hairs yellowish, some dark blue/green, some dark brownish.	Blue
70	(10) Rauna, stray find, RDM I 3676b, 11th-13th cent.	Fragment of the end of the shawl, inwoven spirals, fringes. Double line of embroidery on the fabric: stretches of red and dark reddish brown.	In the fabric – dark blue-black; fibres well preserved.	Blue
71			In the embroidery – dark red.	Red
72	(11) Taurenes Lazdini, grave 7, A 3491 (?), 10th-12th cent.	Fragments of twill fabric. One fragment with a seam, one with a hem. Possibly a coat.	In the fabric – dark greenish blue-black.	Blue



No.	(Number of the site according to Fig. 3), site, burial number, gender of the buried person, collection and accession number of the artefact, dating	Description of the find; possible function	Colours as seen in the microscope	Assumed initial colour
73	(11) Taurenas Lazdini, grave 9, female, A 3520, 12th cent.	Large fragments of a shawl with tablet-woven bands at the edges (blue, gingery, red, yellow) and ends (gingery, red, yellow, blue). Fringes.	In the fabric – blue-green black.	Blue
74			In the tablet-woven band – blue.	Blue
75			In the tablet-woven band – gingery-yellow.	Gingery (red?)
76			In the tablet-woven band – intense orange-red.	Red
77			In the tablet-woven band – light yellow.	Yellow
78	(11) Taurenas, stray find, A 7694: 2, 10th-12th cent.	Fragment of a twill fabric with a zigzag embroidery of plied yarn.	In the fabric – dark blue.	Blue
79			In the embroidery – orange, some hairs – brighter red.	Red
80		Embroidered curves of plied woollen yarn on a linen shirt (?).	In the embroidery – red.	Red
<i>Daugavpils region</i>				
81	(12) Aizkalne, grave 2, female, A 10557:1, 9th-11th cent.	Fragments of a shawl, a fabric with inwoven rings, an inkle-woven ribbon (15 warps) attached to the fabric. Fibulas put into the fabric.	In the inkle-woven ribbon – dark greyish blue.	Blue
82			In the inkle-woven ribbon – yellowish.	Yellow
83			In the inkle-woven ribbon – reddish, some fibres disintegrated, darkened and lost colour.	Red
84	(12) Aizkalne, grave 2, female, A 10557:5, 9th-11th cent.	Head ornament, made of bronze rings and spirals threaded on plied yarn. With a naked eye – red and blue yarn.	In the filling of the ornament – dark blue black.	Blue
85			In the filling of the ornament – reddish, has turned darker.	Red
86	(12) Aizkalne, grave 11, female, A 10566: no accession number, 9th-11th cent.	Fragment of fabric, found by the right knee. With a naked eye – blue.	In the fabric – blue.	Blue
87		One twisted yarn used for threading a bronze spiral, found together with the fabric.	In the yarn – gingery	Red (or gingery?)
88	(12) Aizkalne, grave 12, male, A10566: no accession number, accession number of the fibula A 10567:9, 10th cent.	Fragment of a twill fabric, inwoven bronze spirals, a fibula put into the fabric.	In the fabric – blue.	Blue
89		Fragment of a coarse twill fabric.	In the fabric – blue, disintegrated hairs – yellow.	Blue
90		Fragment of a leg-wrap – a twill fabric.	In the fabric – bluish.	Blue



No.	(Number of the site according to Fig. 3), site, burial number, gender of the buried person, collection and accession number of the artefact, dating	Description of the find; possible function	Colours as seen in the microscope	Assumed initial colour
91	(12) Aizkalne, grave 12, male, A 10567: 2, 10th cent.	Fragment of a coat, inwoven bronze rings, decorated with pendants, a fibula put into the fabric.	In the fabric – dark blue-green-black.	Blue
92		Some pieces of plied yarn tied to the fibula.	In the yarn – brownish red with red-orange gloss.	Red
93	(12) Aizkalne, grave 12, male, A 10567: 13, 10th cent.	Fragment of a twill fabric.	Blue-black.	Blue
94	(12) Aizkalne, grave 18, male, A10573: no accession number, accession number of the fibula A10573:2, 10th cent.	Fragment of a twill fabric – front part of a coat, inwoven bronze rings, a fibula put into the fabric. The edge of the V-neck cut hemmed with plied red yarn.	In the fabric – half of the hairs – blue.	Blue
95		Fragment of a coarse twill fabric, inwoven bronze rings.	In the yarn of the sewing – red, greyish-brownish red.	Red
96		Fragment of a coarse twill fabric, inwoven bronze rings.	In the fabric – blue.	Blue
97	(13) Izvaltas Briveri, grave 7, male, accession number of the fibula A 13508: 37; accession number of the warrior's bracelet A 13508: 45, 9th-10th cent.	Three fragments of a twill fabric, a fibula put into the fabric. Found by the warrior's bracelet.	In the fabric – some fibres disintegrated (light yellow hairs), some fibres blue or greenish blue.	Blue
98	(13) Izvaltas Briveri, grave 11, male, accession number of the fibula A 13508: 45, 10th cent.	Fragments of a coarse twill fabric, a large fibula put into the fabric. Fragments found also over the fibula.	In the fabric – some hairs dark blue, some fibres disintegrated, some – reddish brown.	Blue
99	(13) Izvaltas Briveri, grave 14, female, accession number of the fibula A 13508: 52, 9th-11th cent.	Fragment of a coarse twill fabric, a fibula put into the fabric.	In the fabric – some hairs blue, some greenish blue, some violet-blue, some yellow (degraded).	Blue
100	(13) Izvaltas Briveri, grave 15, male (?), accession number of the fibula A 13508: 55, 10th-12th cent.	Fragment of a twill fabric, a large fibula put into the fabric.	In the fabric – blue.	Blue
101		A thick, plied yarn tied to the pin of a horse-shoe fibula.	In the yarn – reddish.	Red
102	(13) Izvaltas Briveri, grave 15, male (?), accession number of the fibula A 13508: 57; accession number of the ring A 13508: 58, 10th-12th cent.	Fragment of a twill fabric, a small horse-shoe fibula put into the fabric.	In the fabric – blue.	Blue
103		A thick, plied yarn used for attaching a small (female?) ring to the pin of the horse-shoe fibula.	In the yarn – reddish.	Red



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104	(13) Izvaltas Briveri, grave 36, male, no accession number, 10th cent.	Fragments of a twill fabric, found over a fibula and a warrior's bracelet. Could be a cape or a cover of the burial.	In the fabric – some hairs reddish brown, some disintegrated.	Brown
105	(13) Izvaltas Briveri, grave 36, male, accession number of the fibula AP 90: (273), 10th cent.	Fragment of a twill fabric, a fibula put into the fabric.	In the fabric – some hairs brownish blue, some black. Could have been blue.	Blue
106	(14) Visku Maskava, grave 35, female, A 9985: 2, 11th-12th cent.	Fragment of a tablet-woven band (3 tablets), weft of the same colour as the edges of the warp.	In the edges of the band – yellow or blue.	Yellow or blue
107			In the middle line of the band – brownish red hairs.	Red
<i>Jekabpils region</i>				
108	(15) Krustpils Oglenieki, grave 8, female, VI 3:79, 12th cent.	Fragments of two shawls, one with inwoven bronze rings. The other not ornamented – a fragment with a tablet-woven band on the edge (4 tablets: yellow, red, yellow, blue) and on the end (3 tablets: yellow, red, yellow, and fringes).	In the fabric – bluish and dark reddish brown.	Blue (or reddish-brown?)
109			In the tablet-woven band – red, the disintegrated hairs – dark gingery.	Red
110	(15) Krustpils Oglenieki, grave 9, female, VI 3: 86, 12th-13th cent.	Head ornament – 15 mm wide tablet-woven band from fine single yarn.	In the band – reddish orange-brown. Some fibres disintegrated – transparent.	Red
111	(16) Selpils Lejasdopeles, barrow I, grave 2, baby, VI 56: no accession number, 10th-13th cent.	Two fragments of a twill fabric.	In the fabric – some hairs blue, some degraded – yellow.	Blue
112	(16) Selpils Lejasdopeles, barrow I, grave 5, female, VI 56: no accession number, turn of the 12th-13th cent.	Fragment of a rather fine and dense fabric.	In the fabric – blue.	Blue
113		Fragment of a coarse twill fabric.	In the fabric – some blue hairs, some disintegrated – yellow.	Blue
114		Tablet woven band (6 (?) tablets: blue, red, blue, red, blue, red), warp falling apart.	In the tablet-woven band – blue.	Blue
115			In the tablet-woven band – orange-brown.	Red (or gingery?)
116	(16) Selpils Lejasdopeles, barrow I, grave 6, female, VI 56: no accession number, 12th-13th cent.	Fragment of a tartan shawl, only the woolen parts have survived.	In the woolen fabric – greenish blue, some hairs disintegrated – light green.	Blue



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117	(16) Selpils Lejasdopeles, barrow I, grave 6, female, VI 56: no accession number, 12th-13th cent.	Fragment of a fabric and a tablet-woven band (5 (?) tablets) attached to it.	In the tablet-woven band – greenish.	Blue (or greenish blue)
118			In the tablet-woven band – yellow.	Yellow
119			In the tablet-woven band – orange-red.	Red
120	(16) Selpils Lejasdopeles, barrow I, grave 6, female, VI56:46, 12th-13th cent.	Two fragments of a twill fabric.	In the fabric – dark greenish brown and blue (?) hairs.	Blue
121	(16) Selpils Lejasdopeles, barrow II, grave 1, girl, VI 56:48, 10th-13th cent.	Head ornament of a fabric and a decoration of tiny spirals threaded on woolen yarn.	In the fabric – red.	Red
122	(16) Selpils Lejasdopeles, barrow II, grave 17, female, VI 56:II:17, the second half of the 11th cent.	Fragment of a tablet-woven band, length ~ 40mm. Could have been a sash.	In the tablet-woven band – yellow.	Yellow
123			In the tablet-woven band – blue.	Blue
124	(16) Selpils Lejasdopeles, barrow II, grave 17, female, VI 56:208, the second half of the 11th cent.	Tablet-woven band attached to the edge of a shawl.	In the tablet-woven band – blue.	Blue
125			In the tablet-woven band – brownish red.	Red
126	(16) Selpils Lejasdopeles, barrow II, grave 17, female, VI 56:202, the second half of the 11th cent.	Head ornament, made of bronze rings and spirals threaded on plied yarn. Three sections of the “tale”, pendants added to the ends of the “tale”.	In the filling of the ornament – dark reddish brown.	Red
127			In the filling of the ornament – yellow.	Yellow
128			In the filling of the ornament – blue.	Blue
129	(16) Selpils Lejasdopeles, barrow II, grave 17, female, VI 56:II:17:8, the second half of the 11th cent.	Three fragments of plaited plied yarn. Inkle-woven ribbon (~ 32 warps).	In the plaited yarn – dark yellow-orange, one hair – red.	Red
130			In the inkle-woven ribbon – greenish blue-grey.	Blue
131			In the inkle-woven ribbon – yellow.	Yellow
132			In the inkle-woven ribbon – intense bright red.	Red



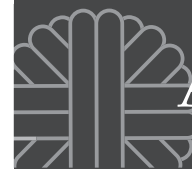
No.	(Number of the site according to Fig. 3), site, burial number, gender of the buried person, collection and accession number of the artefact, dating	Description of the find; possible function	Colours as seen in the microscope	Assumed initial colour	
133	(16) Selpils Lejasdopeles, barrow V, grave 1, male, VI 56:V:1: no accession number, 11th cent.	Fragment of a fabric found at the rings of the left hand.	In the fabric – one blue hair, in many places disintegrated fibres – light yellow or dark brownish.	Blue	
134		Fragment of a fabric with a tablet-woven band, found over the rib cage.	In the tablet-woven band – reddish.	Red	
135			In the tablet-woven band – yellowish.	Yellow	
136		Fragment of a fabric, inwoven one bronze ring, a tablet-woven band attached to the fabric. Found over the belt.	Fragment of a fabric, inwoven one bronze ring, a tablet-woven band attached to the fabric. Found over the belt.	In the fabric – dark blue-black.	Blue
137			In the tablet-woven band – blue (lighter and greener than the blue colour of the fabric).	Blue	
138			In the tablet-woven band – greenish yellow.	Yellow	
139			In the tablet-woven band – gingery.	Red	
140	(16) Selpils Lejasdopeles, barrow V, grave 1, male, VI 56:V:1:40, 11th cent.	Fragment of a coarse twill fabric, used for wrapping female jewellery, placed by the feet.	In the fabric – dark blue.	Blue	
141			In the tablet-woven band – yellow.	Yellow	
142			In the tablet-woven band – brownish red.	Red	
143	(16) Selpils Lejasdopeles, barrow V, grave 1, male, VI 56:V:1: no accession number, 11th cent.	Fragment of a twill fabric with a zigzag embroidered line of plied yarn. Found under two fibulas.	In the fabric – blue.	Blue	
144			In the embroidery – brownish red.	Red	
145		Fragment of a coarse twill fabric, stuck together with a fragment of a linen fabric. Found behind the belt.	In the wool fabric – blue.	Blue	
146		Fragments of two fabrics, stuck together under the possible coffin lid. Found over a buckle, next to a fibula.	In the biggest fabric – brown.	Brown	
147			In the smallest fabric – blue.	Blue	
148		Fragment of a twill fabric with one edge. Found over the arm band and the belt.	In the fabric – brown, some hairs – brownish red, some hairs – black.	Brown	
149	(16) Selpils Lejasdopeles, barrow V, grave 1, male, VI 56:312, 11th cent.	Fragment of the arm band, inwoven bronze rings.	In the fabric – blue.	Blue	



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150	(16) Selpils Lejasdopeles, barrow V, grave 1, male, VI 56:338, 11th cent.	Remains of a decoration: four bronze spirals, plaited yarn and fringes.	In the fringes – orange-gingery.	Red (or gingery?)
151			In the fringes – intense bright yellow.	Yellow
152			In the fringes – dark greenish blue.	Blue (or greenish blue)
153			In the fringes – blue.	Blue
154	(16) Selpils Lejasdopeles, barrow V, grave 1, male, VI 56:339, 11th cent.	Four fragments of a fine fabric. Found over the arm band.	In the fabric – some yellowish hairs, some – blue.	Blue
<i>Latgale (eastern Latvia), place not specified</i>				
155	(17) Latgale, RDM IV 54 (CVVM 64929), 7th-13th cent.	Fragment of a twill fabric, 4 lines of 3 blue threads inwoven close to the edge of the fabric.	In the main parts of the fabric – brownish and yellowish hairs.	Brown
156			In the stripes – blue.	Blue
<i>Liepaja region</i>				
157	(18) Rucavas Geistauti, grave 1, female, A 9904: no accession number, 5th-6th cent.	Two fragments of coarse fabric. Found by the bracelets.	In the fabric – the thicker hairs – dark brown-violet, the disintegrated hairs – thin and yellowish.	Blue (or blue and brown)
158	(18) Rucavas Geistauti, grave 4, female, A 9907: no accession number, 5th-6th cent.	Fragment of a fine twill fabric. Found by the fibula.	In the fabric – the thicker hairs – dark brown-black-violet, the thinner hairs – pale greyish green.	Blue
159		Fragment of a fine twill fabric. Found over the bracelet.	In the fabric – the thicker hairs – dark brownish violet, the thinner hairs – light red-orange.	Blue ?
160	(18) Rucavas Geistauti, grave 4, female, accession number of the pin A 9907: 7, 5th-6th cent.	Single yarn twisted round the pin.	In the yarn – red of a cool tone, one hair – bright red.	Red
161	(18) Rucavas Geistauti, grave 17, female, A 9920: 3, 6th cent.	Small fragments of a fabric. Found by the fibula.	In the fabric – most of the fibres – dark brownish violet, some hairs – reddish, some thinner hairs – yellowish transparent.	Un-identifiable
162	(19) Rucavas Mazkatuzi, grave 18, male, A 9948: no accession number, 3th-4th cent.	Fragment of a fabric, found over a bracelet.	In the fabric – part of the fibres – dark brown (or blue), part – disintegrated, very thin and yellow.	Un-identifiable



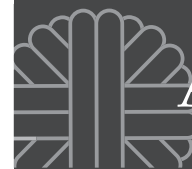
No.	(Number of the site according to Fig. 3), site, burial number, gender of the buried person, collection and accession number of the artefact, dating	Description of the find; possible function	Colours as seen in the microscope	Assumed initial colour
163	(19) Rucavas Mazkatuzi, grave 24, female, A 9953: no accession number, 3th-4th cent.	Two fragments of a twill fabric, fulled. Found over the fibulas.	In the fabric – part of the fibres dark brown (greyish gingery), some hairs disintegrated, thin and yellow.	Brown
164	(20) Rucavas Tiras bog hoard, male, A 9170:13a, 9th cent.	Fragment of a coarse plain weave fabric.	In the fabric – brown.	Brown
165	(20) Rucavas Tiras bog hoard, male, A 9170:13b, 9th cent.	Fragment of a coarse plain weave fabric, one end hemmed. With a naked eye – brown with 3 darker stripes of 6 warps close to the edge.	In the main parts of the fabric – orange.	Brown
166			In the stripes – dark brownish red.	Brown
167	(20) Rucavas Tiras bog hoard, male, A 9170:15, 9th cent.	Fragments of leg wraps, fine herringbone twill, width – 13 cm. With a naked eye – dark brown.	In the fabric – some fibres darker, brownish red, some fibres – lighter, orange-brown.	Brown
<i>Ludza region</i>				
168	(21) Ludzas Odulalns, female, RDM IV119a; b, 11th cent.	Head ornament, made of bronze rings and spirals threaded on plied yarn.	In the filling of the ornament – gingery.	Red
169			In the filling of the ornament – blue.	Blue
170	(22) Pildas Nuksi, grave 119, female, CVVM 65365:1 and 2, 11th cent.	Fragments of a twill fabric, inwoven bronze spirals.	In the fabric – dark blue-black, some hairs – dark brown.	Blue
171	(22) Pildas Nuksi, grave 185, female, CVVM 65426: 1, 10th cent.	Head ornament, made of bronze rings and spirals threaded on plied yarn. Yarn very well preserved.	In the filling of the ornament – blue, some hairs – bright blue.	Blue
172			In the filling of the ornament – reddish, turned paler and more yellow. Could have been bright red.	Red
173	(22) Pildas Nuksi, grave 197, male, CVVM 65437: 7 and 8, 10th-beginning of the 11th cent.	Fragment of a twill fabric with a hemmed edge. Decoration made of some bronze spirals attached to the fabric with a plied yarn. Possibly a coat.	In the fabric – dark blue-violet.	Blue
174			In the yarn of the decoration – reddish, turned more brownish.	Red
175	(22) Pildas Nuksi, grave 198, male, no accession number, 10th-11th cent.	Two small fragments of a twill fabric. Possibly an outer garment.	In the fabric – some hairs reddish brown, some – disintegrated and unidentifiable.	Brown ?
176	(23) Zvirgzdenes Kivti, grave 4, female, A 9591:24, ~year 700.	Two fragments of a shawl, a twill fabric, inwoven bronze rings.	In the fabric – some hairs dark blue-black, some light yellow-brown.	Blue



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177	(23) Zvirgzdenes Kivti, grave 128, male, no accession number, 8th cent.	Fragment of a fine inkle-woven ribbon. Possibly an arm band. Damaged in the process of restauration.	In the inkle-woven ribbon – brownish red.	Red
178			In the inkle-woven ribbon – bluish.	Blue ?
179	(23) Zvirgzdenes Kivti, 171, female, no accession number, 8th-12th cent.	Fragment of an inkle-woven ribbon. Possibly a sash.	In the inkle-woven ribbon – dark greyish blue-black.	Blue
180			In the inkle-woven ribbon – some parts bright red.	Red
<i>Madona region</i>				
181	(24) Dzelzavas Strugukalns, grave 3, female, A 8313:1, 13th cent.	Fragment of a fabric.	In the fabric – light yellowish brown, no darker hairs.	Brown ?
182	(24) Dzelzavas Strugukalns, grave 3, female, A 8313:2, 13th cent.	Fragment of a shawl (?) – a fabric with a tablet-woven band and fringes.	In the fabric – dark blue-black.	Blue
183			In the tablet-woven band – yellow.	Yellow
184			In the tablet-woven band – reddish-brown.	Red
185	(25) Galgauska, stray find, female, RDM I 3664, 13th cent.	Fragment of a shawl, a fabric with a tablet-woven band and decorative lines of yellow glass beads. With a naked eye – blue.	In the fabric – brownish hairs, fibres disintegrated, unidentifiable.	Un-identifiable
186			Fragment of a plain weave fabric. With a naked eye – blue.	Blue
187	(25) Galgauska, stray find, female, RDM I 3666, 12th cent.	Two fragments of a shawl, inwoven bronze rings, a tablet-woven band (11 tablets) attached to the fabric.	In the fabric – blue.	Blue
188			In the tablet-woven band – blue.	Blue
189			In the tablet-woven band – red, two hairs bright red (slightly cool tone), others – more reddish-brown/gingery.	Red
190			In the tablet-woven band – yellowish.	Yellow
191			In the tablet-woven band – orange-gingery.	Gingery (red?)
192	(25) Galgauska, stray find, female, RDM I 3668, 12th cent.	Fragment of a shawl, a fabric with inwoven rings, a tablet-woven band attached to the edge of the fabric. The unravelled stretch of the band has been coarsely mended with a blue twisted yarn.	In the fabric – blue.	Blue
193			In the fringes – red.	Red
194			In the fringes – reddish-brown.	Gingery (red?)



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195	(26) Liezeres Ozolmuiza, stray find, RDM I 3717, 13th-14th cent.	Fragment of a reps (?) fabric, embroidery along the edge, an inkle-woven ribbon sewn to the fabric with a plied yarn. With a naked eye – bluish fabric, ribbon – blue, red, yellow.	In the fabric – dark reddish brown disintegrated hairs, colour unidentifiable.	Un-identifiable
196			In the line of embroidery – light orange.	Red (or gingery)
197			In the inkle-woven ribbon – blue.	Blue
198			In the inkle-woven ribbon – orange-red.	Red
199			In the inkle-woven ribbon – yellow.	Yellow
200			In the yarn used for sewing – blue.	Blue
201			Fragment of a diamond twill (?) fabric.	In the fabric – dark blue.
202	(27) Lubanas Licagals, grave 1, male, A 4954, 12th-13th cent.	Fragment of a twill fabric, a fibula put into the fabric. Possible a coat or a cape.	In the fabric – fibre poorly preserved, some darker brownish-red hairs, disintegrated hairs – dim light yellow.	Un-identifiable
203	(28) Meirani, female, RDM I: 3648, 12th- 13th cent.	Four fragments of an inkle-woven ribbon made of fine plied yarn.	In the inkle-woven ribbons – reddish, fibre poorly preserved.	Red
204			In the inkle-woven ribbons - bluish, fibre poorly preserved.	Blue
205		Fragments of a shawl, a twill fabric with a 2 cm line of reps on the end.	In the fabric – dark greyish, black.	Blue?
206		Fragment of a tablet-woven band (5 tablets), three colours, the same colours in the fringes (the blue fringes covered by the line of the red and the yellow fringes).	In the tablet-woven band – reddish, some hairs colourless.	Red
207			In the tablet-woven band – yellow, has become darker.	Yellow
208			In the tablet-woven band – blue, some hairs colourless.	Blue
209		(29) Patkule, grave 1, male, A7981: no accession number, 12th cent.	Fragment of a fabric. Found under the buckle of the belt. Possibly a coat.	In the fabric – yellowish brown, some hairs – dark.
210	(30) Saikava, grave 1, male, A10165:3, 11th cent.	Fragment of a fulled twill fabric, a fibula put into the fabric.	In the fabric – blue.	Blue
211	(30) Saikava, grave 1, male, A10165:6, 11th cent.	Fragment of a fabric, stuck to the bronze decorations of the belt.	In the fabric – light yellowish brown.	Brown



No.	(Number of the site according to Fig. 3), site, burial number, gender of the buried person, collection and accession number of the artefact, dating	Description of the find; possible function	Colours as seen in the microscope	Assumed initial colour
212	(31) Tirzas Zvanulejas, stray find, male, A 9736:5, 11th- 12th cent.	Fragment of a twill fabric.	In the fabric – very dark brown-black and blue hairs, possibly used to be blue.	Blue
213	(32) Viesienas Kalnadzisli, stray find, male, A 8074: 2, 14th cent.	Small fragment of a fabric with a button and a leather strip attached to the fabric.	In the fabric – several hairs have a bright light blue (slightly greenish-blue) gloss.	Blue
214	(32) Viesienas Kalnadzisli, stray find, male, A 8074: 6, 14th cent.	Fragments of a fulled fabric of a coat.	In the fabric – dark gray-blue, some hairs – greenish-blue.	Blue
<i>Rezekne region</i>				
215	(33) Ezernieku Jurkova, grave 1, female, A12078:3, 13th cent.	Tablet-woven band, sewn to the fabric of a shawl with a red plied yarn.	In the tablet-woven band – dark yellow.	Yellow
216			In the tablet-woven band – dark reddish brown-orange.	Red
217			In the tablet-woven band – dark blue-black.	Blue
218	(34) Vidsmuizas Zeimuli, trench 1, grave 2, male, A 12009: no accession number, 9th cent.	Small fragments of a plain weave fabric, stuck to the coffin (?).	In the fabric – dark blue-black hairs, well-preserved colour.	Blue
219	(34) Vidsmuizas Zeimuli, trench 6, grave 6, female, A 12009: 72, 11th cent.	Fragments of a shawl, a twill fabric with inwoven bronze rings.	In the fabric – dark bluish-green-black, some hairs disintegrated (yellowish).	Blue
220	(34) Vidsmuizas Zeimuli, trench 6, grave 6, female, A 12009: 71, 11th cent.	Remains of a head ornament: some spirals threaded on plied yarn and bast, bast wrapped in yarn, a tassel of fringes with two cowries attached.	In the fringes – reddish, orange, brownish hairs, some darker, some more red.	Red
<i>Riga region</i>				
221	(35) Riga castle, trench B (2008), 13th-14th cent.	Fragment of a very coarse plain weave fabric.	In the fabric – parts of fiber – orange and orange-brown, some purple; disintegrated hairs – light yellow.	Brown
222	(36) Katlakalna Plavniekkalns, grave 8, female, no accession number, 5th-6th cent.	Fragments of a twill fabric, the largest piece found over the neck ring, in some places in two layers.	In the fabric – in some places disintegrated fibres – thin, transparent yellow hairs, some hairs – gingery. Possibly was reddish brown.	Brown
223	(36) Katlakalna Plavniekkalns, grave 27, female, RDM I 222 G, 12th-13th cent.	Remains of a head ornament – plied yarns and bronze spirals. Yarns possibly form a tablet-woven band.	In the yarn – orange-reddish hairs, a little disintegrated. Most likely used to be red.	Red



No.	(Number of the site according to Fig. 3), site, burial number, gender of the buried person, collection and accession number of the artefact, dating	Description of the find; possible function	Colours as seen in the microscope	Assumed initial colour
224	(36) Katlakalna Plavniekkalns, stray find, RDM I 3689 / 90, 12th- 13th cent.	Fragments of textiles: a tablet-woven band, fragment of a shawl, part of a head ornament with a decoration of tiny bronze spirals and yellow glass beads.	In the head ornament – reddish.	Red
225	(36) Katlakalna Plavniekkalns, stray find, A: 6799, 5th-6th cent.	Three small fragments of fabric, bronze spirals stuck to two of the textile fragments.	In the fabric – disintegrated fibres, unidentifiable colour.	Un-identifiable
226	(37) Madliena, stray find, female, no accession number, 13th cent.	Tablet-woven band with fringes attached to the end of a shawl.	In the tablet-woven band – dark blue-black.	Blue
227			In the tablet-woven band – reddish-brown.	Red
228			In the tablet-woven band – bright yellow.	Yellow
229	(38) Plavinu Kalniesi II, grave 23, male, A 11272:1, 8th cent.	Fragment of a head covering, possibly a cap.	In the fabric – dark greenish-gray brown.	Brown
230	(38) Plavinu Kalniesi II, grave 23, male, A11272:2, 8th cent.	Fragment of a fabric, found under the owl-shaped fibula.	In the fabric – dark blue or dark greenish-gray.	Blue (or greenish-blue?)
231	(39) Plavinu Radzes, grave 32, male, VI 85:163, the second half of the 10th cent.	Fragment of a head covering (possibly fur), decorated with bronze spirals that are threaded on plied yarn.	Yarn through the spirals – medium light brown.	Brown
232	(39) Plavinu Radzes, 32, male, VI 85: three of the samples, the second half of the 10th cent.	Fragment of a twill fabric. Possibly a cover of the burial.	In the fabric – unidentifiable colour.	Un-identifiable
233	(39) Plavinu Radzes, grave 32, male, VI 85:187, the second half of the 10th cent.	Many small fragments of a coat, inwoven bronze rings. Disintegrated fabric, one fragment of the fabric better preserved.	In the better preserved fabric – blue.	Blue



Kerstin Droß-Krüpe and Yvonne Wagner

Ancient Wardrobe Studies

The Wardrobe of Kroniaina from Tebtynis (AD 54)

Abstract

Documentary sources like papyri provide information about all kinds of ancient social and economic processes, especially in the Roman world. They are a valuable and unique source on the basis of which not only aspects of legal history but also of social and economic history can be investigated. In this study the province of Egypt with its abundance of papyrological evidence is used as a case study to gain insight into the relevance of textiles in ancient marriage arrangements. Apart from jewelry and household items, textiles were the most important items of a woman's dowry and therefore often mentioned in detail in the contracts concluded between husband and wife. They are our only textual evidence of documentary nature showing textiles actually worn by women in everyday-life. Being a highly interesting type of sources in itself, the marriage and dowry contracts preserved will be used to shed light on the value, kind, number and colour of women's textiles in imperial Egypt. After a general introduction into the source material, we will demonstrate the potential insights dowry contracts can provide with regard to tracking everyday female clothing in Roman Imperial Egypt.

Keywords: Roman Egypt, papyri, dowries, everyday dress

Introduction

Sociologists, marketing experts and fashion designers alike recognise the potential of wardrobe studies (eg. Gwerner 2001; Salazar-Sutil 2009; Grimstad Klepp and Bjerck 2012).¹ Wardrobe studies encompass the investigation of the wardrobes of selected persons to find out about their personal style, shopping patterns, favourite colours etc. Wardrobe studies constitute a new type of user studies in the field of fashion research. When it comes to investigating ancient wardrobes, it is much more difficult to gain reliable information on the garments actually worn by people in everyday life. When looking at Roman wall paintings, funerary reliefs or statuary, we are constantly facing iconographic problems – these remains from Roman times demonstrate how people wanted to be seen, and how they wanted their fellow citizens, friends, or families to remember them. This does not necessarily reflect the dresses they actually wore. Another way of exploring ancient wardrobes is based on the archaeological remains of textiles or entire garments. It is not surprising that the last-mentioned are not very

numerous. To make matters even more complicated, most of these textiles originate from burial contexts (if we know their find sites at all). But how can we know that the garments worn by the dead were the same worn by these people during their lifetimes?

Other source material seems to be more helpful. If we consider source groups existing in a larger number, deriving from the actual everyday life of people, we can get a new insight into these 'wardrobes'. So it seems promising to deal – for example – with the papyrological evidence and the references to clothes it contains. Papyri, produced in Egypt, were a common writing material in ancient times. Most of them survived in Egypt but some texts were also found at several other locations (eg. Dura Europos, Palestine, Petra and Herculaneum, in latter case carbonized). The organic material needs dry conditions and a place above the groundwater level to be preserved (Rupprecht 2002, 65-66). These conditions were and are largely present in Egypt so that this area is highly appropriate to approach the clothing habits in Greco-Roman times. Skeptics like to claim that Egypt



is a special case in many ways and that therefore the information from the papyri cannot be transferred to the rest of the Roman Empire. Although Egypt certainly is special in terms of its geographical and climatic characteristics, this applies for almost all the other provinces, too. The Roman Empire was very heterogeneous; the conditions in Britain, for example, are not comparable to any other province. Thus, the history of the *Imperium Romanum* would be a history of special cases and not a history of an empire, which it is without any doubt.

Concerning the clothes, the papyri offer many ways to deal with this topic; apart from information on textile production (cf. Droß-Krüpe 2011), distribution and trade, there are also numerous texts that inform us about clothing colours, styles and materials. Especially marriage and dowry contracts contain many of such details, because it was common to list estimated

values as well as details like material for the included items (Yiftach-Firanko 2003). Thus, by looking at these contracts on papyrus, we can get a glimpse of ancient women's wardrobes. We can find out details about the terminology of female garments, about colours and sometimes even about the value of an actual garment. After a general introduction into this category of source material, we will demonstrate the potential insights dowry contracts can provide with regard to tracking everyday female attire in Roman Imperial Egypt. By analyzing women's dowries and the archaeological evidence of the garments they possessed and wore in everyday life we are able to explore the links between clothing and wealth, fashion and status – not just of upper class women but also of brides from very different social strata of the multicultural society in the Roman province of Egypt.

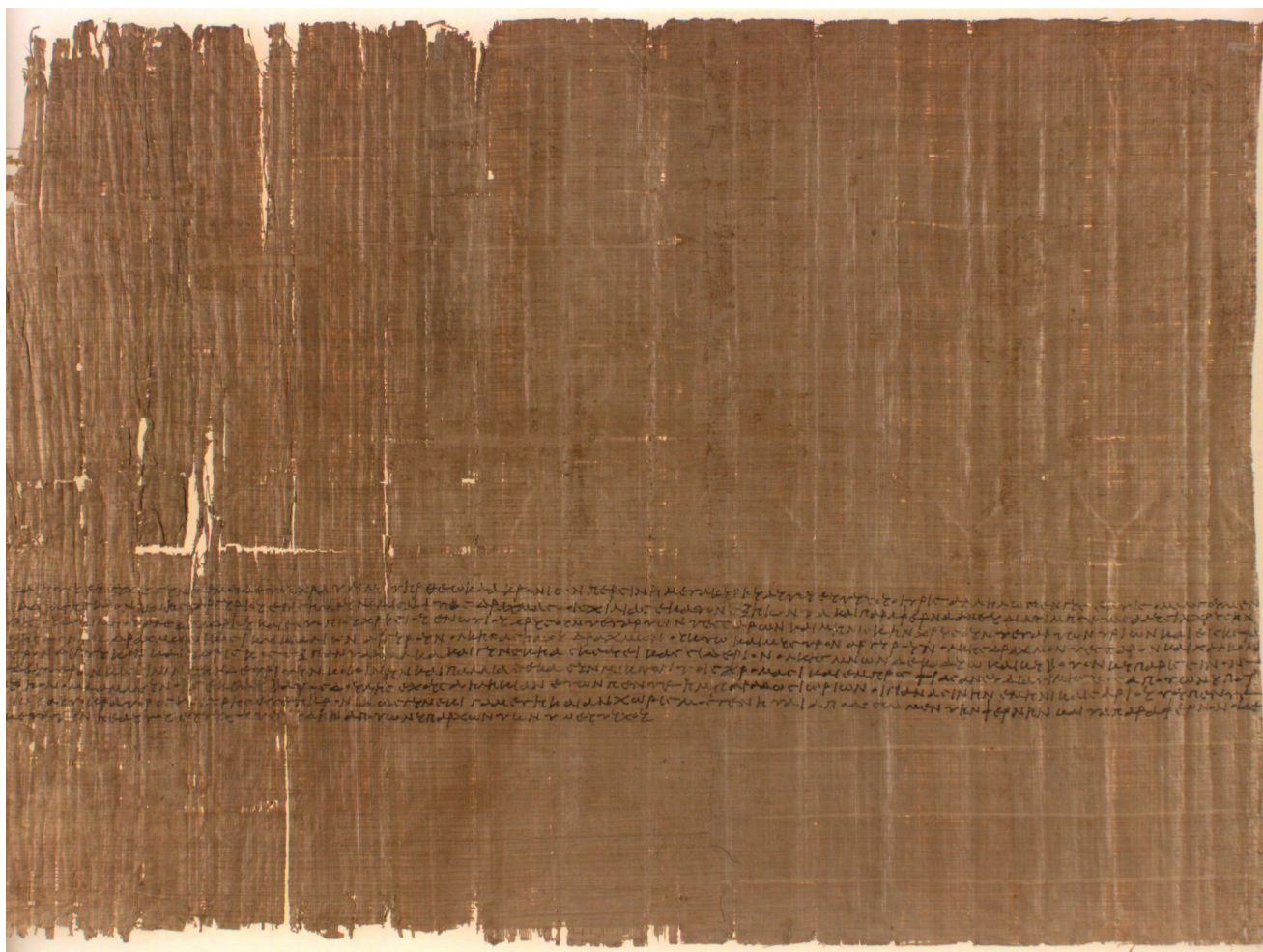


Fig. 1. P.Mich. 5/343 – Marriage between Chrates and Kroniaina; acknowledgment of the receipt of a dowry (P.Mich.inv. 719; University of Michigan Papyrology Collection).



Marriage and dowry contracts in Greco-Roman Egypt

It is necessary to keep in mind that marriage was important and common in ancient times. Analyzing census declarations, Roger Bagnall and Bruce Frier have even proven that in Roman Egypt at least 93% of the women aged between 26 and 35 years were married or already divorced or widowed at the time of declaration (Bagnall and Frier 1994, 117). So marriages were a very common phenomenon!

Turning to the marriage and dowry contracts in particular, there are about 145 of these documents edited, dating between the 4th century BC and the 4th century AD. This type of legal agreement was quite common, though marriages without any written record were fully valid (Palme 2009, 366). Our study focuses on Roman imperial times (1st–3rd centuries AD), as conditions in the Ptolemaic period were notably different, and Late Antiquity experienced a dramatic change in social, economic and political terms alike. Marriage and dowry contracts – like most of the papyrological material – are mostly drafted formulaically, a fact which facilitates the reconstruction of damaged or incomplete texts. They generally consist of the date and name of the contractual partners, acknowledgement of receipt of the dowry, a set phrase of the shared life of the spouses, arrangements in case of divorce (such as the redemption of the dowry and a deadline thereof) and – sometimes – phrases in case of death or a partial divorce.

The most interesting elements of these documents are the dowries which were mostly given by the bride's parents or some relatives to the groom (Kutzner 1989, 43). The content of the dowries is miscellaneous; they include for example jewellery, money, slaves, real estates and – particularly important at this point – various textiles and garments. Of the dowries dating back to Roman Imperial Times (1st–3rd centuries AD), 46 mention textiles (Droß-Krüpe and Wagner, forthcoming) – this is about half of all dowries of that time. This stresses the importance of textiles as part of women's belongings and also highlights the importance of garments and the connection of gender, everyday dress and social status. The overall value of the dowries varies a lot, but this results from the fact that the contracts come from varied socio-economic backgrounds, which is not surprising considering the high percentage of married women. However, based on the items listed and their quantity, one can often make tentative conclusions about the socioeconomic status of the bride's family.

Types of dowries

There are three types of dowries in the Roman period, which do not necessarily appear in all contracts. The *pherne* is usually listed as the first of them and includes movable goods brought into the marriage by the wife, such as money, clothes, jewelry and household items. Ownership and use of the *pherne* lay with the husband during the marriage. In case of divorce he had to pay back the entire *pherne* within regulated limits. The value of *pherne* is always estimated and included in the contract (Häge 1968, 141-142).

Parapherna and *prosphora* probably became usual during the Roman Empire, while the *pherne* was the regular and single form of dowry in papyrological marriage and dowry contracts already in the Ptolemaic period (Kutzner 1989, 44). The items of the *parapherna*, which were usually listed after the *pherne*, are everyday objects, which came directly to the wife for good and were primarily used by her (Kutzner 1989, 48). Erich Gerner therefore came to the conclusion that the *parapherna* is a continuation of “women-things” (*Frauensachen*) known from demotic texts (Gerner 1954, 37). Nevertheless, in terms of the occurrence of textiles it can be stated that clothes are also common items for the *parapherna*. The owner of the whole *parapherna* is the woman, and her husband is not allowed to sell the listed items.

