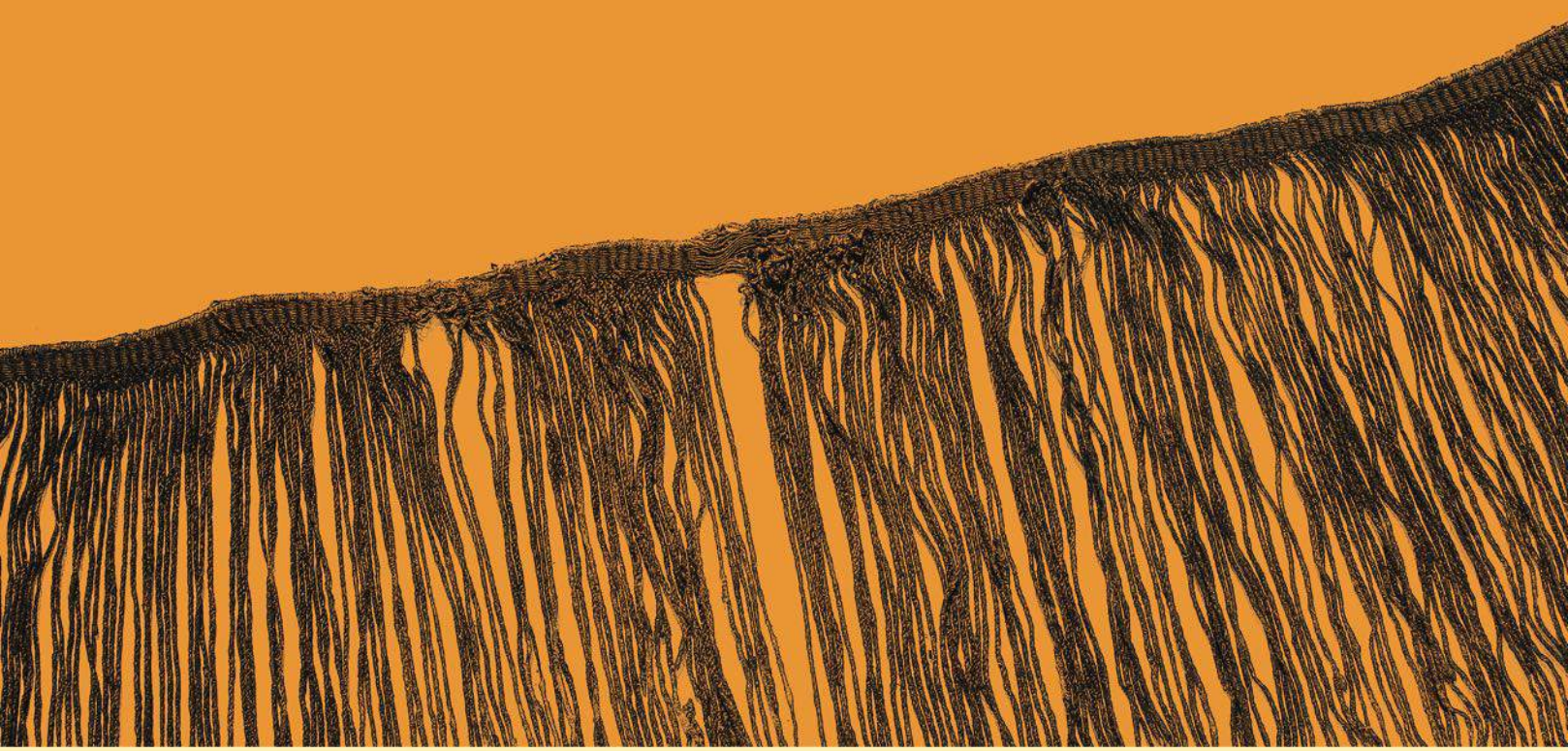
Nº 59

ARCHAEOLOGICAL TEXTILES REVIEW



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Editorial

The year 2017 has brought many great successes for archaeological textile research including several conferences and workshops, interesting results from a variety of research projects, and many new publications, about which you will find information in this new issue of the Archaeological Textiles Review.

For the ATR team, 2017 has also been a great year and we are happy to announce that issue numbers 1 to 58 are now available as free, downloadable PDFs at our web page http://www.atnfriends.com/. User statistics for the web page show that all the issues are downloaded several thousand times each month, which demonstrates that the articles written for ATR reach interested readers all over the world. The ATN/ATR online store has moved to the University of Copenhagen web shop, where you may subscribe and buy back issues via print-on-demand. These changes will benefit both subscribers and editors, who will now be able to focus on the scientific content of the journal. We have also made changes to the editorial board. At NESAT in Liberec this year, Joanne Cutler stepped down with our grateful thanks for all her sterling work and Jane Malcolm-Davies was welcomed to the team.

This issue covers a wide range of topics and time periods. Catherine Breniquet, Marie Bèche-Wittmann, Christine Bouilloc and Camille Gaumat's article "The Gallo-Roman Textile Collection from Les-Martres de-Veyre, France" demonstrates how an investigation of old finds from excavations in the 19th century can bring to light examples of textiles in a remarkable state of preservation. The most famous pieces are a tunic, a 'belt', a pair of stockings, and leather shoes, but there are also other items, such as a shawl and fragments of other garments. These exceptional finds are a small part of a larger collection that has been poorly published in the past.

The importance of new fibre analyses of small organic remains is demonstrated in "First Identification of Club Moss Use in Roman Britain" by Margarita Gleba, Elizabeth M. Foulds, Al Teasdale and Hannah Russ. This discovery widens the repertoire of indigenous plant species used for textiles in Roman Britain and emphasises the importance of fibre identification.

In the articles "Reconstructing the Tunic from Lendbreen in Norway" by Marianne Vedeler and Lena Hammerlund and "Making a Reconstruction of the Egtved Clothing" by Ida Demant the value of making high-quality reconstructions based on scientific analyses is clearly demonstrated. They each show how experimental archaeology contributes to our understanding of craft as well as clothing design in different ways.

The interpretation of archaeological objects can often be difficult, as highlighted in Laura Mazow's article "A Weaving Sword at Miletus? Combat or Weaving Sword and the Complexities of Gender Construction". Laura convincingly argues that metal objects interpreted as swords may have been weaving beaters instead.

Another interesting article, taking a different perspective on textiles from ATR's usual approach, is "The Red-blue Conundrum: an Archaeo-linguistic Approach to Red Dyes and Blue Flowers in Prehistory" by Mikkel Nørtoft. Here, the linguistic origins of the English plant name madder (*Rubia tinctorum*) in Proto-Indo-European are explored, clearly demonstrating the value of interdisciplinarity in textile research.

In this issue, we also provide some preliminary results from "The Central Timna Valley Project" headed by Erez Ben-Yosef and his collaborators Vanessa Workman, Orit Shamir, Naama Sukenik and Margarita Gleba. This project explores the ancient exploitation of copper ore at Timna which was used for the production of ingots traded throughout the southern Levant and possibly the greater Mediterranean region. A few hundred individual textile, cordage and rope fragments have been uncovered in the strata of several newly excavated sites. In light of these discoveries, the team launched multiple investigations into many aspects of production and consumption of textile goods using an interdisciplinary approach. They combine archaeological and archaeometric methods with methodologies applied in historiographical and ethnographic research.

The editorial board has decided to celebrate the 60th issue of ATR – our diamond edition – with a journal devoted to the study of archaeological and historical knitted items, which will be published during 2018. Issue 60 will primarily include articles on evidence for knitting in Early Modern Europe. We hope our readers will appreciate the importance of this long overdue initiative and embrace the need for a scientific approach to recording knitted items. We aim for it to have real scholarly impact and help upgrade this overlooked textile research topic.

As always, we welcome new contributions to forthcoming issues and encourage you to send them to us soon as they are ready, so that we may spread the editing work over the year. The deadline for contributions is **1 May** each year. Please also remember to send you us news of projects, PhDs, publications, and conferences, so that we can continue to be a hub for the archaeological textile community.

The Editors

Laura B. Mazow

A Weaving Sword at Miletus?
Combat or Weaving Sword and the Complexities of Gender Construction

Abstract
A sword from a Mycenaean-style chamber tomb at Miletus in Turkey was described as being of the Hittite type, but it is dissimilar to traditional combat swords in having a tang at both ends. A sword with a tanged tip is ineffective as a weapon as the tip could easily break off. A better comparison is found in the weaving swords from Iron Age European contexts. When used as a weaving sword, the blade functions to beat in the warp. This paper considers the possibility that the Miletus sword is a weaving sword, reviews ethnographic, ethnohistoric and literary evidence for weaving swords in the ancient east Mediterranean world, and discusses the difficulty in recognising weaving swords in the archaeological record.

Introduction
A collection of four swords from a necropolis near Miletus in Turkey was published by Niemeier (1998; 1999) (fig. 1). He identified three of them as Near Eastern in style, specifically of Hittite origin, and the fourth as an Aegean sword (1998, 39; 1999, 153-154). One of the Hittite swords is unusual. Instead of tapering to a point as is the more common form seen in the complete example, the blade tip appears pinched or constricted in profile, giving the appearance of a tanged tip. Presumably the unusual tip was assumed to be an artefact of preservation, but its rounded edges and interrupted blade-to-tip profile in comparison to the complete example suggest that the tanged tip was a reworking of the original sword form. The tanged-tip blade shape, however, is similar to tanged-tip weaving swords that have been found in graves in northern and central Europe (e. g. Hoffman 1964; Harrington 2008) (fig. 2). While acknowledging the chronological, geographical and cultural divide between Bronze-Age Turkey and Iron-Age Europe, the similarities in blade shape are striking enough that the possibility that the Miletus sword is a weaving sword should be considered.

No Bronze- or Iron-Age weaving sword has yet been identified in the archaeological record of the eastern Mediterranean, but most loom technologies would have necessitated a tool for beating together the weft threads. Cross-cultural studies document different types of beating tools – including some which are distinctly sword-shaped – and instances where weapon swords were recycled as weaving swords (McGregor 1985, 188; Harrington 2007; 2008, 29-51). That the Greek word *spáthē* (σπάθη) and the Latin loanword *spatha*, meaning blade, described both a combat sword and a weaving tool (e. g. Theophrastus, *Characters* 25.4; Parthenius, *Love Stories* 24; Pollux, *Onom.* 10.126; Seneca, *Ep.* 90.20) suggests that a sword-like object could be construed in different contexts. With this in mind, could there be archaeological evidence of weaving swords that has been overlooked?

That weaving and martial contexts are typically ascribed to different sexes may compound the difficulty in recognising weaving swords in the archaeological record. Burials are often assigned to gender based on associated grave goods and not on skeletal traits (Weglian 2001; Harrington 2007; 2008; McLeod 2011; Harrell 2014). Thus, a burial is identified as 'male' when a sword is found and 'female' when textile equipment or jewellery is present (eg. Rehak 1998, 230–231; Whitley 2002; Papazoglou-Manioudaki 2015, 321). Where swords have been found in graves with

Fig. 1. The four Miletus swords. The top sword is of Aegean type; the three others are of Hittite type with similar rod-tanged butts. Grips around the rod tangs are preserved on two of the examples. The tanged-tipped sword is the second from the bottom. Note the corrosive flaking and discoloration at the point of constriction (Compilation of individual photographs provided by and printed with permission of Antikensammlung Staatliche Museen zu Berlin, Preussischer Kulturbesitz).

positively identified females, the deceased have been described as 'warrior women' or the burial complex reinterpreted so as to disassociate biological sex from gender attributes (Rehak 1998, 230, n. 31; Doucette 2001; Harrington 2008, 29–30; Harrell 2014; Doumet-Serhal 2014, 32).

The identification of the Miletus sword as a weaving sword enables us to consider the possibility of weaving swords among the textile tools in use in the Bronze and Iron Age eastern Mediterranean world. Furthermore, acknowledging that some 'swords' were used as weaving tools suggests a need to be cautious when identifying biological sex based on our gendered conceptions of grave goods and that we may need to revisit some of our previous assessments of gender identities.

A Mycenaean-style necropolis at Miletus

A large necropolis of Mycenaean-style chamber tombs was excavated by a German team in the early part of the 20th century (Wiegand 1908, 3–9; Fimmen 1924, 15–16, 56, 105; Schachermeyr 1935, 100). The tombs cut into the Degirmentepe hillside, approximately 1.5 km southwest of the main settlement at Miletus and are generally associated with that site. The artefacts were brought to Berlin but presumed lost during World War II (Mee 1978, 133; Ersoy 1988, 81, n. 197). Some of the objects later resurfaced in the Antikenmuseum and the Pergamon Museum storerooms (Niemeier and Niemeier 1997, 191; Niemeier 1998, 36, n. 29).

The tombs are not fully published but Niemeier (1998, 36–37) included copies of an original plan and section drawing of tomb D 33 and a photograph of some of the finds. An additional photograph is published in the Antikenmuseum catalogue (Heilmeyer 1988, 24–25, obj. nos. 1–16) and a few original plans, drawings, and photographs appear as part of the Excavations in Miletus website (http://www.ruhr-uni-bochum.de/milet/in/nekropol.htm).

Artefact description

The description of the tanged-tip sword is based on the photographs (Heilmeyer 1988, 24–25, obj. nos. 1–16; Niemeier & Niemeier 1997, 204, fig. 2; Niemeier 1998, 37, photo 12; 1999, 15.c; 2003, 106, fig. 6) that display an assortment of objects from the tombs, including four swords. In most respects, the tanged-tip sword is similar to a complete sword also depicted. The two are comparable in size, measuring approximately 50 cm in length, with ribbing down the centre of the blade. An incomplete sword is also of similar type. These three swords have been identified as 'Hittite' in style due to the rod-like tang that extends from the base of the blade, which is considered to be characteristic of Near-Eastern swords (Sandars 1963, 141). Niemeier (1998, 39; 1999, 153-154) compared the swords to examples from Tell Atchana/Alalakh, Ras Shamra/Ugarit, Tell es-Sa'idiyeh and Egypt. These parallels, however, focus on the butt end of the sword – the rod-tang, hilt and grip – but ignore the distinction that is evident in the tanged tip.

The abnormality of the tanged tip most likely has been viewed as an artefact of post-depositional corrosion, a suggestion supported by the discoloration at the point of constriction (see figs 3 and 4). However, although we lack a detailed analysis of the original burial context, bronze corrosion rates are generally very low, especially in relatively dry environments (Scott 2002, 35-37). Furthermore, studies of bronze objects in different burial contexts have concluded that the original object shape is likely to be preserved, even in cases of advanced corrosive deterioration (Scott 2002, 39). The flaking that can be seen on the surface of the Miletus sword is typical of corrosion factors, but the constriction along both blade edges is not consistent with corrosive deterioration (pers. comm. S. Grieve, Director of Conservation, East Carolina University,

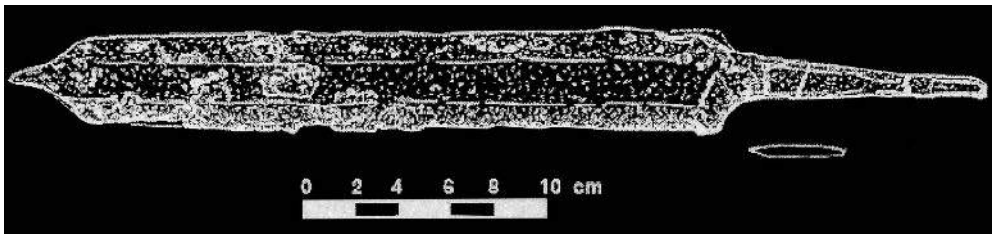

Fig. 2. An Anglo-Saxon weaving sword with tanged tip, from Schretzheim, 6th century AD (After Harrington 2008, fig. 6).

1 December 2015). Thus the constricted shape is not likely to have resulted from corrosion. This leaves open the possibility that the unusual tip stemmed from tool use or manufacture.

Although tanged-tip combat swords are uncommon, a thin tip that is sometimes described as a 'tang' is found on the Carp's Tongue Sword (Henderson 2008, 69; Cunliffe 2013, 271; Brandherm & Moskal-del Hoyo 2014; Clarke 2014, 197-198). Common to Western Europe during the 9th to 7th centuries BC, the Carp's Tongue is known for its elongated, narrow tip that can comprise up to one third of the blade length and seems to have been intended for thrusting – thus combining in one weapon the attributes of both a slashing and a thrusting sword. The elongated tip of the Carp's Tongue Sword, however, is distinctly different from the 'tang' on the Miletus example (fig. 5). In the former, the elongated tip is fashioned through multiple blade angle changes that were achieved through the manufacturing process (Brandherm & Moskal-del Hoyo 2014). The tip of the Miletus sword, however, follows a single blade-to-tip angle as can be seen in the complete example from Miletus but with the dual-sided edge constriction interrupting – but not changing – the tip's angled profile (figs 3 and 4). If it can be assumed that these two Miletus swords were originally of similar type, as suggested by Niemeier (1998, 39; 1999, 153-154), then the constriction and tanged tip reflect a reworking of the blade tip.

Artefact context

The Mycenaean-style chamber tombs from which these objects derive were used for multiple burials; the original drawings show some clustering of artefacts (Forbeck 2002; Benzi 2005, 23 n. 47) but it is not clear if the objects presented together in the photographs derive from one tomb or reflect finds from different locations. A few swords are visible in the drawing of tomb D33 (Niemeier 1998, 36 photo 11) but it is not possible to identify which illustration is of which sword. Currently, there is no clear context for the tang-tipped sword that can provide information about its function. What can be deduced is that it was found in a Mycenaean-style chamber tomb that has been dated by the

Fig. 3. Views of both sides of the tanged-tip sword (Compilation of individual photographs provided by and printed with permission of Antikensammlung Staatliche Museen zu Berlin, Preussischer Kulturbesitz).

associated pottery to the Late Bronze Age (Mountjoy 2004, 199-200).

Non-functional swords

The tanged tip is an unusual feature for a sword-like weapon: the narrowness of the blade at the base of the tip, which then appears to bulge outward, creates a weak point that could easily break upon impact at the blade tip (Mödlinger 2011, 164). This blade-to-tip shape is different than the 'tongue' of the Carp's Tongue swords where the manufacture of the elongated tip through blade-angle changes creates an even transition and not one weak point. Swords contemporary with the tanged-tip Miletus sword, such as the Aegean type F found with it, have relatively parallel cutting edges and broadly angled tips, which make them effective slashing and penetrating weapons (Molloy 2011). The elongated tip of the Carp's Tongue swords adds a thrusting attribute. The constricted tanged tip of the Miletus sword would be ineffective for slashing or thrusting.

Not all swords, however, were crafted for battle. The heavy ornamentation, including decorated blades and inlaid and gold covered hilts, and the often weak connection between hilt and blade, suggest that some swords were designed more for appearance than their ability to maim (Sandars 1963; Kilian-Dirlmeier 1990; Driessen 1999, Georganas 2010, 306; Molloy 2010, 412; 2013, 62-63). Miniature swords also evidence a symbolic function that did not require every example to be a functional weapon (Whittaker 2001; Molloy 2013). The Miletus sword in question, however, which lacks any embellishment and is full size, does not contain elements characteristic of purely symbolic weaponry.

***Spatha* as a weaving sword**

Literary evidence for a sword-shaped weaving tool comes from the Greek word *spáthē* (σπάθη; in Latin, *spatha*), meaning 'broad blade'. Its use-context includes, among other things, both combat and weaving activities and thus is similar to the Arabic *saif* (also *sef*, *seyf*) meaning 'sword' (Crowfoot 1941, 150-151). The verbal form *spathān* is used in weaving contexts to mean 'hit weft home, weave' (Liddell & Scott 1940). Although the Greek word *krekein* carries a similar meaning and is more commonly found in the literature on weaving, *krekein* is associated specifically with the *kerkis* – the small pin beater (Landercy 1933; Crowfoot

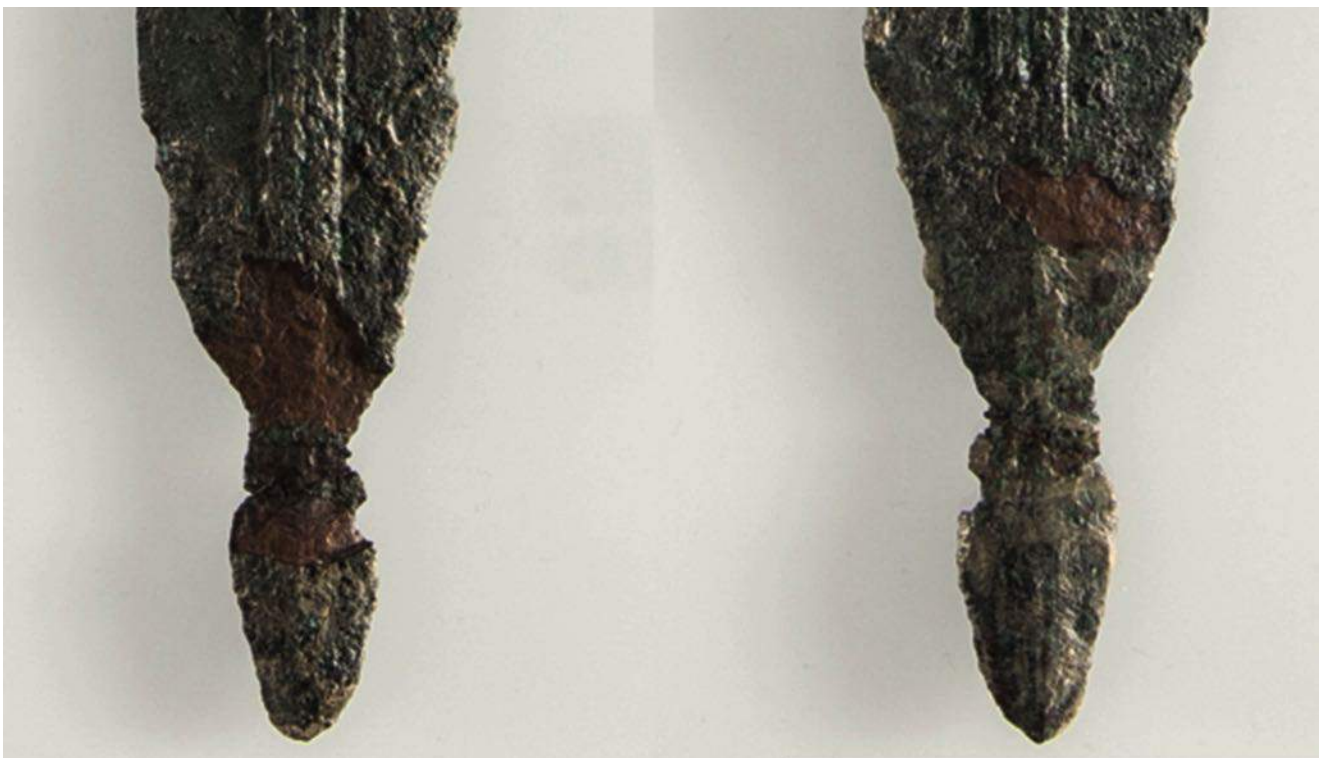

Fig. 4. Close-up of the tanged tip, photographs of both sides. Note the corrosive flaking that is typical of bronze corrosion but is distinct from the indenture factors that contributed to the tanged-tip shape (Compilation of individual photographs provided by and printed with permission of Antikensammlung Staatliche Museen zu Berlin, Preussischer Kulturbesitz).

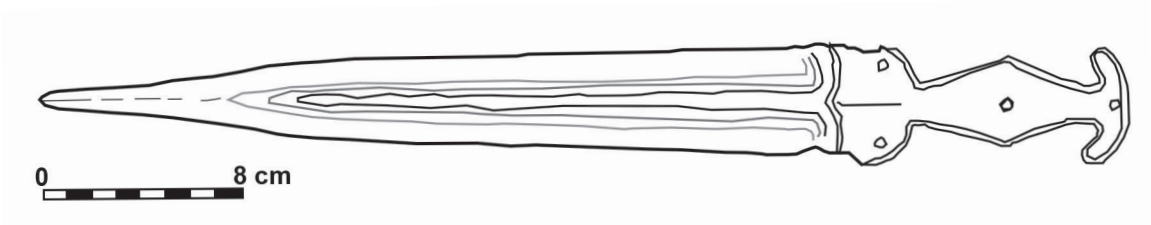

Fig. 5. Example of a Carp's Tongue Sword, from Veii, Vaccareccia, Tomb XVIII (After Hencken 1956, fig. 14B).

1936/37, 44-46). Literary references suggest that both *spáthē* and *kerkis* were used with the warp-weighted loom, but that Aristotle distinguished between them – *kerkisis* (use of the pin beater) and *spathēsis* (use of the sword) – may reflect that the two tools were not functionally interchangeable (Edmunds 2012). It has been suggested that *spathē*, then, refers to the larger weaving sword (Barber 1991, 274, 280).

Weaving swords of all shapes and sizes

A weaving sword is a long, flat, blade-shaped tool that compacts the weave by forcing together new lines of weft against the already woven edge. Referred to as 'beating in', weaving swords are also referred to as 'beaters' or 'battens'. These terms, however, cover a wide range of variously sized and shaped objects – such as pin beaters and combs, as well as sword-and spear-shaped implements – that are associated with different types of looms, size of textile being woven, and the nature of the weaving. The weaving sword is the longest of the beating tools (Wild 1970, 66-67; McGregor 1985, 188). Its size, ranging from 25 to 75 cm in length, enables the weaver with one movement to beat in a weft row spanning a wide width of weave. The long surface enables contact with a large number of threads.

Cross-culturally, in both the ethnographic and archaeological records, beaters are usually of wood or bone but can also be made of metal (McGregor 1985, 188; Broudy 1993; Harrington 2007; 2008). A heavy beater has certain advantages. The heavier the beater, the more force it can apply. A heavy beater would also rest more securely in the shed than a lighter one (Holmqvist 2013, 60). In experimental work, Andersson Strand demonstrated that metal sword beaters functioned more efficiently than wooden ones in the production of coarse wool fabrics (as cited in Olofsson 2015, 34). Resource limitations, however, probably impacted material availability. Furthermore, the disadvantage of a heavy beater is precisely that it is heavy – a problem that would be particularly acute when working on a warp-weighted loom where the direction of force is upward.

Weaving swords played a role in the main loom types that were in use in the eastern Mediterranean: horizontal ground, vertical two-beam and warp-weighted (Crowfoot 1936/37, 37, fig. 1). The weaving sword associated with the horizontal ground loom is more widely recognised (fig. 6). It survives in examples of Bedouin ground looms that have enabled researchers to recognise its reflection in Egyptian representations (e. g. Broudy 1993, 39 fig. 3.1). In the horizontal ground loom, the weaving sword is introduced to beat in the lines of weft thread and/or placed as a semi-permanent fixture between the heddle rod and the finished

Fig. 6. Using a weaving sword with the horizontal ground loom, in Bilbas, Egypt, in 1989 (Image: courtesy of Joy Totah Hilden).

weave (Crowfoot 1936/37, 37-39; Weir 1970, 18-23; Vogel 1989, 81, bottom image; Hilden 2010). In the latter placement, the weaving sword performs additional functions: in a flattened position, it beats in the weft; in a vertical position, it provides firm backing against which smaller groups of weft threads could be manipulated with a pin beater or beating hook. "Flattening or raising the weaving sword on end helps separate the warp threads when shifting from shed to counter shed and enlarges the opening – functions that are particularly helpful in looms with a fixed heddle" (Weir 1970, 18, 20–21). Additionally, keeping the previous shed propped open with the beater enables easy repair of mistakes (Holmqvist 2013, 60).

Less well-known is the weaving sword in use with the warp-weighted loom. No examples of the warp-weighted loom survive in the eastern Mediterranean as it was mostly replaced in that region by the vertical two-beam loom in the Roman or Byzantine period (Crowfoot 1936/37, 40; 1941, 148-149; Wild 2003, 143). Ethnographic examples, however, can be found in northern Europe that are similar enough to eastern Mediterranean iconography to be useful for comparative study (Hoffman 1964; Broudy 1993, 28). In Scandinavia, where there is an extensive history of warp-weighted looms in use until relatively recently, it has been possible to study the long-term association of weaving swords with that loom type, an association that dates to the Iron Age as reflected in the co-interment of weaving swords and loom weights (Hoffman 1964, 279–282, 379 n. 4).

The weaving sword in use with the warp-weighted loom differs in blade-shape in comparison to that with the horizontal ground loom (fig. 7). Ethno-historical sources describe sword- and spear-shaped weaving beaters with a differentiated handle or grip at one end and sometimes a tongue-like projection or tang at the tip (Hoffman 1964, 279; Harrington 2008, 29-51). Within this, a range of shapes and sizes is documented, with differences related to chronological or regional variation.

One of the key differences in shape of the weaving sword for the warp-weighted loom is this differentiation between blade and handle. Although a handled-tool could be used on a horizontal loom (e. g. Crowfoot 1936/1937, 37 fig. 1c; Broudy 1993: 39 fig. 3.1), most examples document a flat-sided, broad board or wooden plank that was gripped at both ends and pulled towards the edge of the weave (e. g. Vogel 1989, 81; Broudy 1993, 103 fig. 6.1). Images of vertical looms (e. g. Broudy 1993, 46 fig. 3.11) demonstrate a similar technique of seizing the beater with both hands along the blade length and pushing down towards the weave's edge. Using this technique with the warp-weighted loom, however, would require the beater to be lifted over-head and thrust upward towards the weave edge. This action would decrease the force that could be brought to bear on the weave and thus be an ineffective method for beating-in. Ethnographic observations of the warp-weighted loom depict a beating-in technique where the weaver stands to one side of the loom and grasps the handled-end of the beater with both hands (Hoffman 1964, 47 fig. 14). A similar position is suggested by the placement of the iron- and wood-handled weaving sword illustrated in Hoffman (1964, 35 fig. 5); by the size of an Icelandic whalebone beater whose handle is described as "sufficiently long for it to be held with both hands" (Hoffman 1964, 118); and further documented in experimental work (Hoffman 1964, 135). An alternative use-position is proposed by Harrington (2008, 46-47), who suggests that the well-balanced weight between handle and blade reflects an effective single-handed operation, a position demonstrated in experimental work by Grömer (fig. 8) and illustrated in Olofsson and Nosch (2015, 122 fig. 4.3.6). Both these techniques imply a handled tool.

A second difference in blade shape in comparison to the weaving sword in use with the horizontal ground

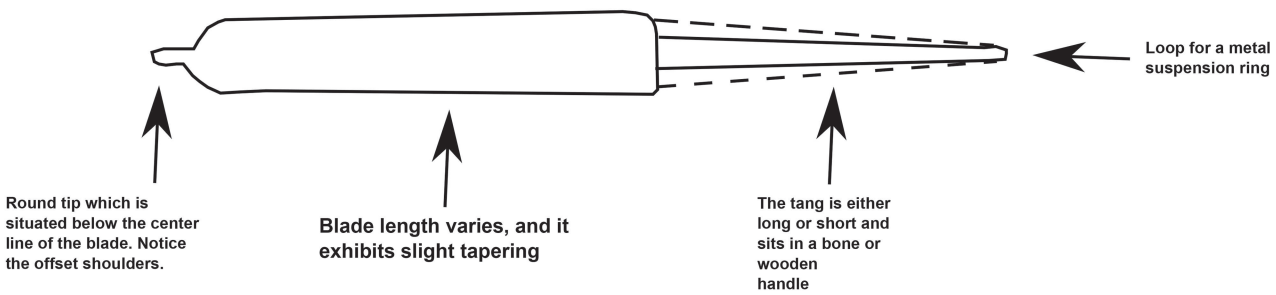

Fig. 7. The different parts of a weaving sword (After Harrington 2007, 341).

loom is the addition of a 'tongue-like projection' at the tip end on some weaving swords that are associated with warp-weighted loom technology (Hoffman 1964, 279 fig. 112; Wild & Walton Rogers 2003, 17 fig. 1.7c; Harrington 2007; 2008, 29-51). The function of this extended tip is not known, but Harrington (2007, 341-342; see also 2008, 47-48) proposed possible explanations for its development:

First, a specific tip length may have been a means of weaving through coarse warp threads, to produce manually the required shed for a simple plain weave or a simple twill. Second, it may have been a means of rapidly producing short widths of cloth using a manually picked shed, reducing the amount of time required to set up the loom. Once the threads had been picked using the elongated tip, the blade could be rotated through 90° to open up the warp threads for the insertion of the weft. Finally, a specific tip length may have been a means of introducing an additional thread pattern into the cloth, without changing the basic shed pattern.