The third form of dowry, the *prosphora* consists mostly of real estates, slaves and money. Although textiles are therefore not listed therein, the presence of a *prosphora* also facilitates the possible conclusions about the socio-economic background of the bride's family, provided that they are also the donor of the *prosphora*, which usually is the case (Kutzner 1989, 49).

Kroniaina's wardrobe

As we have seen, garments were part of the *pherne* and the *parapherna* and were included in the contracts from the Ptolemaic period (306-30 BC) as well as in those of late antiquity. The phenomenon of providing textiles of various kinds as a dowry was obviously not time-limited. Textiles were very commonly included in dowries. Using one particular dowry contract (or more precisely an acknowledgment of the receipt of a dowry), we demonstrate the value of this source material in investigating everyday female garments during the Roman Empire in the province of Egypt.

The bride, Kroniaina, was given several different garments as a dowry (Table 1). The dowry is paid for by the bride's brother, Horion, and is received by Chrates, the groom, and his parents. The contracting parties were situated in the village of Tebtynis, in the Arsinoite nome. The settlement of this marriage contract consists of all three dowry categories



mentioned above, *pherne*, *parapherna* and *prosphora*. It also includes provision for the return of *pherne* and *parapherna* in case of divorce.

The papyrus is 49.2 x 28.8 cm wide, its verso is blank (Fig. 1). It is broken off on the left-hand side; about 20 to 25 letters from the beginning of each line are lost. There is no exact date for the contract given, the only date mentioned in this document is referring to a time in the future, at which a slave will be given to the newly married couple, and this will take place

in the month Kaisareios (July 25 - August 23) in the fifteenth regnal year of the current Roman Emperor. The remaining parts of the Emperor's name given read Claudius Caesar Augustus Germanicus Imperator, the first part of the name is missing. It might be Nero or Claudius. As the document is part of the archive of Kronion, son of Apion, who was head of the record and writing office (*grapheion*) at Tebtynis AD 26 to 56, this document is most certainly referring to the fifteenth year of Emperor Claudius. This Emperor died

Table 1. P. Mich. 5/343. Text and translation.

[Χράτης Εὐτύχου καὶ Εὐτυχοῦς Χράτου οἱ δύο Περσῆς τῆς ἐπιγονῆς καὶ ἡ τοῦ Εὐτύχου γυνὴ ἐμοῦ δὲ τοῦ Χράτου μήτηρ Θεωκλᾶ Κρονίων Περσίνη μετὰ κυρίου αὐτοῦ Εὐτύχου οἱ τρεῖς ἀλλήλων ἐγγυς <εἰς> ἐκτὸς ὁμολογοῦμεν | [ἔχειν παρὰ Ὠρίωνος] παραχρημα φερνὴν ὑπὲρ τῆς ἡε[υ]τοῦ ἀδελφῆς Κρονιένιας ἀργυρίου ἐπισήμου νομίματος δραχμᾶς δισχιλίας ἑκατὸν ἑξήκοντα καὶ παραφέρνα ἄνευ διατιμήσεως ἄλυσιν χρυσῆν | [-20-25-] ἵν τετάρτων τεσσάρων ἄμφω τ[ο]ῦ χρυσίου δοκιμίου Ἀλεξανδρίου καὶ ἐντοπίου χρυσίου ἐνωτίου χρυσοῦν τετάρτων τεσσάρων καὶ μηνισκην χρυσοῦν τετάρτων τριῶν καὶ εἰσκεφα- | [-20-25-] ἕξ καὶ ψεελίων ἀργυριῶν ζεῦκος [ὄλ]κῆς ἀσήμου δραχμῶν ἵκοσι καὶ κλάλων ἀργυροῦν ὄλκῆς ἀσήμου δραχμῶν οὐκτὼ καὶ μύστρον ἀργυροῦν ὄλκῆς δραχμῶν τεσσάρων καὶ χαλκῶμα- | [τα -18-23-] ἡ δὲ χρυσὸν καὶ ζμημοδοκίον καὶ κά[τ]ροπτρον δίπτυκον καὶ ὑδρίσκος ἕξ πάντα χαλκᾶ καὶ γυνεκῆα σκευεῖ κασιδερίον ὄλκῆς μινῶν δέκα δυὼ καὶ κυβοτὸν κυπαρίσσινον | [-10-15-] καὶ στολὰς γυνεκίας τρεῖς μίαν μὲν λευκὴν τὴν δὲ δευτέραν κισσίνην τὴν δὲ τρίτην κοκίνην καὶ πάλλια δέκα σύνμικτον τοῖς χρομασι-καὶ ἐμ προσφορας ἄνευ διατιμήσεως ἀπὸ τῶν ὑπαρ- | [χόντων αὐτῶν δουλικῶν σω]μάτων οἰκογενὴν πεδίσκην δούλην ἣ ὄνομα Ἀμμουνοῦς ἐκ Θαυβάτος δούλης ἔχουσαν ἡλικίαν ἐτῶν πέντε ἡμ παραδώσι Ὠρίων οἴγιαν ἀσινὴν ἐ μὲν Καισαρίου τοῦ πεντε- | [καιδεκάτου] ἔτους Τιβερίου Κλαυδίου Καίσαρος Σεβαστοῦ Γερμανικοῦ Αὐτοκράτορος. καὶ χρῆσετε ἡ Κρονία ὡς γυνεκί γαμετῆ καὶ ἂν χωρισμὸς γένηται ἀποδόσωμεν τὴν φερνὴν καὶ τὰ παραφέρνον. οἱ δὲ | [δύο Εὐτυχὸς τε καὶ Θεωκλᾶ] [σ]υνηγοροῦσι ἀπομερίτεν ἑαυτῶν Χράτη μετὰ τὴν ἡεαυτοῦ Εὐτύχου τελευτὴν ἀπὸ τῶν ὑπαρχόντων τῶ Εὐτύχου.

[We, Chrates, son of Eutychos, and Eutychos], son of Chrates, both Persians of the epigone, and the wife of Eutychos, who is also the mother of Chrates, Theokla, daughter of Kronion, a Persian, with her guardian, the same Eutychos, all three being mutual security for the payment, acknowledge [that we have received from Horion, son of . . .], at once, the dowry on behalf of his sister Kroniaina, consisting of two thousand one hundred and sixty silver drachmai in coin; and as parapherna without valuation a gold necklace [- - - and - - -] of four quarters, both of Alexandrian current gold coin, and a gold earring of native current gold coin of four quarters, and a gold lunette of three quarters and a [- - -] and a pair of silver armlets of a weight of twenty drachmai of uncoined metal, and a silver bracelet of a weight of eight drachmai of uncoined metal, and a silver spoon of a weight of four drachmai, and bronze utensils [- - -] and a box for ointment and a folding mirror and six water jars all of bronze, and women's utensils of tin of a weight of twelve minas, and a cypress chest, [- - - and] three women's [dresses], one white, the second ivy-colored, and the third scarlet, and ten cloaks of various colors; and as a gift, without valuation, from the slaves that belong [to him], a female child slave, born in the house, whose name is Ammounous and who was born of the slave Thaubas and is five years of age, whom Horion shall give over in good health and unharmed in the month Kaisareios of the fifteenth [year of Tiberius Cl]audius Caesar Augustus Germanicus Imperator. And he (i.e. Chrates) will treat Kroniaina as his wedded wife and, if a separation shall occur, we shall return the dowry and parapherna. And [Eutychos and Theokla] agree to bequeath to Chrates after the death of Eutychos from the property of Eutychos.



Fig. 2. Common Ivy (*Hedera helix*) growing on a red brick wall (Photo: Derek Ramsey).

13 October AD 54, a fact that was known in Middle Egypt at the latest since mid-November (cf. P.Oxy. 7/1021). Thus November AD 54 would be the *terminus ante quem* (date before which) for this contract. It is likely that the document was written between January and November AD 54.²

It is beyond doubt, that the dowry provided for Kroniaina is a large and precious one (Table 1). Among various items (mostly jewelry), her *parapherna* includes thirteen garments – the largest known number of garments in a dowry. The type of the first group of garments is lost, but the editor of this document suggested reconstructing the phrase as women's *stolai*. The *stola* was the typical garment worn in public by Roman matrons, i.e. free-born married women (Pliny, *Naturalis Historia* 33,40). It was a long, pleated dress, entirely covering the body (Horace, *Satires* 1,2,99). The *stola* reached to the ankles and was typically girt with two belts at bust and waist level (Martial 3,93,4). Though this type of garment was a typical female one and is often attested in dowries, the lacuna in the text could also be reconstructed differently: Other dowries contain the more general term *ἱμάτια γυναικεῖα*, women's garments (BGU 4/1050, BGU 4/1101 or BGU 3/729). Thus we cannot be sure if Kroniaina's wardrobe contained *stolai* at the day of her marriage. What we can be sure of is that her dowry contained three garments of the same kind, but in different colours.

The colours given for the garments are noteworthy. The first garment is said to be *λευκήν* – white. This might include a hint towards the raw material used. Though linen could be dyed (eg. Goyon 1996; Kourkoumelis et al. 2012), scholars mostly assume that white linen was preferred (Germer 1992, 95-96; Mossakowska 2000, 290-291) and more precious (Ezzeldeen Ahmed 2009, 28). The white garment could thus be made of undyed wool or bleached linen. Usually all items in

a dowry are given in decreasing order of value – and Kroniaina's dowry follows the same pattern: The commodities of her *parapherna* are arranged according to categories – first the most precious, her jewelry and other prestigious items made of precious metal and expensive wood, followed by her garments. The metal and wooden objects are arranged according to the value of the material used: In first place, the golden jewelry, in descending order by weight; in second place, the silver items, arranged in the same way, followed by those of bronze, tin and cypress wood. We may conclude that the following garments are arranged similarly. This would make the *stolai* (or *himatia*) more precious than the *pallia* and the white garment the most precious of all. The colours given for the remaining two garments are *κισσίνος*, meaning ivy-coloured, and *κοκίνος* (= *κοκκίνος*), scarlet. While scarlet garments appear quite frequently (e.g. P.Hamb. 1/10; P.Hamb 3/220; P.Tebt. 2/405), *κισσίνος* is hardly ever attested. As far as we know, this document is (up to now) unique in using this term to describe a colour. Ivy was very common in the ancient world (Fig. 2): Pliny the Elder describes the plant in his famous *Naturalis Historia* (16,145). The wreaths made from its foliage were dedicated to Dionysos, to a lesser extent to Apollo and Aphrodite, Artemis and Athene (Hünemörder 1997). However, an ivy-coloured garment appears in this particular dowry alone. Generally speaking green female garments seem to have been more of an exception than a rule in dowries from Roman Egypt. Preliminary analyses have shown that only 6% of all garments in the dowry contracts specified according to colour (of a total of about 50 coloured garments in 46 dowry arrangements from imperial times) are different shades of green. It is often stated that dying threads, yarns or entire textiles green became popular only in Late Antiquity and even more



so in (Early) Islamic times (e.g. Paetz 2003, 99, no. 206; Colburn 2012, 169, no. 111). But the archaeological record from Imperial Egypt, for example from Mons Claudianus, quite often provides us with green fabrics, which forms a remarkable contrast to the dowry contracts. For now it must remain an open question whether this contrast may be the result of differing tastes of men and women (as dowries only contain female garments whereas Mons Claudianus is clearly a male dominated settlement; cf. Bülow-Jacobsen 1988; Mannering 2000) or if different colours were used for different types of textiles (e.g. green might have been a fashionable colour for household textiles but not for garments). Comparing the overall record of the dowry arrangements, we are faced with a clear preponderance of different shades of white (31%), red (33%) and yellow (12%). Interestingly, the value attested for a certain garment does not necessarily correspond to the fact that it was dyed.

Looking at the values of the individual textiles one can detect an astonishing range: The cheapest garment in a dowry is a milk-white tunic worth 12 *drachmai*, the most precious one is a combination of a silver *dalmatike* and *maphorion* worth 260 *drachmai*. This very expensive garment is often translated as hooded mantle but most likely consisted of two different garments worn together to form an entire outfit. A white *pallion* can be worth 125 *denarii* (~ 125 *drachmai*), a white tunic 160 *drachmai*. The most common garment, the tunic, appears in various value gradations – 12, 20, and 160 *drachmai*; and various colours – purple, mulberry red, sandalwood red, chrysanthemum yellow, sulphur yellow, safflower yellow, milk white and white (Droß-Krüpe and Wagner, forthcoming).

In addition to the three garments discussed in detail above, Kroniaina was also given ten *pallia* of various colours. This type of garment is a traditional Roman mantle worn by women of all ages, often fastened by brooches (Apuleius 11,3). Two facts are remarkable: ten mantles form the largest group of garments in a dowry known up to now. Thus, no other woman of Greco-Roman Egypt we have evidence for owned more garments than Kroniaina. However, the *pallia* seem to be less precious than the garments mentioned before. This is not only indicated by the position in the text but also by their less detailed description. No individual colours are listed, but a broader term “of various colours” is used. Obviously these garments were of lesser importance and probably of lesser value (be it the value attributed to them by the bride or their material value).

As Kroniaina was presented a huge amount of money in her *pherne* (2,160 *drachmai*): a lot of precious metal, wooden items in her *parapherna*, and unusually a

female child slave as *prospora*, we can clearly detect a very well-off family. The value of her *pherne* alone would be sufficient to feed, dress and shelter a family of six people for almost three years (cf. Drexhage 1991, 453)!

Conclusion

The Roman dowry contracts provide a unique possibility to detect the social realities of clothes as actually used and worn. They can be used to detect textile tastes and to make the wardrobes of women visible. They provide unique insights in everyday life of women, the dresses they possessed and their colours. Combined with the value of textiles often provided in these documents, we can get a good glimpse of the taste of Roman women – at least in the parts of the Roman Empire that provide us with papyrological evidence. This case study is the starting point for a more thorough analysis of this material – and a unique chance to take a look into ancient wardrobes.

Notes

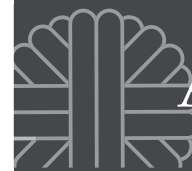
1. One could also mention the “Wardrobe studies” network between fashion and dress scholars from Holland, Iceland, England, Sweden, Norway and Denmark: <http://www.re-ad.dk/en/activities/garderob-eundersoegelser%20e137f10-1d42-11df-a5a5-000ea68e967b%29.html> (last retrieved on 15 May 2013).
2. Cf. Mitthoff 2007, who gives an even narrower time frame from the end of August to the end of November.

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Authors:

Kerstin Droß-Krüpe: kerstin.dross-kruepe@uni-kassel.de
Yvonne Wagner: wagner.yvonne@gmx.at



Naama Sukenik, David Iluz, Orit Shamir, Alexander Varvak
and Zohar Amar

Purple-Dyed Textiles From Wadi Murabba'at

Historical, Archaeological and Chemical Aspects

Abstract

This article presents three prestigious textiles dyed with murex shellfish, which were found in the Murabba'at Caves in the Judean Desert and are dated to the Roman Period. The textiles were analyzed using High Performance Liquid Chromatography (HPLC). The results of the analysis indicate that one textile was dyed using Hexaplex trunculus and its color tends to blue-greenish; apparently, the dye solution was exposed to the sun during the dyeing process. The other two textiles underwent a double dyeing process using the Hexaplex trunculus and the Armenian Cochineal insect dye in order to give the fabric a reddish purple color, which was indicative of high status. Such a combination has not been reported in the results of dye analysis of ancient Israel textiles. Furthermore, these finds are unusual and unique in light of discoveries of other textiles from Israel dated to the Roman Period. According to the dye analysis and tests of different aspects of the purple textiles, we propose the origin of the textiles.

Key words: Royal purple, Hexaplex trunculus, Armenian Cochineal, HPLC, Dyes, Murabba'at Caves.

Introduction

The Royal purple dye is a reddish-purple natural dye which was the most prestigious of all dyes used in the ancient world. The true Royal purple was produced primarily from three species of sea mollusks of the *Muricidae* family, which were common in the Mediterranean Sea: *Hexaplex trunculus* (*Murex trunculus*), *Bolinus brandaris* (*Murex brandaris*) and *Stramonita haemastoma* (*Thais haemastoma*). Although the use of murex mollusks for dye began in Early Bronze Age (Stieglitz 1994, 46-54), it appears that during the Hellenistic and Roman periods, the popularity of purple dye grew as never before. In the 3rd and the 4th centuries CE, this tendency became stronger after an edict was issued prohibiting the public from wearing purple, thereby making it exclusive to the Emperor and his family. This prohibition made the purple dye even more popular among the public.

The process of producing dyes from murex mollusks is more complex than the process required for producing dyes from plants. The murex fisher must

have the appropriate skill and a close familiarity with the different species of mollusks. The dye substance in the murex mollusks comes from the hypobranchial gland located under the mollusk's mantle (Spanier and Karmon 1987), and therefore it is necessary to remove the gland from the mollusk. This is accomplished by cracking the shell, an action requiring much physical effort, accuracy and proficiency (Amar 2013, 115-120). Moreover, Royal purple belongs to the class of vat dyes, dyestuffs which must be reduced to soluble leuco form before they can be used for dyeing (Koren 1996). Vat dyeing involves biochemical and photochemical reactions and complex reduction and oxidation processes, which would have taken a number of days in ancient times and required the inclusion of additional materials (Karmon 1993, 36; Cooksey 2001, 737-738). It was only after many attempts and experiments that this complex process was successfully reconstructed (Edmonds 2002; Kanold 2005; Koren 2005).

Researches have previously noted excessive amounts of murex needed for dyeing (Friedlander 1909, 766);



this craft obviously required large quantities of mollusks. According to new research one mollusk has only 1.5 g dye on average and in order to dye 3 kg of wool, it is necessary to use 1000 mollusks (Amar 2013, 122). This is probably the reason that true purple was usually used only in decorative elements requiring small amount of dyed wool.

Furthermore, unlike other dyes, the final color depends on exposure to light and demanded a high level of expertise, resulting in a range between shades of bluish purple when the dye solution is exposed to sunlight and reddish purple when the dye is not exposed to sunlight (Elsner and Spanier 1985, 126). Vitruvius, who observed this phenomenon, wrote in his book that the color of purple “does not yield the same colour everywhere, but is modified naturally by the course of the sun” (*De Arcitectura*, VII, 13.1). Similarly most researchers agree that the two prestigious colors in the Bible, *Argaman* (reddish purple color) and *Tekhelet* (bluish purple color) derived from the *Hexaplex trunculus* species (eg. Exodus 26: 1; Elsner and Spanier 1985, 125-126; Ziderman 2008). The attributes of this dye are also reflected in it being color-fast after washing and exposure to the sun. Plutarch (45-120 CE) noted that among the treasures of the Persian kings, Alexander found purple cloth which had not faded although it had been dyed 180 years earlier (Plutarch, *Lives*, XXXVI, 1). The beauty of the color on the one hand, and the difficulty in obtaining and using it on the other hand, were reasons that made it the most expensive of all of the dyes.

Many of the natural historians devoted considerable attention to purple, among them: Pliny (*Naturalis Historia*, VI, 201; IX, 125-142; XXXV, 44-45), Vitruvius (*De Arcitectura*, VII, 13.1) and Aristotle (*Historia Animalium*, V. 15). Compared with the many literary sources, there are far fewer archaeological traces of the purple dye industry. Accumulations of crushed murex shells found along the seacoast represent indirect evidence of the purple dye industry that flourished along the Mediterranean Sea shore (Karmon and Spanier, 1987, 147-158; Reese 2010, 113-141). Other archaeological finds are stains of purple pigment in the inner surface of jars associated with the purple dye industry and identified by means of analytical instrumentation as ‘Royal purple’ (Karmon and Spanier 1987, 151-155; 1988, 185; Koren 2008).

Other important evidence for the use of true purple can be found in archaeological textiles. Purple-dyed textiles are few and were found on sites that were generally located along important commercial routes, such as Palmyra (Pfister 1934, nos. L.12, T.10, T.11, T.12; 1940: nos. T.84, T.85, T.86, T.87, T.91) and Dura Europos in Syria (Pfister and Bellinger 1945, nos. 57, 58,

61). Prior to the present study, only two textiles found in Israel were identified as dyed with Royal purple. They have been found at Masada and are dated to the Herodian period (37-4 BCE). One of these textiles is blue and the other purple (Koren 1997, 23-24; Kraft 2011). Recently, in a comprehensive study conducted on the textiles found in the Judean Desert in order to identify dyes, 180 samples of textiles were analyzed. These selected textiles came from the Cave of Letters, the Cave at Nahal Hever, the Christmas Cave, the Pool Cave and the Murabba’at Caves (Sukenik 2013). In this article the dye analysis of three textiles from the Murabba’at Caves is presented. The three textiles are stored at the Israel Antiquities Authority.

Textiles from the Murabba’at Caves

Wadi Murabba’at is a deep ravine descending from the Judean Desert towards the Dead Sea (a descent of 200 meters), some 18 kilometers south of Qumran. Along the wadi, five caves were discovered. These caves were excavated by Harding, de Vaux and Barthélémy at the beginning of 1952, following the discovery of written documents by the Bedouins (de Vaux 1961, 3-8). The archaeological artifacts that were recovered in the caves were dated to the Chalcolithic Period, the Middle Bronze Age, the Roman Period, the early Islamic Period, as well as more recent times, but the largest bulk of the material is dated to the Chalcolithic and Roman Periods (de Vaux 1961, 10-13). The caves are known primarily for the many documents that were found inside them. These documents had been brought to the site during the Bar Kokhba Revolt (waged between 132-135/136 CE by the Jews of the southern Levant against the Roman Empire). Among these documents one was of supreme importance to academic research, as it stated the full name of Bar Kokhba who was the leader of the revolt (Milik 1961, 122-134).

Among the finds were 109 textiles from various periods. Some of these textiles were examined and catalogued by Grace and Elizabeth Crowfoot (Crowfoot and Crowfoot 1961). Some of the linen textiles were dated to the Chalcolithic period, while a smaller group in linen, cotton and silk were dated to the medieval times, and 86 of the textiles dated to the Roman Period. Of these 17 were of linen, one of goat-hair, and 68 were of wool (Crowfoot and Crowfoot 1961, 54-60; Shamir 2006, 85). Dyed textiles are all made of wool, and the possibility that some of the dyed textiles could be dated to the Chalcolithic Period is ruled out because at that time, only linen was used for weaving textiles in the area (Schick 2002, 238; Shamir 2013b). Furthermore, Crowfoot and Crowfoot dated the dyed textiles to the days of the Bar Kokhba Revolt based on

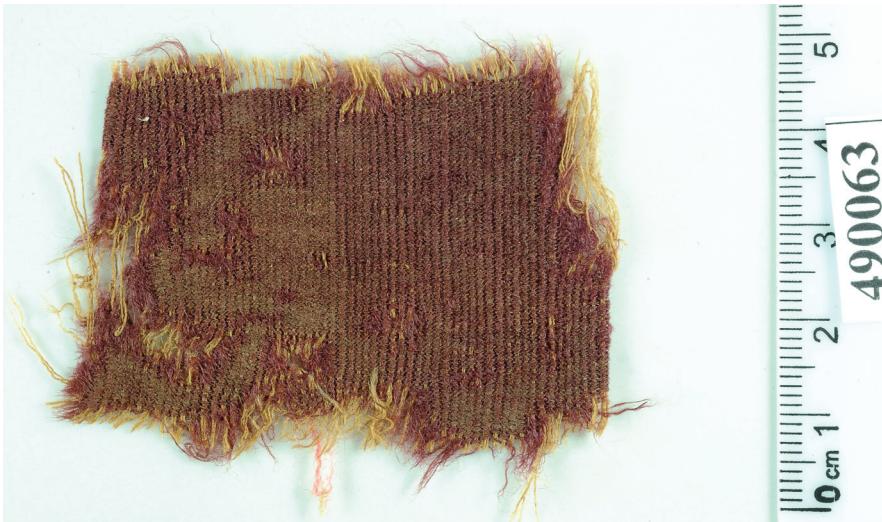


Fig. 1. Textile no. 12 from Murabba'at Caves (Photo: Clara Amit, courtesy of the Israel Antiquities Authority).

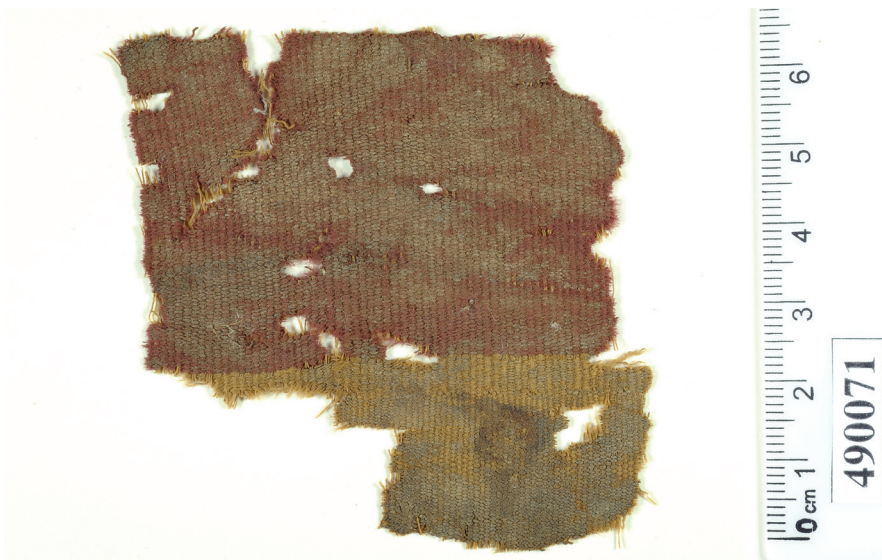


Fig. 2. Textile no. 20 from Murabba'at Caves (Photo: Clara Amit, courtesy of the Israel Antiquities Authority).



Fig. 3. Textile no. 22 from Murabba'at Caves (Photo: Clara Amit, courtesy of the Israel Antiquities Authority).

the archaeological context (Crowfoot and Crowfoot 1961, 51). On some of the textiles, vertical woven-in bands (*clavi*), in various shades of red, brown, purple, blue and green were found, a decoration characteristic of the Roman Period tunic (Bender Jørgensen 2011; Shamir 2013).

The textiles

The three textiles from the Murabba'at caves chosen for dye analysis are all fragmentary and were originally part of larger textiles. Textiles nos 12 (IAA No. 490063, Fig. 1) and 20 (IAA No. 490070, Fig. 2) are decorated with *clavi* in a reddish purple colour but only part of the bands are preserved. Warp and weft in both textiles are made of z-twisted yarns. The ground weave in Textile no. 20 is plain weave while it is not preserved in the other textile. The warp threads are made of undyed wool yarns. The bands are weft-faced with approximately 80 weft threads/cm, and wefts completely cover the warps threads. In order to achieve this effect the warp threads are grouped in the band. This phenomenon is typical of the Roman period (Bender Jørgensen 2011, 78) and was also documented in textiles from sites such as 'En Rahel (Shamir 1999, 94) and Masada (Sheffer and Granger-Taylor 1994, 198-199).

Textile no. 22 (IAA No. 490073, Fig. 3) is decorated with stripes in a greenish-blue colour, which probably originally have been blue, mixed with narrow brown and cream coloured stripes. The textile is a warp-faced tabby. The warp is made of plied yarns, S2Z with 25 threads/cm, while the weft is made of single s-twisted yarns with a thread count of 7 threads/cm. The textile has three coarse sewing threads inserted into the weave, indicating secondary use.

Dye identification

In the course of the study, the textiles were analyzed by HPLC (High-Performance Liquid Chromatography). The samples were tested several times, according to a number of parameters and under identical conditions (for a detailed description of this method, see Sukenik 2013, 165-167; for parallel studies Koren 2006, 47-48), and they were compared to samples of modern wool that we dyed with shellfish purple experimentally. In the course of the analysis, we identified the various components of the dye sample and determined the source of the dye at the level of species.

The major dye component that were detected in extracts from Textile no. 22 was indigotin (IND), which is found in plant sources such as woad (*Isatis tinctoria* L.) and the indigo plant (*Indigofera tinctoria* L), but also in several species of shellfish (Koren 2006; Clark *et al.* 1993) (Fig. 4). In addition, two more substances were found which exist only in mollusk dyes: 6'-monobromoindigotin (MBI) and 6,6'-dibromoindigotin (DBI) (Wouters and Verhecken 1991, 269, Fig. 4) Therefore, it can be determined with certainty that the textile was dyed with genuine shellfish dye. Moreover, although the results of the analysis are affected by many factors such as the sex and age of the mollusks, geographic location, the dyeing process and the method of the analysis (Koren 2008, 388-389), it may be established based on the percentages of the substances identified, that the origin of the purple color that was used in this textile was *Hexaplex trunculus*. According to the chromatogram, the percentage of IND and MBI material was high, and this is characteristic particularly of *Hexaplex trunculus*, in contrast to *Bolinus brandaris* and *Stramonita haemastoma* in which the concentration of IND is low

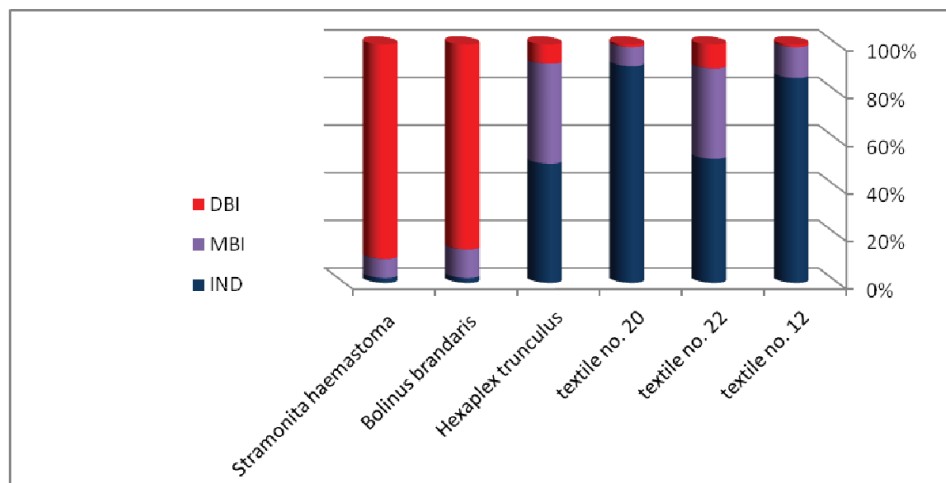


Fig. 4. Relative presence of dyes components at 554 nm of archaeological textiles compared with modern textiles dyeing with three species of sea mollusks.



and the concentration of DBI is high (Koren 2013, 32; Michel et al. 1992, 147, Fig. 4). A similar profile is also seen in textiles no. 12 and no. 20 and thus it can be determined that they, too, were coloured with dye substance obtained from *Hexaplex trunculus*.

At the same time, analysis of Textiles nos 12 and 20 detected the presence of an additional component, Carminic acid, which is found in various species of insects (*Coccidae spp.*), which were known to the dyeing industry in antiquity. It can be determined with certainty that the source is not the Oak Kermes (*Kermes vermilio* and *K. echinatus*) that was known to be used in the Middle East region, because this kermes does not contain any Carminic acid (Wouters and Verhecken 1989, 192; Amar et al. 2005, 782). It can further be established with certainty that this is not the American Cochineal (*Dactylopius coccus*), despite the high concentration of Carminic acid in it, because this insect belongs to the New World and was originally endemic to Central and South America (Cardon 2007, 619-632). Carminic acid is the principle component found in the Armenian Cochineal (*Porphyrophora hamelii*), in contrast to the Polish Cochineal (*Porphyrophora polonica*), which also contains kermesic acid in a significant quantity (Wouters and Verhecken 1989, 193). Most of the researchers date the use of the Polish Cochineal to the 6th or 9th century CE (Forbes 1964, 102; Cardon 2007, 644), and as this is considerably later than the dating of the textiles examined here, the use of the Polish Cochineal as a dye substance in this context can be excluded.

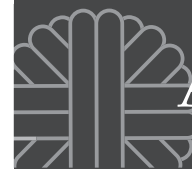
Discussion

Based on the chemical analysis that was conducted on the textiles in order to identify the dyes, it appears that the three textiles from Murabba'at were dyed with *Hexaplex trunculus* sea mollusk. One textile was dyed using *Hexaplex trunculus* and its color tends to be blue-greenish, and so it seems that during the dyeing process, the dye solution was exposed to sunlight to produce the blue color (by photodebromination of the reduced leuco-dye; Elsner and Spanier 1985) or heated after having been dyed to produce this color. The importance of this textile is extremely significant as there are practically no parallels for it in the archaeological record. As mentioned above one blue-purple textile was found in Massada but published only in conferences and press (Kraft 2011). Other textile in the Katoen Natie Collection in Belgium, have only blue fibers which produced from Murex snail (Koren 2013, 31). In burial in Pazyryk at Siberia blue textile was found (Serman and Serman 2012, 44-47). The other two textiles underwent a double dyeing process, using *Hexaplex trunculus* and Armenian Cochineal in order

to give the textile a reddish purple color. These results are interesting in light of the dye analyses conducted by Sukenik on the Judea Desert Cave textiles. Out of the 180 tests conducted on the wool textiles from the Roman Period, no other textiles contained dyes from animal sources such as sea mollusks and insects (Sukenik 2013). In all other instances the purple shade was obtained with dyes from plant sources and using the 'double-dye' technique, i.e., double dipping wool in two separate dye solutions in order to produce a new hue. First the wool was dipped in a solution of madder (*Rubia tinctorum L.*) which gave a red color, then it was dipped in an indigotin containing dye bath, based on woad (*Isatis tinctoria L.*) or the indigo plant (*Indigofera tinctoria L.*), in order to imitate the purple color at a low cost (Cardon et al. 2011, 199-200). The use of this technique, as well as the absence of true purple in the majority of textiles examined, are compatible with other sites in Israel from the Roman period (except Masada) such as En Rahel (Koren 1999), Mo'a (Sukenik et al. forthcoming), and Wadi ed-Dâliyeh (Whiting and Sugiura, 1974). A new research suggests that wearing true purple textiles was more accessible to the middle and lower classes than previously thought (Cardon et al. 2011, 197-214). From our results, it appears that true purple textiles were not commonly used in Israel of the Roman period, and the discovery of purple-dyed textiles from Wadi Murabba'at is unusual and perhaps unique.

Dyeing techniques according to literary sources

Literary sources indicate that the purple colour was not limited to one specific hue. According to Pliny the Elder, the fashion in hues of purple ranged from shades of bluish purple to reddish purple, and Pliny the Elder used different words to describe the various hues: *violacea* and *purpura* for bluish purple, and *rubra* to indicate a reddish purple colour (*Naturalis Historia* IX, 137). It seems that, in antiquity, people took advantage not only of the dye's property of changing color in response to exposure to sunlight (see above), but they also used to dip the purple fleece in additional dye solutions to give it a new and unique color. 'Double dyeing' was a common technique used in the dyeing industry to imitate prestigious dyes. With this technique it was possible to change the shade of purple obtained only from shellfish and to produce a reddish purple by dipping it a second time in a red solution produced from the madder plant (*Rubia tinctorum L.*) or from the Coccid scale insect (*Coccidae spp.*). The technique required great skill and precision and was carried out by professional craftspeople who were expert in the art of dyeing, which most likely made the cost of the finished garment higher.



Pliny the Elder mentions two different colors produced by the double dyeing technique and each was given a different name. Tyrian purple, whose color resembled wine or clotted blood (*Naturalis Historia* IX, 135), was the most prestigious of these dyes. According to Pliny's description, Tyrian purple was made by using two species of muricid mollusks, and it cost ten times as much as a textile dyed with only one species (*Naturalis Historia* IX, 137). The other dye of similar color was called *Hyssine* and was obtained by using the shellfish and various insects dyes (*Naturalis Historia* IX, 141).

Shellfish Purple and Insect Dyes

Using insects as a source for the high-status scarlet dye was known from earlier times, and it is accepted that this is the color referred to in Jewish sources as 'Tola'at sha-hani' (Amar et al. 2005), which appears in the Bible many times along with 'Argaman' (e.g.: Exodus 36: 35). The dye is produced from several types of scale insects (*Coccidae spp.*), which live as parasites on various plants. The dye is collected from the body of the females and the eggs they contain. They must be harvested within a short period lasting less than a month and requires skill and experience. The Armenian Cochineal (*Porphyrophora hamelii*) is not native to Israel but is found on the roots of grass plants (*Gramineae*) in the Mountains of Ararat in Turkey and Armenia (Donkin 1977, 849-853; Cardon 2007, 646-652). The difficulty in identifying the insects on the plants and the short period of time during which it must be harvested, in addition to the beautiful red hue produced by it, made this dye one of the most sought after of the red dyes, and Pliny listed it among the three most important dyes in the industry (*Naturalis Historia* XXI, 45-46).

Reddish purple colors obtained by using the 'double dyeing' technique is known in a number of other textiles dated to the Roman Period. Pfister who examined the Palmyra textiles found textiles which were double dyed with murex and an insect dye which he identified as Persian Cochineal (*Cochinille de Perse*; Pfister 1934, nos. T.18, T.19). In an additional report published in 1940, Pfister re-identified the dye as Polish Cochineal (Pfister 1940). The re-examination of the textiles established that the insect dye was in fact Armenian Cochineal (Böhmer and Karadag 2003, 92). Furthermore, at the Maximianon site in eastern Egypt a textile was found dated to the Roman Period, which was dyed with Kermes and *Hexaplex trunculus* (Wouters et al. 2008, 13, textile no. 95.33039.9) and two other textiles came from Didymoi – another Roman fortresses on the road to Berenike (Cardon et al. 2011, 202-203). It may be assumed that this technique of dyeing was used widely for apparel worn by the

upper classes and indicates the popularity of the reddish purple shade.

Textile Origin

Based on the identification of the dyes, it may be suggested that Textile No. 12 and Textile No. 20 from Murabba'at are imported textiles. That is because they were dyed with the Armenian Cochineal, an insect that was not prevalent in the southern Levant. Furthermore, this premise is consistent with the technical aspect of the textile, since both warp and weft are z-spun, a manner of spinning that is very rare in Israel and Egypt. An examination of thousands of textiles throughout this region that was carried out by Shamir revealed that most of the textiles from the Roman period are s-spun and the few that are z-spun in both warp and weft are considered to be imported (Shamir 2006, 210-212). The high-quality weave, the fineness of the textile in addition to the dyeing technique used suggest that both textiles were imports. On the other hand, we believe that Textile no. 22 was probably locally made, because the warp and the weft threads are s-spun, which is typical of the southern Levant. Furthermore, the textile is crude (the weft threads are very thick). Moreover, it was dyed only with *Hexaplex trunculus* which is common in the Mediterranean Sea.

It is difficult to determine the identity of the owners of these luxury textiles and how the later found their way to the Murabba'at Caves in the Judean Desert. However, several suggestions may be cautiously proposed:

1) The textiles were the property of the refugees from the Bar Kokhba Revolt even before they reached the Murabba'at Caves, while they were still living a life of affluence and enjoying the benefits of foreign trade. According to Eshel and Amit (1998, 14), the refugees who reached the caves included the commanders and leaders of the administrative and military center of the revolt and therefore they probably owned valuable property, including imported textiles. Similarly, luxury items such as glass utensils and metal appliances were found in the Cave of Letters (Yadin 1963, 42-110).

2) The textiles represent part of the spoils that the rebels took during the Bar Kokhba Revolt and so do not necessarily attest to the economic status of the cave inhabitants.