In the horizontal ground loom, the weaving sword performs a secondary function as shed manipulator (above), but this would not have been useful with the warp-weighted loom where the warp tension is provided by the hanging weights on either side of a fixed shed bar and the shed is changed by moving the heddle bar. In the warp-weighted loom, the weaving sword is inserted into the warp on demand (Munro 2003, 192). The need to continually re-insert is implied in representations of the warp-weighted loom where the sword is depicted to the side in comparison with other loom types where it is held in place by warp thread tension (Crowfoot 1936/1937, 37 fig. 1; Hoffman 1964, 116-117, 138, 147 figs. 53, 54, 60, 66). A tanged tip would enable easy darning between the warp threads during repeated insertions, especially with woollen threads that have a tendency to cling to each other.

Finally, Harrington (2007, 341-342; see also 2008, 47-48) observed that the alignment of the extended tip, often below the centre line of the blade, and the offset shoulders on these swords provides a good finger grip that enhances control of a long, heavy blade: if sword-shaped beaters were effectively held with one hand on the handle, then the second hand could be used for control to prevent the heavy sword from swinging out.

The relationship between pin and sword

In the Bronze and Iron Ages, the pin beater is the better-known beating tool; more are found in archaeological contexts than other beater types (Wild 1970, 66; McGregor 1985, 188). It is also the only beating tool documented thus far in the archaeological record of the eastern Mediterranean in association with warp-weighted loom technology (Smith 2001; 2013, 166-168). The characteristics of pin beaters – smaller size, easier manufacture, and production from raw materials such as bone that preserve better in the archaeological record – probably contribute to their larger recorded numbers than weaving swords (McGregor 1985, 188). Pin beaters range in size from 8 to 23 cm with a sharpened or pointed tip (fig. 9). They are multi-functional tools but also developed specific functions that

Fig. 8. Experiment using a weaving sword with a warp-weighted loom. Note the position of the right hand with fingers balancing the tip (Image: courtesy of Karina Grömer, Natural History Museum Vienna, Prehistoric Department).

Fig. 9. Bone pin beater, from Enkomi, Cyprus, Late Bronze Age (After Smith 2001, 84, fig. 2, courtesy of Joanna Smith).

depended on loom type, material and weave complexity (Crowfoot 1936/1937, 44; Smith 2001; Edmunds 2012). Among other uses, pin beaters beat in the weft and are particularly useful when working a small area: limited sections of warp can be individually lifted to create temporary sheds (Barber 1991, 360 n.3; Smith 2001, 88; Edmunds 2012; 2013, 165-168). The pin beater is light and easy to lift over-head but it lacks the heavy weight necessary to provide sufficient impact to create a tight weave.

The working relationship between pin and sword beater – whether they were used singly or in concert – is not always clear and points to regional, technological and chronological differences. Ethno-historic descriptions suggest that the two tools were used together, performing complementary tasks (Crowfoot 1936/37, 44-45; Edmunds 2012), but modern ethnographic examples of weaving on the warp-weighted loom do not demonstrate this: pin beaters were no longer in use in 19th and 20th century warp-weighted loom technologies. Beating in was accomplished with weaving sword only (Hoffman 1964, 320-321). These developments suggest a shift in weaving styles and changes in the types of cloth woven. Where weaving was primarily "reduced to the specialized function of weaving coarse blankets", the smaller pin beater was not necessary (Hoffman 1964, 320-321); its functions could be taken up by the heavy weaving sword which was particularly useful for compacting relatively thick threads to produce coarse- to medium-quality cloth (Harrington 2007, 342; 2008, 48). Alternatively, "[W]here the pin beater occurs as a very important tool, it may be safe to assume that fairly close-set fabrics were woven" (Hoffman 1964, 320-321). This latter scenario fits the archaeological record of the eastern Mediterranean, where many more pin beaters than weaving swords are preserved.

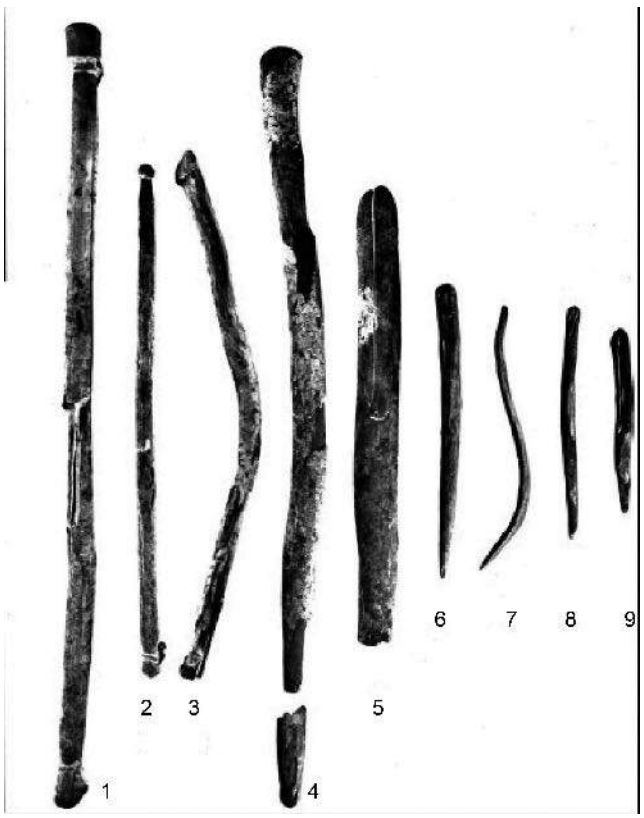

Fig. 10. Wooden pieces of a horizontal ground loom, from Nahal Mishmar, Israel, Chalcolithic period. Number 5 is a weaving sword (After Bar-Adon 1980, Ill. 55, with permission of the Israel Exploration Society).

In Late Bronze and Iron Age eastern Mediterranean and Levantine contexts, the pin beater appears concurrent with a decrease in the size and weight of loomweights and the introduction of clay spools (Smith 2001, 88; 2013, 165). Smith suggests that these changes reflect the introduction of tapestry weaving, where individual sections are worked on separately so that weaving progresses unevenly across the width of the shed. Thus, the long weaving sword would be used only intermittently to alleviate buckling or ribbing caused by uneven tension across the width of the weave. According to Barber (1991, 360 n. 3), in true tapestry "the large sword-beater would be useless and the small pin-beater would be the weapon of choice for hitting home the short stretches of different coloured wefts". In contexts of simple, coarse weaves, however, the tang-tipped weaving sword, unique to beaters in use with the warp-weighted loom, may have developed to better suit the needs of that loom type (Harrington 2008). Although some of Late Bronze and Iron Age weaving may have focused on producing complex patterns, when coarser weaves were desired that had no requirements of specialised sheds, a weaving sword with tanged tip could have been used.

Problems in identifying weaving swords in the archaeological record

The shape of the weaving sword should make it an easily-identifiable piece of loom technology (Hurcombe 2007, 133; Harrington 2008), yet weaving swords have not been found in the archaeological record of the eastern Mediterranean. It is possible that the absence of weaving swords reflects that they were not common, however the ethnographic and literary data strongly suggests they were used in conjunction with warp-weighted loom technology and were part of the weavers' toolkit. Their absence from the archaeological record, then, must be due to other causes.

Most weaving swords were probably made of organic

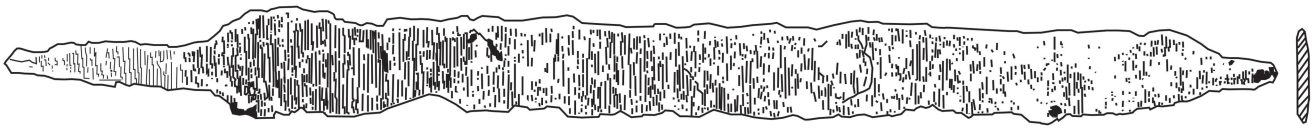

Fig. 11. Weaving sword made from reworked combat sword, from Finglesham, Kent, Anglo-Saxon (After Chadwick 1958, fig. 7e).

materials that do not preserve well (McGregor 1985, 188; Gleba & Mannering 2012, 16) and furthermore may not be easily recognised as weaving tools (Hurcombe 2007, 133). Examples from the Cave of the Treasure, Gurob and Amarna are exceptions (fig. 10), although even these have not been securely identified (Petrie 1917, 53-54 no. 136; Peet & Woolley 1923, 69; Bar-Adon 1980, Ill. 55.5). The fact that more metal than wood or bone weaving swords have generally been identified is probably an artefact of the better preservation of the former.

A compounding problem is terminological inconsistency that stems from lack of knowledge of specific technologies and tools used (Hurcombe 2007, 133; Michel & Nosch 2010, xiii–xiv). While there were distinct Greek terms for the pin beater (*kerkis*) and the weaving sword (*spathē*), these can be confused in translation. Preserved classical texts also suggest terminological confusion in textual transmission, most likely due to a lack of technical knowledge that is compounded by changes in technologies over time (Mazow 2014). There may also have been an editorial effort to update ancient texts with technologies that were more familiar, leaving us with the impression of more modern instruments in association with ancient scenes and images (Holmqvist 2013).

Re-use, recycle, repurpose

A further issue is the possible misidentification of metal weaving swords as combat swords (Harrington 2008). Although some weaving swords have a tanged tip that suggest they were purpose-made objects, others share all the characteristics of a weapon sword (McGregor 1985, 188; Harrington 2007; 2008). Cross-cultural examples demonstrate a strong resemblance between metal weaving and weapon swords, and document the re-use of weapon swords as weaving swords by blunting or grinding down the sharp edges or re-working the blade tip (Chadwick 1958, 34; Gilmour 1984; Harrington 2007, 337-338, 346; Wild 2012, 453). Chadwick (1958, 34 n. 64) describes a weapon sword that was "clearly" ground down and blunted to form a weaving sword, and a second example of a pattern-welded sword where the tip was produced post-forging by folding over a metal strip (fig. 11). Harrington (2007, 337-338; 346) describes examples of converted weaving swords, one where the weapon's sharp edges were rounded and an "elongated finger grip" was created at the blade tip, and Wild (2012, 453) notes evidence from Anglo-Saxon England of "modified iron swords," which were probably used as weaving swords. Harrington (2007) observed such close similarities between weaving and weapon swords that she postulated a common production system and manufacturing location for some of them.

The use of the term *spáthē*/*spatha* to describe both a weaving tool and a weapon makes possible the idea that these artefacts could move between contexts, perhaps because function was determined in post-production use or that recycled tools could be repurposed. Evidence that Bronze Age swords may have been mass-produced suggests that some aspects of function were defined only in post-production processing (Molloy 2011, 77-78). Examples of swords where the edges have not been sharpened, such as a hoard of metal objects from Ugarit (Schaeffer 1956, 256) or a sword cache found in Arkalochori cave on Crete (Molloy 2013, 62), swords with both edges rounded such as one from Sharif Khan (Curtis 2013, 37 pl. VIII, 97), swords described as "unserviceable" (Molloy 2010, 412), and swords lacking evidence of combat use (Molloy 2010) may reflect alternative functions for these objects.

Grave goods and gender identification

Most of the recovered swords are found as grave goods in burials that have been identified as male. Sexing of burials, however, is often determined on a gendered assessment of interred objects (Harrington 2007, 336-337; McLeod 2011; Harrell 2014; Papazoglou-Manioudaki 2015, 321). In a number of studies, osteological analyses have overturned initial artefact-based sex identifications (e. g. Angel 1973; Disi et al. 1983; McLeod 2011). More often than not, however, where positively identified females have been found in association with swords, they have been interpreted or re-interpreted as knives, or decoded for their symbolic or material value (e. g. Rehak 1998; Harrington 2008, 29). Furthermore, in multiple burials that include individuals of both sexes, swords are assumed

to belong to the male(s) (Rehak 1998, 230 n. 31; Gleba 2008, 158-159, 173; McLeod 2011, 343; Harrell 2014; Doumet-Serhal 2014, 38).

I am not suggesting that all swords should now be considered weaving swords, that the combination of sword, dagger and spear as a grave assemblage should not continue to reflect a warrior status or that women were never buried with combat swords. That there is a complicated relationship between presence/absence of swords and social identity reflection, however, is demonstrated by cemeteries where burials include unused swords, others with no sword yet the associated human bones display evidence of combat, and burials of juveniles with swords (Crass 2001; Whitley 2002; Molloy 2010; 2013; Focke 2013; Doumet-Serhal 2014, 29; Paradimitriou et al. 2015, 172). Depictions on seals, frescoes, wall engravings and ceramic vessels demonstrate swords in combat contexts but these figures are not restricted to males; seals and frescos of women brandishing swords, wielding bows and wearing armour reflect a combat role for females (see Harrell 2014, 101 for references: Kopaka 1999). However, when osteological analysis supports the identification of sex, a pattern of male warrior burials – a funerary kit including sword and spear – is positively supported as is a positive correlation of weaving equipment with females (Whitley 1996; Gleba 2008, 173).

Weaving swords that have been found in female burials fit a pattern of weaving tools associated with women but it is not a simple association (Harrington 2008). In the Anglo-Saxon sample, weaving swords and spindle whorls did not correlate with each other, possibly indicating that weaving and spinning were separate activities performed by different groups of women (Harrington 2007, 344). Alternatively, in the Scandinavian Iron Age graves there appeared to be a positive association between weaving swords and loomweights (Hoffman 1964, 279). Hoffman (1964, 282-282) also cited a study of graves in Norway where weaving swords were found in men's graves. These studies represent the complicated relationship between gender identity and its reflection in material culture.

Conclusion

The tanged-tip Miletus sword resembles the weaving swords found in Iron Age northern European contexts. A shape-based interpretation of this Late Bronze Age sword grounded only on similarities with these examples may be a geographic and chronological stretch, but the ethnographic and ethno-historic evidence supports the conclusion that a sword-shaped tool would have been part of a weaver's tool kit. The use of the word *spáthē*/*spatha* in classical literature for something sword-shaped, whether it be in martial or weaving contexts, recognises a strong similarity in shape between the two objects and possibly even that these sword-shaped tools moved between contexts, as exemplified by the reuse of re-worked combat swords as weaving swords.

The geographical and chronological distances may not be as significant a hindrance as supposed as new scientific methods demonstrate long-reaching trade connections between Europe and the eastern Mediterranean world (e. g. Kaulet et al. 2014). Combat swords tend to be conservative in shape (Kostoglou 2010, 176, 179) and examples such as the Naue II travelled the distance from Europe to the Mediterranean (Kristiansen & Larsson 2005, 128-129, 231-236; Peatfield 2008, 99; Georganas 2010, 306-307; Kostoglou 2010, 176 fig. 9.3; Molloy 2013). Furthermore, the ethnographic and ethno-historical record documents shape consistency in weaving swords and other beater types over a long time-span and great geographic distance (Broudy 1993). Weaving technologies, such as the warp-weighted loom, are also known to have diffused over large geographic areas (Barber 1991, 113; Rahmstorf 2015, 16). Rahmstorf (2015, 16) in particular notes that the early and well-documented trade in textiles likely also supported an exchange of textile tools and transfer of textile knowledge.