3) In our opinion, the most probable explanation is that the textiles may not have belonged to the same group of refugees who sought shelter in the caves, but were the property of a military unit that was stationed in the Murabba'at Caves after the Bar Kokhba Revolt. According to the excavation team, finds indicate that a small Roman military unit was deployed in the caves



after the suppression of the Bar Kokhba Revolt (this is unlike the case of the Cave of the Letters, in which no evidence was found of the presence of a Roman military unit). This is based primarily on the documents found on the site that are attributed to the soldiers who served in the 10th Legion (Benoit 1961, 240-243; Popvić 2012, 558). In a number of wall-paintings that were found in various locations such as Brigetio in Hungary and Dura Europos in Syria, and are attributed to Roman military units, figures depicted wear tunics which are decorated with a reddish purple *clavi* (Sumner 2009, 137-138; Pászttókai-Szeőke and Paetz gen. Schieck, in press). Similarly, at the Maximianon site and Didymoi in Eastern Egypt, which served as a military fortresses for protecting the roads (Wouters et al. 2008, 1; Cardon et al. 2011), purple textiles were found, the dyeing process of which is similar to that of the textiles discussed here. Accordingly, it is possible that senior officers had the resources to purchase such valuable clothing (Sumner 2009, 116). We note that the textiles found in the Cave of Letters did not include textiles that had been dyed with true purple (Abrahams and Edelstein 1963, 270-279; Sukenik 2013, 232-234, who inspected 126 textiles from the Cave of Letters). It is possible that this is due to the presence of the military unit at Murabba'at caves.

Conclusion

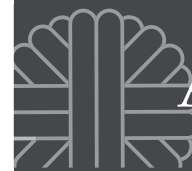
Yadin, referring to the report on the textiles in the Murabba'at Caves published by Crowfoot and Crowfoot, commented: "Only one important factor – in our opinion – was neglected: the dyes were not analyzed" (Yadin 1963, 170, note 10). In the present study, an attempt was made to complete the task, and the results of the dye analyses on the textiles of the Murabba'at Caves expand our understanding of the purple dye use. It appears that this discovery from the Murabba'at Caves is indicative of the influence of Roman culture on the local population in the southern Levant. These precious textiles symbolize the economic and social status of the upper class and were eagerly sought after by people from various social strata at that time. Apparently, evidence of what Pliny the Elder called *purpurae insania* (*Historia Naturalis* IX, 127) or "the mad lust for purple" survived not only in his writings but is also reflected in the archaeological finds.

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Authors:

Naama Sukenik: naamas@israntique.org.il
 David Iluz: iluzda@gmail.com
 Orit Shamir: orit@israntique.org.il
 Alexander Varvak: Alexander.Varvak@mail.biu.ac.il
 Zohar Amar: amarzoh@gmail.com



Beatrix Nutz and Claudia Ottino

Weaving Pictures

15th Century Tapestry Production at Lengberg Castle

Abstract

This article, based on finds made during an archaeological investigation carried out at Lengberg Castle, East-Tyrol, explores the possibility of small scale tapestry production at castles of the minor nobility in the medieval period. Seven finds could be identified as textile tools, two of which were used for weaving. A tapestry bobbin and a pin beater suggest tapestry production. This article introduces the technique of tapestry and the use of a tapestry bobbin. It describes the tapestry bobbin and pin beater from Lengberg in detail, together with the results of the botanical analyses. Comparable finds from Great Britain and Denmark are considered and the proper function of a bobbin is examined. The extent to which tapestry production took place at Lengberg is discussed, who could have been employed in it, and what the results of this study signify with respect to possible tapestry production at other small castles in Europe.

Key words: tapestry bobbin, pin beater, tapestry production, 15th century, Lengberg Castle

Weaving Pictures

„...Arachne was the first person to create the arts of dyeing wool in different colours and of producing what we would call fine tapestries from weaving pictures on cloth to make them look like paintings.“ Christine de Pizan, *The Book of the City of Ladies*, 1405, Chapter 39 (Pizan and Brown-Grant 1999, 73).

During research at Lengberg Castle in 2008, a filled vault was detected below floorboards in a room on the second floor of the south wing of the castle. The filling included dry material in various layers. The building history, according to notes in the itinerary of Paolo Santonino 1485 CE (Egger 1947, 34-35), as well as investigations on construction techniques and the archaeological feature, suggested a dating of the finds to the 15th century. This date has now been confirmed by five radiocarbon-dates from fibre samples done by the ETH-Zürich. It may be assumed that the cache was filled with waste during the addition of the second storey, as insulation or to level the floor.

Besides more than 2700 textile fragments, such as pieces of linen underwear, shirts, dress linings with remnants of the outer woollen layer, fragments of woollen trousers and various silk fabrics (Nutz and Stadler 2012, 79), several tools for textile production were discovered among the discarded goods. The tools consist of five wooden spindle shafts together with two lead spindle whorls and an object that turned out to be a tapestry bobbin (in German *Fliete*). Together with a possible wooden pin beater it provides evidence of 15th century tapestry production at Lengberg and offers the rare opportunity to study medieval weaving tools of organic matter, as wood is seldom preserved.

How to use a tapestry bobbin

Although the term tapestry has been used to describe any pictorial weaving and even needlework such as the Bayeux Tapestry, it is, strictly speaking, a weft-faced plain weave with discontinuous wefts. It can be woven on both a horizontal or low-warp loom and a vertical or high-warp loom. In European tapestry manufacture of these are known as *basse lisse* and *haute lisse* (Harris 2010, 24-26). Tapestry bobbins used on a

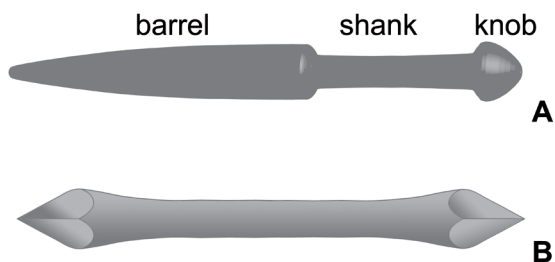


Fig. 1.

A: Outline of a tapestry bobbin (*broche*) with tapered barrel, shank and knob.

B: Outline of a *flûte* with diamond shaped ends.

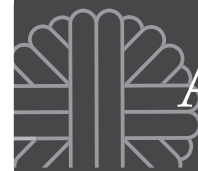
(© Institute of Archaeologies, University of Innsbruck).

vertical loom are also called *broche* (French = brooch, pin, spindle), whereas bobbins for a horizontal loom are called *flûtes* (Müntz 1885, 358 and 363; Göbel 1923, 6 and 11). Tapestry bobbins or *broche* have a tapered barrel, a knob shaped end sometimes also slightly tapered, and a rebated section (shank) in between (Fig. 1, A) onto which the weft threads are wound. *Flûtes* are spindles with two diamond shaped ends (Fig. 1, B), the flattened ends preventing them from rolling away when laid down (Todd-Hooker 2011, 17).

In tapestry weaving, many wefts are used at the same time to weave the design and bobbins are used like shuttles holding the differently coloured weft yarns (Fig. 2). A weft yarn of a particular colour only crosses the warp where it is needed for the design.



Fig. 2. Modern tapestry with multiple tapestry bobbins in progress
(Photo: Kathe Todd-Hooker, Albany / Oregon).



When winding thread onto the shank it should not be overfilled (exceed the width of the barrel or ends) as this may cause rounds of weft to be dragged off due to friction when passing through the shed. When working on a vertical loom the tapestry bobbin is passed knob first through the open shed in order to prevent the longer tapered end becoming tangled in the warp threads (Fig. 3) and the side and tip of the pointed end are then used to pack or scrape down the weft (Fig. 4) before it is beaten down with the beater (Göbel 1923, 7). The tip should not be used for beating since it might get caught in the weft or break, as it might also do when used to adjust weft and warp. This is where pin beaters come into use. If the tip of a bobbin does break or splinter a small knife may be used to sharpen the point again (Todd-Hooker 2011, 30-31 and 37-38).

The tapestry bobbin and pin beater from Lengberg

The tapestry bobbin from Lengberg Castle (Fig. 5) with a length of 14.2 cm, a maximum diameter of 1.1 cm and a weight of 2.32 g has been carved from beech wood. The width at the tip of the barrel measures 0.2 cm. The pin beater (Fig. 6), with a length of 16.6

cm, a maximum width of 2.2 cm at the handle and a weight of 13.08 g, has been carved from birch wood. With a diameter of 0.5 cm its tip is much sturdier than the tip of the tapestry bobbin and therefore less likely to break when used to beat down the weft. On both tapestry bobbin and pin beater distinct tool marks can still be seen.

The tapestry bobbin from Lengberg can be compared to modern turned bobbins. Its shape is very similar and offers no difficulties in identifying this object as soon as one knows what to look out for (Fig. 8).

Based on finds of pin beaters from other sites and from medieval pictorial sources, pin beaters are considered to have been used on vertical looms from the late 9th century. These pin beaters look slightly different from the one from Lengberg as they are made from bone or antler, cigar-shaped with two working ends or a flatter form with only one working end (Rogers 1997, 1755). They do not have a handle like the wooden pin beater from Tyrol. The reason why bone and antler pin beaters have more often been found can be explained by the small number of finds of organic material such as wood. The lack of a handle can be explained by bone and antler being harder to work.



Fig. 3. Bobbin passed knob first through open shed (Photo: Kathe Todd-Hooker, Albany / Oregon).



Fig. 4. Using the edge and tip of the pointed end to pack down the weft (Photo: Kathe Todd-Hooker, Albany / Oregon).



Fig. 5. Wooden tapestry bobbin from Lengberg Castle, East Tyrol (© Institute of Archaeologies, University of Innsbruck).



Fig. 6. Wooden pin beater from Lengberg Castle, East Tyrol (© Institute of Archaeologies, University of Innsbruck).



Fig. 7. Tapestry bobbin from Coppergate / York, 6651 (© Penelope Walton Rogers).

It is unlikely that the pin beater from Lengberg would have been used on a regular vertical loom for the production of plain cloth, as by the 15th century CE the vertical loom had been replaced by the treadle loom throughout most of Europe. Using a pin beater while working on a treadle loom seems impractical, thus making this tool redundant. Only on a vertical tapestry loom would it still be of use.

Botanical analysis

In order to determine the kind of wood used for the textile production tools from Lengberg Castle, seven objects were chosen for botanical analysis. Five of these were identified as spindle shafts (Find nos. 605, 628, 405, 697 and 622), one as pin beater (Find no. 150, Fig. 6) and one as tapestry bobbin (Find no. 629, Fig. 5).

Due to the centuries of storage in a permanently dry environment, the preservation of the wood was very good, apart from small cell contusions and disruptions. This provided perfect conditions for wood sampling and identification of the species.

Botanical samples were taken from six of the seven objects at already existing fractures. To identify the anatomical patterns, thin cell layers of tangential, radial and cross-sections were extracted with a razor blade. The analysis of the anatomy was carried out using an optical microscope (Olympus BH2) and referring to standard literature (Grosser 1977; Schweingruber 1990; Schoch et al. 2004).

Because of its rarity, a non-invasive method was chosen for the tapestry bobbin. To analyse the superficial visible microscopic characteristics, a reflected-light microscope (Zeiss Axioskop) was used. Together with the macroscopic appearance, e.g. colour, wood anatomy visible to the naked eye, texture, etc., the most likely species was determined with some uncertainty. Deciduous wood characteristics were made visible by staining the samples with phloroglucinol and hydrochloric acid following the method of Biebl and Germ (Biebl and Germ 1950).

Find no.	Artefact	Wood species
150	pin beater	<i>Betula sp.</i>
		Birch
629	tapestry bobbin	<i>Fagus sp. cf.</i>
		Beech

Table 1. Results of the botanical analyses from Lengberg Castle, East Tirol. Analyses by Claudia Ottino.

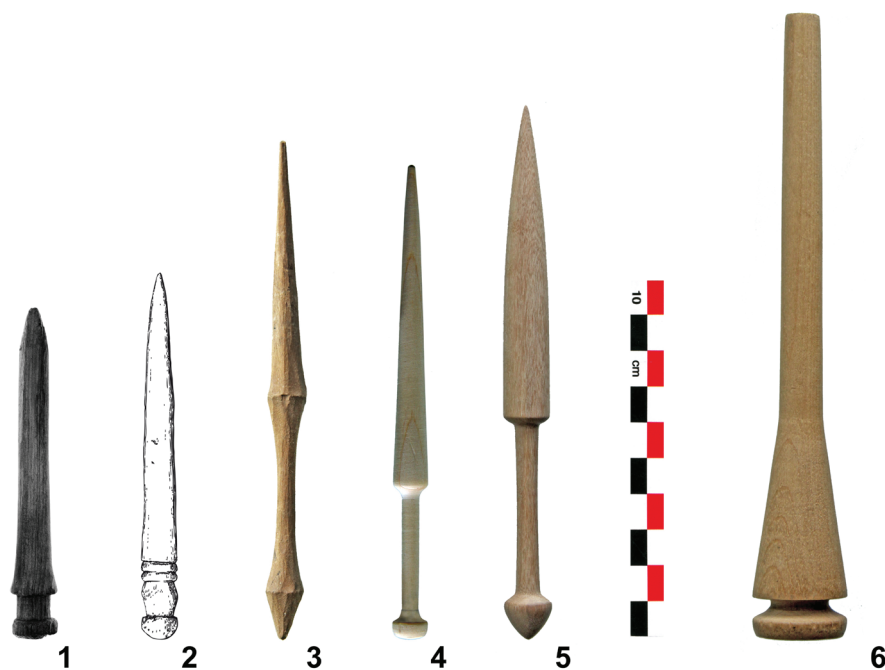
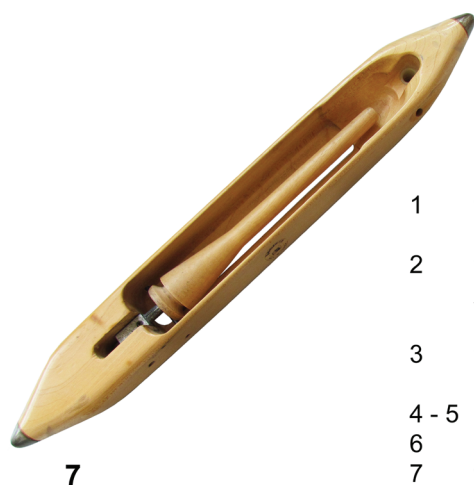


Fig. 8. Medieval and modern tapestry bobbins and pirns (No. 1 © Penelope Walton Rogers, No. 2 redrawn after Hellmuth Andersen 1971, p. 111. No. 3 © Institute for Archaeologies, University of Innsbruck).



- 1 tapestry bobbin from Coppergate / York period 5B, c. 975 - early/mid 11th century
- 2 tapestry bobbin? made of antler Århus Sønder vold early 13th - early 14th century
- 3 tapestry bobbin from Lengberg Castle, East-Tyrol, 15th century
- 4 - 5 modern tapestry bobbins
- 6 modern pirn for flying shuttle
- 7 flying shuttle with inserted pirn

Four of the five spindles were carved, or turned, out of softwood such as larch (*Larix/Picea*-Type) and spruce (*Picea/Larix*-Type) and one from a hardwood identified as lime (*Tilia* sp.). The two weaving tools were carved out of the hardwoods birch and beech (Table 1). As the pin beater and the tapestry bobbin would be under greater strain when used than a spindle shaft it seems prudent to fashion them from sturdier woods.

Medieval tapestry bobbins from York and Århus

Only two comparable examples of (possible) tapestry bobbins from the Middle Ages have been identified to date. At Coppergate, York, a wooden peg-like object, 9.4 cm long, dated to c. 975 – early-/mid-11th century CE was identified by Carole A. Morris as a

tapestry bobbin (Fig. 7). The rebated part here is much smaller than on the one from Lengberg, therefore it was thought that the weft yarn also might have been wrapped around the barrel (Rogers 1997, 1761). If this was the case it would cause the same problems as an overfilled shank and the work would have to proceed very carefully to prevent the weft yarn getting tangled in the warp. A textile tool of very similar shape as the bobbin from York is a pirn onto which the weft thread is wound for use in weaving, too. Modern pirns are made of wood or plastic, slightly tapered for most of their length and the thread is delivered off the end of the pirn rather than from the centre (Fig. 8, No. 6). In contrast to a bobbin it is fixed over a pin inside an end delivery or flying shuttle (Fig. 8, No. 7) and the



surrounding shuttle protects the weft from friction. Although the tapestry bobbin from Coppergate was certainly not used inside a shuttle, the consistency of this tool shape throughout the centuries is remarkable. An object made from antler found during an excavation in Århus, Denmark, in 1963/1964 and described as needle without needle eye with a length of 11.2 cm (Hellmuth Andersen et al. 1971, 111) might also have been used as tapestry bobbin (Rogers 1997, 1761) although the rebated section is very slight (Fig. 8, No. 2). The needle has been found in a layer dating from the beginning of the 13th to the early 14th century CE. Other possible applications for this needle would be as pin beater or as parchment pricker, although the required metal tip for a pricker is missing. Parchment prickers were used by medieval scribes to pierce small holes on either side of a parchment in order to control the spacing of the horizontal lines drawn on the pages to guide the hand of the scribe (MacGregor 1985, 123-125).

The dawn of European tapestry

Even though written documents mention decorative pictorial wall hangings, little is known of early medieval tapestries. From the 9th century CE inventories from minsters and episcopal churches list *tapetia*, (Zentralinstitut für Kunstgeschichte 1967) and monasteries employed *tapetarii* or *tapeziarii* (Heinz 1963, 29), but the terms may also be applied to embroidered or brocaded pictorial textiles like the above mentioned Bayeux Tapestry and the 'tapestry' from the Oseberg ship. There is a written record dating to c. 985 CE stating that Abbot Robert of the monastery of Saint-Florent de Saumur¹ "acquired or gave commissions for a quantity of dossers², cushions, curtains, carpets, and wall hangings, all of wool. He had two grand pieces of tapestry executed, in the manufacture of which silk was introduced. ... That these various fabrics were woven, not embroidered, the word *texere* [= weave] places beyond doubt" as Eugène Müntz wrote in his "Short History of Tapestry" (Müntz 1885, 68-69). But woven can also mean brocaded.

The use of the vague word *tapetia* in written records can be found throughout the centuries and is not limited to earlier times. Some sources are more nondescript than others. In a charter (c. 888 CE) of the Holy Roman Empress Richardis items from a donation of her husband Charles III to the Benedictine nunnery in Andlau, Germany, are listed, amongst them *tapetiis*. An inventory of donated manuscripts and implements from the parish church St. Pauls in Eppan near Bozen in South Tyrol lists one *tepetum* in 1241 CE. Both records do not offer any further descriptions (Zentralinstitut für Kunstgeschichte 1967, 13 and 119).

More information is provided by the instructions for various liturgical ceremonies dating to about 1105-1246 CE from the cathedral in Metz, France: "*A sancto Michaeli infra debet pendere illud tapetum magnum, quod dependet infimum ante chorum in quadragesima. Supra sanctum Michaelem vero debet esse tria tapeta de sancto Arnulfo, in medio quorum est depicta ymago Sapientie*" (The large *tapetum*, which hangs in front of the lowest chancel during the fasting period, should be hung under St. Michael. Three *tapeta* of St. Arnulf should be hung above St. Michael, the one depicting the image of Sapientia [the personification of wisdom] in the middle) (Zentralinstitut für Kunstgeschichte 1967, 139). Another more detailed source is a report the former Archbishop of Mainz, Christian II (1249-1251), wrote in 1253 CE on the furnishings and treasures of the cathedral in Mainz: "*Erant tapecia et dorsalia mira picture varietate distincta, que operis sublimate et pulchritudine animos intuencium admiratione mirabili delectabant*" (There were *tapetia* and *dorsalia* decorated with a wonderful variety of pictures, that amazed the souls of the onlookers because of the grandeur and beauty of the work) (Zentralinstitut für Kunstgeschichte 1967, 52). *Dorsalia* (or *pallia dorsalia*) may be freely translated to "back sheets". They served as covers on the walls of the choir and especially behind the stalls of the clergy (Bock 1871, 192-197). Both descriptions, the one from Andlau and the one from Mainz, make it evident that those hangings were pictorial, but again do not provide us with information as to the applied textile technique.

These records suggest that the earliest and main client may have been the clergy, although the *tapetiis* donated to Andlau by Charles III might have been used for secular purposes by the Emperor prior to their endowment. Monasteries and bishops used the tapestries as wall hangings in collegiate churches and cathedrals, where they served both as decoration and instructive elements for worshippers. Workshops were based in both monasteries and nunneries (Egg 1964, 1).

The earliest surviving example of genuine tapestry (= weft-faced plain weave with discontinuous wefts) in western Europe, dating to the 11th century, is the Cloth of Saint Gereon, Cologne, which has a repeating pattern of a bull being attacked by a griffin. Fragments of the tapestry are now at the Germanisches Nationalmuseum, Nuremberg, the Victoria and Albert Museum in London and the Musée des Tissus, Lyon (Wilckens 1991, 260 and 262). The earliest preserved large-scale pictorial tapestry of West-European origin is the Abraham and the Archangel Michael tapestry in the cathedral of Halberstadt, Germany. It has a length of 1026 cm and is dated to c. 1150 CE. An indication of

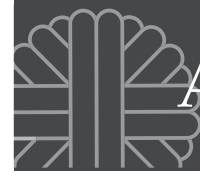


Fig. 9. Two Dominican nuns working on a tapestry loom. Detail from the lower border of a Passion tapestry, c. 1490/1500 (© Diocesan Museum Bamberg).



Fig. 10. Nun at a tapestry loom. Detail from the tapestry "The Adoration of the Magi", c. 1490/1500 (© Bavarian National Museum, Inv. No. T 3803).



Fig. 11. Noble lady in a castle weaving on a tapestry loom. Book illustration from "De Lof der Vrouwen", a Dutch version of the Cité des Dames of Christine de Pisan, written in 1475 at the desire of Jan de Baenst Riddere Heere van Sint Joris (© The British Library Board, Add. 20698, f. 90).



earlier tapestry production is provided by the tapestry bobbin found in York but to what extent it flourished cannot be determined.

For the following century little is known of European tapestry production. There are some knotted carpets, for example the section of the Marriage of Mercury and Philology in Quedlinburg (Wilckens 1991, 266-267), made c. 1200 CE, suggesting contemporary tapestry, but with the exception of a fragment from Norway³, no examples from the 11th to 13th century appear to have survived.

From the beginning of the 14th century urban craftsmen adopted tapestry production and archival records provide evidence that tapestries were woven in Arras and Paris on a small industrial scale that extended rapidly after 1350. From then on large scale tapestry production spread across Europe and account records show that members of the French and Burgundian nobility sometimes spent huge sums on this art (Campbell 2010, 188). However, the production of tapestries in monasteries and nunneries did not cease. There is evidence for some tapestries woven by Dominican nuns in Bamberg in the late 15th century. The nuns marked their products by weaving small depictions of themselves working at vertical looms into the tapestries (Figs 9-10).

Simple, small-scale figurative tapestries were produced by workshops throughout the middle ages and well into the 16th century along the Rhine and in the Swiss cantons (Campbell 2002). Clients, owners and donors, also of large tapestries, were not only members of the nobility but also wealthy citizens. In 1453 Margarete Brand, daughter of the shoemaker Thomas Brand from Basel and widow of the merchant Peter Geisler called Lostorf, employed the *Heidnischwerkerin*⁴ Berbelin Langenstein, who mainly worked for home and personal requirements of her mistress but also produced tapestries that were sold to the nunnery Klingental in Basel. Shortly before her death in January 1474 Margarete Brand commissioned the rather large (97 x 219 cm) wall hanging "*Verkündigung, Kreuzigung und noli mi tangere*" (annunciation, crucifixion and *noli mi tangere*) (Rapp Buri and Stucky-Schürer 1993, 88-89).

Even the elite circle of monarchs, princes, dukes, and the highest ecclesiastic echelons prized not only monumental but also small tapestries with devotional subject matter. These tapestries, often less than two meters square in size and of refined workmanship, were used as lectern covers or as frontals or dossals suspended from altars. Less than a meter in height or width these pieces could be executed at small looms by only one weaver (Cleland 2009).

Tapestry production at Lengberg Castle

Given the widespread growth in European tapestry production, it is surprising that no significant manufacture is known to have taken place in Tyrol or other Austrian counties. Surviving 15th century tapestries from Tyrolean castles and monasteries originate mainly from Switzerland or Germany. For example, six tapestries now in the monastery of Muri-Gries in Bolzano, South-Tyrol, come from the monastery Muri in Canton Aargau (Rapp Buri and Stucky-Schürer 1993, 11). From c. 1500 German tapestry production was absorbed by manufacturers in Belgium and the Netherlands and their costly tapestries also were bought by the Austrian nobility, first and foremost by Emperor Maximilian I (Egg 1964, 3). A letter from the Raitkammer (account chamber) in Innsbruck to Jörg and Leo von Niedertor, issued March 8, 1503, instructs the two noblemen to make inquiries as to the cost of some golden and other precious tapestry bought in Brussels by Sigmund von Niedertor and to report to the chamber (*Regesta Imperii*, RI XIV, 4, 2 n. 20297). Even as late as 1671 there is no mention of valuable Austrian tapestry in the sumptuary law of Emperor Leopold I, Archduke of Austria, but only "*Niderländisch- oder andere Aufsländische theure Teppich*"⁵ which are prohibited and the "*geringeren Tappekeren, der gemeinen Türkischen und andern dergleichen Teppich*"⁶ which are permitted for members of the lower classes (Guarient und Raall 1704, 155).

What does this lack of evidence of tapestry production on a large scale and of superior quality in Austria signify for Lengberg? Primarily that tapestry production at the castle only would have been undertaken on small scale, probably for home requirements. Christine de Pizan, in her 1405 book "*Le Trésor de la Cité des Dames*", gave advice for proper tasks and behaviour for women of various social classes:

"Which explains how ladies and demoiselles who live on their lands should conduct themselves with respect to their households. She, her daughters, and attendants will make cloth, separating the wool, sorting it out, and putting the fine strands aside to make cloth for her husband and herself or to sell. The thick strands will be used for the small children, her servingwomen, and the workmen. She will stuff bedcovers with the large balls of wool. And she will have hemp grown by the farmers. During the long winter evenings, her maids will work and spin it into coarse linen. Many more such tasks as these would take too long to describe here." (Pizan et al. 1989, 170-173).



Although Christine Pizan does not explicitly mention tapestry in these lines it is clear that she thought that textile production in general befitted the rank of women of the minor nobility.

That textiles were produced on some level at Lengberg is evident from the spindles found in the cache and it may be assumed that the spun yarn was consequently woven into cloth. Was tapestry weaving done as a mere pastime by the lady of the castle, or extended to serve the needs for decorative wall hangings, cushions and the like not only for the castle but for the surrounding area as well? Maybe it was not even the female members of the household who worked on the tapestries or any permanent residents but a hired foreign, male *tapessier* who left some of his tools behind as he went to seek employment elsewhere after the termination of his contract. At least at the royal court the employment of foreign craftsmen was common practice in Tyrol by the end of the 15th and beginning of the 16th century. For example, Lienhart Straßpurger was appointed *tapessier* by the Royal Chamber in 1500 in order to look after the tapestries stored in Innsbruck (*Regesta Imperii*, RI XIV,3,1 n. 10413). Jean Feron was *tapessier* from 1498 to 1523 and Mahu (or Mahus) from Antwerp is mentioned as royal *tapessier* from 1500 to 1517 (Egg 1964, 3). But this was the royal court in Innsbruck. What about tapestries in Tyrolean castles of the minor nobility like Lengberg or even in houses of wealthy commoners?

To the possible use of lower quality tapestries for members of the minor nobility or wealthy citizens: In household inventories and estate accounts from 15th century Tyrol listings of *tebich* (modern German: *Teppich* = carpet) or *gewurkt* or *geworcht tuch* (modern German: *gewirktes Tuch* = tapestry woven cloth⁷) can be found.

In the estate account of Hans von Werberg (also: Wehrburg, a castle in South Tyrol) from the year 1420 it lists: "34: *ain seydein kúzz vnd ain ander kúzz, ain gewurkt tuch vber ain kúzz*" (34: a silk cushion and another cushion, a [tapestry?] woven cloth over a cushion (Zingerle 1909, 173). The silk cushion mentioned together with the cloth to cover another cushion could mean that this cloth was of a more expensive nature, too, and therefore a piece of tapestry. On the other hand the word *geworcht* appears several times in the inventory of Antoni Hertl, an *Amtmann* (bailiff) of Bozen in South Tyrol. "132: *ain geworcht pancktuch*. 133: *vier gross, geworcht, neu vnterzogen decken*. 149: *ain geworchte, gute decken*. 185: *ain geworcht pancktüch für ain pett*. 216: *zwo geworcht golterdecken*"⁸ (= 132: a woven cloth for a bench. 133: four big, woven, new lined blankets. 149: a woven, good blanket. 185: a woven bench-cloth for a bed. 216: two woven quilts). It seems

unlikely that, although being a bailiff and therefore either a member of the nobility, a cleric or a member of the wealthy classes amongst the citizenship, Antoni Hertl would have owned that many tapestries even if they were of the poorest quality or that they would have been used as blankets. In addition here the word *geworcht* is also applied to quilts which would most certainly not be made from tapestries. This means that here the word was used in a different sense and probably just meant "woven" without any further connotations to a distinct technique. Unfortunately it might apply to all the records where the word "*gewurkt*" is used.

The word *tebich*, in other German sources also called *tappe* or *dappet*, is just as problematic, as it can be applied to any fabric hanging on a wall or spread on floors, tables, over chests, benches or beds (Zander-Seidel 1990, 369). To complicate matters the word *Teppich* (carpet) does not refer to any specific textile technique but can be applied to embroidered or brocaded cloth, tapestry or knotted pile fabrics. However, it is noteworthy that in Tyrolean inventories and estate accounts from the 15th century *tebich* only seem to be listed as furnishings belonging to members of the nobility or clergy. In the estate account of Count Johann Meinhard von Görz (* 1378/1380; † 22 Mai 1430) "*i kisten dar inn tebich sind*" (one chest in which are carpets) is listed as item number 24 of his possessions, unfortunately without any further explanation or description (Zingerle 1909, 205). As part of the inventory of Segonzano Castle in the Trentino in the year 1459 only "*ain tebich*" (one carpet) is mentioned laconically as item number 18 by Heinrich Anich (Zingerle 1909, 39-40).

The estate account of Georg Hak, the Bishop of Trent, from 1465 CE at least reveals a little bit more about the use of *tebich*: "84: *ii tebich oben in dem gemach*. 85: *darnach ain grossen tebich, den man praucht vor dem altar*. 86. *Item ain franzosys, groß tuech*" (84: two carpets in the upper chamber. 85: then a large carpet that is needed for the altar. 86: and a big French cloth) (Zingerle 1909, 197). Considering the extensive tapestry production in France maybe the French cloth is rather meant to be a tapestry? The carpet however seems to have been spread out over the altar - in this case the medieval German "*vor dem*" is probably to be translated with "for the" - and not hung in front of the altar as it would be if the "*vor dem*" was taken literally (= in front of) in the modern sense. Another carpet used in the chapel of Thaur Castle near Innsbruck in North Tyrol listed in a 1488 inventory supports the notion of the carpet spread over (*über ain*) the altar: "147: *Ain tebich über ain altar vnd sunst leuchter vnd glogken, was zu ainer cappellen gehort*" (147: a carpet over an altar and else



candleholders and bells, what belongs to a chapel) (Zingerle 1909, 140). Pictorial weavings for those carpets therefore seem unlikely as no one would see the image unless they stood right in front of the altar. In-depth descriptions that help identify the exact nature of a fabric are almost non-existent as listings were mostly kept to the absolute minimum of information and the meanings of some old common names elude us today. The prices of those *tebich* are rarely indicated and origin or manufacturer for the most part never mentioned.

Even the more descriptive entry "*schoner grosser teppich mit pildern*" (beautiful, big carpet with pictures) worth 12 gulden from the estate account of Matthias Löffelholz (+ 1547) from Nuremberg does not mention the type of fabric in regard to the applied technique (Zander-Seidel 1990, 355). We can assume that it is a tapestry but pictures can also be achieved otherwise, again providing the possibility of embroidery, brocading, knotted pile or even painting. Records from late 15th and 16th century Italy like the guide to the city of Venice by Francesco Sansovino in 1581 show that at least the homes of wealthy citizens were decorated with tapestries, mostly imported from the Low Countries. With these imports we can be certain these were indeed tapestries with weft-faced plain weave and discontinuous weft. In the *portego* (reception room) the walls were hung with tapestries and hangings of brocade and damask for special occasions 'according to the season' (Fortini Brown 2006, 52-55). For warmth, tapestries also were hung in bedrooms and the 1496 inventory of Francesco di Angelo Gaddi, a Florentine politician, lists three tapestries worth 12 florins for this room (Currie 2006, 346).

However, according to Venetian archives, carpets from the Middle East were imported from the 13th century constituting one of the Republic's biggest yearly expenses (Contadini 2006, 315). Carpets can be of the knotted variety (pile fabrics) or kilim (tapestry woven). Renaissance paintings depict them being used as chest covers, hung from windowsills and even as tablecloths and surviving pieces are mostly knotted. This suggests that at least some of the *tebich* mentioned in German sources could have been of oriental origin and woollen knotted pile carpets rather than tapestry.

To date there seem to be no surviving medieval household accounts or inventories of Lengberg Castle to provide us with information on the furnishing of this estate but based on the find of the bobbin there must have been at least some tapestry. So far the only known record is the travel diary of Paolo Santonino who briefly describes the construction of the castle after its remodelling in the late 15th century but has

even fewer words for its interior: "The internal layout is exquisite, and on the lower and upper floor there are beautiful living rooms, prepared for summer and winter" (translation from: Egger 1947, 37). Considering Paolo Santonino went to great lengths in describing the two meals served at Lengberg during his visit, listing each course and how it tasted, one can only wish he would have been as meticulous with the interior of the castle.

The reconstruction was commissioned when Virgil von Graben became Burggraf (burggrave)⁹ at Lengberg in the name of the Archbishop of Salzburg in 1480. He had the old castle "Veste Lengenberch" remodelled into a new representative *palais* by adding another storey. The Burggraf might have initiated the production of tapestries in order to decorate the newly established rooms. But as both the tapestry bobbin and the pin beater were found below the floor of the new top level of the castle, where they are believed to have been dumped during reconstruction, they probably predate the remodelling and were discarded before the newly constructed rooms needed furnishing.

Ultimately the problem of who made the tapestries and when at Lengberg can only be solved if further evidence is found, such as written records (e.g. a book of household accounts) that tell us if wages were paid for tapestry weaving or profits earned by the sale of the product. We cannot even guess the amount of money spent or earned at Lengberg because prices for tapestry vary depending on region of origin, period and quality as records show. The prelate of the Bishop of Basel Johann von Venningen (1418- 1478) paid "7 gulden für drü heidesch tappeten koufft zu Regensburg" (seven gulden for three pagan carpets bought in Regensburg) in 1471 (Göbel 1934, 17), whereas the gold-beater Georg Palm, who died 1547 in Nuremberg, left two "*Debich an der Wand*" (carpets on the wall) with the modest appraisal value of one-quarter to one and a half gulden compared to the prize of 12 gulden for the "*teppich mit pildern*" of Matthias Löffelholz who died the same year (Zander-Seidel 1990, 355). Wages were paid either per finished piece for contract work done by autonomous weavers, or depending on the period of employment. In an account from 1563 "Allexannder Tapeciermaister" receives a yearly payment of 180 gulden and his apprentice 25 gulden from the *Hofzahlamt* (royal account office) in Munich, while the independent weaver Hans Gräfinger is paid eight gulden and four kreutzer ("*Gräfinger tebichmacher vmh arbeit 8 fl. 4 kr*") probably for one tapestry (Göbel 1933, 200).

So until further notice for Lengberg, let us cling to the, admittedly, romantic image of the lady sitting at her loom, working leisurely on the tapestry as befits one



of her noble status. There is even no need for much imagination. A book illustration from “De Lof der Vrouwen”, a Dutch version of the *Cité des Dames* of Christine de Pisan, written in 1475, depicts a lady sitting in front of a vertical loom in what is clearly a room in a castle (Fig. 11). At her feet are placed two baskets containing balls of coloured yarns. In her left hand she holds what might be either a tapestry bobbin or a pin beater made of wood, as suggested by the brown colour. Looking at the loom one can see that the artist even painted the discontinuous weft of tapestry correctly, as the last worked row does not run in a straight line.

Conclusion

Despite the great number of textile fragments found in the cache at Lengberg, even pieces of brocaded silk, unfortunately none of them are pieces of tapestry. Yet because a bobbin and a pin beater were recovered, there must have been some tapestry weaving taking place in the castle. Maybe there were no big wall hangings but rather smaller pieces such as decorative covers for pillows, chairs and other furniture. That no fragments were stored in the vault could be mere chance or they were considered too valuable to be thrown away, although there were no such qualms regarding the silk. Whatever the reasons and whoever worked on the tapestries at Lengberg, the one crucial fact that can be gained from the finds is the appearance of tapestry bobbins in Central Europe in the late Middle Ages as well as their construction and the material from which they were made. This provides us with the information needed to make replicas and study the serviceability of the tool.

The evidence from this study suggests that tapestry production was more widespread than previously believed and not necessarily carried out only in cities or monasteries by skilled craftsmen, but also on a small, local scale. As it is hard to believe that Lengberg would be the exception to the rule, one can assume that tapestries were produced in many small- to middle-sized castles in this region and across Europe. A future study investigating written records on the topic of tapestry production at castles would be worthwhile and provide further insight into medieval household manufacture of tapestries.

Notes

1. Former St-Florent-le-Vieil or Mont Glonne (founded c. 390 CE by St. Florent, a disciple of St. Martin), plundered by the Normans. The Benedictines of Saint-Florent Mont Glonne took refuge in the castle of Thibault, Count of Blois and founded in c. 940 CE a new abbey dedicated on 2 May 950 CE. After the storming of the castle in 1025 they settled near the church of Saint-Hilaire-des Grottes. A new abbey was built, dedicated on 15th October 1040 CE, which took the name of Saint-Florent-de-Saumur (Cottineau 1939, 2675-2678; Retrieved on 11th March 2013 from World Wide Web: Bibliothèque nationale de France).
2. Also: doser, dorser. An ornamental cloth used as a wall hanging or as a cover for a seat or altar, a piece of tapestry (Kurath 1959, 1243).
3. The Baldishol Tapestry depicting the 12 months of the year, although only the panels of April and May have survived, has been radiocarbon dated to between 1040 and 1190 CE (Nockert and Possert 2002, 90-92).
4. Since the second half of the 14th century tapestries are called “Heidnischwerk” (pagan work) in Basel and Strasbourg. This has nothing to do with the pictures depicted on them, as this name was also applied to religious motifs, but with the applied technique (Rapp Buri and Stucky-Schürer 1993, 21).
5. Dutch and other foreign expensive carpets (translation: B. Nutz).
6. Tapestries of little value, common Turkish and other such carpets (translation: B. Nutz).
7. Centre International d’Étude des Textiles Anciens <Lyon> (1971) *Vokabular der Textiltechniken Deutsch : Englisch - Französisch - Italienisch - Spanisch - Schwedisch*. Lyon. But although Oswald von Zingerle (Zingerle 1909, 315) translates *gewurkt* into *gewirkt*, *gewurkt* could also mean *gewebt* (= woven) in modern German.
8. kolt-, golt-, gollt-, gólt-, gölter-, golt-, göltar, gult-, güllter-, gultar-, masc., fem. neutr. s. pl. (s. culcitra), *gefütterte Steppdecke* (Zingerle 1909, 279). *Steppdecke* = quilt.
9. One appointed to the command of a burg (a fortress or castle).

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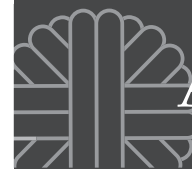
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Authors:

Beatrix Nutz: beatrix.nutz@uibk.ac.at

Claudia Ottino: claudia.ottino@student.uibk.ac.at



Dominique Cardon, Corinne Debaine-Francfort, Abduressul Idriss, Khasim Anwar and Hu Xingjun

Bronze Age Textiles of the North Cemetery

Discoveries made by the Franco-Chinese Archaeological Mission in the Taklamakan desert, Xinjiang, China

This paper is dedicated to Martin Ciszuk

Abstract

A cemetery dated to the Middle to Late Bronze Age (c. 1700 BC and earlier), recently excavated by the Franco-Chinese Archaeological Mission in the Taklamakan desert, Xinjiang, north-west China, is the source of more than one hundred different textiles. The background to the North Cemetery excavation and its context within a survey of ancient sites among the dried-up deltas of the Keriya River are described here by the directors of the Mission, Corinne Debaine-Francfort and Abduressul Idriss. The second part of the article is a catalogue by Dominique Cardon et al. of all the artefacts found in one of only two intact burials found by the Mission which had been left undisturbed by looters. This complete assemblage gives a very good idea of the range of textiles originally present across the cemetery. It also provides a striking comparison with the textiles found at another Bronze Age site, Xiaohe or Small River, near to Lopnor and about 600 km to the east of the North Cemetery (Xiaohe, has recently been re-excavated by Abduressul Idriss; the textiles from the Folke Bergman's original excavation were published in 1941 by Vivi Sylwan but at that time were undated).

Key Words: *Bronze Age textiles, archaeological excavation, Xinjiang, Keriya, red wool, cloak-blanket, fringed girdle / corded skirt, felt hat, necklace, basket*

Introduction

The Franco-Chinese Archaeological Mission is a close collaboration between the "Archaeology of Central Asia" team of the National Centre for Scientific Research (CNRS, UMR 7041), France, and the Xinjiang Institute of Cultural Relics and Archaeology, China. The Mission has been working since 1991 on an extended exploration of the dried-up branches of the Keriya River (Fig. 1). The Keriya River, one of a number of rivers flowing northwards from the southern edge of the Tarim Basin, now extends as a single channel into the centre of Taklamakan desert where it peters

out at about 200 km to the north of Keriya Town. But satellite images and the geomorphology of the desert show that, in earlier times, the Keriya had reached further north and had been characterised by branches and deltas, these deltas succeeding each other as the river gradually retreated. The hypothesis on which we have based our project is that ancient agricultural settlements once existed among these deltas; if the opportunities for irrigation had been exploited, whole tracts of land could have been cultivated here, from protohistoric times until the flow of water ceased to be sufficient.

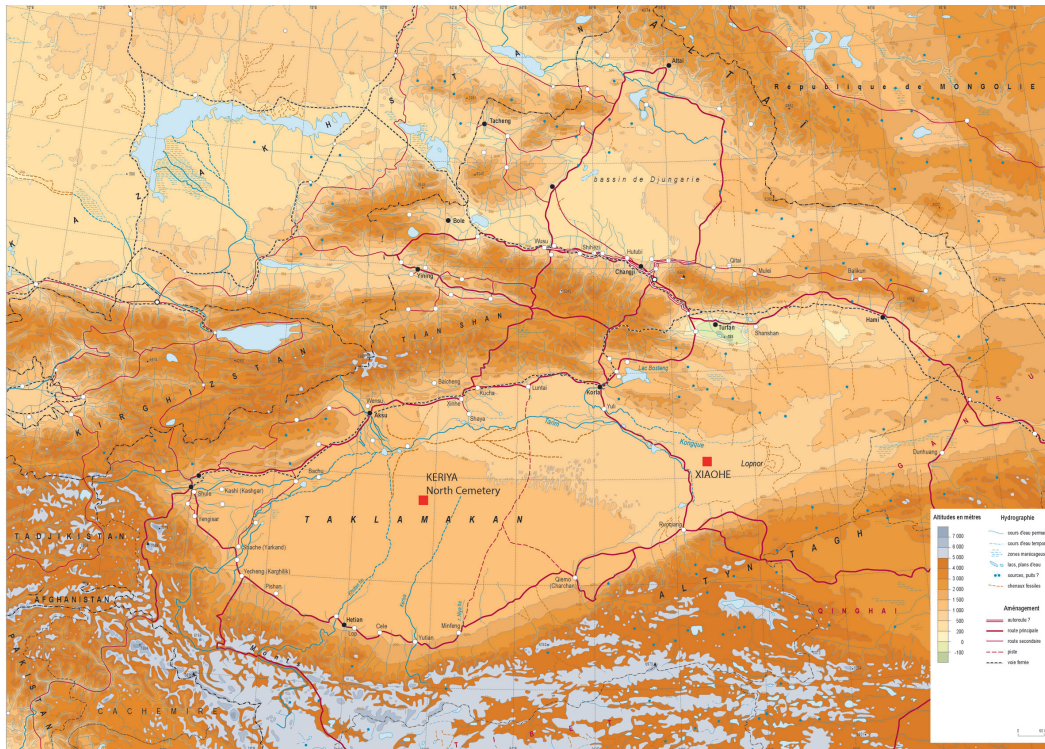


Fig. 1. Map of the Keriya valley with the North Cemetery. Southern Xinjiang, Khotan (Hetian) region, Yutian district, China (© Mission archéologique franco-chinoise au Xinjiang, MAFCX).

These areas at the centre of the Taklamakan desert are even in modern times very difficult to reach but nevertheless, guided by satellite photographs, we have undertaken a survey of the Keriya River, following it on the ground from its present course to the outer extent of its dried-up deltas. This gradual progression backwards through time, towards the heart of this immense sand desert, has allowed us to validate our hypothesis. We have plotted nearly 600 sites and find-spots and, in this process, have discovered evidence of previously-unknown cultures. The study of the finds has allowed us to propose a chronology for the settlement of the successive deltas of the Keriya, going back in time as follows: Antiquity (3rd-4th century AD), Iron Age (1st millennium BC) and Bronze Age (3rd -2nd millennium BC). For each of these periods we have identified a repeating settlement pattern consisting of an oasis with a principal dwelling place at its centre (Debaine-Francfort and Idriss 2001; Debaine-Francfort et al. 2009).

The first signs of an occupation earlier than the Iron Age appeared in 2005, in the form of surface features discovered during surveying: the remains of enclosures, of cattle-sheds, and of a dwelling site with various stages of occupation, all attributable to the 3rd and 2nd millenniums BC. These remains proved that this delta, both the northernmost and the earliest in geographic terms among the Keriya

deltas we had surveyed, had like the other deltas also been settled and irrigated. The discovery of this very early occupation provided the final proof for the archaeological model which we had been building. We are now in the process of studying and describing these remains.

Discovery of the North Cemetery

In 2008, a discovery was made by some local people which was to lead to the completion of our project on the ground and to a greatly enhanced understanding of life in southern Xinjiang during the Bronze Age: this was a large burial site situated in the same area as the dwellings earlier surveyed by us in the northernmost delta of the Keriya (hence the name North Cemetery). An exploratory expedition undertaken by us in 2008 was able to identify the astonishing similarities between this cemetery and that at Xiaohe, a site which until then had been considered to be unique and which is more than 600 km away to the east. At the North Cemetery, we estimated the number of preserved graves to be about 50, including 20 undisturbed, representing at least two chronological levels.

Xiaohe, in the Lopnor desert, had originally been discovered in 1934 by the Swedish archaeologist Folke Bergman (Bergman 1939). The textiles recovered from the site were published by Vivi Sylwan (Sylwan 1941/2001), but at that point the very early date of the



Fig. 2. Map of the North Cemetery (Drawing: J. Suire © MAFCX).



burials was not recognised. Xiaohe was re-discovered and thoroughly excavated under the direction of Abduressul Idriss between 2002 and 2005. 167 burials were found there, arranged on five superimposed levels and corresponding to two burial phases dated between 2000 and 1500 BC. Xiaohe has produced the most ancient (and spectacular) archaeological remains discovered until now in southern Xinjiang. It has also become the reference site for the Bronze Age, still poorly known for this region (Xinjiang wenwu kaogu yanjiusuo 2003, 2007a, 2007b; Mair 2006; Li 2007).

The similarities with Xiaohe therefore enhance the significance of the North Cemetery on the Keriya. The Mission was allowed to start the thorough investigation of the North Cemetery only in spring 2011, and we then faced particularly difficult weather conditions. Since its discovery in 2008, the cemetery had been repeatedly plundered and, as a result, had regrettably become badly degraded. Our investigations were therefore limited to the topographical mapping of the site, to a salvage excavation and to a survey of the neighbouring areas, close to those that had already been surveyed in 2005 (Anwar 2012; Debaine-Francfort and Idriss 2013).

Now marooned in the middle of a dune field, the North Cemetery, measuring approximately 40 x 30 m, is smaller than the cemetery at Xiaohe. It was identified in the first place by the presence of many pieces of wood, still standing or scattered on the ground. But like the Xiaohe cemetery, it is also situated on a natural mound which originally would have allowed it to dominate the surrounding landscape.

By 2011, debris from looting had been scattered along the slopes of the mound. We opened two large trenches across the least disturbed areas. In them we discovered twenty burials *in situ* (all facing north-east), of which only two had been completely spared. These twenty burials all belong to the same stratigraphic level, which is the most ancient phase of the site. The upper levels observed in 2008 had been destroyed, and we cannot know how many graves there were originally. The first radiocarbon dates obtained (calibrated to c. 1900-1740 BC) revealed that the site is contemporary with Xiaohe. Since the North Cemetery has been found in conjunction with the remains of settlement, it is more than simply Xiaohe's "twin site". It allows us to begin to build up a picture of the culture of the period, something which was not possible with the evidence from Xiaohe alone, a site apparently isolated within its region of Lopnor. The growing evidence of the very close parallels between these two sites, though separated by a distance of more than 600 km, suggests that during the Bronze Age there was a population, unsuspected until now, which was scattered over a

vast territory, not only within the Tarim basin, but even further. Our task now is to look for archaeological evidence of contact between the two sites.

The identification and study of the archaeological material gathered in the North Cemetery is still in progress. It was only possible to start this in 2012 and many kinds of scientific analyses still need to be performed. In spite of all the damage done by the looting of the site, the comparison of the data provided by the excavation of the North Cemetery with those obtained from Xiaohe has given us an inspirational insight into this ancient culture. This article, on the artefacts from grave M3, is the first detailed publication dealing with finds from the North Cemetery and their relationship to the finds from Xiaohe.

We selected this grave, M3 and the textiles and other artefacts it contained firstly because the burial had been left unplundered and so offered the whole range of material usually found in the site of Xiaohe. Our second reason was that the principal textiles from this grave – the cloak-blanket and the fringed girdle – are comparatively well preserved here and, at the same time, are good representative examples of these garments, which stand out as the most typical among the range of textiles now emerging as characteristic of southern Xinjiang during the Bronze Age. Due to lack of space, we have not included in the present paper the textiles and other artefacts typical of men's graves, though these are also very interesting.

Grave M3 - a woman's burial (calibrated radiocarbon date 1890 to 1740 BC)

Preliminary remark: the anthropological study of the body in the grave has not yet been done; for the meantime the identification of the deceased's gender therefore rests on the study of her clothes and associated funerary objects, particularly the small wooden phallus (see below).

Length of grave: c. 190 cm; width: c. 32 cm (at the feet) to 40 cm (at the head).

Facing NE, like the other graves of the North Cemetery (and like the graves at Xiaohe), grave M3 was one of the only two burials found more-or-less intact after the looting of the site; the other was M2, next to it. But while relatively complete, these two graves were situated near the edge of the cemetery mound (see Fig. 2, square H11) and had therefore been exposed to dampness, resulting in the poor preservation of the wood and of the bodies, the latter being largely reduced to the state of skeletons. Both graves were both excavated in March 2011. Owing to particularly difficult weather conditions, the excavation was done in two stages: 1) removal of the lid, first examination of the deceased in her cloak, replacing the lid and protecting the grave



against the wind with an emergency foil blanket; 2) four days later, re-opening of the grave, cleaning, excavation and removal.

The coffin was composed of two curved wooden sides fixed at both ends by a standing plank. It was closed by seven wooden boards forming the lid. The lid was covered with three layers of hide, making it waterproof from above. Tamarix branches were placed on the lid and a round pole stripped of its bark was set up at the foot of the grave. Inside the coffin were found the remains of a woman lying on her back, wrapped in a cloak-blanket (see below 11KB/M3:1). At the level of her groin, a small basket had been placed on top of the cloak (11KB/M3:8). Only the deceased's head (damaged) and the ends of her shoes were protruding from the cloak (Fig. 3). The human remains and the artefacts have been brought back to the Xinjiang Institute of Cultural Relics and Archaeology, Urumqi, for thorough study.

The cloak-blanket, made of undyed off-white wool, was held closed by a badly-preserved wooden pin over the chest; the cloak-blanket is without fringes and is decorated with a group of four coloured bands, in dark brown and pink. Towards one of its upper corners the fabric has been gathered into a little pocket, tied up by turns of a wool thread; when the coffin was opened this pocket was visible over the deceased's chest, to the proper left of a selvedge which ran down the centre of the body. As it was intact, the pocket was left unopened but its contents can be guessed by comparison with similar pockets on or from other cloak-blankets, from the North Cemetery and from Xiaohe; some of these were poorly preserved allowing their contents to be seen, some had been torn off by looters, and some (from Xiaohe), were deliberately opened. These other pockets usually contained grains (wheat and millet) and twigs of different species of

Ephedra (medicinal plants with a sympathomimetic effect).

The small basket placed over the cloak, approximately conical above a round base, is decorated with a band of lozenges along the rim, partly painted red, and two rows of stepped lozenges further down. It has a beige felt lid and a handle of wool cord. It contained a little cake and probably also the millet grains that were found scattered nearby, on the deceased's belly.

Under the cloak-blanket, the woman's clothing just consisted of a narrow girdle with well-spaced hanging cords, its ends tied in a knot in front of the body (11KB/M3:2). Her head and the upper part of her long brown hair were covered by a beige-coloured felt hat (11KB/M3:3), poorly preserved. This was decorated on the left side with two hatpins ending in feathers (11KB/M3:4) and was tied under the chin by an off-white woollen cord. Her footwear, also poorly preserved, can be seen by its surviving fragments to have consisted of leather ankle boots of the type most common both in the North cemetery and at Xiaohe, with soles made of fur, worn with the fur on the outside, and decorated with a red painted line, feathers and red wool threads. Well-preserved examples of such boots have been described and published by Vivi Sylwan (Sylwan 1941/2001, 42-44).

The deceased's personal ornaments consisted of a necklace made of red wool threads embellished with beads and feathers (11KB/M3:5) and a matching red wool bracelet (11KB/M3:6). She also wore earrings: two blackened metal rings provisionally identified as silver (11KB/M3:9) (Fig. 4). A little wooden object in the shape of a phallus wrapped with red wool threads (11KB/M3:7), typical of women's burials in Xiaohe, was placed on her chest, under the little pocket tied with wool thread, formed near one of the selvedges of the cloak (Fig. 5).



Fig. 3. Tomb M3 - a woman's tomb (Cal BC 1890 to 1740), one of only two tombs left untouched by looters. She is wrapped in her mantle, with a basket on her lap (© MAFCX).



Fig. 4. The lady in the tomb, with the remains of her felt cap with tying cord, silver ear rings, and a red wool necklace (© MAFCX).

Textiles and funeral items from grave 3

1. Cloak-blanket

11KB/M3:1 A + B (Figs 6-7). Rectangular cloak-blanket in off-white undyed wool decorated on each side of its lower half by four tapestry bands, starting at or near the side selvages but discontinued across the centre, in pink and dark brown wool; further decoration in the form of many irregular self-bands, starting all along the selvages but again discontinuous across the centre of the textile; the selvages each have a twisted cord as their outer element, the upper horizontal edge of the textile is finished with a border of twined warp loops and the lower horizontal edge with a closing cord; close to the corner where one side selvage meets the end of the twined loop border, a little filled pocket made by gathering up the textile and tying it up with a thick wool yarn.



Fig. 5. Wooden object in the shape of a phallus wrapped with red wool threads (11KB/M3:7), typical of women's burials (© MAFCX).



Fig. 6. 11KB/M3:1. Mantle/shroud, decorated with four tapestry bands in dark brown and pale red (© MAFCX).

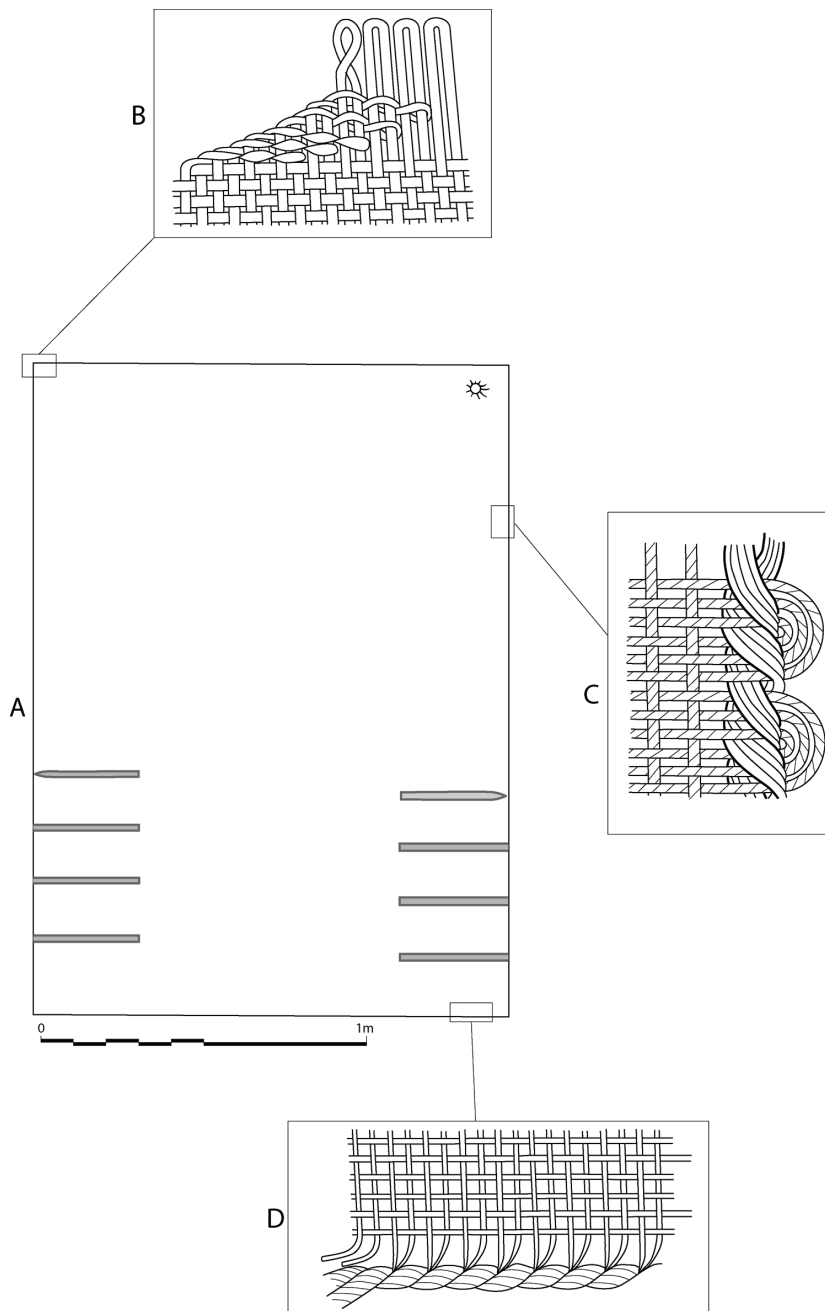


Fig. 7. Diagram of mantle-shroud 11KB/M3:1 to scale (A), with details of the edges:

B: chaining of warp loops;

C: structure of decorative side selvedge;

D: finishing cord (Drawing: J. Suire, © MAFCX).

Dimensions and preservation

Fragment A. Length: c. 134 cm; width: c. 131 cm

Fragment B. Length: c. 66 cm; width: c. 146 cm

Length of complete textile: c. 200 cm

Width of complete textile: c. 146 cm

Distance from bottom of cloak (as "worn" in the coffin) to start of 1st tapestry band: c. 22.5 cm on the left side, c.16 cm on the right side; distance between first and second bands: c. 16 cm on the left, c. 15 cm on the right; distance between second and third bands: c. 14.8 cm on the left, c. 14.5 cm on the right; distance between

third and fourth bands: c. 14.5 cm on the left, c. 14.5 cm on the right; depth of tapestry bands: c. 2 cm; length of tapestry bands, starting from side selvages : c. 32.5 cm on the left side, c. 34 cm on the right.

The two fragments, A and B, together correspond to the whole cloak with its four original edges (two side selvages and two different finishing borders parallel to the weft). The two fragments were found next to each other *in situ* but had become separated because of an area of decay. Preservation is least good towards the middle and upper part of the cloak, where



Fig. 8. Tapestry band in mantle-shroud 11KB/M3:1, with inclusion of thicker irregular ground wefts (© MAFCX).



Fig. 9. Mantle-shroud 11KB/M3:1: bottom left corner, closing cord tied with the two last warp threads into a knot (© MAFCX).

the body was lying directly against it: in other areas, the wool is still clean and white but quite worn and fragile, the fragility probably at least partly due to the extreme dryness of the environment; in the tapestry bands, preservation of the wool and of the dyed colour is good. The twisted cord incorporated into each side selvedge is very worn and has not been preserved along the whole of the textile's length.

Technical characteristics

Wool, tabby weave, weft-faced, with two types of decoration.

First decorative technique: reaching inwards from the selvages, self-bands within the ground weave and of the same colour as the ground - in places the weft yarn grows thicker or thinner or even becomes doubled, after which it reverts to its previous regular diameter; in these self-bands there is no detectable change of weft yarn or turning back of the weft threads and the impression given is that the yarn was spun deliberately with these variations directly before weaving. (Another possibility is that the thicker parts of the yarn represent splices; note, however, that splices were carefully looked for but could not be observed). The visual effect is a succession of flame-like bands in relief, starting from the selvages and pointing towards the centre of the cloak. These self-bands are situated along the whole length of the textile and are not symmetrical.

Second decorative technique: curvilinear tapestry and interlocking tapestry weaves. A group of four

discontinuous tapestry bands in two colours, dark brown above and below and pink in the middle, decorate each side of the lower half of the textile: they start at the selvages (except the last bands from the bottom on either side) and continue into the web for about one quarter of the textile's width (Fig. 7). The last tapestry bands from the bottom on either side do not start from the selvages: in these places, a succession of thicker and irregular ground wefts are woven into the outer few warp threads and some picks of this ground weft encroach into the start of the tapestry bands themselves, requiring the coloured weft threads to curve around the thicker undyed white weft threads (Fig. 8).

The second to lowest bands are a little different from the others, extending by four warp threads/ends closer to the centre of the textile. For the duration of the tapestry bands, the warp threads are paired or, exceptionally in the case of lowest left-hand band, are grouped into three. At the vertical junctions at the inner ends of the bands, ground and contrasting weft are interlocked between two adjacent warp threads. After each band, the contrasting weft threads are wrapped around the outermost selvedge warp thread for a short distance.

At the upper edge of the textile, loops of warp thread remaining after weaving have been twined across their neighbours to the right to form a neat firm border of slanting elements (Fig. 7B). At the lower edge, a fringe of cut warps thread has been twisted together to form a S-twisted closing cord, with groups of warp thread



Fig. 10. Mantle-shroud 11KB/M3:1: upper right corner shaped into a little bag, filled up with herbs and grains and tied with several turns of a thick wool yarn (© MAFCX).



Fig. 11. 11KB/M3:2. Fragments of a woman's sash/loin-cloth/corded skirt (© MAFCX).

added gradually as the cord was worked from right to left (c. 1,5 S-twists in 1 cm). At the lower left corner, the closing cord is tied with the outer two warp threads into a knot (Fig. 9).

The left selvedge is without warp or weft grouping but the outer element is formed by an S-twisted cord which is twisted through the individual loops of returning weft.

The right selvedge is in principle like the left selvedge but the weft loops of weft threads are grouped in threes as the cord is twisted through them (Fig. 7C)

Warp, wool, off-white, undyed and unpigmented; relatively fine, fairly tight Z-spin, 3.5 epcm.

Ground weft, wool, colour as warp; fairly loose S-spin, 10 ppcm.

Contrasting weft: 1) wool, undyed, dark-brown pigmented, fairly loose S-spin, 5 picks in 0.5cm; 2) wool salmon pink, fairly loose S-spin, 5 picks in 0.5 cm.

Cords in the selvedges composed of two groups of threads similar to warp yarn; fewer threads in the cord in the left selvedge than in the right one.

Adaptation/Use

Close to the upper right corner of the textile, a little pocket was created by gathering up the fabric; once filled, this was tied closed with several turns of a thick wool yarn, undyed white, S-spin (Fig. 10). For the manner in which the cloak was pinned, see the description of the complete grave above.

Wool type

Samples for analysis have been taken but the work has not been done yet.

Dye analysis

Samples of the dyed pink yarn have been taken but results are not available yet.

Discussion

Large rectangular textiles similar to this were found in all the undisturbed graves so far excavated, both in the North Cemetery and at Xiaohe. Used to wrap the bodies in the coffins, they could be considered to be shrouds. Prior to deposition they may well have been used at night as blankets. But the way they are arranged in the burials, pinned in one or several places over the chest, without covering the deceased's face, indicates that their principal function was as a piece of protective clothing, more precisely a cloak.

According to Abduressul Idriss' observations, the decoration of this cloak has no exact parallel in Xiaohe, where cloaks-blankets are more commonly decorated with three tapestry bands at most, of one colour only.

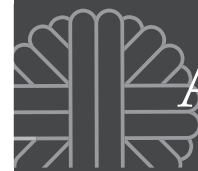


Fig. 12. 11KB/M3:2. Detail of the tapestry weave, with last pick of dyed weft threads extending into the next step block of same colour (© MAFCX).



A woman's cloak-blanket from Xiaohe (grave M4, no. 6) is decorated with three pink tapestry bands, and the warp is paired in the bands as here, but the Xiaohe cloak differs from the North Cemetery cloak in several aspects: the ground is in different shades of brown pigmented wool, there are no self bands and the pink tapestry bands all end in curvilinear shapes rather than neat vertical junctions (Xinjiang wenwu kaogu yanjiusuo 2003, 23-25, pl. 5, this cloak is currently exhibited in the Archaeological Museum in Urumqi). Another cloak from Xiaohe (grave M28, no. 18) is not decorated with formal tapestry bands or with dyed weft yarn but can be compared to the North Cemetery textile because it has a very striking arrangement of flame-like tapestry motifs in different shades of pigmented brown wool; in the ground, this cloak also has inwards-pointing insertions of white wool yarn of irregular thickness that produce a similar effect to the self-bands in the present cloak (Zhongguo Sichou bowuguan 2013, 11). It is not to be excluded that such series of irregular lines and flame-like motifs may have carried some symbolic message and indeed, may have been some kind of notation system

2. Fringed girdle / corded skirt

11KB/M3:2 A + B + C (Fig. 11). Fragments of a woman's wool fringed girdle/corded skirt in tapestry weave, design of a repeating stepped block motif in red, brown and yellow (or white turned yellow); at the one original end still visible, weft-faced bands in the same colour as the stepped design and, beyond these, a fringe of looped warp threads; two side selvages, one plain and the other with a well-spaced fringe of inserted hanging cords.

Dimensions and preservation

Fragment A. Length (warp direction): c. 35 cm; width (weft direction): c. 2 cm; maximum length of fringe elements: c. 33 cm; depth of group of coloured bands at visible end: c. 2.1 cm; depth of stepped motif repeat: c. 3.5 cm; distance between fringe elements: c. 5 cm.

Fragment B. Length (warp direction): c. 9 cm; width (weft direction): c. 2 cm; maximum preserved length of fringe elements: c. 7 cm; depth of stepped motif repeat: c. 3.5 cm; distance between fringe elements: c. 5 cm.

Fragment C. Length (warp direction): c. 6 cm; width (weft direction): c. 2 cm; preserved length of fringe: c. 4 cm; depth of stepped motif repeat: c. 3.5 cm; distance between fringe elements: c. 3.5 cm.

Preservation rather poor. The girdle is torn in several places in the warp direction and along the selvedge adorned with inserted fringes. The wool yarns are encrusted with earth (alkaline?) or dirt, and in places the girdle has darkened and become very brittle (due to contact with the body?); in other parts, both wool and colours are fairly well preserved.

The lower parts of the fringe elements have been worn away or torn off on fragments B and C and on all three fragments some of these fringe elements appear to be missing altogether.

Technical characteristics

Wool, tapestry weave with some weft-faced tabby, regular close texture.

Weft-faced bands at visible end composed of 10 picks of each colour: red, brown, yellow (or yellowed undyed wool), brown, red, yellow/yellowed. Stepped block motif in interlocked tapestry weave (Fig. 12): 9



warp ends across width of girdle, each colour block composed of 3 warp ends and 16 weft picks, the last of which extends into the next block of the same colour (Fig. 12). Two side selvages, plain apart from inserted fringe. At visible end, fringe of warp loops. Second end hidden inside knot and structure uncertain (but comparison with fringed girdles from other graves suggests that it also finished in a fringe of warp loops). Hanging fringe elements made of a singles thread inserted between 2nd and 3rd warp end from selvage, doubled over and twisted on itself; loose ends.

Warp, undyed pigmented brown wool,, fairly tight Z-spin, medium 2 S-ply, c. 4.5 epcm.

Weft, wool in three colours , 1) undyed, pigmented brown, 2) red and 3) yellow or undyed white now yellowed; all medium Z-spin, , medium 2 S-ply, c. 15 ppcm.

Red fringe elements, wool, medium Z-spin, S-plied after insertion into girdle; yellow/yellowed fringe elements, wool, medium S-spin, Z-plied after insertion into girdle.

Adaptation/Use

The two ends of the band are tied together by a reef knot SZ (Fig. 13). One of the original ends of the girdle is hidden inside the knot. As found, this knot was at the front of the woman's waist.

Wool type

Samples for analysis have been taken but the work has not been done yet.

Dye analysis

Samples of the red and the yellow yarns have been taken but results are not available yet.

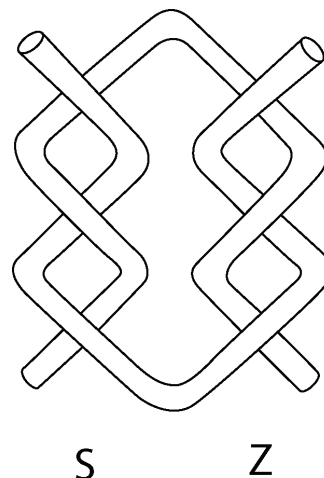


Fig. 13. 11KB/M3:2. Reef knot closing fringed sash in the front part of the body (Drawing: J. Suire, © MAFCX).

Discussion

This textile is representative of one of a number of types of fringed girdles/corded skirts found on the site. Such "skirts" are present in all women's graves but the present type, with a narrow woven band and thin fringe elements made of only one plied thread, inserted at some distance from each other, is the version that is hardest to reconcile with the modern concept of a skirt. It may be a late style, or a kind of symbolic version of a corded skirt. Several corded skirts looking much more like the Bronze Age examples known from Denmark were also found, both in the North Cemetery and at Xiaohe. Unlike these, most of the narrow girdles, of which this is an example, are beautifully decorated with tapestry motifs of stepped blocks in two or three different colours. The opposed spinning and plying directions in the red and in the yellow hanging elements of this



Fig. 14. 11KB/M3:3. Fragments of off-white undyed felt cap (© MAFCX).



belt provide a beautiful example of the combination of “sunwise” and “withershins” spinning in the same textile and, if we follow Lise Bender Jørgensen’s suggestions about the symbolic importance of spinning direction, are doubtless meaningful (Bender Jørgensen 2012). Two similar fringed girdles/corded skirts from Xiaohe, the contemporary site in Xinjiang with the best range of comparative archaeological material, have been published. One was described by Vivi Sylwan (“loin-cloth” 5.B:1, Sylwan 1941/2001, 77-8, pl. XIV.3-4). It has a stepped block tapestry motif, reversing halfway through the weaving of the band, but in only two shades of undyed wool, light and dark brown. Spin and ply directions are the same as in the present fragments, for both warp and weft, but the warp in Xiaohe 5.B:1 is paired and the tapestry pattern less regular. Warp and weft counts are not recorded. The other comparable item is no. 19 from Xiaohe grave 13 but this has not yet been published with all the technical details that would allow a really close comparison: it also has a stepped block motif, reversing halfway through the weaving of the band, and bands of alternate colours at both ends, in pinkish red and old gold. It is further decorated with a row of small copper rings strung on the warp thread which runs along the centre line of the girdle (Xinjiang wenwu kaogu yanjiusuo 2007a, 15-16; Zhongguo Sichou bowuguan 2013, 20-21). Similar copper rings have been found in the North Cemetery, but loose, none being still attached to a textile. Interestingly, contemporary Bronze Age corded skirts from burials in Denmark often are decorated with small bronze tubes, covering different parts of the corded fringes (Fossøy and Bergerbrant 2013, 27).

Cap

11KB/M3:3 A + B (Fig. 14). Fragments of off-white undyed felt cap with tying cords.

Dimensions and preservation

Fragment A. Length: c. 11.5 cm; width: c. 13 cm

Fragment B. Length: c. 9.5 cm; width: c. 8 cm

Preservation generally poor, due to contact with the back of the deceased’s head. The back of the cap has not survived but on the left side the wool is fairly well preserved and only slightly discoloured.

Technical characteristics

Wool, undyed off-white, shaped into felt cap.

Tying cords: wool, undyed white, 3-strand braid; each strand composed of a pair of S-spun threads; at the end of the braid, each pair of S-spun threads is Z-plied together.

In order to fix them to the cap, prior to felting, the

tying cords were incorporated into the edges of the mass of wool due to form each side of the cap.

Adaptation/Use

The two cords are tied together with a reef knot SZ, one part of which includes a loop.

Discussion

In the North Cemetery as at Xiaohe, men, women and children alike were buried with felt caps on their heads, most of these approximately conical in shape but some rounded, of different natural colours of pigmented or white wool. Since only parts of this cap are preserved it is difficult to be certain which of the two shapes it had, possibly the rounded type. Both shapes of cap are often but not always decorated, more or less richly. The rounded type usually only has wooden hatpins ending in feathers. Some conical caps also have rows of red wool stitched to the felt, hatpins with feathers, and weasel pelts stitched around the crown so that the head and forelegs of the animal extend over the front of the cap (Xinjiang wenwu kaogu yanjiusuo 2003,



Fig. 15. 11KB/M3:4. Fragments of two wooden hat pins decorated with feathers (© MAFCX).



Fig. 16. 11KB/M3:5. Fragments of necklace of red wool with a jade bead (© MAFCX).

17-19, 22-25, 32-33, Pl. 4-5, 8; Xinjiang wenwu kaogu yanjiusuo 2007a, 6-8, 13-15, 24, 26-27, 35-36, 38, 41-44, Pl. 1-3, 4; Xinjiang wenwu kaogu yanjiusuo 2007b, 10-12, 14-15, 17-18, 21-22, 27-30, 34-38; Zhongguo Sichou bowuguan 2013, 30-33).

Hatpins

11KB/M3:4 A + B (Fig. 15). Fragments of two wooden hatpins decorated with feathers.

Dimensions and preservation

Fragment A. Length: 8 cm; diameter of pin: 0.4 cm; length of feather: 5 cm

Fragment B. Length: 8 cm; diameter of pin: 0.4 cm; height of feather: 4.5 cm

The ends of the wooden pins are broken; the feathers are incrustated with earth.

Technical characteristics

The quills of the feathers are fixed to the wooden pins by means of a wrapped red wool thread Z-spin, 2 S-ply.

Adaptation/Use

The hatpins were stuck into the left side of the cap.

Discussion

In the North Cemetery as in Xiaohe, men's caps are more richly decorated than women's, especially in respect of the number of feathered hat pins.



Fig. 17. 11KB/M3:6. Fragment of red wool bracelet (© MAFCX).

Necklace

11KB/M3:5 A + B (Fig. 16). Fragments from the central part of a necklace of red wool embellished with a jade bead, two small bone beads and two feathers.

Dimensions and preservation

Fragment A. Length: 52 cm

Fragment B. Length: 7 cm

Preservation poor, due to contact with the back of the deceased's neck. The wool is brittle and discoloured in places.

Technical characteristics

Wool, dyed red, principally a group of 6 threads, each Z-spun, 3 S-ply, plus fragments of 3 wool threads, beige, Z-spun, 3 S-ply.

Adaptation/Use

The core of the necklace, the group of six red 3-ply threads, is wrapped around at intervals by thinner red threads. On the larger of the two fragments, the additional wrapped threads attach embellishments: at about 8 cm from left broken end a wrapped red thread, Z-spun, 2 S-ply, has strung on to it, from left to right, an oval translucent green jade bead (1.5 x 0.7 cm) and two bone beads, one shorter (0.35 cm), the other longer (0.9 cm); close to left broken end, a wrapped red thread, Z-spun, attaches a feather by its quill – this feather points towards the beads; at about 6 cm to the right of the beads, a wrapped red thread, Z-spun, attaches a second feather in the same way – this feather points away from the beads.



Discussion

In the North Cemetery as well as at Xiaohe, similar necklaces are worn both by men and women, but they are not found in all graves. Examples from North Cemetery are: 08KLY. ML. 09.11, 11KLY. ML. 23 bis, 11KLY. ML. 35; two further necklaces, derived from the looting of the site, are exhibited, one in the Western Region Culture Museum of the Tarim University in Alar, the other at the Cultural Activities Centre in Yutian. Similar examples from Xiaohe are published (Zhongguo Sichou bowuguan 2013, 47; 2003.2, 25-26. Xinjiang wenwu kaogu yanjiusuo 2007a, 15, 17; Xinjiang wenwu kaogu yanjiusuo 2007b, 19, 23).

Bracelet

11KB/M3:6 (Fig. 17). Fragment of red wool bracelet.

Dimensions and preservation

Length: c. 7 cm; diameter: c. 0.35 cm

Preservation poor, due to contact with the body.

Technical characteristics

Wool, dyed red, Z-spun, 3 S-plied.

Adaptation/Use

This short length of yarn is the only preserved fragment.

Discussion

In the North Cemetery as well as at Xiaohe, bracelets of similar red wool yarn are worn by men, women and children but do not occur in every grave. Other examples from the North Cemetery are 11KLY. ML.36 (surface find) and 11KB.M4.1 (grave of an infant wearing a bracelet made of plaited red wool thread); two further bracelets, derived from the looting of the site, are exhibited in the Museum of the Tarim University in Alar - they are made of red wool threads onto which a jade bead is strung. Some bracelets of red wool from Xiaohe have been published (Zhongguo Sichou bowuguan 2013, 46, 48; Xinjiang wenwu kaogu yanjiusuo 2003, 23-28, pl. 5-6; Xinjiang wenwu kaogu yanjiusuo 2007a, 7-8, 14-17, 24-27 (grave 24, a man's grave, n° 20), 41-44, pl. 2-3; Xinjiang wenwu kaogu yanjiusuo 2007b, 10, 13, 23, 29, 37).

Wooden phallus

11KB/M3:7 (Figs 5 and 18). Wooden object in the shape of a phallus made of two matching halves bound together with red wool thread.