A greater discussion of the context in which swords are found might help determine whether a particular sword functioned as a combat or a weaving sword. Unfortunately, edges are rarely preserved on metal swords (Molloy 2010, 414 n. 102), which limits use-wear analysis as a viable option. Furthermore, while archaeological context is usually the best means of identifying tool function, it is not always insightful for metal artefacts that are often found in caches that may reflect their material or symbolic value rather than their use (e. g. Molloy 2013). A similar problem is seen with swords in burials where assumptions of gender and implicit martiality have led researchers to overlook other possible associations.

Although little information can be deduced from the context of the Miletus sword, archaeological and textual evidence documents that Miletus was a textile production centre, with a large established wool textile industry (Gleba & Cutler 2012; Benda-Weber 2013, 174-175, 178). Also an analysis of the loomweight assemblage points to "diversified manufacture of different products" that includes both fine and coarse fabrics (Gleba & Cutler 2012, 118-119). While acknowledging the need to be cautious in arguing analogous

function of objects that appear similar but are distant in time and space, the tanged tip that makes the Miletus sword so distinctive suggests that it was used on a warp-weighted loom for the production of coarse weaves, a scenario that fits well with the evidence for contemporary textile production in the main settlement at the site.

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First Identification of Club Moss Use in Roman Britain

Abstract
Archaeological works undertaken as part of Highways England's A1 road improvement scheme between Leeming Bar and Barton encountered a large rural Roman cemetery at Bainesse, near Catterick in North Yorkshire, United Kingdom. A copper-alloy bead was found to contain preserved string formed of two strands of an organic material twisted together in one of more than 200 burials. Scanning electron microscopy analysis suggests that the string was made of a club moss or a related species of fibre. This discovery further widens the repertoire of indigenous plant species used in Roman Britain for the production of textiles and emphasises the importance of fibre identification even of small organic remains.

Introduction
Archaeological works undertaken by Northern Archaeological Associates (NAA) as part of Highways England's A1 Road Improvement Scheme between Leeming Bar and Barton encountered human remains within the scheduled monument at Bainesse, near Catterick in North Yorkshire (fig. 1a-b). Excavations revealed over 200 burials, forming one of the largest rural Roman cemeteries known in Britain, which included sequences of intercutting inhumations and cremations (NAA 2015). The cemetery and contemporary settlement at Bainesse was located along a major north-south Roman roadway, known today as: Dere Street. Approximately 2.2 km to the north-west of Bainesse lay *Cataractonium*, a Roman fort and small town, which is of national importance due to its size and location in the north of Britain. The recent excavations by NAA have thrown new light on understanding not only the relationship between Bainesse and *Cataractonium*, but also on the character of Roman life in the frontier.
In total, 255 burials including cremations and inhumations were excavated at Bainesse, some of which contained grave goods including complete ceramic vessels and objects of personal adornment. Based on burial practices and grave goods, it is clear that the main period of use for the cemetery spanned the Roman period (AD 43-410), with continuation at least into the early post-Roman period as evidenced by two radiocarbon dates on human remains recovered from the site during previous excavations (Speed 2008, 7; Speed *pers. comm.* cal AD 428-618 (2σ; 1515±35 BP SUERC-20369) and cal AD 400-550 (2σ; 1585±35 BP SUERC-39626) calibrated with OxCal 4.2 using IntCal 13 (Reimer et al. 2013)). A full program of radiocarbon dating is pending in order to establish when the cemetery first came into use and for how long it served as a location for internment of the dead.

Context
During excavation of burial 203 (fig. 1c) an assemblage of three copper-alloy beads and a poorly preserved copper-alloy object (RF11325) later identified as a possible phallic pendant (Alex Croom *pers. comm.*, 2017) were recovered from a discrete deposit that had been placed on top of the grave, representing a separate, and possibly later, feature. One copper-alloy bead was found to contain a preserved 'string', which was formed of two z-twisted strands of an organic material loosely S-plied (fig. 2). The grave cut of burial 203 was small (L: >0.95 m, W: 0.65 m, D: 0.37 m), which suggests that it may have been a child's burial, although it contained no skeletal evidence. Across the site, there was a varying range of

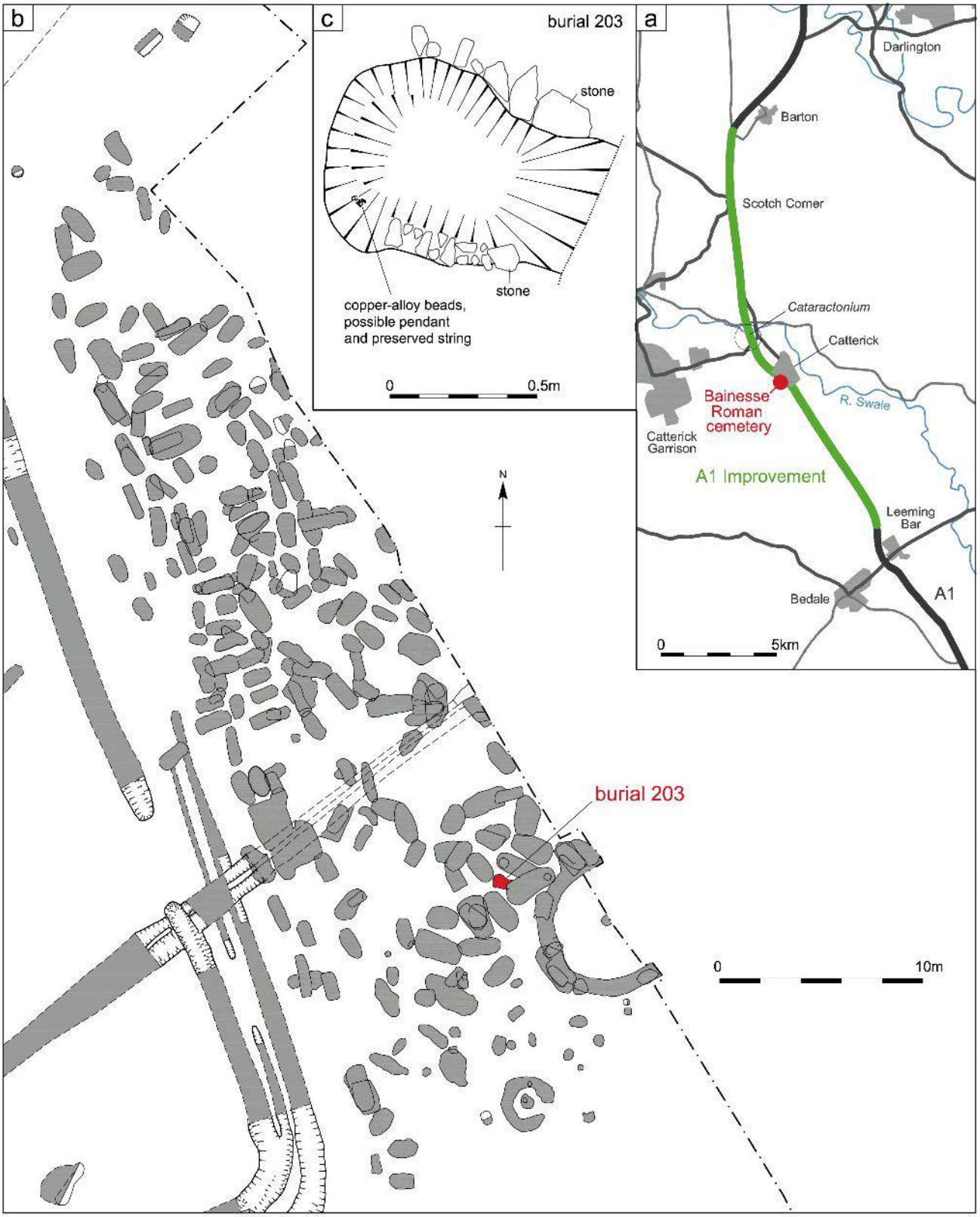

Fig. 1. a) Location of Bainesse Roman cemetery on the A1 improvement scheme. b) Plan of of the cemetery, with burial 203 location indicated. c) Plan of burial 203 (Image: © Northern Archaeological Associates).

Fig. 2. a) Three copper-alloy beads and a copper-alloy pendant in situ. b) Preserved string in situ with copper-alloy bead. c) Copper-alloy bead after conservation. d) Preserved string after conservation (Images: © Northern Archaeological Associates).

preservation from no skeletal remains to complete skeletons in very good condition. Although burial 203 cannot be dated directly, human remains from burial 202, which cut into burial 203, produced a radiocarbon date of cal AD 85-234 (2σ; 1852±29 BP SUERC-73007). This suggests that burial 203 could be as late as the early 3rd century AD, although it is not entirely clear how the copper-alloy assemblage with the organic string related to the inhumation. It is possible that they were added later.

The 'string'

A sub-sample of the string was submitted for identification and analysis using a scanning electron microscope (SEM) at the McDonald Institute for Archaeological Research, University of Cambridge, to determine the morphological characteristics of the fibre and to acquire more detailed surface information for fibre identification. The fibres were examined longitudinally for morphological features, which were compared with the author's (MG) reference collection

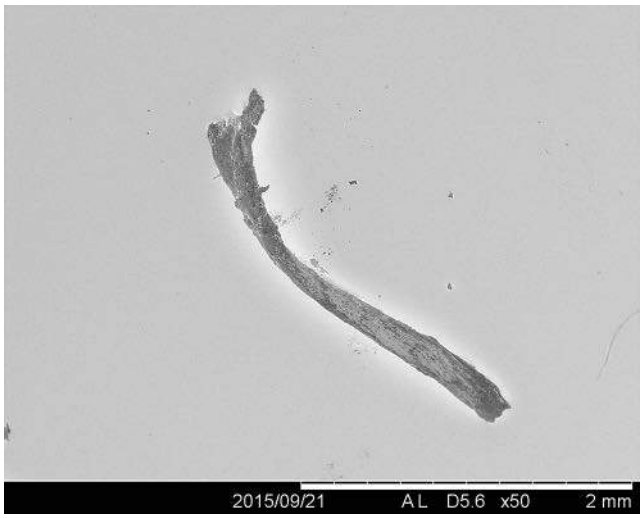

Fig. 3. SEMicrograph of the sample showing the stem (Image: Margarita Gleba).

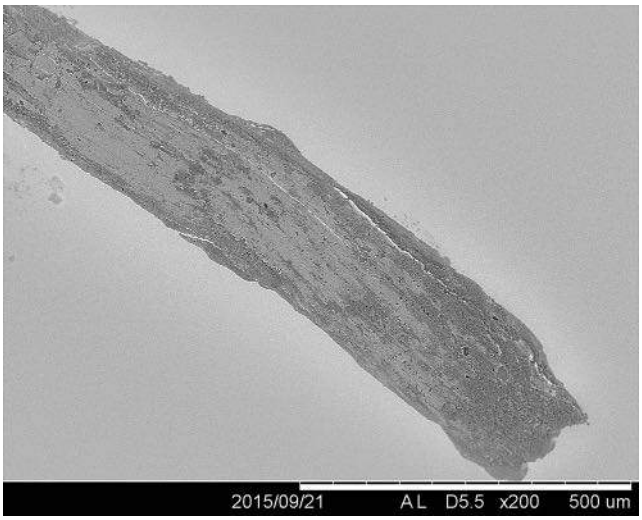

Fig. 4. SEMicrograph of a stem with a woody appearance, longitudinal splits and thickenings where leaves may have attached (Image: Margarita Gleba).

of plant, animal, and synthetic fibres. The reference collection includes processed and unprocessed fibres from plants and animals expected for the prehistoric (flax, nettle, various types of tree bast, sheep wool, goat hair, horse hair) and later periods (cotton, hemp, silk, ramie, camel hair, yak hair), as well as hair moss (*Polytrichum commune*), running or stagshorn club moss (*Lycopodium clavatum*), and cotton grass (*Eriophorum angustifolium*).

The sample fragments did not show the characteristic knee-joint dislocations of plant bast fibres, such as flax, hemp, or nettle (Catling & Grayson 1982). Instead, they had a woody appearance and occasional slight thickenings and splittings along the surface of the stem (figs. 3-4). The surface showed parallel grooves (fig. 5). In one area, a feature resembling a stoma was present (fig. 6). The diameters of these fibres were between 100-200 microns, which is significantly greater than any typical bast fibre (mostly well under 50 microns). The closest parallel in the reference collection in terms of all these characteristics is the stripped stem of running or stagshorn club moss (*Lycopodium clavatum*), which has a woody stem, grooves on the surface, splitting and frequent thickenings along the stem where the leaves were attached before their removal, and frequent stomata on the stem (figs. 7-8). The fibre analysis thus indicated that the sample may have derived from a type of club moss or similar plant species.

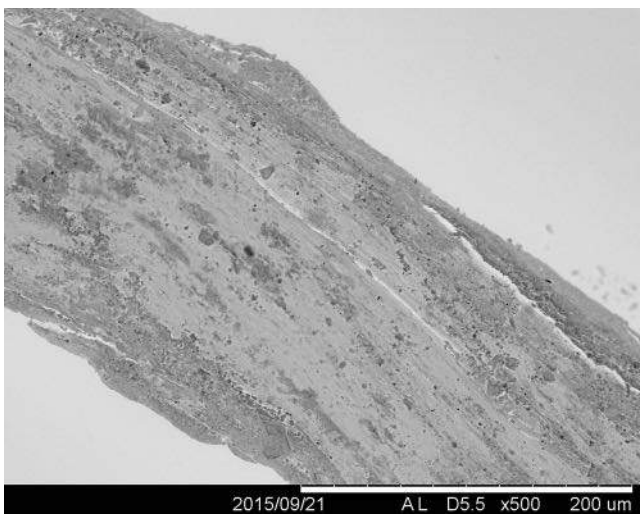

Fig. 5. SEMicrograph showing the thickenings and splits along the stem (Image: Margarita Gleba).

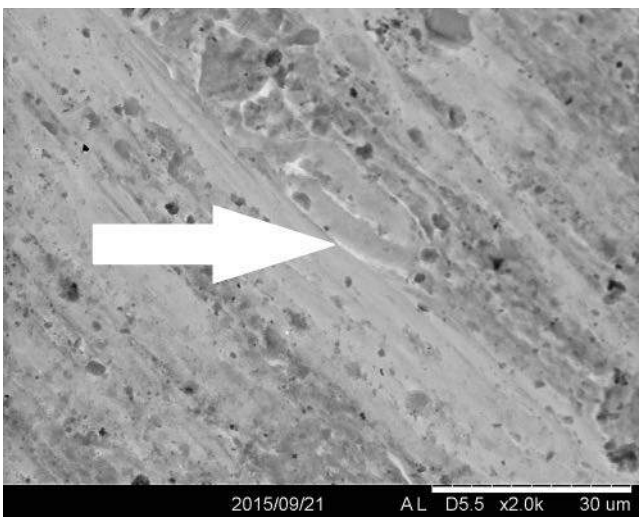

Fig. 6. SEMicrograph of a stoma-like feature (Image: Margarita Gleba).

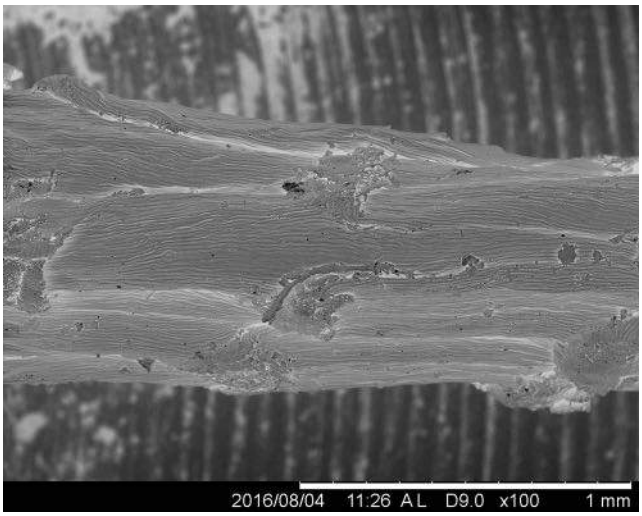

Fig. 7. SEMicrograph of a stripped stem of running or stagshorn club moss (*Lycopodium clavatum*) (Image: Margarita Gleba).

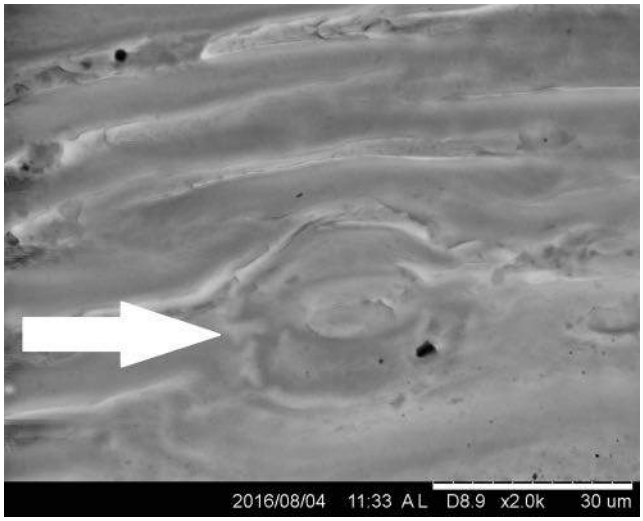

Fig. 8. SEMicrograph of stoma present on club moss (*Lycopodium clavatum*) stem (Image: Margarita Gleba).

Club mosses can have very long stems (runners), which are strong and relatively flexible. There are three species of *Lycopodium* that are native to Britain (*L. clavatum*, *L. annotinum,* and *L. lagopus*), as well as several others in related genera (http://www.ferns.rogergolding.co.uk/ferngenus/lycopodium.html). The club moss fibre reference samples have diameters (stem without leaves) of 450-850 microns. The smaller diameter of the sample may, however, be explained by the following: 1) a younger plant with smaller diameter may have been used; 2) diameter of a single club moss stem is uneven along its length and the sample may come from a section closer to the 'tip' where it is generally thinner; 3) shrinkage due to preservation conditions; 4) a different species of club moss with similar characteristics, but thinner stem, was used.

Although club moss has not, to our knowledge, been identified in archaeological contexts before, its use for medicinal purposes, in dyeing, and as a decorative item is well known from ethnography and modern use. *Lycopodium clavatum* is, for example, still used to decorate traditional Easter egg baskets in Lithuania. Its long and flexible runners, once defoliated, can easily be used as ready-made 'string' for a variety of purposes – as in the case of our Roman beads and possible pendant. The use of a wide variety of indigenous plant fibres in everyday life should not surprise us, as in addition to the more common species (e. g. flax, nettle, and hemp), hair moss string and basketry items have been identified in several prehistoric and Roman contexts in the British Isles (Harris & Gleba 2015).

The beads

The three copper-alloy beads (RF 11319, RF 11320, RF 11321) were barrel shaped and measured approximately 13 mm in diameter, 11 mm in height, and had a perforation about 9 mm in diameter (fig. 2). One of the beads (RF 11320), which was found with the fibre fragment still threaded through the perforation, was slightly flattened and broken. Given the good state of the other two beads, it seemed likely that the damage occurred in antiquity.

It is unclear how copper-alloy beads were used in Roman Britain. They are generally considered rare finds at Roman sites. Previous excavations at Catterick unearthed a number of copper-alloy beads, which Cool (2002, 27) noted as being 'remarkable' when compared to the numbers found at other sites. These beads were a mixture of the long facetted tubular type, as well as examples that were globular and barrel shaped, which are similar to the three from burial 203. However, none of these were found in burial contexts, but instead came primarily from later phases at Sites 433, 434, and non-inhumation contexts at Site 46 (Wilson 2002, 52, 109). Of particular note was cat. no. 90 (Wilson 2002, fig. 246), which recorded three globular copper-alloy beads of a similar size to the Bainesse examples, and one contained a fragment of leather thong.

Association between the beads and possible pendant (RF 11323) is interesting, as it is not only rare to find so many copper-alloy beads deposited together, but it is also rare to find beads associated with a pendant. If it is in-fact a phallic amulet, then association with beads is even more unusual. It is not clear how such amulets were worn, or how they were suspended. Greep

(1983, 139) remarked that fist and phallus amulets would have been worn individually and they were not a component of more complex necklaces; however, Parker's (2015) re-assessment of a group of five phallic pendants from a burial at Catterick suggested that this may not always be the case. There were several types of Roman phallic pendants and they are generally thought to have been worn for amuletic, apotropaic, general good luck/protection purposes, and sometimes associated with child burials and/or sites with military activity (Crummy 2010, 51). Although no skeletal material was recovered from burial 203, it is possible that the small grave cut represented a child's inhumation and that the amulet was a later addition.
Alternatively, if the pendant was not of a phallic nature, it remains unlikely that the beads were used on necklaces, which are often associated with female Roman dress (cf. jet necklace at Catterick (Cool 2002, 28; Isaac & Thompson 2002, 177, Plate 100)). These necklaces were composed primarily of glass and sometimes mixed with jet beads, although other exotic materials were used, including semi-precious stones, coral, or amber. In contrast, the association of copper-alloy beads with military sites has been highlighted and discussed (Mould 1991, 194). The inclusion of the possible pendant with the beads in burial 203, suggests that they may have been used together as decoration on military equipment.

Discussion

It is not common for organic fibres to be preserved in non-waterlogged archaeological contexts. However, organic materials are known to survive for long periods as a result of their proximity to metal artefacts and their corrosion products (e. g. Janaway & Scott 1989). Archaeological examples from the region include the flax or hemp textiles preserved due to proximity to copper-alloy brooches in the female Viking burial at Aldwick-le-Street, South Yorkshire (Speed & Walton Rogers 2004), and wool twill preserved in association with copper-alloy brooches and buckles in Anglo-Saxon graves at Scorton in North Yorkshire (ASUD 2002; Jones 2004; Walton Rogers 2004). This also appears to be the case for the string recovered from burial 203 at Bainesse Roman cemetery. Here, the corrosion product from one of the copper-alloy beads facilitated the survival of the organic string, from which, presumably, the bead(s) and the possible pendant once hung. This find also highlights the necessity for examining fibre samples under high powered magnification (e.g. SEM), as such techniques permit a more robust method for identification.
The survival of this short piece of string informs us further about the use of natural plant resources during the Roman period and about string technology in Roman Britain. While many examples of preserved textiles have been recovered from Roman deposits elsewhere in the Roman Empire, string and textiles produced using club moss have not been recovered outside of Britain, despite it being likely that the plant grew on the European continent during the Roman period, and thus was an available resource. Nonetheless, archaeological finds from Britain suggest that various types of moss were a utilised resource in the prehistoric periods. A rope made of hair moss (*Polytrichum commune*) was found on North Ferriby Boat No. 3 (Wright & Churchill 1965, 5). Other types of moss wadding (*Neckera complanata*, *Eurhynchium striata*) were used as caulking on this same boat. There is evidence for the continued use of moss in the Roman period from two moss caps (*Polytrichum commune*), both found in northern Britain. The cap from *Vindolanda* Roman fort was dated to AD 97-103, while the Newstead Roman fort example was dated to *c.* AD 86. Although these examples are different species of moss compared to the Bainesse string, it perhaps suggests that the use of different types of moss as a resource more generally had its origins in local prehistoric tradition, one that continued into the Roman period in Britain, rather than being an idea or items brought to Britain.
The post-excavation works on remains recovered during archaeological excavations at the cemetery are still in progress, with publication expected in 2018.

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Reconstructing the Tunic from Lendbreen in Norway

Abstract
A woven wool tunic with damaged sleeves and repairs to the body dating from AD 230 to AD 390 was discovered on the Lendbreen glacier in Oppland County, Norway in 2011. The Norwegian Mountain Centre in Lom (Norsk Fjellsenter) and the Museum of Cultural History at the University of Oslo each commissioned a reconstruction of the tunic for exhibition and research into prehistoric textile production. The original was woven in 2/2 diamond twill with differently coloured yarns producing a deliberate and even mottled effect. The reconstruction project investigated the materials required, the likely tools used and the weave, with new investigations into the processes of collecting, sorting, and spinning the wool, the thread system, the finishing treatment and sewing to produce two tunics as they might have been as new with complete sleeves and no repairs. Estimates for the labour required for each stage suggested a total of just over 402 hours per tunic.

Introduction
In August 2011, a group of archaeologists was searching the mountains on the Lendbreen glacier in Oppland County, Norway. The country's glaciers are melting, and objects that have been hidden under the ice and snow for thousands of years are now coming to light. On the mountainside, the archaeologists came across a crumpled piece of textile, which, when examined at the Museum of Cultural History in Oslo, turned out to be a tunic (fig. 1). The Lendbreen tunic is the oldest piece of clothing found in Norway and one of the few surviving garments from the 1st millennium AD. As snow patches and glaciers rapidly melt in mountainous areas worldwide, hundreds of archaeological finds have been emerging from the ice each year (Nesje et al. 2011, 2-3). Artefacts from different periods are found deposited in the ice patches, many of them made of organic material rarely preserved elsewhere. Ice patches often provide exceptionally good conservation conditions for textiles. The Lendbreen glacier is located approximately 1,900 m above sea level in an area which was used for hunting activity over a long period up to modern times. The wool tunic was left there between AD 230 and 390 (Vedeler & Bender Jørgensen 2013, 789, 792).

The tunic from Lendbreen
The chest of the tunic measures approximately 1.08 m and the length is c. 92 cm. By modern size standards, this would fit a slender man who is 1.70 m to 1.76 m tall. The tunic is relatively short and constructed from a simple pattern. It consists of a body section and sleeves. The main body section is in one piece. The sleeves are set in curved sleeve openings (fig. 2). The

Fig. 1. The tunic from Lendbreen in situ (Photo: Vivian Wangen, Museum of Cultural History UiO).

Fig. 2. Front of the tunic from Lendbreen (Image: Marianne Vedeler, Museum of Cultural History, UiO).

body piece has a seam on the wearer's left side and is folded on the right. The tunic has a straight boat neckline with a small, raised rim on the back edge. Simple folds are used both in the front and at the back of the neckline. The lower part of the tunic shows that it was a well-worn garment. It was repaired using two patches at the back. Both sleeves are partly torn off, and the remaining sections are narrow tubes.

The fabrics used for the body section and the sleeves of the tunic are both woven in 2/2 diamond twill, but of slightly different qualities and colours. The same fabrics are also used in the two patches. The sleeves are dark brown in colour. Due to uneven exposure to the sun, the surface colour of the body appears patchy, but closer examination reveals that the fabric is deliberately and evenly mottled. This effect is caused by the use of two light and two dark brown threads made of naturally pigmented wool alternating in one thread system (Rast-Eicher 2011, 1). In the other thread system, only the light yarn is used. While the dark yarns are generally z-twisted, the light yarns shift to s-twisted in some areas. The alternating colour pattern causes the diamond pattern to almost disappear. The diamond twill pattern is slightly irregular. The diagonal lines are reversed after 8 to 11 threads in one direction and after 12 to 30 threads in the other (Vedeler & Bender

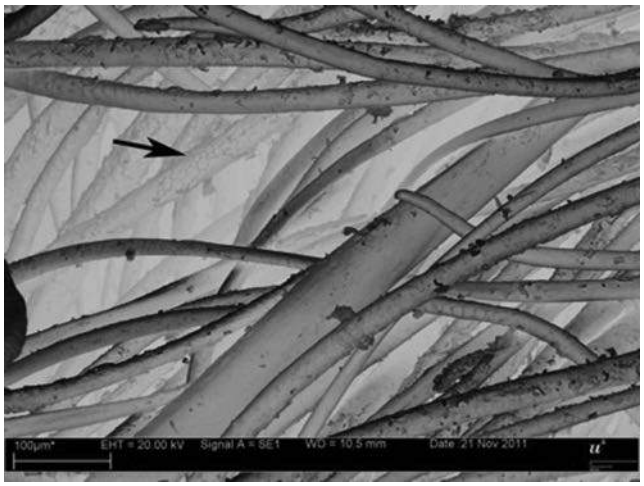

Fig. 3. The fibre thickness in the original tunic varies from fine to very coarse (Image: Antoinette Rast-Eicher, Archeotech).

Jørgensen 2013, 791). A narrow tablet-woven band attached to the side seam in the body is very difficult to investigate. The band is hidden inside the tunic and only visible from the reverse. Tablet-woven edges are quite common in Scandinavian Roman Iron Age textiles and appear to have been used both for starting borders and for selvedges (Schlabow 1976; Hald 1980; Ræder Knudsen 2011, 163-198).

The reconstruction

In spring 2016, the Museum of Cultural History at the University of Oslo and the Norwegian Mountain Centre in Lom (Norsk Fjellsenter) were planning two new exhibitions. The two museums decided to make reconstructions of the tunic from Lendbreen. The goal was twofold: the Norwegian Mountain Centre wanted a copy for exhibition purposes, the Museum of Cultural History (who had the original tunic in its collection) wanted to learn more about prehistoric textile production. During the reproduction process, the production time was measured in terms of labour hours used for the main stages: collecting, sorting, spinning, weaving, finishing treatment and sewing the wool.

The wool

The wool fibres in the Lendbreen tunic were examined using a scanning electron microscope and a light microscope. The fibre tips recorded during this analysis indicated that both fabrics were made of wool from lambs or plucked from an adult sheep with moulting properties (Rast-Eicher 2011, 1). Further, the fibre analysis showed a fibre diameter ranging from very fine (13 µm to 14 µm: from 0.5% to 2.7 % in all seven samples) to very coarse fibres measuring up to 98 µm (1% in one sample). An average of 68.3% of the fibres was below 25 µm (Rast-Eicher 2011, 7) (fig. 3). In the modern textile industry, fibres with a diameter of c. 25 µm and higher are considered to prickle and are not desirable in fabrics which touch the skin. The general fibre classification for modern Merino wool is fine: <20 µm, medium: 20-23 µm and strong: 23-25 µm (Robson & Ekarius 2011, 138).

Based on the above information, wool from Gamalnorsk sau – also called Villsau – was chosen for the reconstruction. This is a sheep belonging to the northern European short-tailed family. A double-coated fleece with fine wool and coarser hair are desirable properties for today's breed. The hair should not be too long, and not hang down on the sides of the body. The fleece should be dense, preferably with no parting on the backbone. The sheep moult annually (fig. 4) and live in harsh conditions outside all year around. Over-long hair would result in lumps of snow adhering to the fleece in the winter. The parting of the fleece at the spine results in warmth reduction in cold or wet weather (Norsk Villsaulag: Villsau).

The description of preferred properties from the Norwegian Villsau breeding society (Norsk Villsaulag) illustrates how sheep breeding is affected by climate and living conditions. The wool used for the reconstruction was collected from a flock at Aursneset on the west coast of Norway. The sheep graze outside all year and shed their wool naturally in the late spring. The wool from the sheep was rooed, that is, pulled off by hand (fig. 5). In the Lendbreen reconstruction project, it took less than 20 minutes for an experienced person to harvest the wool gently from one sheep and to do the initial rough sorting. On average, 1.5 kg of wool was collected from each sheep.

Prehistoric sheep fleece came in a variety of natural colours from white and grey to brown and almost black. The colour variations, not wanted in the modern textile industry, were used in the past for pattern building and decorative effects. Gamalnorsk sau has a large variety of natural fleece colours and to come as close as possible to the original tunic, a light beige and a dark brown naturally-coloured wools were selected. The sorting and fibre separation for the fleeces used in the reconstruction project was done by Ingvild Svorkmo Espelien at Selbu Spinneri. The coarsest parts were removed and the hair of the remaining fleece was separated by hand or with help of a broad wool/flax comb. After this process, too many short, coarse hairs and kemp fibres still remained in the material and had to be picked out by hand. In all, c. 90 hours were spent on the sorting and fibre separation process to produce enough wool for the reconstruction (fig. 6).

Fig. 4. The flock of Norwegian Villsau whose wool was used for the reconstruction project. The colours vary from light beige through brown and grey to almost black (Image: Marianne Vedeler, Museum of Cultural History, UiO).

Fig. 6. A sample showing different kind of fibres in the same staple: wool, hair and kemp fibres. The varied colours of the kemp fibres are a primitive feature (Image: Lena Hammarlund).