Dimensions and preservation

The two halves have a semi-circular outline in cross section and a rounded upper end. One half is slightly

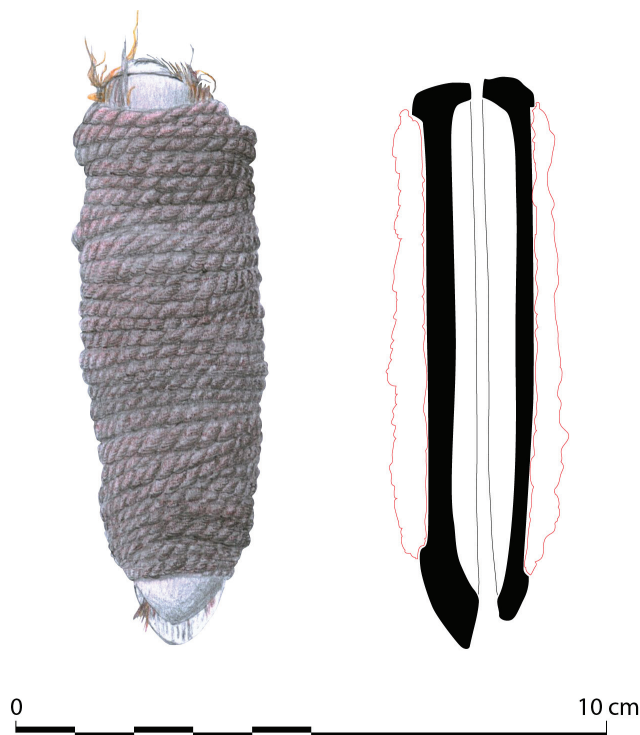


Fig. 18. Construction of wooden object in the shape of a phallus wrapped with red wool threads (11KB/M3:7) (Drawing J. Suire, © MAFCX).

longer than the other.

Half 1, length: c. 10.1 cm; half 2, length: c. 9.5 cm

Width: c. 1.2 cm unwrapped, c. 3.5 cm with wrapped threads. Depth: c. 0.4 cm unwrapped, c. 3 cm with wrapping. Preservation fair.

Technical characteristics of wool yarn

Binding thread, wool, dyed red, Z-spun, 2 S-plied.

Construction

The two halves of the object enclose an offering which, judging by the parts that are visible (at both ends and under the red wrapping thread), includes hair and/or feathers. The start of the wrapping thread is held in place by the first turns of the thread; the end is tucked back under the last turns.

Discussion

At the North Cemetery, a similar object was found in grave M12 and others, mostly incomplete, among the scattered remains left behind by the looters. Examples derived from the looting are exhibited in the Museum of Tarim University in Alar. The inside face of each wooden half was hollowed out, to receive small organic items such as lizards, feathers or animal hair,



and some are decorated with carved lines or zig zags. Similar objects were also found in Xiaohe, where they all come from women's graves (Xinjiang wenwu kaogu yanjiusuo 2003, 39, Fig. 54 and pl. 6; Xinjiang wenwu kaogu yanjiusuo 2007a, 9, Fig. 10/6, 19 Fig. 18/2 and col. photo no. 22; Xinjiang wenwu kaogu yanjiusuo 2007b, 24 and 14, Fig. 25; Wieczorek and Lind 2007 no. 27; Zhongguo Sichou bowuguan 2013, 51). These little objects in the shape of a phallus are manifestations of a crossed sexual symbolism characteristic of both sites. Other evidence is provided by the poles that are erected near the graves: some, oblong and painted red, are interpreted as phallic symbols - they are systematically associated with women's graves. The others, paddle-shaped and painted black, symbolise the female sex - they are systematically associated with men's graves.

Basket

11KB/M3:8 (Figs 19-20). Conical basket of plant stems with felt lid and wool cord handle, sides decorated with two interlocking rows of large lozenges built up from stepped block motifs woven with active elements of a contrasting shade; the rim has a smaller row of smaller lozenges and, below this, a band of waling with traces of red paint.



Fig. 19. 11KB/M3:8. Basket with felt lid and wool cord handle (© MAFCX).



Fig. 20. 11KB/M3:8. Base of basket (© MAFCX).



Dimensions and preservation

Height: c. 18 cm; diameter at brim: c. 16.3 cm; rectangular base: c. 3.1 x 2.1 cm; diameter of waling around edge of base: c. 4.8 cm; distance from upper edge of this waling to 1st addition of passive elements: c. 1.3 cm; distance between 1st and 2nd second additions of passive elements: c. 2.7 cm; distance between 2nd and 3rd addition of passive elements: c. 6.2 cm; distance between 3rd addition of passive elements and lower edge of waling around rim: c. 4.9 cm; depth of band of waling around rim: c. 0.8 cm; depth of row of lozenges around rim: c. 2.2 cm.

Length of wool cord handle: c. 30 cm; thickness/diameter: c. 0.9 cm.

Preservation fair but the basket, although semi-flexible, has been crushed (by the lid of the coffin?) and flattened: one side has more or less retained its convex shape but the opposite side has become concave. The convex side is broken with a small hole in its lower part and is incrustated with earth and a fragment of skin with hair. The epidermis/cortical layer of the grass used for the lozenge motifs has been very poorly preserved, making the motif barely legible. When the basket was crushed the major part of the felt lid was pushed into the opening of the basket. The wool parts are well preserved.

Technical characteristics

Basket:

Passive elements or stakes: plant stems possibly grass (no identification available yet), without twist, 4 stakes/cm in the sides of the basket.

Active elements or weavers: two different species of grass or reed, or same species differently prepared, with and without the cortical layer (no identification available yet);

- "ground" active element: grass or reed stems, beige, not shiny, without twist, 10-11 weavers/cm in under one / over one ground weaving.

- contrasting active element: buff-coloured stems with fibrous, shiny cortical layer, without twist, 8.5 weavers/cm in stepped motifs.

Base of basket (Fig. 21): 9 stakes cross 7 stakes perpendicularly; they are held together by alternate rows of twining and waling: across the centre of the base, one row of twining (paired weavers worked in Z direction), alternates with one row of waling (three weavers worked in S or Z direction) making up a total of nine parallel rows. From this point on the rows are circular and worked anticlockwise if viewed from outside the basket: 3 rows of twining, Z, including some additions of stakes; 3 rows of waling, Z, also including additional stakes (altogether 15 stakes are added to the base during weaving).

Sides of basket:

Ground woven in under 1 / over 1 using only one weaver; decorative lozenges (built up from stepped blocks reversing in both vertical and horizontal directions) are created with a second weaver of a different shade and thickness from the ground weaver. Three successive additions of stakes are made during the weaving of the sides.

Just before the rows of waling marking the beginning of rim, a float of the ground weaver over 4 contiguous stakes on each side of the basket serves to fix the wool cord handle.

Rim of basket:

Three rows of waling (3 weavers in Z direction) followed by 16 rows of weft twining (paired weavers in Z direction), the pattern of lozenges created by floats in two successive rows of the pair of weavers over two stakes.

No finishing structure around edge of basket.

Handle

Wool, undyed white, Z-spin, 9 threads tied in a knot and S-twisted together.

Lid

Wool, undyed, white and beige, lightly felted, shaped into a circular lid.

The lid is held down by a thick wool thread, white and beige, S-spin, wrapped twice around the rim of the basket.

Discussion

In the North Cemetery, men, women and children alike were buried with such baskets. Eleven complete baskets and numerous basket fragments were found by us either at the survey stage or during the excavation. Additionally 21 complete baskets derive from the looting of the site; three of these are exhibited in the Museum of Tarim University and a further 18 are stored in the Cultural Activities Centre in Yutian. Most of the complete baskets cannot be opened without damaging the felt lids. Where the contents could be studied, these were found to mostly consist of little cakes, grains including millet, and/or twigs of *Ephedra* spp. *Ephedra* bushes are typical of the Taklamakan desert environment and are also known to have had very early medicinal applications in Asia. For the presence of this plant in the North Cemetery, see Anwar 2012; Debaine-Francfort and Idriss 2014 forthcoming. For Xiaohe, see Xinjiang wenwu kaogu yanjiusuo 2003, 20, 27, 34-35, pl. 9; Xinjiang wenwu kaogu yanjiusuo 2007a, 9, 13, 17, 23, 25, 34, 40, 44, pl. 1; Xinjiang wenwu kaogu yanjiusuo 2007b, 11-12, 19, 23, 26, 28, 38; Wiczorek and Lind 2007 no. 5, 12; Zhongguo Sichou bowuguan 2013, 39-41.

The very thin, soft texture of the felt lid, common to



all these baskets, was obviously intended to serve as a filter, letting the air pass but protecting the contents of the basket from the sand that certainly used to blow across the Taklamakan desert in ancient times as it still does nowadays, penetrating everywhere.

Ear-rings

11KBM3:9 (Fig. 4). Silver ear-rings in the form of complete rings.

Dimensions and preservation

Diameter of rings: c. 2.1 cm; thickness of metal: c. 0.3 cm.

Both ear-rings are complete closed rings; oxidation has made them look black. Thicker zones (4 on each ring), fairly regularly spaced, may correspond to a decorative pattern, illegible in the present state of preservation.

Metal analysis

A preliminary identification of the metal as silver was obtained in Urumqi in October 2012 by Mei Jianjun (Institute of Historical Metallurgy and Materials, University of Science and Technology, Beijing) using a portable XRF machine. Definitive results are forthcoming.

Discussion

Similar ear-rings, with open or closed rings, have been found elsewhere on the site, for instance in grave M20 (the ring is smaller) and scattered on the ground (08KLY:18). At Xiaohe, ear-rings of silver, copper or gold were found both in men's and women's graves.

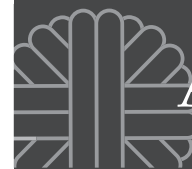
Concluding remarks on the textiles from grave M3

In a recent paper, Sølvi Helene Fossøy and Sophie Bergerbrant have discussed the scope for creativity available to textile producers in Bronze Age Scandinavia; more particularly, they have shown the

different ways in which a person's creativity could be expressed in the conception and making of a corded skirt (Fossøy and Bergerbrant 2013). It is not only because a number of fringed girdles/corded skirts have also been discovered in the North Cemetery – among them some examples quite similar to the Scandinavian finds – that this point is relevant here. When we publish the complete corpus of textile finds from the North Cemetery it will be possible fully to explore this theme of creativity. But as a conclusion to the present short study, we can already offer our finding that the people of the North Cemetery had established in their culture an interesting balance between a marked homogeneity in their overall appearance – with a limited range of items of dress and personal adornments – and a surprising variety in the technical details of their clothing and in the arrangement of motifs and colours on it. No two textiles are identical among the more than one hundred discovered by our mission, a source of great interest and satisfaction for a textile researcher. Our finding also serves as a warning: if we had had access to only a few textiles from the site, and especially if these had been separated from their archaeological context, it would have been tempting to present as a general rule some of the sorts of detail which were actually played with by the textile artists and colourists of the time to give variety and distinction to their artefacts.

Acknowledgements

We are very grateful to our colleagues at the Institute of Archaeology and Heritage of Xinjiang and to its Director, Professor Yu Zhiyong, for their warm welcome and for their help in finding practical solutions to the problems of studying such large and dirty textiles as the cloaks from the North Cemetery. Many thanks also to Hero Granger-Taylor for improving the fluency of the text and for her suggestions.



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Authors:

Dominique Cardon: cardon.dominique@wanadoo.fr
Corinne Debaine-Francfort: corinne.debaine@mae.cnrs.fr
Abduressul Idriss: yidilisi@hotmail.com
Khasim Anwar: anwarsaga@yahoo.com.cn



Olga Orfinskaya and Irina Arzhantseva

The Cut of the Clothes of North Caucasian Alans

Abstract

The paper is an attempt to reconstruct the evolution of costume cut through the examination of examples of North Caucasian Alan costume dated to the 8th-13th centuries AD. The analysis indicates that the cut of Alan clothes was based on the Central Asian pattern with a smooth bodice-sleeve line. The cut changed with the gradual transition from felt to fabric of fixed width and length. Many questions remain controversial yet a new line of inquiry into the cut of excavated sewn clothes is proposed.

Keywords: Middle Ages, North Caucasian Alans, Moshchevaya Balka, Lower Arkhyz, clothes, cut, sewing, costume reconstruction

Introduction

A good state of preservation of organic material, including almost intact clothes, in the rock cemeteries of the North Caucasus enables us to study the cut of the Alan costume (Ierusalimskaya 1996; Orfionskaya 2000, 105-108; Runich 1971, 167-178; Savchenko 1999, 125-141). The Alans were a coalition of Iranian-speaking tribes who came to the North Caucasus from Central Asia, probably from the area east of the Aral Sea, in the early centuries AD. In the 1st millennium AD they occupied key positions in Central Ciscaucasia and constituted a substantial political power to be reckoned with, not only for their immediate neighbours but also for all nations whose interests clashed at this historical crossroads. Important trade and military routes ran through the Alan territory and the Alans were thus involved in the relations between early medieval superpowers, namely Byzantium and Iran, Turkic and Khazar Khaganates and the Arab Caliphate. A series of Irano-Byzantine wars in the 6th century AD was a fight for the control over the main caravan routes, especially the Great Silk Route. There were two branches of the Silk Route: the southern running from China via Afghanistan and Iran to Syria and Byzantium, and the northern running via Central Asia and the Aral Region to the North Pontic Greek cities (Lubo-Lesnichenko 1994, 234-246). While Iran controlled the major land part of the Great Silk Route, Byzantium held practically all the approaches to the Black Sea shores. Irano-Byzantine wars blocked the

western end of the southern land branch of the Silk Route (via Iran) and thus revived its North Caucasian branch (China – the Usturt Plateau – the Caspian Region – the North Caucasus – the Pontic Region). The latter ran through the land of the Alans who became involved in the functioning of trade roads. The intensification of trade along the North Caucasian branch of the Silk Route resulted in an influx of silk fabrics to the region which, in its turn, influenced the cut of Alan clothes. Changes in both male and female costume could also have been brought about by the infiltration of the Turkic population, probably belonging to a Bulgar tribal union from the Azov Region, since the late 6th century AD.

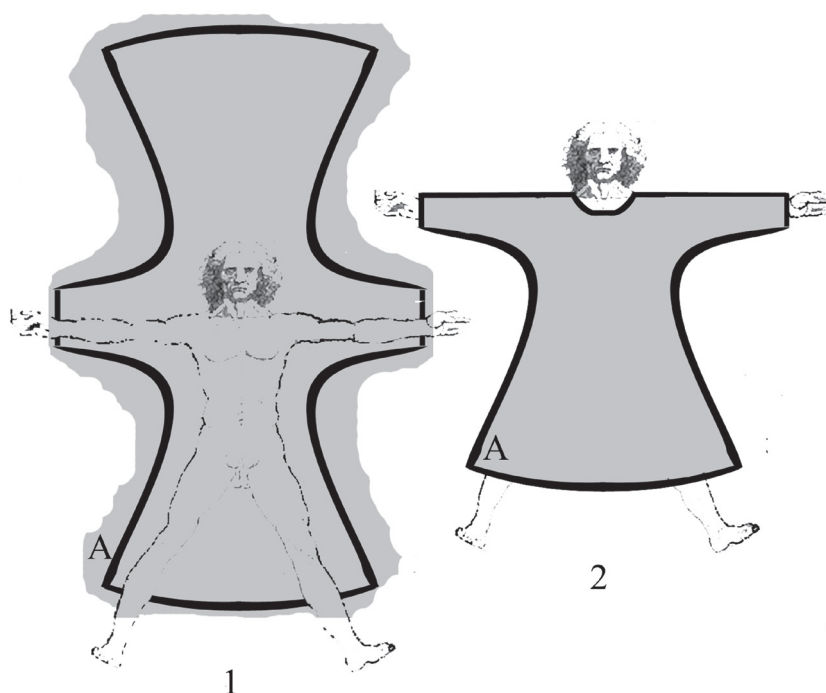
Male Alan dress

Although Alan male costume, judging from the archaeological record, consisted of one or two caftans, trousers, leggings, footwear, and headgear, in this paper we deal solely with caftans. Gillian Vogelsang-Eastwood regards Alan caftans as originating from the south of Central Asia (Vogelsang-Eastwood 2004, 209-224). This area was inhabited by nomadic stockbreeders. Sychev linked the origin of clothes with economy and suggested that stockbreeding milieu gave rise to the garment based on a piece of felt (Sychev 1977, 38). This conclusion is quite plausible: it can be surmised that the caftan evolved gradually from a certain felt garment. Felt is characterized by its physical adaptability; one can manufacture felt



Fig. 1. Clothes of Central Asian cut (Drawing; author).

1 – A variety of the emergence of the Central Asian cut based on the use of a felt sheet (A); the outline of the cut reproduces that of the human body with allowance for the unrestricted movements of arms and legs;
2 – general appearance of the basic clothes of Central Asian type.



fabrics of any shape and size, being guided solely by the intended shape and size of the end product. Let us illustrate this point by analogy with footwear. The earliest shape of footwear was based on the outline of a foot and a device fixing this piece to the foot. The same is probably true of the case when a suitable body cover was cut from a large piece of felt (Fig. 1). The salient trait of this cut is a smooth line of the side seam and a widening hem.

A textile fragment, probably a part of an outer garment with a central slit, was discovered in the Lisakovo cemetery of the 12th century BC in Kazakhstan (Central Asia). This piece was made of several layers and the right side consisted of narrow strips of braided wool which were sewn together (Orfinskaya and Golikov 2010, 120). It seems therefore likely that in this territory there existed a certain cut in which narrow strips braided wool could have been sewn together, thus forming the surface of a garment. We shall call such a cut with a smooth line from the waist to the sleeve Central Asian and surmise that it represents the origin of the early medieval Alan clothes.

The Moshchevaya Balka cemetery is one of the renowned North Caucasian Alan sites. Its materials are kept in the Hermitage (Ierusalimskaja 1996). A good state of preservation of the organic material, including almost intact clothes, in the rock cemeteries of the North Caucasus is due to climatic conditions and peculiarities of funerary rites (Ierusalimskaya 1996; Orfinskaya 2000, 105-108; Runich 1971, 167-

178; Savchenko 1999, 125-141). The presence of silks in Moshchevaia Balka is accounted for by its location on a branch of the Silk Route. There exists, however, a network of lesser known cemeteries yielding early medieval textiles. They are kept mostly in the Karachai-Circassian Museum-Reserve (KCMR) in Cherkessk, in the Karachai-Circassian Republic of Russia (Golikov et al. 1998, 133-140). In this paper, we will use this collection to analyse the cut of the clothes from the North Caucasian rock cemeteries (for the description of the relevant textiles cf. Orfinskaya 2001, 269-449).

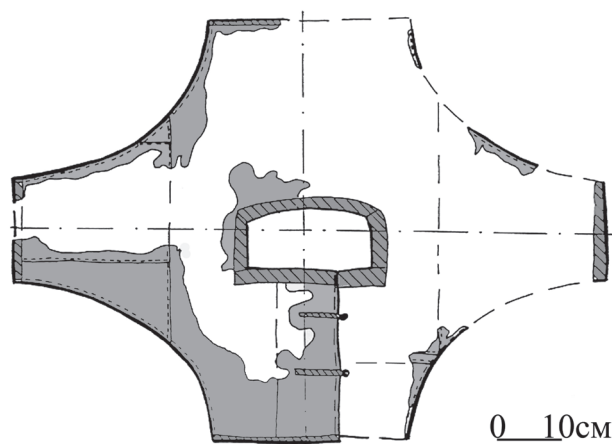


Fig. 2. Child's shirt (KCMR no. 9107/107) (Author's drawing).

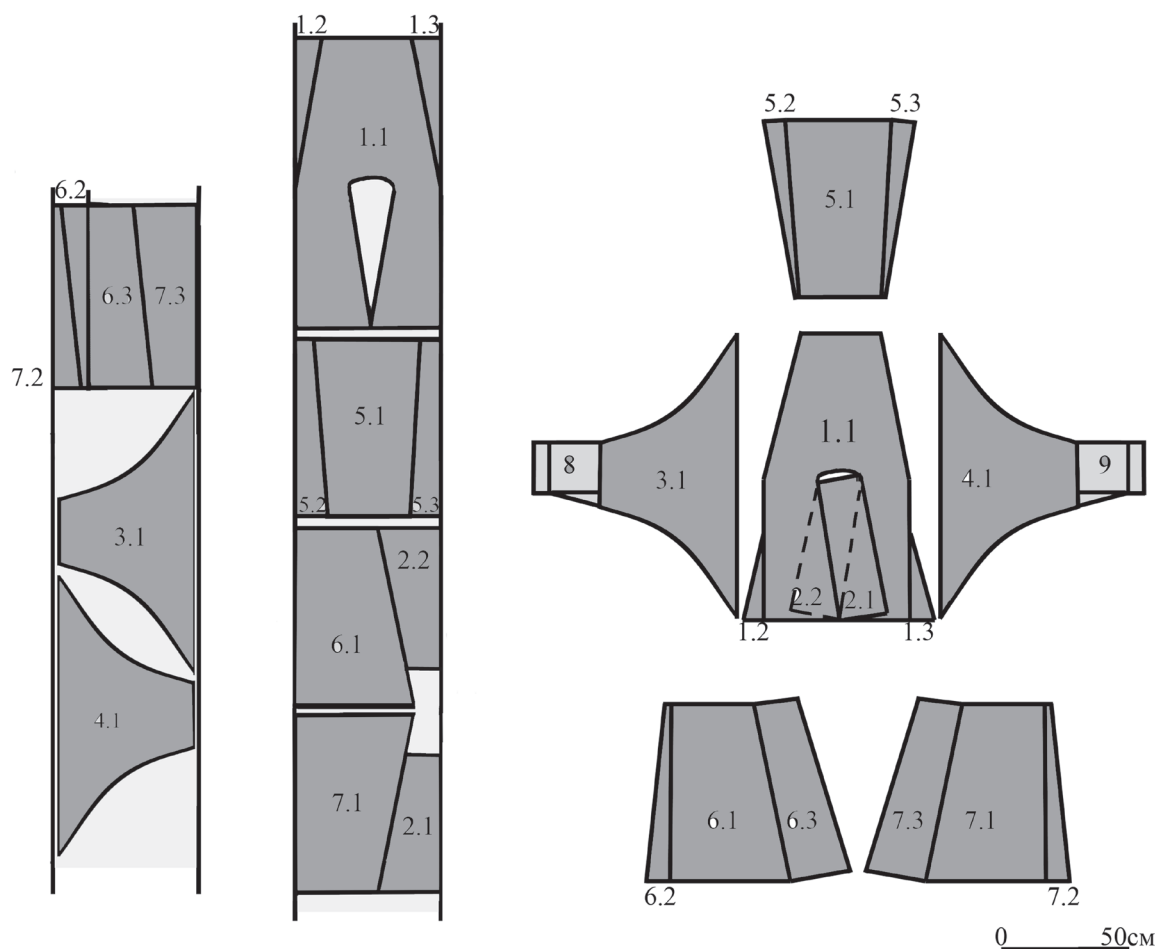


Fig. 3. Man's caftan (KCMR no. 10269/1). Cut and arrangement of the cut on fabric (Drawing: author).

1.1– Bodice of the caftan. 2.1 – Upper right flap; 2.2 – Inner left flap. 3.1 – Right sleeve. 4.1 – Left sleeve. 5.1 – Skirt, back, basic detail; 5.2 and 5.3 – Skirt, back, side gussets. 6.1 – Skirt, upper right part, basic detail; 6.2 – side gusset of the front right part of the skirt; 6.3 – right flap of the skirt. 7.1 – Skirt, front left part, basic detail; 7.2 – Side gusset of the front left part of the skirt; 7.3 – Left flap of the skirt. 8 and 9 – Double cuffs.

Some 6 m of fabric with a piece 56-58 cm wide were needed to make such a caftan.

The basic cut of a child's shirt (KCMR no. 9107/107)¹ is 'Central Asian' with a smooth line running in an arc from the waist to the sleeve (Fig. 2). Caftans of an adult man and a teenage boy (KCMR nos. 10269/1; 9537/16) show the same basic cut (Fig. 3). The cut of other men's caftans (KCMR nos. 9644/2; 3971/88; 6235/80.a), however, changed. What conditions may account for it?

Any change may be caused by both external and internal factors. The former include the movement of human populations (migration), goods (trade), ideas (religion and philosophy), and technologies. Although Alania's location on the Silk Route was conducive to external influence, the gradual changes of the cut of

the most widespread linen garment, however, seem more likely to be due to internal reasons. It can be surmised that it was due to the change in the attitude towards the fabric used to make clothes. If we accept that the original Central Asian pattern was based on felt having no restrictions on its width and length, the choice of fabric prone to such restrictions entailed its more sparing use. Thus, a man's caftan (KCMR no. 9644/2) has sleeves consisting of four pieces (Fig. 4). It is a striking example of the transformation of a smooth waist-sleeve line into a broken line formed by regular geometric patterns, i.e. triangles and rectangles, which, in their turn, were cut from rectangles with sides running along the warp and weft threads. The cut of a

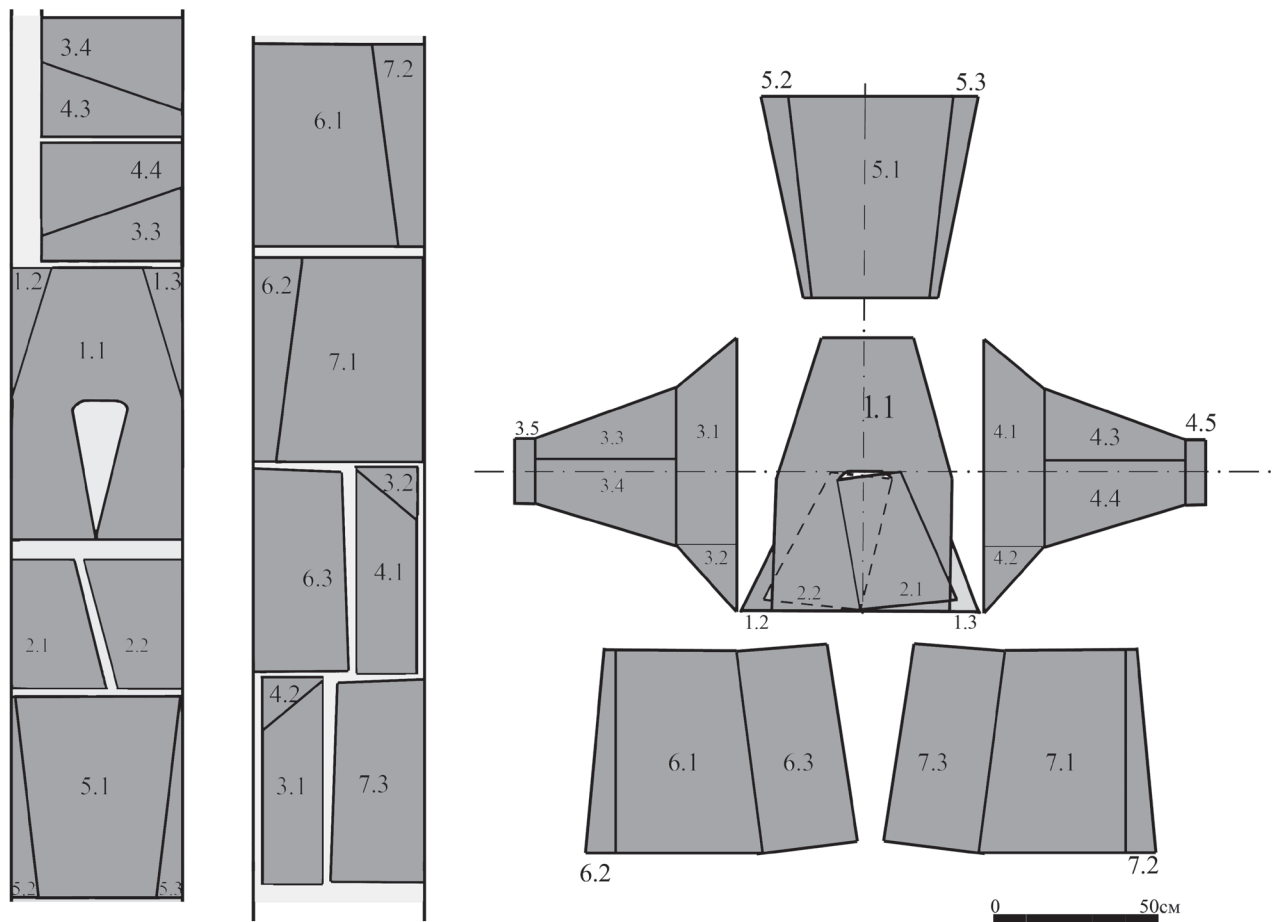


Fig. 4. Man's caftan (KCMR no. 9644/2). The cut and its arrangement on fabric (Drawing: author).

1.1– Bodice of the caftan. 2.1 – Upper right flap; 2.2 – Inner left flap. 3.1–4 – Details of the right sleeve; 3.5 – Cuff. 4.1–4 – Details of the left sleeve; 4.5 – Cuff. 5.1 – Back of the skirt, basic detail; 5.2 and 5.3 – Back of the skirt, side gussets. 6.1 – Skirt, upper front part, basic detail; 6.2 – Side gusset of the front right part of the skirt; 6.3 – Right flap of the skirt. 7.1 – Skirt, front left part, basic detail; 7.2 – side gusset of the front left part of the skirt; 7.3 – left flap of the skirt.

Some 5.5 m of fabric with a piece 52 cm wide were needed to make such a caftan.

caftan from the Metropolitan Museum (Kajitani 2001, 96; Knauer 2001, 125-154) is intermediate between those shown in Figures 3 and 4.

The division of the basic cut into the upper and lower parts could have been caused by several reasons not related to the sparing use of fabric, which does not take place under such conditions. It might be due to the lack of woven pieces of required length. The length of a piece for a pattern without a waist seam must average two lengths of the garment. If a seam is made, several smaller pieces for bodice and skirt are needed. Thus, the division of the pattern into the upper and lower parts likely took place in the milieu where short fabric pieces were manufactured. It can be

surmised that the pattern with a detachable skirt and oriental sleeves was brought to the North Caucasus by the Alans. The second reason is the widening of the hem, which would have been especially important for a horseman's caftan. Folds are the simplest means of doing it, but in this case they are not used. Alan caftans are widened through insertion of side gussets and vents, which may be reminiscent of the basic cut where the hem widening is attained by means of a curved line of the side seam.

Thus, setting apart the skirt in the Alan male costume led neither to the more sparing use of fabric nor to the widening of the hem by means of folds. It seems likely that the separation of the skirt is related to the length

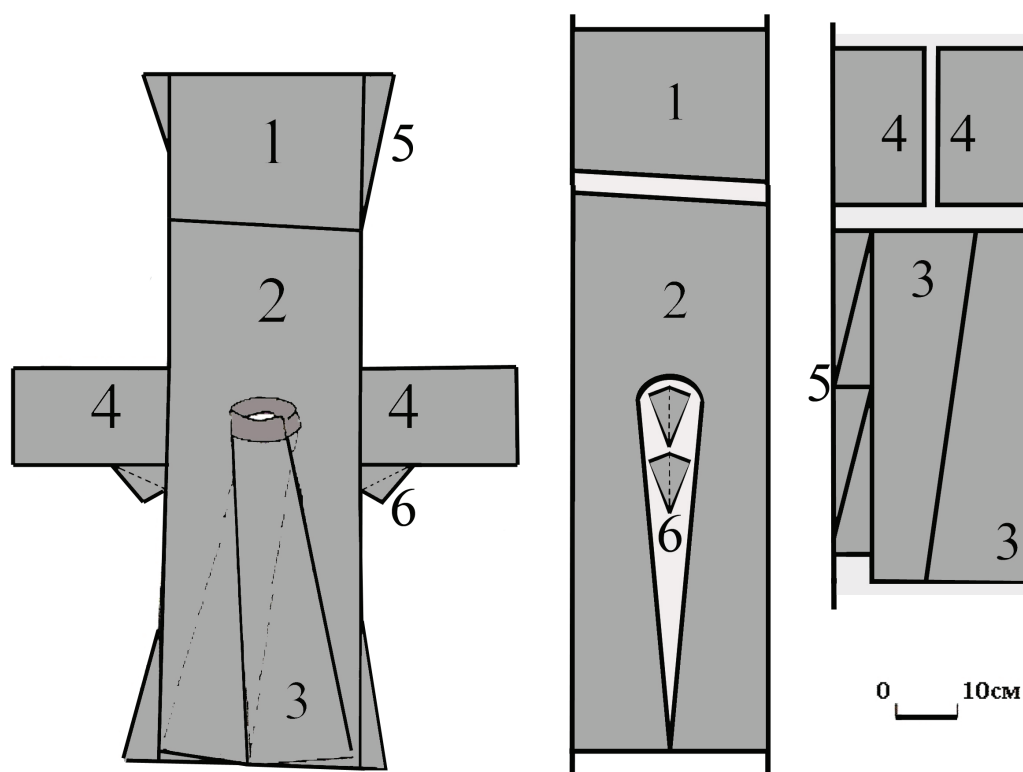


Fig. 5. Child's caftan (KCMR no. 3969/88). The cut and its arrangement on fabric (Drawing: author).
1 – Bodice, back; 2 – Bodice, basic part; 3 – Upper right and lower left flaps; 4 – Sleeves; 5 – Side gussets of the bodice; 6 – Gussets.

of the woven piece available at the time of change-over from felt to fabric².

A child's caftan (KCMR no. 3969/88) is based on a piece 30 cm wide (Fig. 5). It differs from the adult's caftan in the position of sleeves with respect to warp threads. The sleeves of the child's caftan are positioned along the piece³ while those of adult men's caftans are crosswise. A small gusset was sewn into the lower part of the sleeve to widen it. Such a change in the cut may be due to the change-over from the 'Central Asian' to the tunic-shaped cut more suited to woven fabrics⁴.

Let us turn again to the standard cut of a male caftan. Its bodice has two gussets transplanted from the back to the front part. These gussets, cut from the back, make it narrow at the waist and consequently make the shoulders square. The same gussets sewn into the front part of the garment widen the waistline, which is perfectly reasonable if a man has a paunch. Changes in the design of the man's caftan were probably due to

the emergence of a new standard of beauty: a stately, portly, i.e. well-fed, man.

Silk caftans should be treated separately. They are exemplified by a caftan in a fabric with a *senmurv* pattern from Moshchevaya Balka described by Ierusalimskaya (1978). Its cut differs from those of all the other specimens we examined. It can be accounted for either by its unique character or, which cannot be excluded, by an error of judgment on the part of the researcher (Ierusalimskaya 1978, 183-213, Fig. 17; the same pattern is reproduced in Ierusalimskaya 2012, 240, Fig. 142, i.e. it has not been reviewed in 35 years). Photographs show that mythical beasts on the bodice and skirt are positioned with their heads up. The same is true of the back part (Ierusalimskaya 2012, 235, Fig. 139). It seems likely that it was the intention to place these beasts in the natural position that led to the appearance of the shoulder seam. Yet, the surviving part of a sleeve shows *senmurvs* upside down (Knauer

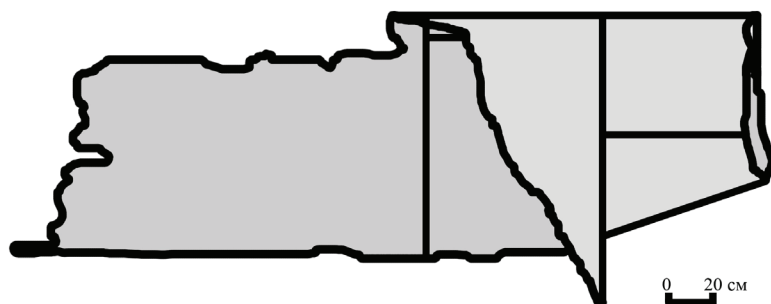


Fig. 6. Fragment of man's silk caftan from the collection of the Karachai-Circassian Museum (KCMR No. 9243/79) (Drawing: author).

2001, 129, Fig. 5). Thus, an assumption that the decorative pattern on fabric was regarded as a 'text' accounts for the position of *senmurvs* on the bodice and skirt but not for their placement on the sleeves. There can be several answers to the problem: 1) fabrics were in short supply; 2) the 'text' was not supposed to be read on sleeves; 3) the decorative pattern was not perceived as a text. No unambiguous solution can be obtained at present, yet it is evident that the sleeve of the caftan was cut along warp threads. A fragment of another caftan from the Hermitage collection made of Sogdian silk with a fur lining shows that the silk fabric of the sleeve was also oriented along warp threads (Ierusalimskaya 2012, 216, Fig. 132)⁵. A fragment of a caftan from the Lower Arkhyz reflects a similar line of joining of the bodice and sleeve and the spread of silk fabric on the sleeve (Fig. 6). Ierusalimskaya, while describing the large caftan from Moshchevaya Balka, insists that the 'local manufacture of this garment

is beyond doubt' (Ierusalimskaya 2012, 238). Yet, is it possible that these caftans were brought to the Caucasus ready-made.

It can be inferred that costly silk caftans were cut according to a modified pattern. This modification could be due to the use of ornamented fabrics. What all the caftans of this group have in common is the cut of the skirt, the narrowed back and the smooth sleeve-bodice line.

The analysis of the Alan male caftan hence indicates the following:

- 'Central Asian' pattern was divided into two parts, the upper and the lower, when the transition from felt to woven fabric took place. The division could have been conditioned by the restricted dimensions of the woven fabric pieces used.

- Alan tribes brought this pattern to the North Caucasus (Table 1, Im) where textiles were probably rare, which would explain the need for a more economical cut. The local linen fabric may have been used at that time, resulting in the division of the sleeve area into two parts (Table 1, II_m).

- Changes in the bodice and sleeve patterns took place while making expensive silk caftans, probably taking into account the orientation of the decorative pattern on the main fabric (Table 1, III_w). Making of the elite local silk dress was heavily influenced by external factors.

- A child's caftan with a straight sleeve and a small gusset in its lower part made of plain linen fabric represents the ultimate change of pattern (Table 1, IV_m), when a re-orientation of the sleeve fabric took place.

- Child's shirts of groups Im and III_m were recovered from one and the same burial which is indicative of the synchronous presence of several cut varieties.

- The connection between the first three groups and group IV is still elusive.

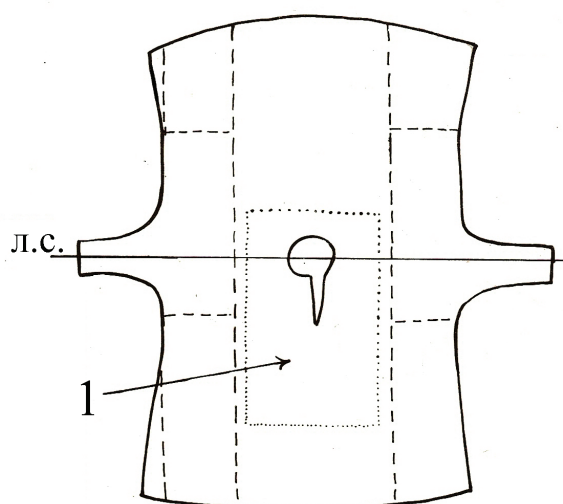


Fig. 7. Woman's dress (K3 6696, cat. 10) from the Moshchevaya Balka cemetery (After Ierusalimskaya 1992, Fig. 43).