Fig. 5. Sheep farmer Alv Ottar Folkestad collecting wool from a sheep on the west coast of Norway (Image: Marianne Vedeler, Museum of Cultural History, UiO).

Fig. 7. The finished yarn is spun with a hard twist. A few pigmented coarser hair and kemp still remains in the light and well-separated fibre material (Image: Lena Hammarlund).

The spinning

The yarn in the original tunic was spun using a hand spindle, which is a very time-consuming process. Spinning has been considered a main bottleneck in textile production until recent times (Burnette 2008, 39-40). As time has become one of the most critical factors in today's production, some difficult choices had to be made during the reconstruction project. To reduce costs, the wool was machine-spun. This was done at a small spinning mill, Selbu Spinneri in Klæbu, Norway, where a yarn could be produced that closely resembled the original at a reasonable price (fig. 7).

At the same time, a spinning experiment was conducted: 10 hand-spinners from across Norway were given 50 g of the processed fibre material to spin a yarn with the same diameter and degree of twist as observed in the original tunic.1 On average, it took the spinners c. 11 hours to comb and spin 50 g of the wool, making an average amount of 292 m per 50 g. The spinners had very varied experience, and the time they used also varied significantly, from seven to 17.5 hours. From this, it can be concluded that, despite the careful sorting and preparation process, short hair, kemp fibres and small lumps still present in the wool made it difficult to spin an even yarn. About 2.5 kg of wool was used to make yarns for the reconstruction of two tunics. Based on the results of the spinning experiment, hand spinning the yarn for the reconstruction would have taken about 270 hours for one tunic or c. 540 hours for both.

Fig. 8. The reconstructed fabric was woven on a warp-weighted loom by Lena Hammarlund (Image: Marianne Vedeler, Museum of Cultural History, UiO).

The weaving and finishing treatment

Textiles dated to this period of the Iron Age are usually interpreted as having been woven on a warp-weighted loom. Loom weights and weaving swords are common artefacts in archaeological sites dating to the Iron Age in Norway and Denmark (Bender Jørgensen 1986, 140; Andersson 1996, 14). Finding preserved edges and weaving details in an archaeological textile can provide evidence of the loom type used (Ciszuk & Hammarlund 2008). A tablet-woven starting border, for instance, could indicate the use of a warp-weighted loom. An edge with visible small loops running along the lower front edge could be a starting or finishing border. This kind of edge with loops is found in Danish Iron Age textiles woven on a vertical two-beam loom by tubular warping with a warp-lock (Ciszuk forthcoming). In the reconstruction process, a weaving sample was made in this way, showing that it is possible to use such small loops as a starting or finishing border. On the other hand, the edge with small loops could be a simple selvedge. To conclude, it is not possible to know for sure what kind of loom was used originally, but based on the pattern in the archaeological find, it was decided to weave the fabrics for the reconstruction project on a warp-weighted loom (fig. 8). Further, when the original tunic was studied by Vedeler and Bender Jørgensen in 2013, it was not easy to establish the warp and weft directions in the fabric of the body. One aim of the reconstruction project was to look into this question again.

In the first publication of the Lendbreen tunic, the warp direction was interpreted as running vertically through the garment, giving stripes in the weft direction. This interpretation was made because a narrow tablet-woven band found on one side of the body was interpreted as a selvedge (Vedeler & Bender Jørgensen 2013, 791). Due to the difficult position of the tablet-woven band, it was not possible to study it any further. It is therefore still not possible to say whether the band was sewn on to or woven into the fabric, and thus, it cannot contribute further to the identification of the warp and weft directions.

The choice of twist direction, degree of twist and yarn diameter are also aspects that could provide clues about warp direction. However, the yarns in the body of the tunic all are spun with a z-twist with the same amount of twist and diameter in warp and weft. This means that no specific deductions can be drawn from these data. Neither the thread ratio for warp and weft in the tunic is of help in solving the question of warp and weft direction because these fall within the documented variants commonly used in the period (Hammarlund 2015). Other details such as gores and weft crossings could potentially be used to determine the warp and weft direction (Ciszuk forthcoming), but none has been identified in the tunic thus far.

More concrete features that could help in the identification of the warp and weft directions are the diamond twill pattern units. Technical analyses of archaeological textiles with diamond twill, where warp and weft directions are known, show that the majority of them has documented twill diagonal turns after an even number of threads in the warp direction, with 10 threads before the diagonal turns a typical number. In the weft direction, an uneven number often occurs, e. g. nine threads before the diagonal turns (Bender Jørgensen 1986, 194-204, 243-247). Choosing an even number of threads between the diagonal turns makes the heddling easier and more logical compared to uneven numbers. By using even numbers, two of the sheds can be easily picked up with the help of the starting border in which the threads run in pairs. This could be an argument for interpreting the fabric as having a striped warp.

Specifically in the chest area of the tunic a distinct stripe made of four light threads can be seen. It is broader than the other regular stripes made of two light and two dark threads. The broader stripe is possibly a weaving fault. Weaving experiments undertaken

Fig. 9. A stripe of four threads woven in the warp direction appears different from a stripe woven in the weft direction. To the left the stripe is made in the weft, in the middle is the original and to the right the stripe woven in the warp direction (Image: Lena Hammarlund and Marianne Vedeler).

during the reconstruction process showed that this stripe appears differently depending on whether it occurs in the warp or weft direction. This is due to the colour effect combined with the diamond twill pattern weave. In comparison with the original, the visual appearance of that with the stripe woven in the warp is closer to the original than that woven in the weft (fig. 9). When making the stripes in the warp direction, the edge with small loops can be interpreted as a simple selvedge. This also means that the heddling follows the easier and more logical working process for making diamond twill reverses in the warp with an even number of threads between the diagonal turns.

The warp direction in the textile used for the body of the original tunic is still very difficult to determine, but the visual appearance of the weaving fault and the diamond twill pattern indicate that the mottled fabric was woven with a striped warp, not a striped weft, as suggested by Vedeler and Bender Jørgensen in 2013. The weave was reconstructed with a striped warp.

In the dark brown fabric used for the sleeves, no edges or other details were documented that could help to establish warp and weft direction. For this fabric, it was decided to follow the same principle for heddling as used in the mottled fabric for the body, with an even number of threads between the diagonal threads.

The surface of the original tunic shows no traces of finishing treatments. There were, however, traces of felted fibres inside the seams which indicate some kind of finishing treatment such as fulling. This phenomenon of hidden felted fibres can also be seen in textiles from the Thorsberg find (Möller-Wiering 2011, 63-64). Because of the traces of felted fibres, the reconstructed cloth was lightly fulled. This finishing treatment was used to smooth tensions and irregularities in the fabric (fig. 10).

Fig. 10. The finished fabric ready for sewing. The top fabric is the one made for the sleeves , while the fabric underneath is for the body part of the reconstructed tunic (Image: Marianne Vedeler, Museum of Cultural History, UiO).

The reconstructed mottled body cloth measured 1.25 m x 3.35 m when taken from the loom. The weaving and finishing treatment of the mottled cloth took approximately 104 hours. A total of 67 hours was needed for the weaving itself, to insert the weft, change the shed and beat the weft. Approximately 2 cm to 2.5 cm were woven per hour, using 20 wefts or 8.5 wefts per cm. The finishing treatment, including fulling by foot and stretching during drying, took approximately three hours. For the dark brown fabric used for the sleeves, measuring c. 0.55 m x 2.50 m, the weaving and finishing treatment took 52.5 hours of which 35 were used for the weaving. For this fabric, c. 3 cm to 4 cm were woven per hour, using c. 50 wefts or 13.5 wefts per cm. The difference in weaving time between the two fabrics is partly due to one being wider than the other. The mottled fabric measured c. 125 cm on the loom and the dark brown only 55 cm. Another difference is due to the warp set, with 11 to 12 warp threads per cm in the mottled fabric and 9 to 10 warp threads per cm in the dark brown fabric. The denser warp set makes the sheds harder to change and because of this the weaving took a bit longer.

The sewing

The original tunic from Lendbreen has a simple pattern consisting of three pieces of cloth: a body in one piece and two sleeves, each made from only one piece of cloth. In addition to this, two patches had been added at the back for repair. Four different types of stitches were used to form the garment: running stitch, casting stitch, blanket stitch and a so-called Thorsberger seam, where two pieces of cloth were first folded to each side and then the four layers of fabric joined by a seam of running stitches locking the tears (Vedeler & Bender Jørgensen 2013, 299) (fig. 11). The sleeves were set into rounded sleeve openings which were already locked with a double hem (Vedeler & Bender Jørgensen 2013, 293).

When reconstructing a prehistoric object, it is necessary to make a number of choices. The analysis of the tunic in 2013 suggested that it originally had been sleeveless and that the sleeves were a later addition. Should the reconstruction then be a sleeveless tunic or should it be the tunic worn with the sleeves half torn off? The tunic was made with long, untorn sleeves and without patches on the back (fig. 12). The cutting and sewing was done by professional tailors at Heimen Husflid in Oslo. They used the thread made at Selbu Spinneri. This was the same thread as was used for the weaving of the cloth. This sewing thread was not easy to work with, as it was too hairy for this purpose. Therefore, the tailors used beeswax to smoothe it before sewing by hand. They used the same stitches as in the original tunic. It took them approximately eight hours to cut and sew together one tunic.

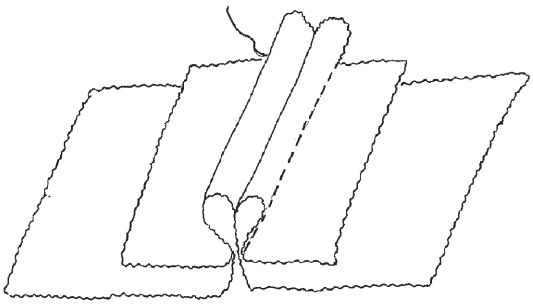

Fig. 11. The Thorsberger seam was used to join the body part on the left side of the tunic (After Möller Wiering 2011).

Conclusion

There are many steps in the production chain of a garment: from harvesting the wool through spinning, weaving, cutting to sewing. As demonstrated in the Lendbreen reconstruction project, it was a very time-consuming process. The wool used in the original yarn contains a mix of finer and coarser fibres and some very coarse fibres, possibly kemp, but the length of the fibres or how the original fleeces were composed before sorting is not known. This makes it hard to tell how much time was spent on sorting, fibre separation, teasing and combing before the actual spinning. The yarns in the original tunic have an even appearance, which could indicate that the wool was combed before spinning. A combed fibre material would reduce the

Wool collection and first sorting	2 hours
Second sorting and fibre separation	90 hours
Combing and spinning with spindles according to the experiment	540 hours, c. 14,625 m yarn
Weaving the two fabrics including finishing treatment	156.5 hours 5.5 sq m
Cutting and sewing	16 hours
Estimation of total work time for the two reconstructed tunics	804.5 hours

Table 1. The approximate time used to produce the two tunics.

Fig. 12. Cecilie Eskild at Heimen Husflid with the two finished tunics: one made for the Museum of Cultural History in Oslo, the other for the Norsk Fjellmuseum in Lom (Image: Marianne Vedeler, Museum of Cultural History, UiO).

spinning time compared to a teased material, if an even yarn is desired. The yarns in the Lendbreen tunic can be described as common, standard Iron Age yarns and would not have demanded any specialist knowledge to produce. Both fabrics in the tunic are woven in 2/2 diamond twill. This weaving technique requires specialist knowledge when woven on the warp-weighted loom. Compared to tabby and plain 2/2 twill, knowledge about pattern units and counting is needed for both the heddling and the weaving.

In Table 1, the time required to produce the two tunics in the reconstruction project is shown. From this, it is evident that wool preparation and spinning is more time-consuming than the weaving, finishing treatment and sewing.

In prehistory, the time spent on fibre preparation, spinning and weaving must have varied greatly depending on differences in the raw materials and the tools used, and the knowledge and skills of the people producing the textiles. It must still have been a very time-consuming task to produce a textile. This applies to everyday fabrics as well as to the most valuable ones. Archaeological finds have shown that textiles were often reused not only as re-tailored garments, but also for many other purposes. Excavations from medieval Tønsberg and Oslo in Norway have revealed textiles reused as tar brushes, as toilet paper or as material for sealing in houses and boats (Universitetsmuseenes gjenstandsdatabaser). Another way to get a realistic view of the value of prehistoric textiles could be to look at the relationship between production costs and circulation time. This could also be an interesting focus in the light of today's problems of textile overconsumption and growing amounts of textile waste.

One of the goals with the Lendbreen reconstruction project was to create two new tunics as similar as possible to the original. But there was also a broader aim: to gain greater knowledge of time and labour used in each step of the chain of production by analysing the original fabric. It is known that prehistoric textile production was a very time-consuming process, but timing each step of the process gave a more detailed picture. A striking example is the time-consuming process of sorting and separating fibres into different qualities. Some questions will never be answered because the original fabrics do not provide the required information.

There is still a need to look further into the direction of the warp and weft but it is now clear what to search for when the original tunic is available for new analyses. The narrow tablet-woven band is an area that needs further investigation, as are the some weft crossings. Those will be easier to find and recognise next time the Lendbreen tunic is examined. The light stripe consisting of four bright threads is puzzling. Is it an error or a decoration? This question leads to another: was the mottled fabric originally used for something else? This remains a matter of speculation.

The original tunic is in the collection of the Museum of Cultural History (UiO) in Oslo, and will be on display at the Norwegian Mountain Centre in Lom in Norway from 2018. One of the reconstructions can be seen at the same museum from 2017.

Acknowledgements

Ingvild Svorkmo Espelien and Selbu Spinneri in Klæbu in Norway did a great job spinning the yarns for the two reconstructions of the tunic from Lendbreen. Espelien also coordinated the spinning experiment that took place in 2015. Many thanks to Cecilie Eskild and her team at Heimen Husflid in Oslo for cutting

and sewing the two reconstructions. Thanks also to sheep farmer Alv Ottar Folkestad and his flock at Aursneset, Eiksund in Ulstein who provided the wool. The project was funded by the Museum of Cultural History at the University of Oslo and the Norwegian Mountain Museum in Lom. Many thanks!

Notes

1. The spinners were: Ingvild Svorkmo Espelien, Sissel Brun Ellevseth, Linda Thiis, Lillian Koehler, Henriette Aasen, Reidun Lien Horgen, Marianne Glørstad, Ingvild Sjøbakk. Spinning experience, weight and diameter of spindle were documented.

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Ida Demant

Making a Reconstruction of the Egtved Clothing

Abstract
A reconstruction of the Egtved woman's clothing dating to the Early Bronze Age (1370 BC) was made for exhibition near the grave in which the originals were found. The clothing consisted of a blouse, belt and corded skirt. Previous observations of the garments were investigated for clues as to the raw materials used and construction methods. Close-up photographs of the originals made further detailed study possible. New observations were made of the wool fibres. Although the project was not primarily intended as experimental archaeology, it offered opportunities for some exploration of the tools and techniques potentially employed in the Early Bronze Age. The project showed it was possible to process the wool fibres using a comb and spinning hook, to weave the blouse on a warp-weighted loom, and that the choice of fleece was crucial to the look and feel of the finished garments. A further outcome of the project was an investigation into how the items were worn and whether they had been previously interpreted accurately for a woman the size of the Egtved woman. The results demonstrated that the clothing did not require the wearer to bare her midriff as had been suggested in the past.

Introduction
In the spring of 2013 the textile workshop at Sagnlandet Lejre in Denmark was contracted by Vejle Museerne in Jutland, the museum responsible for the area in which the Early Bronze Age grave of the Egtved woman was found in 1921 (Thomsen 1929), to produce a replica of the blouse, belt and corded skirt found in the grave (fig. 1). The grave is more specifically dated to 1370 BC (Christensen 1998, 113). The previous clothing reconstructions, which were exhibited in a small exhibition building placed close to the grave mound, had been stolen some years earlier and the museum needed new reconstructions to be made. This was a great opportunity to take a new look at this find and work experimentally with how it could have been produced.
The primary goal of the project was to make reconstructed garments as close to the originals as possible. Although this included hand spinning and hand weaving, this process was not in itself an archaeological experiment. Therefore, it was not considered necessary for the production to use the same type of tools as could have been used for the originals. However, it offered the opportunity to consider which tools and methods could have been used. The yarn for the pro-ject was spun by textile technician Anne Batzer and the different parts of the clothing were woven by the author.
A first important question to consider is in which stage of its use the reconstruction should be produced (Nørgård 2010, 17). This is particularly important in relation to traces of wear and repairs in the originals. In this case, it was decided that they should look new, thus omitting a repair on the original corded skirt.
Over the years, several reconstructions of the Egtved as well as other Bronze Age clothing items have been made. Margrethe Hald was the first to produce a number of copies which are known from illustrations in books on Bronze Age clothing (Broholm & Hald 1940; Broholm 1961). Only rarely has such work and the experiences during the working process been published. At best, it is documented in unpublished

Fig. 1. The corded skirt, blouse and belt belonging to the Egtved Woman (Image: National Museum of Denmark).

reports. An exception is the work of Karl Schlabow in which he discusses possible methods for the production of the Danish Bronze Age clothing items based on his own experiments (Schlabow 1937). The aim of this article is to present the reconstruction process and discuss some of the technical challenges which were confronted.

The Egtved corded skirt, blouse and belt is today on display at the National Museum of Denmark in Copenhagen. It was therefore not possible to make a detailed close-up study of the different clothing items except by looking through the glass of the display case in the museum and at high-resolution photos of the different garments kindly provided by the museum. For information regarding the technical details, first and foremost were the descriptions by Broholm and Hald (1935; 1940). The work of Karen Hanne Stærmose Nielsen was also of great help (Stærmose Nielsen 1981). Where no other reference is given, the data presented is based on observations made during the reconstruction by the project team.

Preparations

One important issue that had to be decided before the work could begin was to find the right raw material for the reconstruction, and thus to know more about the type of wool used in the originals (Demant 2008; Nørgård 2010; Christiansen & Hammarlund 2013; Demant & Batzer 2015). For the yarn to be of the right character in relation to the originals, it is paramount to choose a similar wool fibre, not only regarding colour, but more importantly, regarding the quality and diameters of the fibres. When the project began, no analysis of the wool quality had been made, and Broholm and Hald give only very little information about the character and colours of the yarn used (Broholm & Hald 1935; 1940). Therefore, we had to rely on a visual evaluation of the different yarns, and, on the basis of personal knowledge and experience, choose an appropriate modern wool material with which to work.

Studying the yarns of the original

The visual examination of the original clothing items made it evident that specific colours of wool were used for the different items, even if it all fell within a range of brown colours. In the skirt, the cords are made in a dark brown wool, whereas the yarn in the waistband appears to have a slightly lighter colour. A thicker thread running along the upper edge of the waistband, termed the selvedge cord, looks very light, as do the felted rings at the bottom of the cords. It is likely that this wool was originally almost white and as such stood out from the rest. Furthermore, the yarn in the waistband looks slightly thinner than the yarn used in the cords, and is very tightly twisted. The yarn used in the belt is also spun with a high twist and is slightly thicker than the yarn used in the waistband. Altogether, the belt is woven very tightly and has a solid look. The yarn used in the blouse seems generally thicker than the yarn used in the skirt and the belt, and the colour is more of a golden brown.

Choosing the wool

There is no contemporary sheep breed which has survived unchanged since the Bronze Age, nor has a fleece type similar to the wool used in the Danish Bronze Age textiles. Therefore, it was necessary to look at a variety of modern primitive sheep breeds, and to choose a wool type thought to be the most appropriate for the purpose.

Earlier published reconstructions of Bronze Age clothing have been undertaken using the Swedish Gute sheep, which is considered to be a good representative of an ancient sheep breed (Stærmose Nielsen 1979, 9; Hatting 1993, 29). The Soay sheep known from the

Fig. 2. Fibres and tools used in the work process: 1) Staples of Spelsau lamb. 2) The modern comb used for separating the fibres. 3) Undercoat fibres from Värmland lamb. 4) Combed staples of fine fibres in the undercoat wool from Spelsau lamb. 5) The wooden comb with a band of mixed outer and undercoat fibres. 6) A spinning hook, which is a tool that may have been used in the Bronze Age (Image: Anne Batzer).

island of St Kilda in the Hebrides and the North Ronaldsay sheep from the Shetland Isles have also been suggested as sheep breeds with comparable types of wool as in the Bronze Age (Ryder 1983, 47). All three sheep breeds have a wool in different shades of white, grey and brown, and an under coat with very soft fibres. An old Swedish sheep breed, the forest sheep, also called Värmland's sheep, which is a crossbreed between the Norwegian Spellsau and some Shetland sheep (pers. comm. with former breeder Martin Stoltze, Scania in Sweden) is another possible wool type to use in a reconstruction of Bronze Age textiles. This breed also has wool in different shades of white and brown. All four sheep breeds belong to the European short tail category, which has a double-coated fleece with soft fine fibres in the undercoat and with coarse hairs in the outercoat (Robson & Ekarius 2011, 53), which could match the look of the yarns used in the Egtved clothing items.

In order to decide what kind of wool would be most appropriate for the reconstruction, the different kinds of wool were tested. The available Soay wool had only short stables between 3 cm and 5 cm in length. It was, however, possible to prepare the fibres for spinning with a wooden comb, and it was also possible to spin the fibres into yarn using a drop spindle and a spinning hook. However, the Soay yarn did not resemble the yarn used in the Danish Bronze Age clothing items. A North Ronaldsay fleece had a good mix of a fine undercoat and outercoat, and not much kemp. However, this was available only in grey tones, and it was not possible to find a fleece in different shades of brown within the timeframe of the project. Wool from Sagnlandet Lejre's own flocks of Gute sheep was also tested, but it was not possible to find a fleece with sufficiently fine fibres in the undercoat and evaluation suggested that this wool contained too many kemps.

The best result was achieved using the wool from the Värmland sheep. This fleece had the best variation in colour shades, and a silky sheen, which is a characteristic of the skirt. Two fleeces from the first year cuts of three to six-month-old lambs with very fine

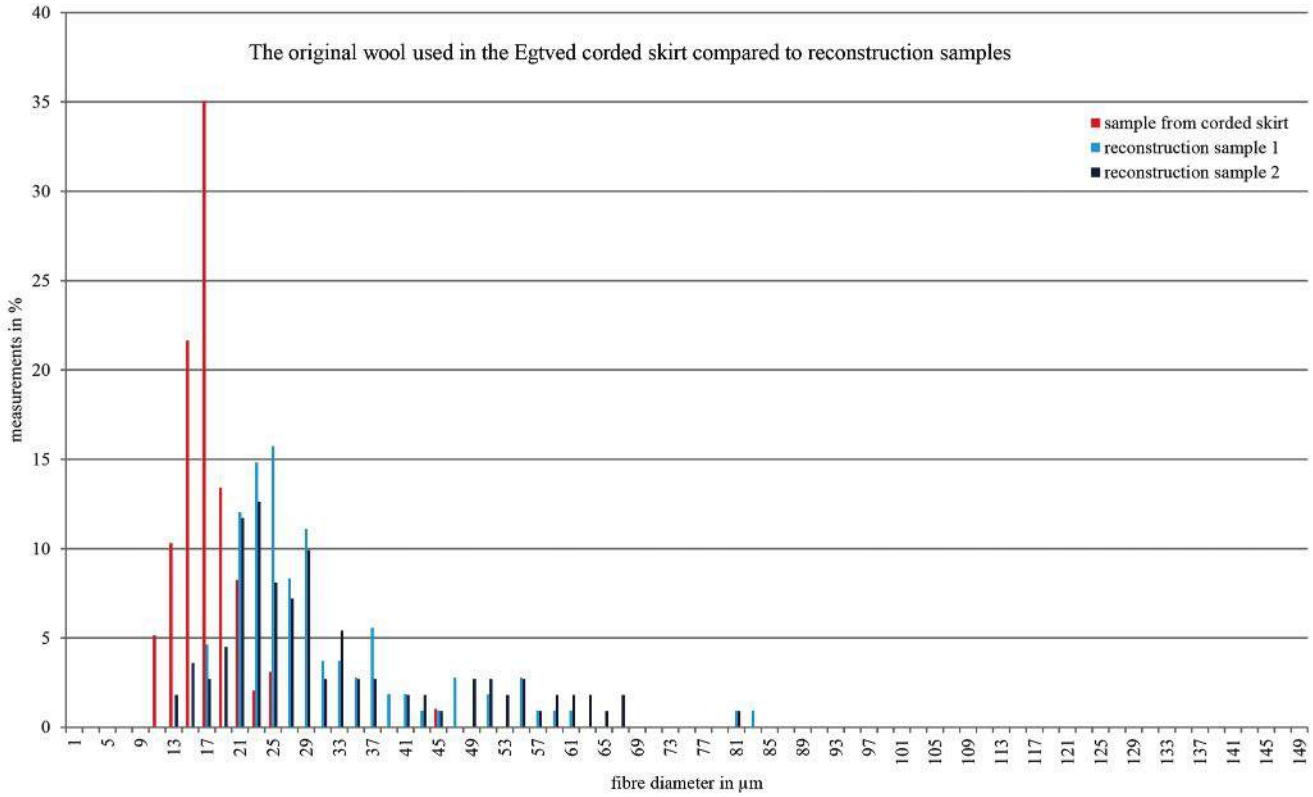

Fig. 3. Diagram comparing the results of the fibre analysis. The red lines to the left represent the fibre measurements from the original corded skirt. The blue lines to the right represent two different samples of wool from the reconstruction. The original wool was finer and more homogeneous than the wool used in the reconstruction (Image: Irene Skals, National Museum of Denmark).

undercoats and a very silky outercoats were obtained. The colours varied between light brown, warm golden brown, and greyish brown. A fleece from a one-year-old ewe lamb with a fine golden brown undercoat, and a rather bleached outercoat was also obtained. However, as the wool sorting progressed, it became clear that there was not enough of the golden brown fleece. Therefore, a mix of the Värmland fibres with two fleeces from very fine-fibred Spellsau lambs, which were available from a local breeder, was used.

Experimenting with wool preparation and spinning

Before spinning the yarn, experiments with tools and methods for preparing the fibres which could have been used in the Danish Bronze Age were undertaken. These showed that a wool comb would be necessary for separating the fibres. Many combs made of bone and horn are preserved from the Nordic Bronze Age (Brøndsted 1966, 54). Two combs of a similar shape but made in wood were used (fig. 2, no 2 and 5). Using only one comb at a time, the undercoat was first separated from the outercoat. Then, in order to ensure the right wool softness and also the right colour shades in the yarn, the fibres were mixed with selections of the finest parts of the outercoat. This produced a mixture of three-quarters undercoat and one quarter outercoat. The fibres in the undercoat were approximately 5 cm to 6 cm long and the outercoat staples were approximately 12 cm long. This fibre mix was then placed on the comb again so that long bands of fibres could be pulled out for spinning. Spinning without combing was also attempted by separating and mixing by hand, but the finer fibres were difficult to separate and this thread became uneven. This method was abandoned.

The earliest known spindle whorls found in Scandinavia are dated to the end of the Bronze Age (Hald 1980, 134). It is thus uncertain what tool was used for spinning in the Early Bronze Age. One option is the simple spinning hook, which is a useful tool for spinning both long and short fibres (fig. 2, no 6). Using this tool, the twist is added softly and a relatively high twist angle can easily be achieved. An advantage of this tool is that it is easy to pull out the fibres going into the yarn by hand, and it can produce both a soft, loosely twisted thread and a hard, densely packed

thread, thick or thin, just as they appear in the Bronze Age textiles. The tool is particularly good for making a thick, rounded yarn using short fibres. The same tool has been used with success at the textile workshop at Sagnlandet Lejre for spinning nettle and bast fibres in earlier projects.

The spinning of the yarn

Once the look of the different yarn types was decided, it was possible to rationalise the spinning process. Instead of using wooden combs, the fibres were lightly combed with the help of a hand carder. The wool was not carded in a traditional sense, but the undercoat and outercoat was separated by sweeping the staples over one carder and when enough fibres were gathered in this way, they were given a few separating brushes, and gathered into a bundle which could be spun easily.

Spinning was performed on a modern spinning wheel with scotch tension. This is suitable for spinning relatively thick yarns with a soft twist, as it can be adjusted to avoid pulling the yarn too hard, in a similar way to how the spinning hook works. In this way, the desired appearance for the yarn was achieved.

Fibre analysis

During the reconstruction process, Irene Skals from the National Museum of Denmark performed fibre analysis of the wool used in the corded skirt. For comparison, fibre analysis was also performed on a sample of the wool used in the reconstruction. The visual evaluation of the modern wool by eye suggested this wool had a similar appearance to the original, but the fibre analysis showed this was not the case (fig. 3). In the original corded skirt, almost all fibre diameters measured between 10 and 25 microns, with a majority around 17 microns and only a few fibres measured more than 40 microns. Contrary to this, the fibre histograms for the yarn used in the reconstruction showed a much wider curve with measurements between 13 and 45 microns and a peak at 25 microns, and some measurements are as high as between 50 and 70 microns. Despite the care taken to make a very soft mix of fibres, the fibres were still too coarse in comparison to the original wool from the Bronze Age. In hindsight, it can be concluded, based on the fibre diameter distribution, that the outercoat should not have been included in the yarn even though it was taken from a young sheep. The original wool must have been extremely soft to the touch.

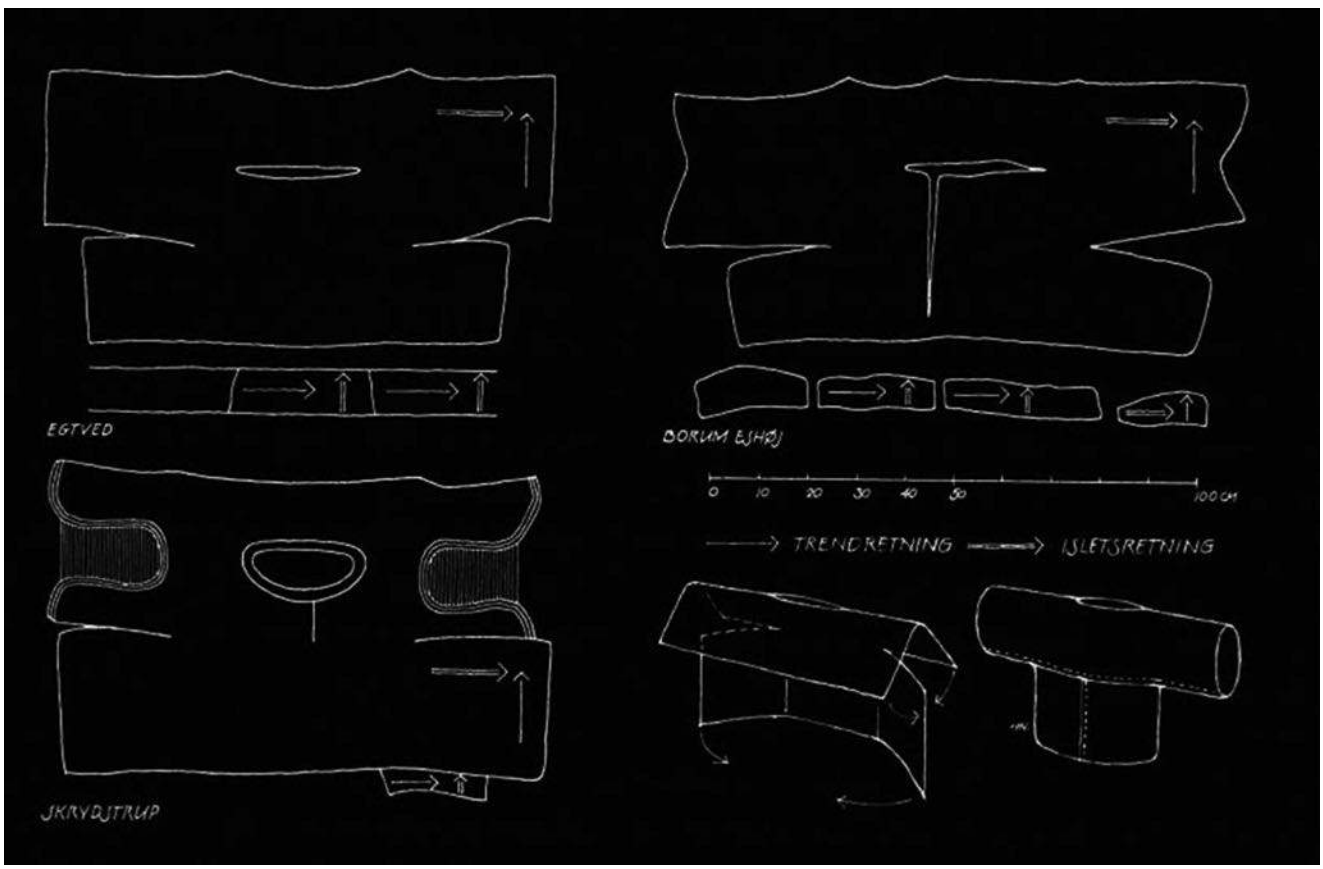

Fig. 4. The patterns of the three known blouses from the Bronze Age (After Stærmose Nielsen 1989)

Fig. 5. The fabric woven for the blouse (Image: Ida Demant).