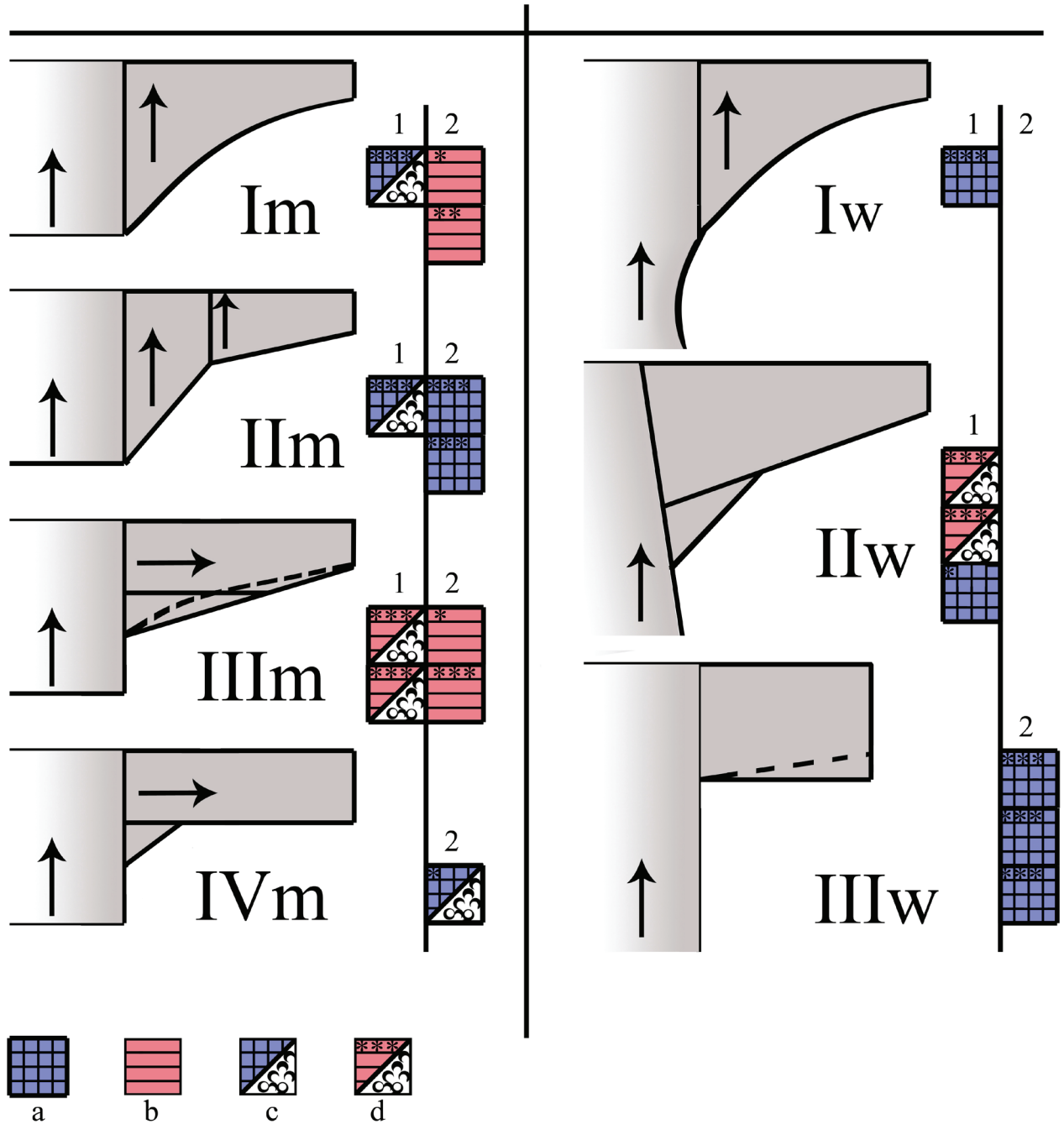
1 – patch pocket; л.с. – bend line.

Female Alan dress

While the Moshchevaya Balka cemetery dates primarily to the 8th-9th centuries AD, the date of the



Table 1. Diagram of different sleeve constructions (Drawing: author).



Lower Arkhyz cemetery, which is closely related to the Lower Arhyz settlement, may be extended to the 13th century AD (Tichonov 1997, 105-116). The cut of the female dress from the two cemeteries differs markedly. Dresses from Moshchevaya Balka may be earlier than those from the Lower Arkhyz. All the female dresses have a wide bodice and sleeves.

They are high-necked, with a small stand-up collar and a central slit covered with a breast pocket⁶. The catalogue of the exhibition 'Caucasus on the Silk Route' (Ierusalimskaya 1992, 43) presents cuts of an adult and a child dress from Moshchevaya Balka. The former (Fig. 7) fully fits within the Central Asian cut. It is also worth noting that this pattern demonstrates

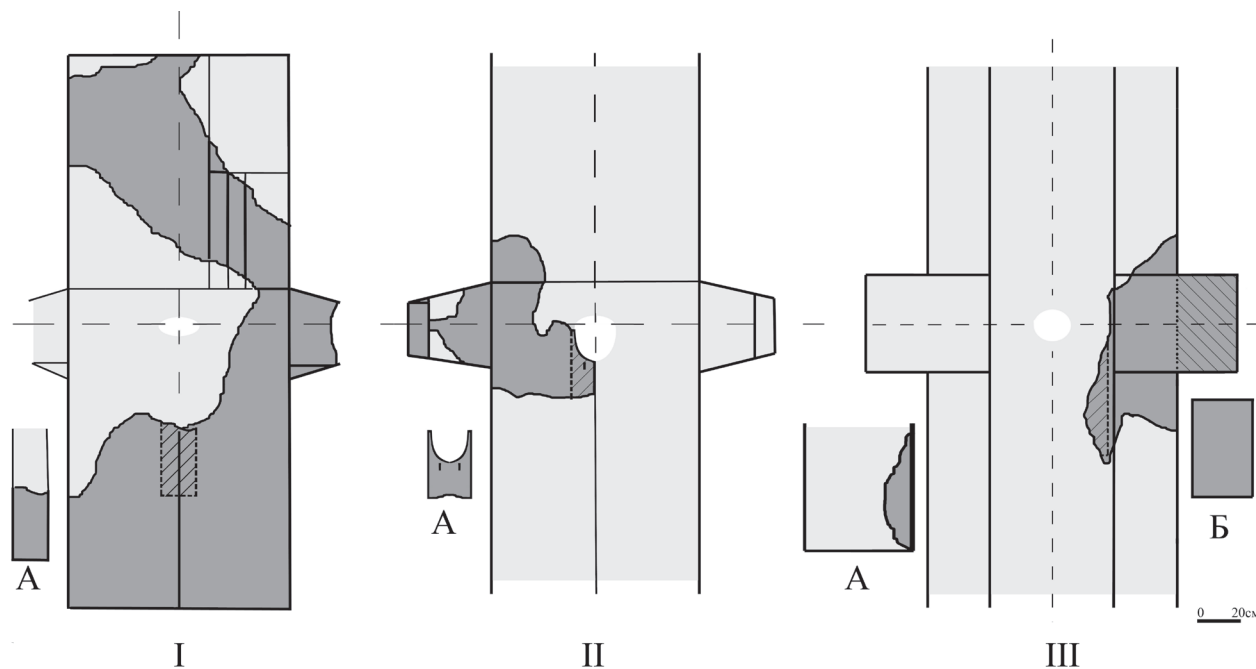
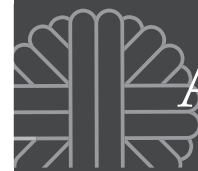


Fig. 8. Women's dresses from the Low Arkhyz cemetery (Drawing: author).

I – Dress (KCMR no. 6235/82), neckline unknown. II – Dress (KCMR no. 9541/34), length cannot be determined. III – Dress (KCMR no. 10288/17), neckline and length cannot be determined; width of the central sheet is calculated on the assumption that the side part amounts to half of the width of the woven piece. A – a patch detail of breast pocket; B – detail of lining sewn on the inner side of the sleeve.

clearly how the fabric was adjusted to the cut. The child's dress has a bodice consisting of the central sheet and wedge-shaped side parts onto which are sewn rectangular sleeves (the direction of warp threads is unknown) with triangular gussets in the lower part. Two women's fur coats also belong to this group in terms of their general pattern, even if various details differ, such as the absence of pockets (Ierusalimskaya 1992, 41, 42).

Female dresses from the Lower Arkhyz cemetery (KCMR nos 6235/82, 9541/34, 10288/17) have a straight wide bodice and sewn on sleeves (Fig. 8). The bodice of one dress consists of the central sheet with sewn on sleeves and two side parts. No smooth line of the side seam ever occurs in the robes from Lower Arkhyz.

As can be seen in Table 1, the female dresses from the two cemeteries have nothing in common. While Moshchevaya Balka has yielded two interconnected groups (I and II), the third group is present only in Lower Arkhyz. There appears to be no connection between the first two and the third group. Could the Lower Arkhyz robes be worn by representatives of another ethnic group? Unfortunately, we do not have a complete picture Scythian, Sarmatian and Khazar

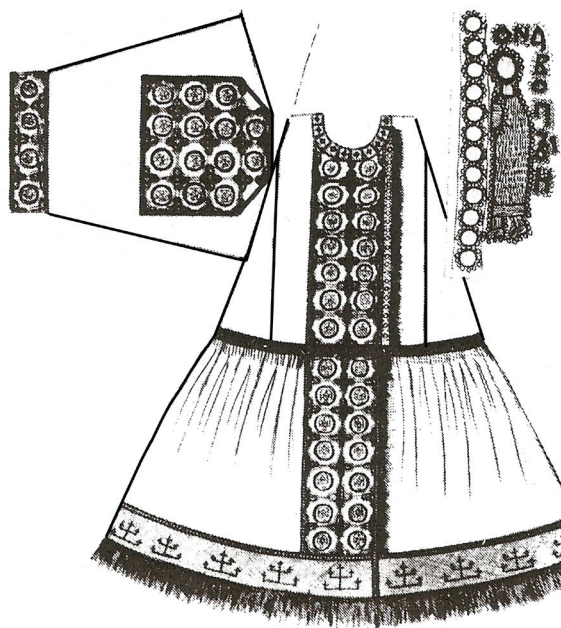


Fig. 9. Polovtsian caftan from the Chingul barrow (After Elkina 1983, Fig. 82).



clothes patterns. Therefore, it is impossible to date the change of the basic cut. However, the subsequent evolution of the Alan caftan can be traced. Thus, Elkina reconstructed the cut of a Polovtsian caftan from the Chingul barrow (Fig. 9; Elkina 1983, 82). The pattern is not complete but two gussets sewn into the front piece of the bodice, similar to those of Alan caftans, are well-marked. This small detail indicates the relationship of two forms, the Alan and the Polovtsian. There is, however, a distinction between the two patterns, i.e. the means of widening the skirt hem. The skirt of the Polovtsian caftan is gathered at the waist but it is beyond the scope of this paper.

Conclusion

This paper by no means intends to present a complete reconstruction of the evolution of the Alan clothes' cut from its emergence to the present. It is merely an attempt to distinguish the original cut whose development can only be traced approximately. The following conclusions can be tentatively put forward:

- Alan clothes were based on Central Asian cut connected to the use of felt for clothing.
- The change of the cut was caused by the transition from felt to woven fabric.
- At the initial stage of change the fabric was adjusted to the cut, i.e. laid out as a flat surface out of which the required pattern was cut.
- The second, transitional, stage only saw small-scale changes. The pattern remains Central Asian, yet it is cut with allowance made for the sparing use of fabric, i.e. the cut is adjusted to the fabric. Ultimately, this change of the male caftan pattern (excluding large silk specimens) was due probably to the attained equilibrium between the comfort of the garment and the expenses of its manufacture.
- At the third stage the properties of fabric prevail and dictate a new pattern of cut. Central Asian type of female clothes gradually becomes tunic-shaped. As to male linen caftans, such a transition is recorded only for children's clothes. The change of the pattern of large caftans was probably due to the use of patterned silk. At this stage the influence of external factors increases. Thus, Ierusalinskaya suggests that ready-made tunics were imported from the Mediterranean to the Caucasus (Ierusalinskaya 2012, 226; this assumption is based solely on the find of a cut-out tapestry wool gusset of a tunic). Maybe it was the imported tunics that had formed the general appearance of the 'new' Alan garment. If so, only the outline was copied, since warp threads of the classical tunic run crosswise to the human body and not along it as in the 'tunic-shaped' clothes. Alan robes have a big breast pocket uncharacteristic of the tunic.

- Female clothes yield two groups of shapes whose connection cannot be traced as yet.

– A gradual change of the cut was taking place in the clothes of the North Caucasian Alans in the 8th-13th centuries AD. Earlier forms with a smooth waist-sleeve line and more recent forms with straight lines of the cut can be recognized. A closer look at the textiles from different collections may help to get a fuller picture of the process.

To conclude, Central Asian pattern appears to originate from clothes whose pattern was based on the use of felt. It is characterized by a smooth transition from the bodice to the sleeve and a semicircular neckline with a straight line on the back. Other basic cuts, e.g. those that emerged with the use of animal hides, can also be distinguished. The proposed sequence of clothes' patterns, though far from being perfect, enables us to trace certain trends in the evolution of the cut of Alan costume.

Notes

1. Regrettably, the materials come mostly from looted burials. Therefore, clothes cannot be linked to excavated skeletons and cannot be dated more precisely than the lifetime of the relevant cemeteries.
2. It is unclear where this change took place.
3. The tunic of Tutankhamen (Crowfoot 1941, 113-130) and a whole series of other known Egyptian tunics (Hall 2001, 30-36; Kemp 2001, 187-220; Egyptian Textiles 2009, 56) were sewn of a piece placed along the torso. The sleeves were cut like the bodice – along the warp threads. It was possible since the Egyptians were able to weave long linen fabrics for making clothes (Chvostov 1914, 18-19).
4. Tunic-shaped clothes originate from linen tunics of Egypt where sheets of fabric up to 8–9 m long were woven (Chvostov 1914, 18). These tunics are made of fabric worn over the shoulders whose warp threads run along the torso. The sleeves were also cut along the warp threads. The neck was round.
5. The fabric orientation along warp threads on sleeves may be accounted for by small dimensions of the pieces of the expensive cloth. We do not know how strict were the requirements imposed on the pattern and what traits should be regarded as 'right' or 'wrong.'
6. The shape of pockets varies from narrow and long to wide and short. Probably this detail was not regulated.

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Author: orfio@yandex.ru



André Verhecken

Spinning with the Hand Spindle

An Analysis of the Mechanics and its Implications on Yarn Quality

Abstract

A qualitative analysis of the process of yarn spinning with the hand spindle is proposed. The parameters influencing the characteristics of the yarn spun are identified: they are mainly defined by the fibre, the spindle and the spinner. Consequently the spindle whorl is not the unique factor determining the quality of the yarn spun with it, as has been suggested in the archaeological and ethnological literature.

Keywords: analysis, handspinning, spindle, whorl, moment, inertia, yarn, quality, archaeology.

Introduction

In the literature, a direct relation between the weight of the spindle whorl and the diameter of the yarn spun with it has been assumed (Bohnsack 1981; Crewe, 1998). Based on form, dimensions and weight of spindle whorls from Belize, Murray (1998, 159) concluded that “it is clear that the whorls were all used for the spinning of cotton, rather than maguey”. Loughran-Delahunt (1996) postulated a relation between yarn properties and the size and weight of spindle whorls, the fibre being spun and the type of thread being produced. Wright et al. (2012, 142) state that “there is a demonstrated correlation between the weight of spindle whorls, the fiber being spun, and the type of thread being produced”, and also that “identification and analysis of spindle whorls and their weights, would demonstrate varied fiber use and thread production.”

Dimensions, mass (‘weight’ in cited texts) and form of the spindle whorl determine its moment of inertia (MI). A higher MI yields a slower but longer rotation (Médard 2006, 107). Generally, the slower the rotation speed, the thicker and looser the yarn; the higher the rotation speed, the finer and more closed the yarn, independent of the lengths of the fibres used. These

indices were thought to allow a precise description of the relations between yarns and spindles (Médard 2006, 109). Therefore a direct relation was supposed between the yarn (kind of fibre, yarn thickness and strength) spun with a given spindle whorl, and the moment of inertia of that tool. But no proof for this idea has been given yet, mainly because of two reasons. First, the determination of the MI of a given spindle whorl is not always an easy task, especially for complicated forms. Recently, a method for its experimental measurement using a torsion pendulum (Chmielewski and Gardynski 2010), and formulas for calculating the MI (Verhecken 2010), have been published. But once the MI is known, it still has to be confirmed that, for a given spindle, a unique relation indeed exists between its MI and the properties of the yarns that can be spun with it.

Based on a restricted number of published and experimental data, Verhecken (2010, 268) could not confirm that supposed relation. The conclusion was: “More insight in the fundamental processes that occur during spinning might shed more light on the factors that determine the yarn characteristics”.

Kania followed up with a well-organised large-scale series of tests, spun at the occasion of Textil Forum



2009, 8-13 September in Eindhoven (Kania 2013). The results of these tests clearly show that there is no strict relation between the MI of the spindle and the properties of the yarn spun with it. Other factors are also involved in the spinning process; the most obvious being the person doing the spinning (here called 'the spinner'), and the properties of the fibre to be spun. This had not yet been studied in detail for hand spinning with the spindle whorl. An approach to that analysis is here presented.

Analysis of the spinning procedure

Kania (2013) gave a good description :

"To spin yarn using a hand-spindle, the spinner imparts rotation on the spindle which is typically hanging from the thread already spun. While the free-hanging spindle rotates, the spinner uses both hands to draft a controlled amount of fibre from the prepared fibre supply. The drafting process is done between the two hands, and twist is then allowed to enter the drafted fibres by releasing the pinch of the fingers of the lower hand on the thread, transforming the drafted fibres into yarn. Drafting is continued by bringing the lower hand back up close to the upper hand. The lower hand grips the yarn, thus stopping twist from travelling upwards into the fibre supply, and gently pulls downward for the next drafting cycle. The thread made in this manner has to be wound onto the spindle stick by hand, periodically interrupting the actual spinning process."

In the following, 'sliver' is an assemblage of fibres in rope form without twist, a 'roving' is the relatively fine fibrous strands used in the later or final processes of preparation for spinning (Anon. 1970), and 'yarn' here refers to the twisted single thread ready for use in weaving etc.

A yarn is characterised by the nature of the fibre, the fibre length, diameter, specific density; the amount of fibres in a yarn cross-section, the degree of packing of the fibres, the twist, expressed as twist angle (β) or as twist intensity ($\kappa = \text{tg}\beta$, or $Z = \kappa/(d \cdot \pi)$, according to different authors), the yarn diameter (d), and the yarn count (T), expressed in Tex (gram per km yarn length), and breaking strength. Some of these parameters are interrelated.

The physics of the processes occurring during spinning is quite complicated. Formulas for a number of parameters have been proposed, based on industrial spinning research, but their mathematics is not easy (Kremenakova 2002). Therefore, in the

following treatment mainly qualitative relations will be used instead of quantitative formulae. An important number of factors influencing the quality of the yarn obtained can be identified and explained in the following:

The spindle: Consists of a spindle whorl with a central boring in which the spindle shaft, generally made of wood, is fixed. In archaeological sites, in most cases the shaft has disappeared; but the rotation properties of a spindle are mainly defined by the spindle whorl.

The roving: Starting from a sliver of fibres arranged in a partly parallel but overlapping position (by carding or combing), the spinner drafts them out to form a roving consisting of an intended *average number of fibres, overlapping* to an average degree. Since not all individual fibres from the same stock are equal in diameter and length, the fibres used have a given *range of diameters* and a *range of lengths*. The *density of the fibre material* also determines the *tex* of the yarn obtained.

Spindle rotation: From this bundle of fibres is manually drafted the material for a rove, that will be converted into yarn by the *twisting* caused by the *rotation of the spindle*. During twisting, each individual fibre is, to a certain extent depending on its radial position in the yarn, simultaneously submitted to bending and to torsion around its length axis. Moreover, the fibres are shifted in their position relative to each other. The amount of energy consumed during the twisting thus depends on the *bending* and *torsional properties* of the fibres and the *frictional properties* of their surface.

To that purpose, the spinner *activates* the spindle by giving it an amount of *energy* in some way, such as rotating the spindle shaft between thumb and forefinger (*flicking*), or by rolling the spindle shaft on the thigh. In both cases the spindle shaft (diameter d_s) is rolled over a length of surface L (thumb or thigh) in a given time t seconds: the shaft makes a number of rotations equal to $L/(\pi \cdot d_s)$, each rotation equals π radians, so the angular velocity ω is $L/(d_s \cdot t)$ rad/s. The energy thus given to the spindle equals $I \cdot \omega^2 / 2$, where I stands for the MI (Verhecken 2010, 266). But as energy is consumed by the twisting of the fibres, the rotation will slow down and eventually stop, and then will start turning backward. The spinner will again activate the spindle before the rotation stops completely, when it still has a given *twist at the end of each activation period*.

It must be remarked that d_s can be different over the length of the shaft; thus d_s at the place where it is activated (flicked) is not indicated by the bore in the whorl, usually the only shaft dimension available to the archaeologist.



The above mainly applies to the freely hanging drop-spindle, but also to vertically or horizontally supported spindles, but in the latter cases extra energy is lost because of friction of the shaft with the support.

Twisting: The drafting action by the spinner, at a given *drafting speed* and for a given *drafting time*, together with the rotating movement of the spindle, produces the *twist* that forms a certain *length* of yarn. This length will be shorter than the rove length, because of the twisting during a given *twisting time*; this produces a *twist angle* β and a *twist intensity* κ (defined as the tangent of the twist angle β between the twist direction and the yarn axis). The rotation also brings more closely together the individual fibres in the yarn, and thus reduces the *diameter* and increases the *breaking strength* of the yarn. On the other hand, in the case of a pending spindle, this yarn length can get a slight relative *increase* owing to the weight of the spindle whorl, according to the *fibre slip* depending on its frictional properties. The yarn length can also be influenced by the *stress-strain properties* of the fibre, which can differ very greatly according to the fibre type (Morton and Hearle 1962, 287 fig. 13.22), but this can, at least partly, be reversed when the yarn is no longer under that strain.

The rotation is strongest immediately after each activation of the spindle, and gradually slows down as the activation energy is consumed by the twisting. Thus, the twist is not evenly distributed over the length of yarn spun from one or several drafts; but the twist is redistributed more evenly over that yarn length (Franzen 1954, 379) to a value called the *twist intensity* (κ), during which period the fibres are packed to the *fibre packing density* (μ).

The cop: The length of freshly made yarn is then wound around the spindle shaft, forming a generally conical *cop* (Cayne 1990), thus increasing the total weight of the spindle as the cop is added to, and consequently also the MI of the spindle, resulting in a *slower rotation* for a same activation energy. This increase in weight also will produce an *extra elongation* of the yarn which is still in the spinning phase, and thus a growing compaction of the fibres in the yarn cross-section. So, these parameters will change during spinning, unless the spinner (intentionally or intuitively) compensates for these effects.

When the spinner judges that the amount of cop is enough (because the spindle is 'full', or spinning the intended yarn quality becomes too difficult, spinning is stopped and the cop is taken from the spindle. Then a new spinning cycle can be started with the 'empty' spindle under parameters markedly different from the situation just before.

The yarn: Since the parameter *yarn count*, expressed in *tex*, is always determined on relatively large yarn lengths, this averages out variations in that value along the yarn. These variations can be important: drop spindle spun woollen yarns typically vary from one-third to three times the average *tex* (Cooke and El-Gamal 1990, 71), and the yarn-breaking strength depends on its thinnest parts. The yarn diameter must be measured at many places, and then averaged.

The yarn count can also depend on the spinning technique used (drop-spindle versus supported spindle) since a very thin yarn (depending on the length and surface properties of the fibre) cannot support the weight of a heavy spindle. But it may be difficult to judge the spinning technique used at archaeological sites, unless spinning-bowls can be identified clearly there.

The spinner: Obviously the experience and skill of the spinner is of great importance for the quality of the yarn produced. Even when the same spinner works with the same fibres, the yarns obtained will not be completely identical: they will show differences that are not accounted for in this study but which can be measured and statistically evaluated. However, such close scrutiny is severely problematic in archaeological contexts.

Results

From the above description it is clear that the parameters of importance for spinning depend on: a) several properties of the fibre used; b) the characters of the spindle used: mainly the spindle whorl; c) input given, intuitively or based on experience, by the spinner; d) values derived from combinations of all the above.

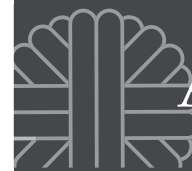
Some of the parameters are basic physical values such as length, mass, speed; others are derived from these basic values. Some of the relations governing fundamental yarn parameters such as yarn count (*T*), twist intensity (κ), packing density (μ), and diameter (*d*) have been quantitatively studied in industrial contexts (Kremenakova 2002); but other parameters have not yet been fully studied. In these latter cases, when values cannot be calculated (yet), the dependency can be established qualitatively by straightforward reasoning.

Table 1 lists the parameters influencing the yarn quality, and indicates whether they are dependent on the spinner, the spindle, the fibre, or on a combination of some of these factors. In number, the spindle parameters form only a minor part; but the relative amount to which every parameter influences the properties of the yarn cannot be derived in a simple



Table 1. The parameters influencing the yarn quality, and the factors by which they are defined.

	Parameter	Symbol	Unit	Defined by			Derived	
				Spinner	Spindle	Fibre	from	Relation
1	Activation energy	E	joule	x	x		x	$E=I \omega^2/2$
2	Spindle mass		g		x			
3	MI spindle	I	g cm ²		x		x	2 form-dependent
4	Cop mass		g	x		x	x	
5	MI cop	I	g cm ²	x				6 form-dependent
6	Number of fibres in draft		n	x				
7	Mean fibre length	lf	mm			x		
8	Mean fibre diameter	df	mm			x		
9	Fibre density	ρ	g/cm ³			x		
10	Fibre count	dT	g/kg			x		decitex
11	Fibre bending properties					x		
12	Fibre torsion properties					x		
13	Fibre friction properties					x		
14	Fibre stress-strain propert.					x		
15	Rotation speed at start		RPS	x	x		x	$\omega=\sqrt{(2E/1)}$
16	Drafting time		sec	x				
17	Length per draft		cm	x				
18	Drafting speed		cm/sec	x			x	16, 17
19	Twist equilibration time		sec	x			x	15, 24
20	Twist at end of activation	Z	m-1	x				twists /m
21	Twist intensity	κ	none				x	20, 25 $\kappa= \text{tg}\beta = \pi d Z$
22	Twist angle	β	°				x	21
23	Draft-to-yarn shortening		%	x			x	21
24	Rotation speed at stop		RPS	x		x	x	15
25	Total nr of rotations at stop		none	x			x	15, 20, 24
26	Weight-induced elongation		%		x	x	x	13, 14
27	Yarn count	T	g/km				x	tex
28	Yarn diameter	d	mm				x	6, 8, 21
29	Yarn density	γ	g/cm ³			x	x	9, 30
30	Fibre packing density	μ	none				x	21, 29, 9 $\mu= \gamma/\rho$



way. In studies on archaeological spindle whorls, the influence of the spinner is generally not mentioned, obviously by lack of data.

Conclusion

The important parameters for the action of yarn spinning with the manual spindle were identified, and found to be dependent on the characteristics of the spindle whorl, the fibre spun, and on the actions of the spinner. This is shown here based on a qualitative analysis. Consequently, it must be concluded that the properties of the individual spindle whorl used do not uniquely determine the properties of the yarn spun with that spindle whorl. This implies that it is not possible to deduce the properties of the yarn that had been spun with spindle whorls of known MI, found at archaeological sites. Only very wide ranges of yarn properties can intuitively be related to coarse groups of spindle whorls, as illustrated e.g. by the incompatibility of a very thin yarn and a heavy spindle (cfr. the yarn).

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Author: andre.verhecken@telenet.be



Stella Spantidaki

Textile Production in Classical Attica

A brief PhD Thesis Summary

Abstract

This study examined textile production in Attica with an interdisciplinary method, which combined information from the written sources, iconography, textile production tools and textile remains, in order to establish the most complete image possible of the textile activity in the Classical period. These sources inform us of an elaborate textile production and a division of labour in this domain. The Greeks have inherited a great textile tradition and technical knowledge, which, combined with their familiarity of the natural environment, allowed them to choose between various raw materials, production and embellishment techniques in order to achieve the desired result. Differences in the quality of the raw materials, production and embellishment techniques indicate that a great variety of textiles of different qualities were produced in order to respond to the needs of all social classes.

Key words: *Archaeological textiles, textile production, household, workshop, embellishment, classical Greece*

Textile production holds a major place in ancient societies. Its study informs us about both the significance of textiles and the people involved in their manufacture and distribution. The aim of my PhD thesis was, through the study of this activity, to enhance one of the most dynamic aspects of the classical Greek society and to contribute to its better understanding. This subject was particularly interesting for two reasons: firstly, the study of textile production is a rather recent development in Greece due to the rarity of archaeological textile remains until the last decade; secondly, this activity required a combination of great manual and cognitive skills.

Apart from a few textile discoveries in the mid-20th century, such as the textile from Eleusina, we did not know about other extant textiles in Greece until recently. In fact, the Mediterranean climate of Greece is not favourable for the conservation of organic materials. Fortunately, since 2000, the excavations for the underground construction in Athens have brought to light several textile fragments dated to the Classical period. At the same time, archaeologists

began to “discover” extant textiles in storage rooms of museums of Attica. Today, there is a corpus of 26 textile fragments from Attica and several pieces from other regions of Greece that date to the Classical period (overview in Spantidaki and Moulherat 2012, 198-199). The mode of conservation most commonly observed is mineralisation as a result of contact with corroded metals. Until recently, studies of mineralised textiles were limited to their technical characteristics (i.e. weaving techniques), due to the lack of an appropriate method for the identification of raw materials. Fortunately, the multiplication of textile discoveries in Greece has coincided with the development of a methodology appropriate for the analysis of mineralised textiles, at the Centre de Recherche et de Restauration des Musées de France (C2RMF). This method combines the use of optical and SEM microscopy and allows the identification of the fibre, irrespective of the mode of conservation of the textile. So the researchers have at their disposal, for the first time, a new corpus of textiles and a method of analysis suitable for their most common conservation form



Fig. 1. Hard twisted threads on the textile 3 from Koropi (Photo: ARTEXT).



Fig. 2. Traces of supplemental weft on the textile 3 from Koropi (Photo: ARTEXT).

(Moulhérat 2005, 13). The creation of the Centre for Research and Conservation of Archaeological Textiles (ARTEXT) in 2002 in Athens launched the study of Greek extant textiles with this new method. Being a member of ARTEXT, I participated in the analysis of numerous fragments and personally studied the latest discoveries.

My aim in my PhD thesis was to create a clearer image of textile manufacture and distribution during the Classical period. I used an interdisciplinary methodology, combining information from the fields of archaeology, biology, art history and classics. The project structure encompassed two main research strands: Textile manufacture techniques and organisation of textile production.

Textile production in ancient Greece has been traditionally connected with women and the space of the household, the *oikos*. Written sources provide abundant evidence of free and enslaved women being responsible for the family clothes and household textiles. The space used for weaving was called

histeōn, or *histōn* (Menander, *Samia* 234-235). Activities undertaken in the household included spinning, weaving, washing and dyeing. Women often reached a high level of skill, demonstrated by the fact that the peplos, a special dress offered every year to Athena Polias during the Little Panathenaia procession in Athens, was produced by young girls of aristocratic families (Brulé 1987, 83).

Archaeological evidence from the city of Athens provides a lot of information about ancient household production, in comparison to other Greek cities. However, archaeological evidence for textile workshops in Attica is scarce. Only one building has been interpreted as a spinning or weaving workshop, building Z in Kerameikos, dated to the middle of the 4th century BC, where a group of 153 loom weights has been discovered (Knigge 1980, 263). A fullonica or dyer's workshop was probably located in the east of the town at the end of the 4th century BC (Sanidas 2013, 105). Classical texts mention existing textile workshops situated either in or near the private household, or entirely separated from it, in the Agora

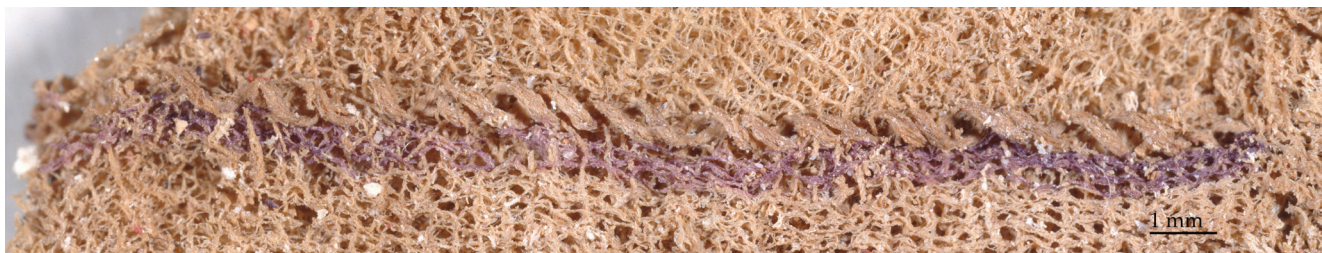


Fig. 3. Detail of the starting border of the textile from Kalyvia decorated with a purple stripe created with seven purple weft threads (Photo: ARTEXT).

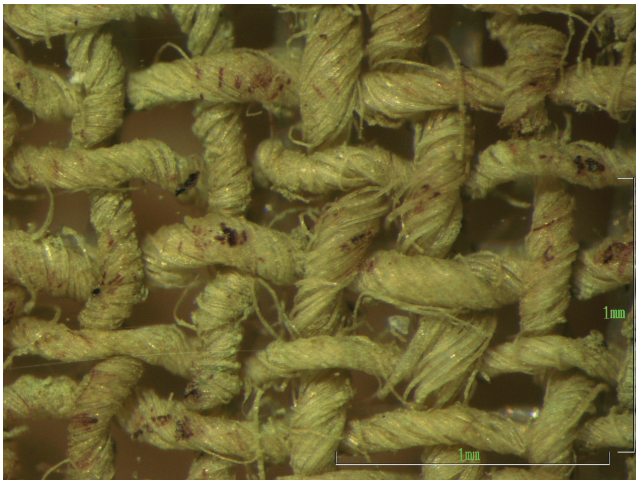


Fig. 4. Detail of red colour traces on the textile 2 from Koropi (Photo: ARTEXT).

and other parts of the city. The workshops could also act as shops for the products made there. A very large number of skilled men and women, very often slaves, but also liberated slaves and freemen, appear to have worked in workshops in the Athenian Agora under the supervision of a master weaver, *hyphantis*. The information about the organisation of these workshops is not always clear; it seems, however, that Athenian citizens could own a workshop and employ a large number of workers, each one of them working at a specific stage of the chain of production. During the classical period we note frequent references to fullers' workshops in Athens, often at the edge of the Agora, and texts of the 4th century BC also mention dyers' workshops. In written sources, we note the clear division of labour concerning textile production. The classical texts mention a high number of specific occupations related to textile production, as terms designating textile workshops and selling places (Spantidaki 2009, 80-83; Sanidas 2013, 220).

The textile fragments of this study have all been discovered in funerary contexts, specifically in cremation urns. Hence, they are not characteristic of the whole textile production of the 5th and 4th centuries BC, but constitute a specific sample related to funerary rites of this period. Their study has allowed the identification of a specific type of textiles used in this context, which present great uniformity in their technical characteristics (raw material, weave, thread count and thickness). This image is in contrast to the information derived from the written and iconographic sources, which mention the use of a large variety of textiles in the daily life of the population. Despite their uniformity, certain fragments present differences in quality, which attest to the existence of

textiles of different value. This funerary textile corpus, however small and specific, helps us get an idea of textile production during the Classical period. The combination of information from textile analysis with that provided by other extant sources allows us to draw an image of textile activity in this period.

The new methods of study and analysis of the extant textiles have allowed the identification of new manufacturing techniques used in the Classical period. One of them is the technique of the characteristic crimped textiles known from vase paintings and sculptures. This effect, called *crepe*, is created by the use of very hard twisted threads with a crimped aspect. Such threads have been identified in several classical textile remains, especially the textiles from Glyphada, Koropi, Marathon and the hemp fragment from Trachones (Fig. 1). This technique resulted in the fabrics with a unique appearance simply by increasing the twist of the threads during spinning, and without the need to change the weave of the cloth. It could be combined with other techniques, such as pleating, dyeing or open weave, in order to achieve more variable results.

The study of the archaeological evidence indicates that the final appearance of a Greek textile did not depend as much on the weaving technique, which was always plain weave or tabby, as on the large variety of embellishment techniques used. The term *embellishment* is used to describe all the different procedures undertaken in order to improve a textile's appearance. These techniques can be divided into two categories: the first includes the decorative techniques used during and after the weaving, while the second refers to the special treatments of the whole or parts of the cloth before and during spinning and during and after weaving. One notices that, while always keeping the same weave, ancient Greeks were able to choose between known embellishment techniques in order to create unique products.

This study also demonstrated the existence of a great variety of decorative techniques used in this period. Today we have evidence for the use of embroidery for example on the textile 1 from Koropi (Spantidaki and Moulherat 2012, 193, fig. 7.16), supplementary weft techniques (textiles from Eleusina, Glyphada and textiles 2 and 3 from Koropi; Fig. 2) and dyeing (textiles from Kalyvia, Koropi, Maroussi and Kerameikos; Fig. 3). Each technique could result in very different decorative patterns; using, for example, the techniques of supplementary weft, one could create either small repetitive patterns, or very complex decorations. In the same way, several techniques could be employed for the creation of the same pattern and achieve a similar aesthetic result. Using, for example, the techniques of

supplementary weft, embroidery, reserve dyeing and painting, one could achieve very similar results. Thus, it is rather difficult to associate a specific pattern with a particular decorative technique, apart from the crepe textiles.

Concerning colour decoration, there is archaeological evidence for the use of natural dyes, in particular purple dye, in textiles from Kalyvia, Maroussi and Kerameikos. The dye analysis of the first two fabrics has shown that they were dyed with real murex purple dye (Spantidaki and Moulherat 2012, 195). As for the fragments from Kerameikos, there is no information about a dye analysis (Margariti et al. 2011, 525). The textile 2 from Koropi conserves traces of a painted pattern in black and another in red colour (Fig. 4). We can be sure that it is painted, because the colour has not penetrated into the fibres, but has remained on the surface of the cloth. Finally, a hot wax dyeing technique is mentioned in written sources as used by foreign people, and samples of resist-dyed textiles have been discovered near the Greek colony of Panticipaeum (nowadays Kertch, located in southern Ukraine). Kurgan 4 at Seven Brothers, dated to the mid-5th century BC, yielded a piece of resist-dyed wool tabby (Barber 1991, 206; Gleba and Krupa 2012, 413, fig. 20.14). In Kurgan 6 at the same site, dated to the early 4th century BC, a large wool sarcophagus cover was also resist-dyed (Gerziger 1975, 51; Barber 1991, 206-209, fig. 7.11 and 16.15). Both textiles were decorated with friezes illustrating Greek mythological scenes; the names of the depicted gods and heroes were written in Greek.

The study of the embellishment techniques has given rise to the hypothesis that during the Classical period different techniques were used as substitutes for tapestry and purple dyeing. As these were very expensive and time consuming techniques, the Greeks had found alternatives in order to be able to satisfy the needs and wants of a wider range of social classes. Concerning tapestry, there is no archaeological evidence for its use in Attica during the classical period. However, recent work on experimental archaeology has demonstrated the possibility of creating tapestry on the warp-weighted loom (Ellen Harlizius-Klueck, experiment of tapestry weaving on a reconstructed warp-weighted loom based on a reconstruction of the painting on the ependytes of the «Peplos Kore», done by Vinzenz Brinkmann, 2004. The experiment was done at a research project within the exhibition “Gesponnen und Verwoben. Textiles zu Zeiten von Römern und Germanen”, in the Clothiers Museum Bramsche, Germany, from 5th June until 25th October 2009 (unpublished); Wikman

1996, 18; Oscarsson 2010, 64-73). Hence techniques such as the supplementary weft, embroidery, reserve dyeing and painting, employed for the creation of decorative scenes, could be interpreted as cheaper and less time-consuming alternatives to tapestry. This is archaeologically illustrated in Kurgan 6 at Kertch, where inside the sarcophagus with resist-dyed textile, pieces of a wool tapestry were also found. The presence of both techniques in the same grave indicates that “the resist dyed clothes were the inexpensive, but elegant, substitute for the time consuming and therefore expensive tapestry clothing” (Perivoliotis 2006, 5). Concerning shellfish purple dyeing, written sources mention a long list of colorants as substitutes for purple dye. We also know that, as the major part of the population did not have the means for dyeing their clothes with real shellfish purple dye, they tried to imitate the purple shades using blue and red dyes produced by other plants and animals (Barber 1991, 229). These “imitations” could satisfy the demands of the Greek consumers with minor expense. This study shows that the Greeks of the Classical period had a great weaving tradition behind them and had acquired a high level of knowledge and skill, which allowed the creation of unique textiles with many different ways and techniques. They were able to choose between raw materials, weaving and embellishment techniques, and combinations of these, in order to achieve the desired result. Subtle changes in the twist of the threads, the choice of a decoration technique, the colour decoration, the density of the fabric or the thickness of the threads, all contributed to the final appearance of the cloth and made it unique. At the same time, textile craft counted among the most significant economic sectors of classical society and the study of the organisation of textile production and consumption offers valuable information about the organisation of the society itself.

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Author: sspantidaki@yahoo.com

Ulla Isabel Zagal-Mach Wolfe

Seizing Wind, Wielding Power

The dissertation *Grasping Technology, Assessing Craft: a Research-Method for the Study of Craft-Tradition* (Zagal-Mach Wolfe 2013) is concerned with the subject of craft and technology and the intricate connection between man, his objects and society. The aim of the research has been to achieve a comprehensive understanding of the inherently social phenomena of craft and technology and subsequently how to study them through the limited empirical record of archaeological material.

When archaeologists claim to study social and cultural structures and phenomena, patterns of social engagement and human interaction in general, the study is always based on the material culture of the past. It is understood that these objects have been created and crafted by people of the past, but the weight of this fact is not always recognized; the fact that no matter what phenomenon we might focus

on, we are always studying the material expression of past manufactures and productions. This acknowledgement leads to the question of how and to what degree craft and technology can be said to be inherently human and to what degree they shape and mirror societies.

These questions brought about the topic of the doctoral research project, namely an attempt to discern the complex of craft and production, and to understand the degree to which we can answer questions concerning the technological choices of the past. If we accept archaeological material culture as being a creation, then the artefact, or a structure, becomes not only *form* but also contains the idea of the form, the choices that were made and the ideas about the function in the mind's eye, as well as the social relations and interaction of the craftsmen all culminating in the *gestalt* that is the artefact we see

today. The manufacture and objects of human beings will also be what shape the societies, minds and bodies of the people involved.

The thesis proposes a research-method that puts attention on craft-tradition, understood to mean the comprehensive complex of manufacture, the social relations and context, *actants*, and *habitus* of the craftsman. The research method is general in its design as it outlines the different levels of study necessary when studying a craft-tradition. The aim of the research strategy is to enable the researcher to get an insight into the structure and process of craft.

I discuss and define a theoretical framework using the concepts; technology, craft, technique and tool. I established the concept of craft-tradition as fundamental for my study and research methodology as it includes both the aspect of construction and use of an object as embedded in the practice of technology, craft, technique and the shape of the object. The aspiration is to establish as generalized a model as possible, in the attempt to see the action of craft and production and the social role as a craftsman as a general human phenomenon.

The research method is tested on one of the “black-box” conundrums of prehistoric archaeology: My case-study focuses on the textile craft-tradition during a change that is presumed to have brought about the production and use of textile sails on Scandinavian boats. The population of prehistoric Scandinavia maintained a longstanding tradition of oar-driven boats (e.g. Crumlin-Pedersen 1986; Andersen et al. 1989; Andersen et al. 1989; Andersen and Andersen 1998; Bender Jørgensen 2005; 2012; Bender Jørgensen and Damgaard Sørensen 1999). The archaeological record of south Scandinavia does not give us any remains of textiles that can be presumed to be sails until the beginning of the Scandinavian Viking Age, around 800 AD in the Oseberg burial. Nevertheless, depictions on, for instance, the Gotlantic picture stones and the remains of a developed rig found in the Oseberg ship and later finds, do show us that a development took place in Scandinavia during the late Iron Age, presumably during AD 500-800 (see Christiansen 1974, 167; Varenus 1992; 2006, 255-256; Westedahl 1995; Andersen and Andersen 1998; Bender Jørgensen and Damgaard-Sørensen 1999; Englert 2000, 37; Ingstad 2006; Bender Jørgensen 2005; 2012; Arthursson 2013). This development eventually changed and combined the longstanding tradition of oar-driven boats with the blossoming of a skilled use of rig and sail.

It is safe at this point to rule out the Scandinavian sails as being a completely isolated invention. The ships are a result of a specifically Scandinavian shipbuilding

tradition and displayed a long-standing resistance to the sail. The conceptualization of the social function of the sail seems to be securely embedded in the existing maritime and social structure as seen in the etymological and iconographical evidence. The stringent conceptual boundaries of the social hierarchy, the maritime display of this structure, as well as the craft-tradition of textiles and arguably of boatbuilding, speak against the mere import of an object. It possibly started as a copy and quickly developed into a specifically Scandinavian *object-group*, through the combination of techniques and tools.

In the social and political context of early urbanization processes during the 7th century AD the change in craft-tradition that introduced the use of textile sails in Scandinavia takes on a wider relevance. The economic and political developments in Western Europe and the largely simultaneous establishment of the Caliphate as the leading economic and political power in the Old World are of significance. The north was connected with these powers in a complicated, mainly indirect, center-periphery relationship that gave a general framework for the beginning of the process (Callmer 1994, 79).

The process of urbanization made its mark on the maritime technology in several respects. Specialized landing places in Denmark increased during the 7th and 8th centuries AD, and Ulriksen speculates that this must be a result of a change in the prestige-object trade as well (Ulriksen, 1997, 122). He is of the opinion that the relationship between England and Scandinavia was one of alliances consolidated through gifts and family ties during this period, creating a map of communication routes which Hines describes as used for “migration, trade and the diffusion of craftsmen skills” (Hines 1984, 278). It might be within this context that the fusion of techniques and/or the copying of the *object-group* sail occurred in Scandinavia. After all, the gift of technology, technique, tools, which facilitated the introduction of the sail, must have been one of considerable dimensions, that is to say, when the receiving Scandinavian textile craft-tradition was ready for it, which it appears it was during the 8th century AD: “From a Western European perspective it was the decades around the year 700 that the growing tendencies towards a fundamental rearrangement of the perception of the economic and external political relations were clearly expressed” (Ulriksen 1997, 222, author’s translation).

In other words, the sail did more than adorn the mast of ships or project the aspirations of powerful men. It was part of a fundamental change, both political and economic, binding together lands and people



in new social constellations. I maintain that it is within the framework of the urbanization processes of Scandinavia that the changes within the textile craft- tradition must be seen, and subsequently the introduction of the sail in Scandinavia. Consequently, there is a need for further studies of this relationship that forever shaped not only the socio-political landscape but also the horizons of Scandinavia.

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Author: ulla_isabel.zagal-mach_wolfe@ark.lu.se

Michael Tellenbach

The EU-funded Research Project DressID

Under the heading “Clothing and Identities – New Perspectives on Textiles in the Roman Empire (*DressID*)”, institutions in seven European countries spent five years systematically investigating the question of what knowledge can be gained about the identities of the inhabitants of the Roman Empire – the first multi-ethnic state in Europe – based on their clothing. Hundreds of publications, detailed studies, conferences on specific aspects, papers and reports emerged from the project over the five years of its duration. The project was initiated by the Reiss-Engelhorn Museums in Mannheim; textile archaeology and dress studies formed the starting point for the investigation. The questions that guided the investigation were: Is it possible to find out which animal and plant fibres were used in the Roman period, where they came from, how they were prepared, which weaving techniques were used for what and which colours the garments were dyed? What does this tell us about the dress worn in different parts of the Roman Empire? What insights can be gained through dress into the relationship between Rome and the provinces, the differences between men and women, children and the elderly, clothing and religion, trade and production? Dress is an expression of both the collective and social identity of individuals. Even today, clothing provides insights into a person’s status, religion, ethnicity, gender and background. This kind of self-expression requires far more commitment than, for example, oral statements, which are temporary and from which one can dissociate oneself more easily. The analysis of ancient clothing gives us an idea of which of these categories were rooted deeply in the minds of people in that time. There was lively interest in the project on the part of archaeologists and biologists, textile experts and prehistorians, epigraphers and zoologists, art historians and physicists, chemists and religious scholars in many countries in Europe and beyond. Organisations from six European nations took on the co-organisation of their country’s activities and co-signed the project proposal that was prepared by the

project coordinator, the Curt Engelhorn Foundation for the Reiss-Engelhorn Museums, and sent to the European Commission:

- DNRF Centre for Textile Research (CTR), University of Copenhagen, Denmark
- KIK-IRPA, Brussels, Belgium
- Natural History Museum, Vienna, Austria
- University of Valencia, Spain
- University of Crete, Rethymnon, Greece
- University of Sheffield, United Kingdom

The project grew over the years: more than 90 scholars from 35 institutions were eventually involved. At several European universities, museums and research institutes, textile archaeology has established itself in the course of this project. To support this was one of its original aims.

The following is intended to summarise, with a view to the central question of the relationship between clothing and identity, the many observations and research results of the project partners. Such a summary is necessarily somewhat subjective and preliminary in nature; the research will continue!

Scientific Methods

The members of the project were clear that an interdisciplinary approach would be the most fruitful, particularly the involvement of scholars from the social and natural sciences. In fact, due to the development of new methods in textile archaeology in conjunction with the *DressID* project, a new, more extensive pool of sources has arisen.

Strontium isotope analysis – usually used as a method of investigating prehistoric migration behaviour – was used for the first time in our European project in analysing the origin of wool. Certain geological element combinations in pasture regions enter the bodies of animals through their food. Using mass spectrometry, one can see a specific combination of trace elements in the wool fibres and thereby gain information on its origin.



A key contribution of the Reiss-Engelhorn Museums and the Curt Engelhorn Centre for Archaeometry was the systematic study of animal and plant fibre structures by reflected light, transmitted light and scanning electron microscopy. A reference database has been put together to identify fibres such as donkey and camel hair, cashmere from the Hindu Kush and Iberian sheep and goats.

Another first in the *DressID* project was, in collaboration with the University of Applied Sciences, Cologne, an analysis of the suitability of spectrometry for the identification of ancient dyestuffs. It worked, even in cases in which the colour was no longer visible to the naked eye. In fact, it is even possible to clearly identify real mollusc purple by means of spectrometry, although purple fabric to the human eye is not one single colour, but varies from red to purple to blue. This non-destructive method is an alternative to onerous and costly analysis, which uses physical samples to identify substances and dye residues by breaking the samples down into their chemical constituents.

Due to conservation conditions, Egypt, Syria and northern Europe are major source of large, well preserved archaeological textiles. The aforementioned scientific and methodological advances, have shown the good results that can also be achieved with even small preserved fragments from other regions of the Roman Empire.

Textile Technology

The collaboration of textile specialists and archaeologists in the field of experimental archaeology enabled the evaluation of textile equipment such as loom weights and spindle whorls, finds that had accrued in numerous archaeological excavations, but for which there were few specific evaluation criteria. In particular, the Centre for Textile Research at the University of Copenhagen successfully addressed questions on the relationship of equipment to products: What type of spindle whorls were used to manufacture which threads and yarns? Which loom weights were suitable for the production which cloths? How much time and effort went into different products? How much time did you need to spin a kilometre of yarn? How many kilometres of yarn were needed for which kinds of clothes? Where the production bottlenecks were: in the preparation of the yarn, spinning, dyeing or weaving?

In the West as well as in the East there was a significant connection between female identity and cloth production. Work at the University of Crete has shown how spinning utensils such as spindles adorn female grave reliefs, while men are shown only engaging in specialised activities such as the manufacture of

gold thread or purple dyeing. In Roman discourse on women the traditional description of female identity in the East highlighted a preoccupation with adornment and jewellery, perfume and the frequent change of hairstyle, which was contrasted with *modestia* in Rome, which demanded diligence, modesty, piety and silence, and was associated with *lanificium*, the production of woollen textiles. In contrast, as research at the University of Valencia has shown, the many female professionals, such as midwives, health care professionals, jewellers, innkeepers, beauticians, seamstresses, temple guards, secretaries, bankers, ship owners and wholesalers are known mainly from inscriptions and papyri, and so we have little idea how clothes expressed the professional identities of these Roman “businesswomen” and “entrepreneurs”.

Only from the Egyptian papyri do we know about the conditions of textile production and details of textile trade organisation in the Roman Empire. According to the work of Droß-Krüpe, this involved standardised training contracts for male and female textile artisans, which established a clear training schedule, flexible pay scales, regulated accommodation, vacation time and apparently also a final exam. In Roman Egypt we encounter surprisingly modern forms of organisation that were largely separate from traditional apprenticeship and training within the family; these were forgotten when the Roman world came to an end. They did, however, form part of Roman identity.

An excellent example of the apparently typical planned and systematic approach of the Roman administration is reflected in the context of the identification of a previously unrecognised textile tool, the iron weft beater by Pasztokai-Szeőke (see *ATN* 52). As part of a re-planning of the entire landscape to the south of Lake Balaton, the weft beater was apparently systematically used to produce textile storage containers, which were needed in view of foreseeable agricultural surpluses. Spain and its textile products were held in high regard in Rome. Alfaro at the University of Valencia has shown how this pertained not the only the raw materials, but also the end products. Numerous ancient written sources report on the extensive cultivation of flax and linen yarns and textiles. The exquisite quality of crisp Spanish white linen was especially popular with the consumers in Rome. Of importance were also the colours of the wool: black Iberian wool or reddish wool from Hispania Baetica, which saved expense on precious dyestuffs.

The Origins and Meaning of the Toga

How then was a Roman dressed and how different were his/her clothes from those of the Central European, the Oriental, the Egyptian or that of other

inhabitants of the empire? A person's origins were not necessarily visible in clothing, because apart from the typical Roman toga, there was no set Roman or Italian "costume", and any Roman citizen could wear, regardless of his ethnic background. Status and position were expressed in details such as the type of footwear and the colour of the garment: the purple border of the *toga praetexta* offered quasi magical protection for elite boys and girls, magistrates, senators, Vestal Virgins and the holders of religious offices in ceremonies. Certain leather caps, crowns, rings or white and red bows in the hair and on the clothes provided information about the specific identity of the toga-wearer, as did the way in which it was worn: worn covering the back of the head, it was a sign of the sacrificial priest; folded precisely, it identified the wearer as an official; draped loosely, it was appropriate for a wedding sacrifice.

The Roman encyclopaedian Pliny the Elder pointed out that the origin of the toga lay in the Etruscan *tebenna*. One of the most important aspects of the *DressID* project was the study at the University of Applied Sciences, Cologne of the grave finds from the necropolis of Verucchio near Rimini from the early Etruscan period (7th cent. BC). Already on the basis of the grave inventory – a figuratively decorated throne, gold brooches and a ceremonial club – the robe could be identified as that of a ruler. Only 400 years later on late Etruscan grave reliefs and sculptures do we find the more familiar shape of garment that we know as the toga, which was much larger and covered the whole body. In the following centuries, the toga gained in volume of fabric. As Goette's work has demonstrated, the toga was not 'put on', but rather draped around the body. A jerky movement could put it in disarray, so the *togatus* had to always move in a dignified and measured way; this was an essential part of Roman identity.

The Meaning of Dress in Roman Culture

Clothing was of central significance in ancient Rome. The pictorial evidence alone is proof of this. Unlike in ancient Greece, where the representation of the human body was the most important consideration, the main attraction in the Roman tradition was the representation of the garment. Goette has shown that this can be seen in the fact that Roman statues frequently lack some depth, and this also applies to famous sculptures such as the statue of Augustus as *togatus* from the via Labicana.

While Rome's citizens were represented veiled and draped in robes, the image of the emperor was not limited to the simple *togatus* scheme. Research undertaken at the University of Crete has shown how

in his state robes, in which the hem was also drawn veil-like over the back of the head, the emperor is occasionally portrayed as a pious Pontifex Maximus. When armoured, on horseback or standing, we see him depicted in the tradition of Hellenistic rulers going back to Alexander the Great. Reliefs on his cuirass portrayed his heroic deeds and political programme. A third variant is that of the deified ruler, indicated by the nakedness of his body, such as when he is represented enthroned like Zeus on the frieze of the Acropolis. The works of art that depict the emperor are naturally more diverse than those representing Roman citizens because he was not only revered in representational metaphors, but was also himself the object of sacrifice.

Larsson Lovén's work concentrated on Roman women's dress. The *stola* – an ankle-length pinafore-like garment worn over the *tunica* with a purple bordered hem at the bottom – was the symbol of a newly-married woman's new identity as *matrona*, a married, free and respectable Roman woman, and was in many ways the female equivalent of the toga. In public she also wore a cloak called a *palla* or *pallium* (which corresponded to the Greek *himation*) with which she could also cover the head. Apart from the purely Roman *stola* type, however, which in any case appears to have been out of vogue by the end of the 1st century AD, the sculptural evidence shows no significant differences between Greek and Roman women's clothing. Only the fact that Greek women customarily covered the head while Roman women, especially in the high Empire, rarely did is a major difference. Greek dress obviously influenced the clothing of Roman woman and our investigations have shown that there are Greek models for almost all female depiction types in the statuary art of Rome. A good example is the classic "Herculaneum woman" image type of which there are hundreds of copies in the form of sculptures and funerary reliefs in the Roman Empire.

Luxury Textiles

In the early civilisations of East Asia, America and the Middle East, the purple secretions of sea molluscs were used to dye royal robes and establish elite identity. The work of the scholars at the University of Valencia and at KIK-IRPA in Brussels has shown that this was an extremely difficult procedure because the shellfish contained only very small amounts of dye, and we must assume that it was not stored or transported. In Rome there were even specialised jobs for dyeing different shades of purple. By the end of Roman Empire, the red, purple or bluish purple colour was produced in fourteen large imperial workshops called *baphia* under



the strict control of the imperial court. Naturally, there were many attempts to imitate the precious dye or even to fake it, though this was severely punished. Plant sources such as seaweed, madder, blueberry, etc. were used for these cheap imitations. They did not, however, achieve a comparable durability of colour.

The work of Hildebrandt, Reifarth and Wild has shown that a contradiction between a fascination for oriental luxury and a traditional ideal of simplicity was a central characteristic of Roman identity. Both had a profound impact on clothing habits. Already in the days of the Republic, important figures railed against luxury, which was seen to be evidence of moral softness. The Roman ideal of a simple life stands in contrast to an apparently increasing tendency of the Romans to dress sumptuously. This was no doubt influenced by the splendour and refinement of the newly-conquered Eastern territories. If one looks at evidence for gift-giving practices even in rather poor provinces such as Britain and the grave goods at archaeological sites such as Trier, they suggest a far greater distribution of high-quality clothing than one would think in view of the property structure of the Roman Empire. Purple silk fabric with woven gold threads was the epitome of luxury. Contrary to popular assumptions about the effectiveness of the legal restrictions, this luxurious clothing was apparently widely used in Rome. In the 5th century AD the production and possession of purple silk clothing were identified as imperial privilege and accepted in Rome.

Augusta Treverorum (modern Trier in Germany) became the residence of Roman emperors in the 4th century AD, and as such an economic, political and cultural centre of the empire. The analysis of the partially preserved, luxury textile inventories of 22 never-opened sarcophagi by Reifarth as her Phd, supported by the *DressID* project revealed a (not always complete) quartet of luxury goods: silk, purple, gold and resin impregnation of grave clothes. The latter observation is new. The other features of the grave goods – purple silk with gold thread pattern – characterise a find horizon of corresponding grave goods in a large part of the Roman Empire in the early 4th century AD. Perhaps this was owing to a domestic situation in the empire in which the enforcement of sumptuary laws was no longer an urgent priority. Another discovery in this context is the presence of characteristic gold strips, apparently part of linen fabrics that have not survived due to the high acid levels in the graves.

Military Textiles

Thanks to the analysis of archaeological finds from waterlogged contexts in the fort of Vindolanda on

Hadrian's Wall by Wild, we now have exceptional insights into the clothes of Roman soldiers. The finds consist of hundreds of textile fragments and wooden writing tablets – some with textile-related texts – from the turn of the 1st/2nd century AD. They have been studied in the context of the *DressID* project in view of their technological, economic and sociological information. The textile terms recorded in the texts could be categorised under headings such as 'clothing' (for example, outer garments), 'accessories' and 'household textiles,' and some can be linked with fragments of tunics and coats. The formal wear and lavish lifestyle of the camp commander and his family are revealed in the tablet texts which mention invitations to parties and lists of evening wear. All this transmits the idea of a distinctive class difference between the life of the commander and that of ordinary soldiers in their cramped accommodation in the camp. The study of the archaeological textile finds, however, seems to contradict this generalisation. High-quality, well-made clothing seems to have been a general feature of even the simplest Roman soldiers' kit. If this is the case, then it has implications for our understanding of the relationship of the Roman military to Roman society, i.e. their self-image and identity.

Careful investigation by Mitschke at the Reiss-Engelhorn Museums in Mannheim of the extensive textile finds that have been recovered in the past two centuries at the military camp in Mogontiacum (modern Mainz in Germany) – the largest corpus of its kind in Central Europe – have shown that a significant number of the textiles were of practical use as, for example, ropes, and bands. Fabrics were also used as padding for armour and helmets, packaging etc. Based on quality and decoration many of the Mainz textile fragments can be identified as the remains of clothing. Special technical features such as the spin direction of the threads indicate a local source of clothing for the troops in the Rhine provinces. The different types of textiles could be linked with the respective different images of soldier's clothes, enabling the incorporation of sculptures in the investigation of the textiles. The textile analysis also yielded valuable information on quality standards in the clothing of the Roman army. This is all the more remarkable as uniforms in our sense were unknown and each soldier had to buy his own clothes.

Provincial Dress Styles

The region in which the Mediterranean overlapped with the Oriental world of the Parthians was the oasis of Palmyra (modern Syria). It lay at the western end of the Silk Road from South and East Asia and grew rich

from trade between Asia and the Mediterranean. We know a lot about the private appearance of the leading families in Palmyra because apart from paintings and finds from grave towers of the 2nd century AD, we have tombs that show the deceased surrounded by their families in hypogea of the 3rd century AD, which have been studied by Stauffer. The garment types depicted can even be compared with the Palmyrene textile finds, showing that the individuals were shown dressed in different ways in different functions, from loosely draped robes of Mediterranean style in white and red for sacrifices, to tailored, brightly coloured clothing, such as that worn by the mounted Parthian nomads, at banquets. The research has now made great progress in exploring the meaning of decorative textile elements (*clavi* etc.) at Palmyra. It is increasingly clear that there were not only local and Mediterranean clothing styles that can be related to private and public contexts, but also that social identities as well as special identities such as family rank, clan associations and professions were expressed in decorative elements, draping styles and garment types. The enormous wealth of the trading hub at Palmyra is shown not only in the glorious buildings and grave monuments, but also in the trade goods themselves, first and foremost Chinese silks, Indian cottons, Central Asian cashmere and diverse dyeing substances from India, eastern Anatolia and probably also from the Persian Gulf. The analyses prove that silks with embroidered and woven decoration and even silk fabric came from the Chinese imperial court to Palmyra. It was not only a commercial centre; exotic materials were also processed there, combined with wool, woven with purple decorations etc.

In Roman Egypt, Mediterranean clothing in the Hellenistic tradition was apparently widespread. Due to special burial customs and ideal preservation conditions we have a large number of textile finds in the land on the Nile that have received detailed attention in the course of the *DressID* project, especially by Fluck and Paetz gen. Schieck. They convey a vivid picture of the appearance and texture of Roman garments of linen and wool, which we elsewhere know only from small textile fragments, paintings and sculptures. In addition, the considerable corpus of the so-called Fayyum mummy portraits give excellent, detailed information on clothes, jewellery, hairstyles and make-up. As it dyes better, one must assume from the colourfulness of the garments that most of the textiles were made of wool. The sheer mass of original clothing and high-quality colour painting open up a wide field of possibilities and invites comparison between textile decorative elements in Palmyra and Egypt. Schieck has shown how geometric elements

of decor from the Parthian decorative clothing of Palmyra reveal their presence in Egypt and other parts of Syria. In one case, they could even be linked to Roman Palmyrene troops thanks to the identification of the officer's insignia. Also to be found amongst the Egyptian fabrics are some knitted wares with woollen threads in tendril designs also known from Palmyra. Apparently the exchange of motifs between Syrian and Egyptian textile workshops happened on the basis of pattern sheets or the textiles themselves.

Egypt has rich evidence on Roman clothing, since it houses an excellent range of sources. It is due to the abundant written sources from Egypt that we have, for example, many papyri mentioning garments and details from the textile industry. One example that gives us an idea of the nature and extent of female garments in private households is a papyrus documenting a theft reported by a lady from a wealthy village in the Fayyum oasis, studied by Römer. It mentions the robbery of nineteen sets of dresses, about a third of them in colour, and ten mostly coloured coats and throws, as well as towels and sheets. An indication of the value of the textiles is the fact that the loss of home appliances, jewellery and cash stocks is only mentioned after them.

The work of scholars at the University of Valencia has shown how, although the Roman conquest of the Iberian Peninsula was the result of a bitter war that lasted for over two centuries, it is the only region of the empire in which there are no depictions of the residents in local costume in the Roman period. Our hypothesis – that clothing expresses identity – is further explored here. The preponderance of Roman clothes in Iberia is an expression of a strong identification with Rome. One of the factors affecting the adoption of Roman identity in Spain is the fact that the Iberian Peninsula was already part of Mediterranean culture for centuries before Roman rule, in contrast to Central and Eastern Europe. There are a number of sculptures from the 4th and 3rd centuries BC in Spain representing the human form. They give us a vivid image of the clothes and self-presentation of the people here in the pre-Roman period. The most important find is the so-called Dama de Baza, the most detailed of a group of sculptures depicting women enthroned wearing rich clothes and jewellery the clothing of which was reconstructed on technical grounds by Demant under the archaeological and historical guidance of Carmen Alfaro in the context of the *DressID* project (see *ATN* 52). The Dama de Baza wears a tunic with long sleeves and several layers of tunics or skirts. The reconstruction of the clothing of the Dama de Baza revealed that the woollen cloak, similarly to that of Verucchio, was made from a segment form; but this cloak was worn with the



round edge upwards. The chequerboard pattern at the borders of the tunics and the cloak must have been created using tablet weaving.

In contrast to the Iberian region, the pre-Roman dress, especially of women, in Central Europe, i.e. in Eastern Alpine Noricum and the Pannonian Danube region, is reproduced in great detail on the Roman grave stone markers, as investigated by Rothe and Carroll. They show elaborate headdresses and layered tunics held by brooches at the shoulders. The women appear to have played the key role as guardians of local clothing traditions. Thanks to the inscriptions it is possible to correlate dress styles with individual people and ethnic groups and it is surprising that even the female relatives of former insurgent and forcibly resettled tribes are represented in full local dress and jewellery, while their husbands are usually dressed as Roman citizens and soldiers. It appears that foreign ethnicity did not have negative connotations, and that the depiction of the clothing and identity of local tribes only became possible with the advent of the Roman custom of erecting grave stone markers with the image of the deceased.

Differences and continuities can be observed using the textile fragments from pre-Roman times that have been preserved in the salt mines of Hallstatt, including coloured borders and patterned and embellished fabrics. The work of Grömer has shown how the Hallstatt period was a period of great achievement in textile art, characterised by richly decorated tablet weaving, various other weaving techniques, fabric patterns, plaids and colour variations. In marked contrast, the following centuries are characterised by increasing standardisation apparently emanating from Rome, firstly coming over from the Celtic neighbouring cultures, and later directly from Rome.

The analysis of the Roman textile finds from Pannonia show many references to Romanisation in production and quality. The investigation of textiles from the Migration-Period royal grave of Poprad on the northern edge of the Carpathian Basin by Štolcová and Lau in the context of *DressID* has shown that outside the Roman Empire and then again after the end of Roman rule the pre-Roman textile technology re-emerged: the textile analysis here revealed, for example, considerable variation in the weaves, colours, patterns, especially tablet weaving. In addition, there was gold embroidery imported from the East.

Also in Western European regions of the Roman Empire, in Gaul, Britain and the Rhine provinces, the population commissioned Roman-style grave monuments with representations of the deceased. The women in particular were shown in the native dress of the respective regions, at least until the Flavian

dynasty. The Mediterranean custom of erecting votive stones to the gods was transferred to the local gods, in this case the Ubian mother goddesses – *matronae* – and as in Italy or Greece mortal worshippers were also depicted. Rothe's work has shown how small-scale, local dress disappears in the funerary art of much of the north-west in the 2nd century AD in favour of a more widespread style, the "Gallic ensemble", showing that this region developed its own collective identity, but not as opposition to Rome: rather it was a consequence of integration into the Roman Empire.

Roman Influence beyond the Frontiers

The Roman Empire was heavily involved in trade with regions outside the borders of the empire. In terms of clothing the relationship between Rome and the 'barbarians' can best be examined in northern Europe, where moors and wet soils provide excellent conditions for the preservation of animal fibre textiles. Systematic studies of the rich clothing finds from pre-Roman Scandinavia by scholars at the Centre for Textile Research at the University of Copenhagen have showed that only half of the clothing – that of fur and leather – was cut and sewn, but not the other half, i.e. the textile clothing. In Scandinavia and in the Mediterranean garments were woven whole on the loom. Patterns were achieved using vegetable dyes and the natural colours of wool. Sprang hats and fur hats were apparently the only difference between male and female dress; scarves, coats, large, blanket-like cloaks and tube-shaped dresses were held in place using shoulder brooches. Over this, one wore fur capes. Not even men and women's shoes were different. From the time of Christ onward the north imported precious Roman goods and adapted to more gender-specific clothing. Amazingly, it is only in this period that trousers appear in northern Germany.

The influence from the south by no means led to crass copying and imitation. This has been shown in new investigations of the textiles from Thorsberg and three other major northern European localities by Möller-Wiering. Over a thousand precious weapons and tools were found in these locations, which are believed to have been sacrificed as war booty. Often they display a mixture of Roman and Germanic elements in manufacture and decoration. The most famous are the Thorsberg clothing finds: two pairs of trousers with attached foot pieces, a long-sleeved tunic and large cloaks with wide tablet-woven borders. Comparative analysis of the technical characteristics (yarns, construction, borders) revealed that these textiles were manufactured locally. The first strontium isotope analysis confirms this result. We know that there were also people in the north who were wearing

Mediterranean dress thanks to the careful analysis of the clothing of a man found at Obenaltendorf in 1895. For reconstruction purposes garment fragments from this bog body were reassembled because the significance of some garments had been unknown. Analysis of yarn twist, weave, fabric borders and *clavus* decoration proved that these clothes were of Mediterranean origin. Only the huge figure of the blond man, his decidedly Germanic shoes, his two capsule-like lockets and the absence of any evidence of a belt suggest that he was not a Roman and not a soldier.

The great wealth of results of the *DressID* project are only partially represented here. Thanks to the collaboration of researchers from the many European countries we have gained some initial, more than impressive insights into the relationship between clothing and identity in the Roman Empire. The *DressID* Project "Clothing and Identities – New Perspectives on Textiles in the Roman Empire" culminated in the exhibition *Die Macht der Toga – The Power of the Toga* in Hildesheim, Germany (20th April to 8th September 2013), but the research will continue for many years to come.

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Ulrikka Mokdad and Camilla Ebert

Treasures from the Sea: Sea-silk and Shell Purple Dye in Antiquity

26-28 May 2013, Lecce, Italy

In May 2013 a workshop on “Sea-silk and Shell Purple Dye in Antiquity” was held at Museo storico della città di Lecce, co-organized by Hedvig Landenius Enegren, The Danish National Research Foundation’s Centre for Textile Research (CTR) and Francesco Meo, Dipartimento di Beni Culturali Università del Salento. 23 scholars from 12 different countries were invited to speak at the workshop, including keynote speakers Felicitas Maeder (Naturhistorisches Museum, Basel), Lucio Calcagnile (CEDAD – Centre for Dating and Diagnostics, University of Salento) and Brendan Burke (University of Victoria). Papers treated a variety of aspects including: ‘Sea-silk and byssus in antiquity: a linguistic problem’ (Felicitas Maeder), ‘Recent advances in the understanding of the chemistry of Tyrian purple production from Mediterranean molluscs’ (Chris Cooksey), ‘Identification of sea-silk by characterisation of the amino acid content’ (Ina Vanden Berghe), ‘Purple for the Gods. The use of purple garments in Greek sanctuaries’ (Cecilie Brøns) and ‘Following Threads: the Significance of Murex Purple Dye and Sea Silk in the Ancient World. A synthesis of the workshop’ (Brendan Burke).

Two afternoons of the three workshop days featured experimental archaeology. On the first day the textile artisans Assuntina and Giuseppina Pes from Sant’Antioco, Sardinia, demonstrated the preparation and use of sea-silk, today a protected species, so the sisters used fibres from dead molluscs. The two sisters brought a miniature loom and spindle whorls for the event. First they demonstrated how to clean and

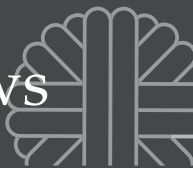
comb the long, silky filaments secreted by the large fan-shell *pinna nobilis* with which the animals anchor themselves to the sea bed, afterwards they spun the delicate fibres into shining, golden threads used for traditional brocaded weaving patterns.

On the second day the artist Inge Kanold Boesken (Lacoste, France) and Rolf Haubrichs (University of Geneva) demonstrated how to extract purple dye from murex shells. This process included several renowned scholars smashing living molluscs in the museum courtyard! Each participant had to stick a pencil inside the mollusc’s hypobranchial gland in order to apply the secretion onto a piece of white cotton cloth. When exposed to sun-light the secretion immediately started to change colour in the spectrum of yellow to violet.

The workshop ended with three days of regional bus-trips to museums and important archaeological sites for those participants who wanted to explore the Puglia province and surrounding areas. The tour included visits to Taranto, Metapontum, Cavallino, Muro Leccese and Otranto. The three day event served to bring together scholars working with byssus and shell purple dye, and hopefully the workshop has secured future collaborative research on these fascinating subjects.

We would like to thank Hedvig Landenius Enegren and Francesco Meo for an exceptionally well-organized and fruitful workshop.

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



Teresa Traupe

Textile Trade and Distribution in Antiquity

Textilhandel und Distribution in der Antike

9-10 April 2013, Marburg, Germany

Textiles have always been coveted goods, yet ancient textile production has only recently become a subject of research. In April 2013 several researchers met at an interdisciplinary conference hosted by Kerstin Droß-Krüpe (Marburg). In her introductory speech she emphasized that in antiquity, just as today, long trade and production routes lay between the harvest of the fibers and the completed garment.

Marie-Louise Nosch (Copenhagen) underlined the significance of flax fiber in the manufacturing of clothes, ropes and sailcloth in ancient Greece and contradicted the widespread opinion that flax could not have been cultivated there because of the climate conditions. Nevertheless the identification of the textiles and fibers in historiographical sources brings up problems. Often it is uncertain if the terms refer to the places of origin, to the production facilities, or to a typical trade market. Herbert Graßl (Salzburg) demonstrated another obstacle related to written sources caused by abbreviations as he proposed new reading of seven lead tags from Virunum, Noricum. The lively exchange of ideas about the diversity of terms for raw materials, stages of the production process, or garments suggested the continuous need for international cooperation. The upcoming conference in Copenhagen on "Textile Terminologies - from the Orient to the Mediterranean and Europe 1000 BC - AD 1000" (19-22 June 2014) is a welcome opportunity to illuminate some dark spots.

Wim Broekaert (Gent) used a theoretical approach to contrast ancient and medieval structures of the cloth trade. As moneylenders, medieval merchants were firmly established in the consciousness of rulers. Because they were indispensable, they received privileges. Assuming that ancient cloth merchants, in contrast, were not perceived in the same way, he suggested that the economic model of John F. Drinkwater cannot be adapted to ancient forms of cloth trade organization. Hence together with Miko Flohr (Leiden), who presented thoughts on economic structures in Roman Italy, he advocated developing the theory of the ancient economy according to recent scientific discoveries on the ancient textile trade.

Discussing the silk trade in the Roman imperial period, Kai Ruffing (Marburg) pointed out that in literary sources silk appears as an oriental luxury good and a sign of growing effeminacy, which would seem to contradict the great demand for silk that found expression in the trade of Roman merchants. The role of the local elites in its commerce and sale was emphasized. Clothes, particularly silk gowns, functioned as status symbols. Mary Harlow (Leicester) reflected on the ancient view of fashion and social components of clothing more generally. Sabine Schrenk (Bonn) discussed the possibility that Chinese silk fibers were also processed in the Western Roman Empire by exploring the Alexandrian and Rhodian motifs. The transfer of technology by specialized



silk weavers was considered in the discussion. Hans R. Goette (Berlin) turned to pictorial representation and conveyed the difference between figurative icons of craftsmen (e.g. for honorary offices, civil services or symbolic property) and literal depictions of the same crafts and trades, though the latter could not be identified with certainty.

Robert Rollinger (Innsbruck) presented his research on Greek specialists in the field of textile production and processing in the ancient Near East. He cited Achaemenid royal inscriptions, which describe stonemasons from Ionia and Lydia but do not provide evidence about merchants or textiles from the Greek-speaking regions. Plutarch, however, writes in his *Life of Alexander* that the Macedonian king found 200-year-old Hermionian purple-dyed textiles of Peloponnesian origin in Susa.

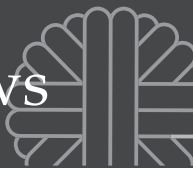
John Peter Wild (Manchester) focused on the textile trade between the harbor city of Berenice and the Indian subcontinent, mentioning archeological finds such as the ship of Greek name which had sailcloth of Indian cotton and a mast of teak.

Cécile Michel (Nanterre) and Eivind H. Seland (Bergen) dealt with trade in border regions. The latter reported on the frontier zone between the Roman and the Parthian Empires using new institutional economics and transaction cost theory. He showed

that Roman authorities strived to control the trade by taxation due to the economic and social significance of eastern textiles, while merchants shouldered the difficult way through the desert to avoid the taxations along the boundary river. Cécile Michel reviewed the long tradition of textile production in the ancient Near East with reference to the trade between Assyria and Anatolia that was already flourishing during the second millennium BC. By introducing several Assyrian merchants' private archives, including letters and contracts, she showcased a revealing source that proves in particular the participation of Assyrian women in the production process.

One conference session was devoted to the new scientific approaches. Karin M. Frei (Copenhagen) presented a method of strontium isotope analysis of wool fibers. Given a sufficient number of samples, it is possible to create a strontium map that allows one to locate the place of origin of a garment's material. Subsequently Margarita Gleba (London) provided an overview of wool fiber analysis which may be used to trace the qualitative development of fibers over time.

One of the conference goals was to give new impetus to the discourse on ancient economy through the observations made of the textile trade. With that in mind we are looking forward to the conference proceedings, which are forthcoming in 2014.



Shujuan Wang

Buried Past in Desert. Textiles from the Small River Cemetery

10 April to 30 June 2013, China National Silk Museum, Hangzhou, China

The exhibition, *Buried Past in Desert. Textiles from the Small River Cemetery*, was held in the China National Silk Museum during the period of April 10th to June 30th 2013. Most of the exhibits were textile objects, especially wool textiles. The exhibition was divided into five units including wool cloaks, loincloths, hats and boots, containers woven of grass and ornaments, and artifacts connected to these objects. All these objects belong to Xinjiang Institute of Archaeology.

In recent years, burial sites in Tarim Basin have warranted scholarly attentions because of spectacular prehistoric mummies excavated there. Among the burial sites, the Small River Cemetery in Lop Nor is the most famous. It was fully excavated from December 2003 to March 2005. During these excavations, prehistoric mummies, textiles, wooden furniture, and plant stem containers have been unearthed. The Small River Cemetery in Xinjiang has seen many wool cloaks unearthed. Most of them are undyed and are white, grey, pale brown or dark brown. Their rectangular shapes and decorations are simple but fit in size to their owners. From the pieces already excavated, it can be seen that female cloaks have a fringe placed along the head and shoulders, whereas the male ones have them placed along the bottom edge. Numerous loincloths were found in the Small River Cemetery. Those of the males were in the form of narrow bands, which were wrapped around their waists. The ends of the band were finished with tassels, which were tied together and hung to cover the crotch. Those of females are longer and could reach all the way to the

knees, in which case they may be termed string skirts. Other items found included felt hats and leather boots. Hats are made of thick felt and some are decorated with feathers or wool threads. Furs were used to line boot soles and heels. Both vamps could be decorated with red stripes, which may have had religious implications.

Textiles excavated from the Small River Cemetery have been studied and treated by the China National Silk Museum and Xinjiang Institute of Archaeology since July 2012. During that period, the textiles were identified, grouped, and cleaned. The results of fibre identification show that all the textiles were made of wool.

Catalogue:

Zhongguo Sichou bowuguan (China National Silk Museum) and Xinjiang Weiwu'er zizhiqu wenwu kaogu yanjiusuo (Xinjiang Institute of Archaeology) eds (2013) *Buried Past in Desert. Textiles from the Small River Cemetery*. Hangzhou, 10 april-30 june 2013.



Berit Hildebrandt

Wool on the Silk Road: Research on the Eurasian Wool Textiles of Bronze to Early Iron Ages

9-10 April 2013, Hangzhou, China

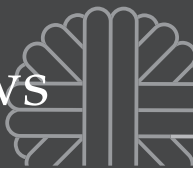
In April 2013 the China National Silk Museum and the Key Scientific Research Base of Textile Conservation (SACH) organized a two-day symposium in Hangzhou in on the topic of Eurasian wool textiles of the Bronze and Early Iron Ages along the Silk Road. The symposium continues a cooperation between China and Denmark established in 2009 between the Danish National Research Foundation's Centre for Textile Research in Copenhagen (CTR) and the China National Silk Museum in Hangzhou. It brought together textile researchers from various institutions in China, Denmark, Sweden, Japan and Germany who addressed the topic of ancient wool finds in archaeological, historical, religious, conservational and scientific perspectives.

In his opening remarks the Executive Director of the China National Silk Museum, Zhao Feng, emphasized the long-standing research connections between Denmark and China, and outlined the aims of the conference. By comparing wool finds of the Bronze and Early Iron Ages from Denmark and the North West of China with regard to costume design, weaving and dyeing technology and preservation conditions, the conference shed light on ancient textile techniques and tools, characteristics of raw materials and their provenience, and the people dealing with the textiles between East and West.

In the first presentation, Eva Andersson Strand from CTR addressed the analyses of textile tools by employing textile experimental archaeology from a

European perspective. As textile tools constitute the most plentiful type of evidence for textile production, this approach can prove fruitful for regions and sites where no textiles are preserved, no literary sources pertaining textile production exist and where the given categories are difficult to interpret. These tools are associated with various stages in the textile manufacture: the preparation of fibres, the spinning of yarn and finally the weaving and finishing. Further, Andersson Strand presented textile experimental archaeology as a method to assess the scale of textile production and technology in prehistory and to make assumptions about the social, economic and cultural impact of textile production at a certain site or region.

Yang Rulin from the China National Silk Museum presented her study on loincloths that were excavated in the Small River Cemetery, one of the Bronze Age archaeological sites in the Tarim Basin of Xinjiang famous for its high numbers of well-preserved mummies and their wool textiles. Loincloths have been found with every mummy of the cemetery, and can be grouped according to kind, production method and the way they were worn. The loincloths associated with male bodies were made as narrow bands that were wrapped around the waist. The bands were finished with tassels tied together in front of the body. The female loincloths were constructed as a kind string-skirt reaching to the knees. The differences in construction thus represent gender-related differences.



Ulla Mannering from the National Museum of Denmark and CTR presented Danish Bronze Age wool textiles and their production. Similar to the spectacular Tarim Basin finds, Denmark has a unique collection of textiles and costumes dated to the Bronze Age (1800-1100 BC) currently undergoing investigation at the National Museum of Denmark. Mannering presented the latest results of this research. Beyond the basic technological analyses of the textiles, fibre analyses to trace the development and potential of raw materials for textile production, dye analyses are carried out.

Wang Shujuan from the China National Silk Museum spoke about red stripes on the cloaks from the Small River Cemetery. The cloaks form the largest group of textiles unearthed in this cemetery, and one of their most striking characteristics is their red stripes. These stripes can be grouped into three types of decoration: horizontal stripes at the bottom of the fabric, horizontal stripes in the middle and vertical stripes. Further, gender differences were expressed through the position of fringed edges. Male mummies had the fringe of the textile placed as the bottom edge, and female mummies as the top edge placed around the head and shoulders. The cloaks attest not only to the technical skills of the Bronze Age societies in the Tarim Basin, but also an aesthetic approach to textiles.

Anne Lisbeth Schmidt from the National Museum of Denmark presented Scandinavian prehistoric leather and skin clothing, focusing on one of the oldest skills of mankind: the transformation of animal skin into clothing. The National Museum of Denmark possesses quite a large collection of skin costumes and items dated to the Early Iron Age (500 BC-AD 400). These skin finds have been investigated thoroughly in a collaborative research programme between CTR and the National Museum of Denmark resulting in the use of new methods and analyses on the documentation of the finds, design, the tradition of making skin clothing, the cutting of skins and sewing techniques. The analyses also included species identification. Next, the question of how to store prehistoric skin items was addressed.

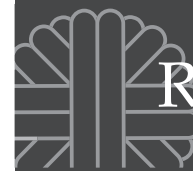
Xin Xiaoyu from Donghua University spoke of the felt caps from the Small River Cemetery. Felt caps are typical for the Bronze Age period of this site. They have simple forms and a characteristic ornamental style. Xiaoyu described the characteristics of the respective styles, material, size, colour, chin-cords and ornaments. The caps allow insights into the felt craft in the Bronze Age as well as into social and cultural aspects. There is for example evidence that the red cords and feathers

that sometimes adorned these caps had not only an ornamental function, but also a religious connotation. Moreover, different arrangements of these decorations seem to have been marked gender differences.

Yang Hailiang from the China National Silk Museum presented the analyses of leather boots from the Xiaohe cemetery. In all, more than ten leather shoes were found in this cemetery. In general, shoes consisted of three pieces of fur (with the fur on the inside) that were stitched together. The shapes were consistent with a sole that was generally composed as an irregular oval, with a wider front for the toes and a narrower back for the heel. The analysis of contemporary Coruk leather shoes in Xinjiang allowed deductions regarding the process of production and the materials employed, eg. goatskin and cowhide, but also regarding the ways the leather was treated. FTIR was used to judge the aging condition of the archaeological finds by the preparation of a simulated modern sample. Finally methods to protect the leather were presented.

Karin Margarita Frei from the National Museum of Denmark and CTR explained the possibilities of the strontium isotope tracing system for wool and silk textiles. In the last two decades the measurements of strontium isotopes in archaeological bone tissue and skeletons have shown to be an effective technique for the characterization of human and animal mobility in prehistory. Frei has developed a new method, based on the strontium isotopic system, to investigate the provenance of ancient wool and plant fibres in Danish Iron Age and Bronze Age textiles. The research implications of this technique are manifold: Strontium isotopic analysis of textiles is able to highlight technological as well as socio-economic and religious aspects of ancient life, and not least trading routes. Furthermore, a new collaborative project between CTR and Zhao Feng will develop a similar method for provenance studies of ancient silk.

Irene Skals from the National Museum of Denmark provided an overview of the characteristics of 2000 years of wool fibres in Danish textiles, with special emphasis on the analysis of wool textiles from the Danish Bronze and Early Iron Ages. The analyses included the measurements of fibre diameters to determine the degree of processing. It was assessed that the spinning of the wool to yarn could be most easily done with uniform fibres. The finer the fibres, the softer the wool textiles. The analyses were carried out by spreading the fibres on microscope slides, putting them under a light transmitting microscope and photographing them digitally. The measurements



were performed on the photographs with the camera's software and the results calculated statistically. A minimum of 100 fibres per yarn were measured. The results of these analyses have demonstrated the kind of wool available in the Scandinavian prehistoric society and how it was processed.

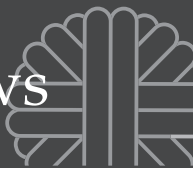
Zhou Yang from the China National Silk Museum reported on an investigation of wool fibres from textiles of the Small River Cemetery. The morphological observation of the archaeological wool fibres, including their cross-sectional and longitudinal appearance using OM and SEM, suggested that the main material of the textiles of the Small River Cemetery consisted of sheep wool. The degradation of these fibres differed significantly, especially between the first and the fifth layer in the cemetery due to chronological and environmental reasons. All in all 125 cross-sectional images for the classification of wool fibre damage were analysed and four stages of damage were distinguished: intact, initial, developed and disintegrated. Combining these observations with the archaeological data gave a better understanding of the present state of preservation and the damage trend in the textiles. Further it was concluded, that chlorides were the principal contributors to the damaging process of the wool fibres. This data can be used as a scientific basis for the wool textile conservation including the consolidation and cleaning of the fabrics.

Luise Ørsted Brandt from CTR explained her research on textiles and ancient DNA. Previous studies have shown that DNA can be extracted from a wide range of ancient material, including teeth, bone and hair. The genetic information can give insights into kinship ties, population dynamics and the development of specific genetic traits. As DNA analysis has not previously been applied to wool and ancient textiles, Brandt started to investigate DNA preservation in modern sheep wool and prehistoric textiles in order to assess the potential to gain genetic information on prehistoric sheep. Her paper demonstrated that mitochondrial and nuclear DNA are present in modern wool and survive most textile treatment processes and even short-term burial. Mitochondrial DNA can even still be present in ancient wool textiles, while nuclear DNA has not yet been recovered from ancient textiles. The analysis of samples from different burial contexts that were subject to different treatments indicates that acidic and oxygenous burial environments seem to degrade DNA as well as some mordants to unamplifiable levels. The conclusion is that the analysis of DNA from ancient textiles strongly depends on the preservation conditions.

Hailing from the China National Silk Museum discussed the application of amino acid analysis in proteinaceous fibres, to which both silk and wool belong. Amino acid analysis is useful to monitor alterations in the chemical composition of these fibres. As it was possible to show by Hailing's research, different silk breeds have different amino acid contents: While *bombyx mori* primarily contains glycine, alanine and serine which represent 85 mol% of the total amino acids and the glycine:alanine:serine mole ratio is about 4:3:1, Tussah's glycine:alanine:serine mole ratio is about 3:4:1. The identification of the amino acid composition thus permits to distinguishing between the cultivated *bombyx mori* silk and wild silk species and also to estimate the silk fibres' deterioration at the molecular level. The method is also useful for the analysis of wool.

Liu Jian from the China National Silk Museum gave a lecture on the identification of dyes in prehistoric textiles from Xinjiang. Due to the extremely dry climate of the Xinjiang area, many of the archaeological wool textiles, some of them 2000 years old, are well preserved. In the last 20 years several of the colourful textiles including mantles, skirts and carpets were analysed with regard to their patterns and weaving structure. Now, also analysis of the dye-stuffs was carried out. Jian focused on a red dye type in wool textiles from four prehistoric sites in Xinjiang. Through the use of high performance liquid chromatography together with a diode array detector and a mass spectrometer (HPLC-DAD-MS) it was possible to trace alizarin, as a major colouring matter, with purpurin and other anthraquinone derivatives. This composition is typical for *Rubia tinctorum*, a madder-type plant that could be identified as the dye-stuff for most of the red wool yarns. For yellow, the results suggested that weld may have been used; indigo was used for blue although its ancient sources remain unclear. Most of the non-red wool textiles excavated from the Bronze Age sites in Xinjiang contained little or no colours, but coloured wool was also used for weaving and knitting.

Peng Zhiqing from the Zhejiang Sci-tech University spoke of a pilot study on the cleaning and consolidation of artificially aged wool fabrics. Artificially aged and contaminated fabrics were cleaned with a tea saponin aqueous solution with the help of a pancreatic enzyme and a pH buffer agent. This combination demonstrated a good cleaning effect and resulted in not more shrinking than cleaning with water. The wool fabrics were artificially aged by photo (UV irradiation), thermal, hydrothermal and alkali ageing. The various aged samples were then treated by EGDE, keratin or



keratin/EGDE by dipping them into the solutions. The results of the textile tensile test proved that the samples treated with the EGDE solution presented a slightly increased strength, while those treated with keratin or keratin EGDE solutions presented very little increased strength or even showed a decrease of strength.

Jorie Johnson, artist and founder of JoiRaeTextiles, gave a lecture on the Shōsō-in Kasen felt carpets, which is probably the world's largest, finest and rarest felt carpet collection belonging to the Japanese Imperial Household Treasures preserved in the Shōsō-in Repository in Nara. The carpets date to at least the middle of the 8th century AD, and an examination of the three basic methods for the execution of the inlay of floral and animal design imagery have shown that they are comparable to other felt works found along the Silk Road today. In addition to the natural colour and over-dyed mono-colour carpets, there are 31 examples of large, colourful and intricately detailed

works. Artisans and carpet makers in Turkey, the Republic of Kazakhstan, Turkmenistan, the Kyrgyz Republic and India, among other countries, skilfully used dyed wool to produce various images and effects similar to the expression of the Shōsō-in *Kasen* felt carpets.

On the second day of the symposium Yidilisi from the Xinjiang Institute of Archaeology gave a fascinating lecture in Chinese on the "Treasures in the Tarim Basin, Xinjiang, China – Looking for the Ancient Civilizations", placing the textiles in their excavation contexts. Finally, Li Wenying, also from the Xinjiang Institute of Archaeology, concluded the conference with her review (in Chinese) on the "Archaeological Woolen Textiles Excavated from Xinjiang", pointing out the developments of sites in different periods, possible cultural influences and the characteristics of the wool finds.

The papers will be published in both English and Chinese.

Christoph Kremer

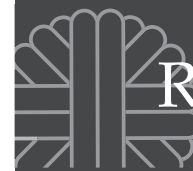
TOTH Workshop: Verbal and Nonverbal Representation in Terminology

8 November 2013, CTR, Denmark

The workshop was held at the Danish National Research Foundation's Centre for Textile Research (CTR), University of Copenhagen, and formed part of the annual TOTH conferences, the platform for discussion of an international network of researchers from various scientific backgrounds, researching into the broad and diverse field of terminology studies. The focus of this one-day workshop was to explore the relations between concepts of verbal and nonverbal representation in textile terminology and

design. The workshop brought together 14 researchers from disciplines spanning from ancient languages to modern design studies.

The workshop was opened by its organiser Susanne Lervad (CTR and TERMPPlus). The first item of the workshop was a joint keynote presentation by the terminology specialists from the CTR research programme on Textile Economy in the Mediterranean Area (TEMA). They presented their projects related to the study of ancient textile terminologies in a cross-



cultural perspective from the 2nd millennium BC to the 1st millennium AD. Aspects of the textile terminology of the Greek world were presented by Marie-Louise Nosch and Peder Flemestad, Matteo Vigo on textile terminologies in the Hittite Empire, Salvatore Gaspa on Assyrian Languages. Miguel Angel Andres Toledo presented his work on ancient Iranian and Zoroastrian textile terminology. Maria Teresa Zanola (Facolta di Scienze Linguistiche e Letterature Straniere, Universita Cattolica del Sacro Cuore, Milan) opened up the workshop with a talk on the study of a semantic shift in fashion terminology. Her case study on the change of meaning of terms describing garments between the 19th century and the modern fashion world demonstrated how concepts and terminology are becoming increasing less precise in their meaning over time. Juan Antonio Prieto Velasco (Departamento de Filologia y Traducion, Universidad Pablo de Olavide, Sevilla) discussed the problem of representing concepts through visualisation of terminology. His study on an illustrated dictionary highlighted the necessity of specialist knowledge for the understanding of certain signs and how one can deal with this asymmetry of knowledge. Further semantic uncertainties, this time in ancient Greek terminology, were presented by Marie Papadopoulou (Academy of Athens, Research Centre for Modern Greek Dialects, Athens). She was able to show how concepts associated originally with a certain type of textile (Schema) can shift from the meaning of this actual textile to gestures and habits originally associated with this dress. Similar flexible semantics exist with the word and concept of design, as Hans Christian Jensen (Institute for Design and Communication, University of Southern Denmark, Kolding) explored the use of the word in contemporary Denmark. Starting as a word for industrial design after the Second World War, it suddenly entered the fashion world and developed into a complex concept with multiple meanings, which is hard to

define. Dardo de Vecchi (Kedge Business School, Marseille) centred his thoughts more on the cognitive circumstances of verbal and nonverbal representation. The focus of his talk was the knowledge required in order to encode the significance of symbols and their represented concepts. Christophe Roche (Laboratoire d'Informatique, Systèmes, Traitement de l'information et de la Connaissance, Université de Savoie, Chambéry) challenged the flexibilities of verbal concepts by a logical approach for the classification and representation of concepts through terminology in the development of international standard (especially ISO 704). Bodil Nistrup Madsen (Department of International Business Communication, Copenhagen Business School) combined the two approaches of classification of symbols and the logic approach in a case study of how nonverbal signs can be classified in databases. The final presentation communication was by Andrée Affeich (Faculty of Letters, Holy Spirit University of Kaslik, Joumieh) on popularised and semi-popularised verbal representation in technical discourse, with a comparison between Arabic and non-Arabic languages in the new media.

The workshop was closed by a brief presentation by Tove Engelhardt Mathiassen and Birka Bitsch (The Danish Costume group) who presented the current state of the *textilnet.dk* project. The scope of this project is to collect and compile a term-wiki about terminologies related to textiles in Denmark from the Early Modern to the Modern periods. Most of the work is based on notes and research results collected by textile researchers such as Erna Lorenzen, Margrethe Hald and Ellen Andersen. The results of this project will be made accessible on the internet in free open-access form. Additionally, Ana Maria Gentile (Universidad de la Plata, Argentina) presented a poster of her project "Formalisation in psychoanalysis: terminology and translation questions." A publication is planned.



Recent publications

***Encyclopaedia of Medieval Dress and Textiles of the British Isles c. 450-1450 (2012)* edited by Gale Owen-Crocker, Elizabeth Coatsworth and Maria Hayward, Brill**

The single volume *Encyclopaedia of Medieval Dress and Textiles of the British Isles c. 450-1450* is a unique work that intends to bring together in 582 signed articles the latest research from across the range of disciplines which contribute to our knowledge of medieval dress and textiles.

There has been a long-standing interest in the subject, which has recently manifested itself in a flowering of research and publications, including activities by the editors of the *Encyclopaedia*: the foundation of DISTAFF (Discussion, Interpretation and Study of Textile Arts, Fabrics and Fashion) as an umbrella organization for the presentation of papers at the major medieval congresses in Kalamazoo and Leeds (Netherton and Owen-Crocker); the establishment of the annual journal *Medieval Clothing and Textiles* (Netherton and Owen-Crocker); the Manchester Medieval Textiles Project (Coatsworth and Owen-Crocker); and the AHRC Lexis of Cloth and Clothing Project (Owen-Crocker and Sylvester).

There is a clear need for an interdisciplinary reference work which will introduce readers to various sources of evidence, and give clear information about the most recent discoveries and interpretations and bibliographical guidance to readers. The *Encyclopaedia of Medieval Dress and Textiles of the British Isles c. 450-1450* contains also over 100 plates and diagrams to illustrate the text.

ISBN: 9789004124356

Price: € 195.00

<http://www.brill.com/encyclopedia-medieval-dress-and-textiles-british-isles-c-450-1450>

***Ancient Textiles, Modern Science (2013)* edited by Heather Hopkins, Oxbow Books**

The European Textile Forum was founded as an annual meeting for academics, craftspeople, re-enactors and enthusiasts to share their experiences and compare notes. With varied day workshops and evening lectures, the 'Textilforum' has something for everyone. The conference takes place over a week, which not only allows time to learn new techniques and discuss new findings, but to also undertake lengthy experiments

that require a large number of experienced specialists. Textilforum is the practical proving ground to test archaeological theories in appropriate surroundings. This book is the publication of a series of lectures and experiments that were undertaken at the First and Second European Textile Forum in 2009 and 2010. Each had a new approach, exploring a question of textile manufacture in a scientific way, revealing answers and outcomes that were unavailable before. The First European Textile Forum hosted an experiment that found the relationship between archaeological hand-spinning finds and the yarn they produce: only a meeting such as the Textilforum could generate sufficient data for analysis. This scientific approach reflects in contributions describing the reconstruction of tablet-woven artefacts, with explorations of the method of tablet-weaving and a reassessment of archaeological finds and depictions. The Second European Textile Forum explored the practical aspects of undertaking reconstructions such as Stone Age fabrics, Roman dyeing or the clothing of Gunnister Man, including the deconstruction of the original artefact, allowing for the unexpected and the implication of new findings. Techniques for treating raw materials, creating fabrics and finishing artefacts are explored. The wider purpose and legacy of the European Textile Forum is as a foundation for the coming years. The basis for research and communication, with a market for exchanging tools and materials, means that each participant can avoid individually 're-inventing the wheel'. The purpose of this book is to share these findings.

ISBN: 9781842176641

Price: £ 35.00

<http://www.oxbowbooks.com/oxbow/ancient-textiles-modern-science.html>

***Making Textiles in pre-Roman and Roman Times: People, Places, Identities (2013)* edited by Margarita Gleba and Judit Pásztoókai-Szeőke, Ancient Textiles Series Vol. 13, Oxford: Oxbow Books**

Textile production is an economic necessity that has confronted all societies in the past. While most textiles were manufactured at a household level, valued textiles were traded over long distances and these trade networks were influenced by raw material supply, labour skills, costs, as well as by regional traditions.

This was true in the Mediterranean regions and *Making Textiles in pre-Roman and Roman times* explores the abundant archaeological and written evidence to understand the typological and geographical diversity of textile commodities. Beginning in the Iron Age, the volume examines the foundations of the textile trade in Italy and the emergence of specialist textile production in Austria, the impact of new Roman markets on regional traditions and the role that gender played in the production of textiles. Trade networks from far beyond the frontiers of the Empire are traced, whilst the role of specialized merchants dealing in particular types of garment and the influence of Roman collegia on how textiles were produced and distributed are explored. Of these collegia, that of the fullers appears to have been particularly influential at a local level and how cloth was cleaned and treated is examined in detail, using archaeological evidence from Pompeii and provincial contexts to understand the processes behind this area of the textile trade.

ISBN: 9781842177679

Price: £ 30

<http://www.oxbowbooks.com/oxbow/making-textiles-in-pre-roman-and-roman-times.html>

Kleidung und Identität in religiösen Kontexten der römischen Kaiserzeit (2012) edited by Sabine Schrenk, Konrad Vössing, Alfried Wiczorek, Michael Tellenbach, Regensburg: Schnell & Steiner
Namhafte Experten der Alten Geschichte, Archäologie und Altphilologie beleuchten Funktion und Bedeutung von Kleidung und Textilien im Rahmen antiker Religionsausübung. Im Blickpunkt steht ein breites Spektrum charakteristischer kultischer Kleidung unterschiedlicher religiöser Gemeinschaften. Mit neuen Forschungsergebnissen schließt der Band eine markante Forschungslücke.

ISBN: 978-3-7954-2603-3

Price: € 29.95

http://www.schnell-und-steiner.de/artikel_7266.ahtml

The World of the Fullo: Work, Economy, and Society in Roman Italy (2013) by Miko Flohr, *Oxford Studies in the Roman Economy*, Oxford University Press

The World of the Fullo takes a detailed look at the fullers, craftsmen who dealt with high-quality garments, of Roman Italy. Analyzing the social and economic worlds in which the fullers lived and worked, it tells the story of their economic circumstances, the way they organized their workshops, the places where they worked in the city, and their everyday lives on the shop floor and beyond. Through focusing on the lower segments of society, Flohr uses everyday work as the major organizing principle of the narrative:

the volume discusses the decisions taken by those responsible for the organization of work, and how these decisions subsequently had an impact on the social lives of people carrying out the work. It emphasizes how socio-economic differences between cities resulted in fundamentally different working lives for many of their people, and that not only were economic activities shaped by Roman society, they in turn played a key role in shaping it. Using an in-depth and qualitative analysis of material remains related to economic activities, with a combined study of epigraphic and literary records, this volume portrays an insightful view of the socio-economic history of urban communities in the Roman world.

ISBN: 978-0-19-965935-7

Price: £ 90.00

<http://ukcatalogue.oup.com/p2p/endecaSearch.do?keyword=flohr>

Antinoé, à la vie, à la mode. Visions d'élégance dans les solitudes (2013) edited by Florence Calament and Maximilien Durand, Lyon, Fage

A catalogue of an important exhibition, which brings together textiles from many Late Antique grave groups of Antinoe for the first time.

ISBN: 978-2-84975-311-8

Price: € 45.00

Die Macht der Toga: DressCode im Römischen Weltreich (2013) edited by Alfried Wiczorek, Regine Schulz, Michael Tellenbach

Rom - Weltreich und Vielvölkerstaat, offenbar ohne ethnische Konflikte! Wie begriff man Identität in der Antike? Kleidung ist ein Schlüssel, um das zu untersuchen: Sie dient zur sozialen Verortung, zur Bestimmung der Herkunft und ist Zeichen gesellschaftlicher oder religiöser Zugehörigkeit. Welche Bedeutung hat Kleidung im gesellschaftlichen Gefüge jener Epoche? Sozialer Rang, Beruf, Geschlecht und Alter sind an der Kleidung ebenso ablesbar wie die ethnische Zugehörigkeit. Kleidung offenbart zugleich den Wandel in den Moden, die Korrelation zwischen Tradition und Innovation, lokale und politische Verortungen. Wie gestaltete sich gegenseitiger Einfluss zwischen Völkern am Rande des Römischen Reiches und dem Zentrum? Gegenstand des Begleitbandes zur Ausstellung ist der »Dresscode« in der Zeit der römischen Kaiser. Überraschende Ergebnisse erbringen - neben der Untersuchung von Skulpturen, Wandmalereien, Mosaiken, und Schriftquellen - neue naturwissenschaftliche Analysemethoden, angewandt auf die Textilien selbst. Der Facettenreichtum des Bandes ist einem internationalen Team von Autoren zu verdanken, die das Thema multidisziplinär



aufbereiten und die archäologischen Zeugnisse und Bilder wie die Quellentexte zum Sprechen bringen. Begleitband zur Ausstellung »Die Macht der Toga - Mode im römischen Weltreich« im Roemer- und Pelizaeus-Museum Hildesheim vom 20.04. bis zum 08.09.2013.

ISBN: 978-3-7954-2590-6

Price: € 34.95

http://www.schnell-und-steiner.de/artikel_7264.ahtml

Textiles from Hallstatt. Weaving culture from Bronze and Iron Age salt mines / Textilien aus Hallstatt. Gewebte Kultur aus dem bronze- und eisenzeitlichen Salzbergwerk (2013) edited by Karina Grömer, Anton Kern, Hans Reschreiter and Helga Rösler-Mautendorfer, Archaeolingua Volume 28, Budapest

The salt mine of Hallstatt is home to more than 700 individual textile fragments, which makes it the largest corpus of prehistoric textile finds in Europe (next to the textiles from the Dürrnberg salt mine nearby). This forms a unique treasure for prehistoric research due to its unusual conditions of preservation. The wide range of still colourful preserved textiles covers the time-span between 1500-400 BC. The textiles shed light on the various developments of textile technology and the combination with the extraordinary context opens a window into the highly complex working processes and resource management of that era.

In recent years, international research projects have been able to provide valuable insights into the beginnings of textile-dyeing and the evolution of fundamental textile techniques, using up-to-date scientific research methods in addition to textile analysis. This monograph is the first to display as a whole all the known textile artefacts from the salt mine of Hallstatt.

ISBN: 9789639911468

Price: € 78

<http://www.archaeolingua.hu/books/main%20series/main%2029.html>

Mittel der Macht. Textilien der Kelten / Instruments of Power. Celtic Textiles (2012) by Johanna Banck-Burgess, Stuttgart: Theiss

Textilien der Kelten - seltene Funde, vergessene Bedeutung Die Fürstengräber der Kelten waren mit Beigaben reich ausgestattet, wie etwa nahe der Heuneburg oder in Hochdorf. Anhand modernster naturwissenschaftlicher Methoden zeigt Johanna Banck-Burgess, dass all diese Beigaben - ja selbst die Kammerwände und Möbel - einst in Stoff gehüllt waren. Textilien waren aber nicht allein Indikator und Bestandteil von Grabsitten und Glaubensvorstellungen, sondern vor allem ein Mittel

der Kommunikation und Machtdemonstration, ein Produkt aufwendiger Herstellungsprozesse und nicht zuletzt ein wichtiger Wirtschaftsfaktor.

ISBN: 978-3-8062-2709-3

Price: € 39.95

<http://www.theiss.de/index.html?/detail.php?n=1465>

NESAT XI (2013) edited by Johanna Banck-Burgess and Carla Nübold, Stuttgart: Marie Leidorf

The conference volume contains a list of participants, a foreword of the editors, 35 papers and - on the CD - 24 posters. The presentations deal with the potential and limitations of iconographic sources, written sources on textiles, analyses of textile fibres and colours, Bronze Age textiles, the so-called Gunnister Man, Migration Period textiles and leather finds, Roman grave textiles in Austria, colours of the Thorsberg "ceremonial cloaks", virtual analyses, pollen analyses of textiles, pre-Roman textiles in Italy, animal fibres, isotopic analyses for the determination of origin, the Hammerum find, the Vehnemoor cloak, the bog body from Cloonshannagh, grave finds from Unterhaching, samite from Oseberg, male dress from a Latvian bog hoard, Great Moravian textiles, Czech cloths for a baby and a woman, figural embroidery, textiles in Speyer Cathedral, Medieval bras, Early Modern textiles from Elbing, hemp textiles, wool textiles from the terp settlement at Hessens, Pompeian dyeing, loom weights and spindle whorls in Etruscan ritual, and Pannonian textiles. The posters offer many additional aspects from the Neolithic until Modern Times.

ISBN: 978-3-86757-002-2

Price: € 54.80

<http://www.vml.de/e/detail.php?ISBN=978-3-86757-002-2&hl=NESAT>

Zur Ausstattung spätantiker Elitegräber aus St. Maximin in Trier: Purpur, Seide, Gold und Harze (2013) by Nicole Reifarh, Internationale Archäologie 124, Rahden/Westf

Die untersuchten und umfassend vorgelegten 21 ungestörten Sarkophagbestattungen stammen aus einer im 4. Jh. vollendeten und in den 1980er Jahren untersuchten Grabbasilika für über 1.000 Sarkophage, deren enorme Ausmaße und aufwendige Innendekoration einzigartig nördlich der Alpen sind. Die auf dem Areal geborgenen Grabinschriften weisen auf eine elitäre Bevölkerungsschicht christlichen Glaubens. Ein integrierter Grabbau gilt als mögliche Grablage des Trierer Bischofs Maximinus [um 330-347]. Die Arbeit untersucht Fundkontext und -umstände, taphonomische Prozesse, insbesondere im Hinblick auf die menschlichen Überreste und den Zustand der Textilfunde, die Bestattungsformen

mit Sarkophag, Hobelspänen / Hobelspan, Gips und Myrte, Alter, Geschlecht, Krankheiten und Haartracht der Bestatteten, die Textilien aus Pflanzenfasern, Seide und Wolle einschließlich der Verwendung von Goldfäden / Goldfaden und Farbstoffen, die Präparation mit Harzen und Erdfarben wie Pistazienharz, Zypressenharz und Gummiharz, Verbindungen aus Ocker und Zucker / Wachse sowie Beigaben in Form von Nägeln / Nagel und Schuhen. Drei Anhänge erschließen Vergleichsfunde aus Europa, Nordafrika und dem Orient.

ISBN: 978-3-89646-499-6

Price: € 74.80

www.vml.de/d/detail.php?ISBN=978-3-89646-499-6

Grasping Technology, Assessing Craft. Developing a Research Method for the Study of Craft-Tradition (2013) by Ulla Izabel Zagal Mach Wolfe, Lund: Acta Archaeologica Lundensia. Series 80

This PhD thesis is concerned with the subject of craft and technology and the intricate connection between man, his objects and society. When archaeologists study social and cultural structures and phenomena, it is understood that the objects have been created and crafted by people, but the weight of this fact is not always recognized. Acknowledging that we are always studying the material expression of past productions, leads us to the question of how and to what degree craft and technology can be said to be inherently human and to what degree they shape and mirror societies. If we accept archaeological material culture as being a creation, then the artefact, or a structure, becomes not only form but also contains the idea of the form, the choices that were made and the ideas about the function in the mind's eye, as well as the social relations and interaction of the craftsmen all culminating in the artefact that is the artefact we see

today. The production and objects of human beings will also be what shape the societies, minds and bodies of the people involved. In short the aim of this thesis is to achieve a comprehensive understanding of the inherently social phenomena of craft and technology, and to understand to what degree we can answer questions concerning the technological choices of the past through the limited empirical record of archaeological material. The study proposes a research method that puts attention on craft-tradition, understood to mean the comprehensive complex of manufacture, the social relations and context, actants, and habitus of the craftsman. The research method is general in its design as it outlines the different levels of study necessary when studying a craft-tradition. The research method is tested on a case-study that is concerned with the introduction of the sail in textile and maritime craft-tradition. During 500-800 AD it would seem a change took place that eventually changed and combined the longstanding tradition of oar-driven boats with the blossoming of a skilled use of rig and sail. This is indicated in the depictions on Gotlantic picture stones and the remains of a developed rig found in the Oseberg ship and later finds. Exploring this claim the textile craft-tradition from the Swedish region of Scania is outlined and the context of manufacture and the craftsman's habitus of the Late Migration and Vendel Period Scania are analysed. A final aim has been to further develop the research model so that it might allow us to understand both the patterns that might be said to belong to the human condition as well as the ones specific to a given social and cultural context.

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Websites

The Project Sea-silk online:

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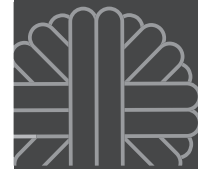
Jeannette H. Boertien was awarded PhD in Archaeology by the Rijksuniversiteit Groningen for her dissertation "Unravelling the Fabric: Textile Production in Iron Age Transjordan".

Nicole Reifarh was awarded PhD in Conservation Science by the Otto-Friedrich-Universität Bamberg for her dissertation "Spätantike Sarkophagbestattungen aus St. Maximin in Trier. Ergebnisse einer methodenkritischen Analyse archäologischer Befunde".

Stella Spantidaki was awarded PhD in Archaeology by UFR Art et archéologie, Université Paris IV Sorbonne/ Institut für klassische Archäologie, Ruprecht-Karls Universität Heidelberg, awarded for her dissertation "L'activité textile en Attique (Ve et IVe siècles avant notre ère)".

Ulla Izabella Zagal Mach Wolfe was awarded PhD in Archaeology by the University of Lund for her dissertation "Sails on the horizon: a craft-oriented study on the change in craft-tradition that put sails on Scandinavian boats 500-800 AD".

Martin Cizuk was in 2012 awarded the Swedish Licentiat Degree in Textile History by Chalmers University of Technology for his dissertation on "Silk-Weaving in Sweden During the 19th Century. Textiles and texts – An evaluation of the source material". Cizuk is currently recovering from a serious accident and is not undertaking academic work at present.



Elizabeth Wayland Barber

Obituary, Irene Good (1958-2013)

Dr. Irene Good was widely known for her pioneering work on archaeological textiles, especially in the area from Central Asia to the Near East and the Indo-Iranian borderlands. She worked to develop new applications of biochemical techniques to the study of severely degraded archaeological fibers, especially silk and wool, and to explore what she termed a “palaeo-environmental perspective”. Her goals were to understand better the local ecologies of production, the procuring of fibers and dye materials, and how to differentiate local from non-local sources of these. She also worked to untangle the history of the early use of silk fibers.

Dr. Good received her doctorate from the University of Pennsylvania in 1999, becoming an Associate of the Peabody Museum, Harvard University, in 2001.

During this period she curated important textile collections at the Peabody, won a Guggenheim Fellowship to work on a major study called A “Social Archaeology of Textiles”, and directed a new archaeological survey in Tajikistan. She was then invited to pursue her research in the prestigious Research Laboratory for Archaeology and the History of Art, at Oxford University, where she remained until her final illness. She had almost completed a book entitled “Cloth and Carpet in Early Inner Asia” for Brill’s Inner Asia Series.

My husband Paul and I first got to know Irene in 1995, working in Ürümqi as a team on the magnificent wool textiles of the naturally preserved Bronze Age mummies found in the Uyghur Autonomous Region. Dr. Victor Mair had invited Irene and me to spend a





month in Ürümchi analysing as many of the earliest textiles as possible, being almost the only scholars he could find in the USA who were crazy enough to specialize in something as perishable as prehistoric cloth. And we each had the same reaction: “If you have invited *her*, why do you need *me*?”

But upon arrival, we were grateful for each other’s company. Working conditions were difficult, time was very short when stacked against the vast amount of material to be studied, and we meshed beautifully in our work habits. Although we had divided what we were to study according to our special fields and training, we could easily help each other if one of us got overloaded. Irene was pure delight to work with: knowledgeable, systematic, careful, never territorial, with an impish grin and a wicked sense of humor that kept us all laughing despite the stress. For example, on the next to last day, which as usual went from 6 AM to 8 PM, we had run out of the chocolate we had brought from the USA. Crisis. So Victor dispatched Paul to the nearby open-air market with a paper bearing the Chinese characters for “sweets” and instructions that, once he attained the candy counter, he would just have to hunt for what might be chocolate, since sugar-candy is not a big item there. When he returned, Paul crept up behind the two of us, who were hard at work, and waggled the chocolate over our heads. Irene looked up and instantly began to whimper and whine, making little clawing motions toward the candy like a frustrated puppy, while I caught the cue and joined in. Everyone burst out laughing. Such was life with Irene.

Another source of compatibility was the almost parallel paths that had led me and Irene to archaeological textiles. Both of us were the daughters of physicists, entailing an upbringing full of sciences; in fact, both fathers had spent a year in Neils Bohr’s laboratory in Copenhagen (in the 1930s and 1960s respectively). Irene was about 8 when they lived in Copenhagen, and it was seeing all the archaeological textiles in the National Museum of Denmark there that hooked her on studying such things. I was 12 when my father took our family to Strasbourg for the year and *I* became hooked on both archaeology and folk textiles. In fact, we both looked and acted enough alike that people would start guessing whether we were sisters.

Because Victor was using his grant money to bring as many study-teams as possible to work on the Tarim mummies, he was extremely frugal—highly laudable, but sometimes leading to merriment, especially from Irene. Thus when Victor needed a haircut, he went to the local barber-college, where someone trimmed his hair on the top at the back closer than a golf green. That evening, walking to dinner behind Victor and me, Irene and Paul noticed a man passing by who had a small bald spot in the same place. “Oh,” said Irene sweetly, “that man went to the same barber as Victor!” But, of course, she was as grateful as the rest of us to Victor for making that remarkable study-trip possible: it changed our professional lives.

Irene passed away quietly in Boston on Sunday Feb. 3, 2013, of cancer. She is survived by her mother, sister, and two children, Ianna and Stephen.

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