Making the costume

The blouse

The fabric used for the Egtved blouse was woven in a balanced tabby with approximately three threads per cm in the warp and the weft. It is made up of two slightly different pieces of fabric. The largest part is a rectangular piece approximately 105 cm x 56 cm, which was shaped into a sleeved bodice using a poncho-like shape with minimal cutting. The blouse is gathered with two seams forming a T on the back. To the lower edge is added a strip of fabric, which probably had the purpose of keeping the shape of the blouse and adding length to the bodice (Broholm & Hald 1940, 85; Stærmose Nielsen 1981, 33) (fig. 4)

It is still an unresolved question which type of loom was used to weave the many Danish Bronze Age textiles. In the earliest publications on the Bronze Age textiles, it was assumed that they were woven on the warp-weighted loom (Broholm & Hald 1940, 127; Schlabow 1938, 26). However, in 1981, in a study of the Egtved find, it was suggested that they could have been woven on a two-beam loom (Stærmose Nielsen 1981). The best way to decide if a textile is woven on a warp-weighted loom or a two-beam loom is to look at the transverse edges of the fabric. The starting borders are recognisable characteristics from the warp-weighted loom and looped warp ends are characteristic of the two-beam loom (Hald 1980, 158-167). However, on the Egtved blouse, there are no visible weaving edges. The edges of the sleeves are described as sewn with buttonhole stitches with no weaving edge, so it is assumed they were cut off or perhaps worn off and were later repaired with the stitches (Broholm & Hald 1940, 85). Further, the construction of the blouse would have resulted in the transverse edges being hidden in the seams (Broholm & Hald 1940, 85) either on the back or where the strip around the lower edge was added to the bodice. This means that it is not possible to say if there are any starting or finishing borders on the fabric, which can indicate the type of loom used. Therefore, the fabric for the blouse was woven on a warp-weighted loom with a tabby woven starting border so that no characteristic starting border would be visible (fig. 5).

The 9 cm narrow piece, sewn on to the blouse, has slightly more threads per cm in one direction than in the other (3.8 threads horizontally on the blouse and 2.4 threads vertically) (Broholm & Hald 1935, 284). A selvedge is also preserved along the lower edge of this piece, but as the upper edge is hidden in the seam, it is not possible to determine if this contains another selvedge or a cut-off edge. This means that either it is a long, narrow piece woven to shape, or it was cut from a larger piece of fabric. Considering that similar small textile pieces have been added to the other blouses from the Bronze Age (Broholm & Hald 1935; 1940; Stærmose Nielsen 1981) and therefore must be considered an integral part of the Bronze Age blouse design, it is most likely that it was woven to shape for this purpose. Therefore, this textile was woven as a simple, narrow tabby, which also made the unbalanced relation between warp and weft easy to achieve. Very little information on how the seams of the blouse were made is published, except that they are made in overcast stitches (Broholm & Hald 1935, 284). The most obvious solution was to let the edges overlap as much as possible (1 cm to 2 cm) and make overcast stitches on both sides. This made the seam reasonably solid.

The belt

The belt is woven in a warp-faced tabby, 2 cm wide and 174 cm long. At one end, the warp threads are finished in a very elaborate tassel (Broholm & Hald 1940, 87). For a long time, it was assumed that the belt was made using the tablet-weaving technique (Broholm & Hald 1940, 143). However, in traditional tablet weaving, the warp threads are twisted in rows of four threads between each weft. In this belt, the warp threads are not twisted, which was already emphasised by Schlabow (1937, 46). Further, as no tablet weaves have been identified in the Danish area before the Early Iron Age (Ræder Knudsen 2015), there is no scientific proof to support this interpretation. Most likely, the belt was woven on an ordinary loom using heddles, which is also how the reconstruction of the belt was made. To make the elaborate tassel at one end, it was necessary to supplement the 20 warp threads from the

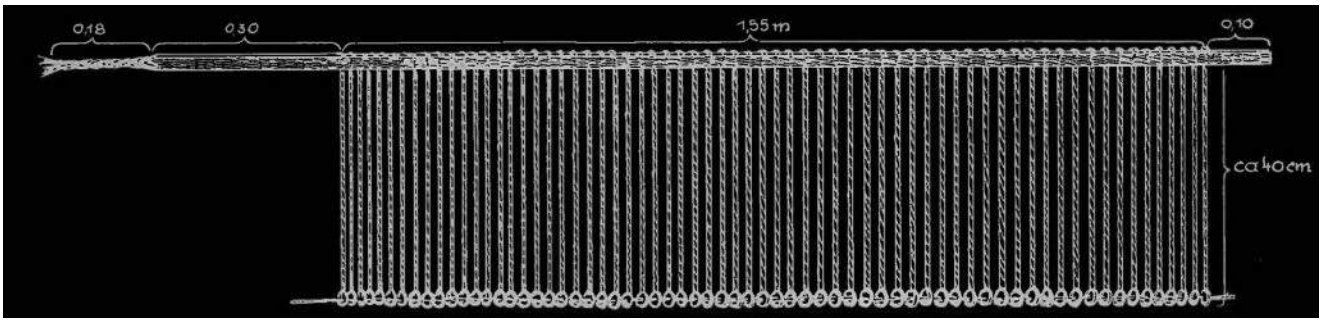

Fig. 6. Drawing of the corded skirt. It is likely that the weaving started with the short part on the right side of the diagram (after Karl Schlabow 1937, 57).

weave with 16 extra threads, which were stitched in on both sides of the weave. All the threads were then twisted, finished and gathered in the same manner as described below for the corded skirt.

The corded skirt

The most challenging task was to make the corded skirt. The original is created as a 210 cm long band, woven in warp-faced tabby. In the middle section of this band, at a length of 154 cm, the threads have been used to create the approximately 38 cm long loops. The loops are hard twisted together two by two into very firm cords. At the bottom, all the cords are gathered with another plied cord and a weft-twine, to form the skirt (Broholm & Hald 1940, 86) (fig 6). There are approximately nine cords in 4 cm in the band and each cord is approximately 3.6 mm in diameter.

The corded skirt has been given a variety of names and descriptions in different publications (Broholm & Hald 1940; Bergerbrant 2007; Randsborg 2011; Fossøy and Bergerbrandt 2013). In Broholm and Hald, it was described as "a belt or band from which a row of cords or fringes hang down" (Broholm & Hald 1940, 86). This description is the most precise. The skirt will be termed here a "waist band with cords". In the first publication of the Egtved find, it was suggested that the cords in the skirt constituted the warp threads of the waistband, while the lengthways threads were identified as the weft. The selvedge cord would then have served as a simple form of starting border (Thomsen 1929, 188-89). This construction method has recently been repeated by Fossøy & Bergerbrant (2013, 25).

As with the belt, it has also been suggested that the waist band of the corded skirt could have been woven using tablets (Nørlund 1941, 11). But, in this case, there are no details which can support this interpretation.

Fig. 7. a The setup of the warp for the corded skirt. b The warp of the waistband. The white cord to the right is the selvedge cord. In the front of the picture, the leashes tied to a small stick can be seen, and in the back, the plied thread which made up the first weft is visible (Image: Ida Demant).

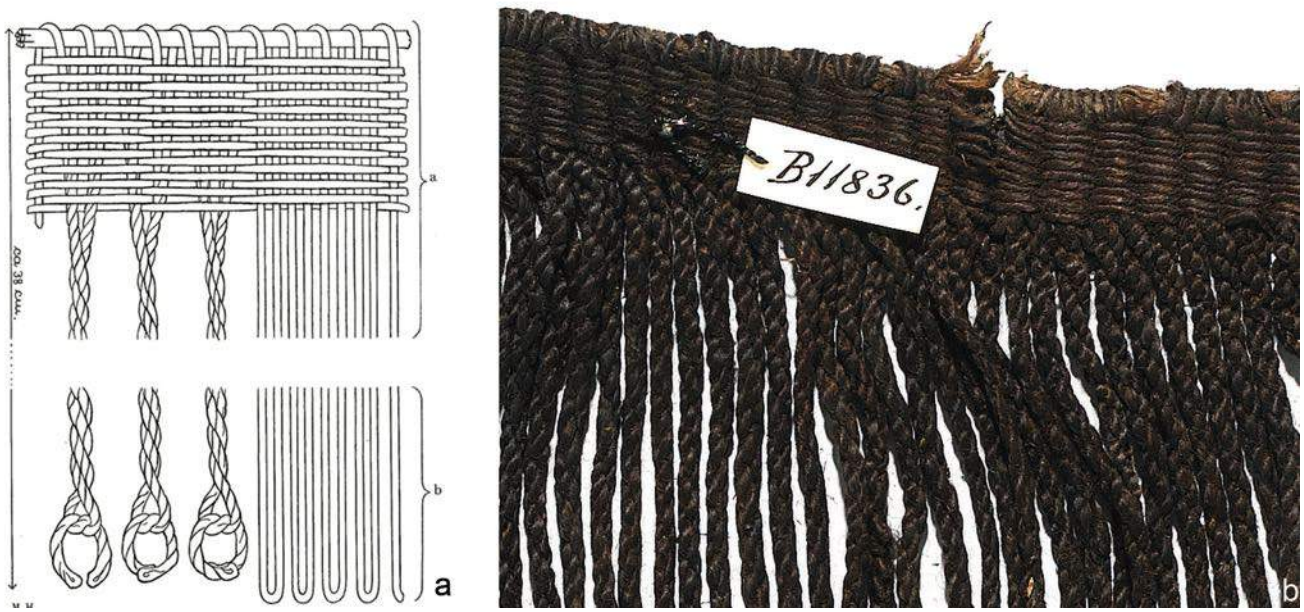

Fig. 8. a Drawing showing how Margarete Hald suggested that the corded skirt was made (after Broholm & Hald 1940, 85). b Close up of the waistband of the corded skirt and the cords (Image: National Museum of Denmark).

When Schlabow made his experiments, the waistband was set up as a simple tabby weave, where the cords were formed by the weft in the band (Schlabow 1937, 58). This is the most obvious method to construct the corded skirt. Therefore, the waistband was set up as a simple tabby weave band with heddles attached to a small stick for the first shed, and the "natural" shed made with a loop of thread behind the heddles.

Another interesting question is how the warp of the waistband should be placed during the construction to achieve a practical weaving position? Schlabow (1937) did not give any suggestions to how the warp would have been set up for weaving the waistband, but in his discussion of how to weave the belt, he presented the idea of using a weaving frame, and even a setup in a warp-weighted loom. These suggestions are all plausible, and it would be interesting to test the different methods, including the starting-border method, in a future experiment. In this project, the warp was secured on one side of a table and the warp ran across to the opposite side, where it was weighed down by a couple of loom weights. This provided a good, comfortable working position (fig. 7a and b).

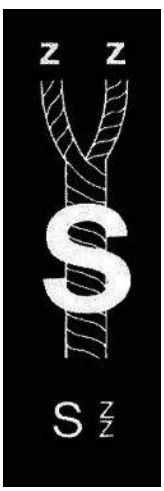

Fig. 9. The twist directions in the cords. The yarn is z spun, the first twist is S ply and the last Z cabled.

The method for making the cords in the skirt was chosen intuitively based on experience as a hand-weaver. According to Hald's descriptions (Broholm & Hald 1940; 86), in each weaving shed of the waist band, 3 double wefts of the same length of yarn form the loops, which are then plied to form the cords (fig. 8a). To make sure that the yarn loops are secured in the shed, and cannot be pulled out of the band, the weft loops are turned around a selvedge cord, a thick twisted cord running along the upper edge of the waistband. In Hald's drawings, it appears that the weft yarn is always passed the same way around the selvedge cord (Broholm & Hald 1940, 85). However, a study of the edge of the original skirt on a close-up photograph shows that another way of passing the thread is a possibility (fig. 8b). While weaving, the ball of weft yarn was kept on the side of the warp which forms the upper edge of the waistband. From this position, first one loop of weft yarn was pulled *over* the selvedge cord and through the weaving shed, and after this, another loop was pulled *under* the selvedge cord and through the weaving shed. Finally, a third loop was pulled *over* the selvedge cord and through the shed before the shed was changed and three new loops were pulled through the next shed in the same way. A video of the weaving process may be seen online (https://vimeo.com/77738761).

After weaving the waistband, the weft loops had to be plied to form the cords. First, each loop had to be twisted, before being plied together with the next loop,

so each cord would consist of four threads. The twist is Z-2S-2z (fig. 9) (Broholm & Hald 1935, 285). The original garment and the available photographs show that the cords were twisted very hard, and the loops in particular were twisted very hard, before being plied with the next one to form the cord. The twist angle in each loop is about 45° to 50°. The angle of the final ply is more varied, but seems to be around 40° to 45° (fig. 8b). In an earlier reconstruction of the corded skirt made by Anne Batzer, the loops were twisted with the help of a stick placed through the end of the loop and turned until the loop was sufficiently twisted. Then, two loops were held together and twisted the opposite way. To spread the twist along the length of the cord, it was necessary to pause occasionally and pull the two sticks apart, before continuing until the cord had the right amount of twist. Another method is to use a drop spindle to add twist to the loops (pers. comm. from Rie Jepsen). However, it was difficult to get the degree of twist sufficiently high in the loops when plying them together using these methods. As it can be seen in the video, a method closer to that used for working with rope and bast fibres was more successful. No tools were used - the loops were held in each hand close to the waistband and twisted hard between the fingers, while at the same time plying them together by shifting them from hand to hand (fig. 10). This method made it easier to maintain the twist in the loop while plying, and to ensure the twist was even between the waistband and the lower end of the cords.

The warp of the waistband was set up with one continuous yarn without cutting the warp ends. This made it possible to start the weaving at the beginning of the warp. The first weft in the original is an approximately 25 cm long light or white two-ply cord, which in the reconstruction was used to fasten the warp at one end. The section before the weft loops is a 10 cm long tabby, and after the weft loops, the band has a 46 cm long section, which ends in a long braid made of the warp ends. The weft thread used in the last part of the waistband is also in a lighter colour than the remaining part.

The last challenge was to finish the cords at the bottom of the skirt. According to Broholm and Hald's description, the two yarn loops were first tied with a single knot, and then the ends were held together, overlapping in part to form a ring. To keep the shape of the ring, a lump of unspun wool was wrapped around the two overlapping yarn loops (Broholm & Hald 1935, 287; 1940, 85). Here it was particularly important that the wool had good felting qualities. Therefore, the wool from the Värmland sheep had to be mixed with another type of wool which had better felting

Fig. 10. Plying the cords (Image: Sagnlandet Lejre).

qualities. Finally, a S2z plied cord of light wool was passed through all the rings and two single threads were twisted above the rings to gather all the cords so that the skirt, despite its light and airy appearance,

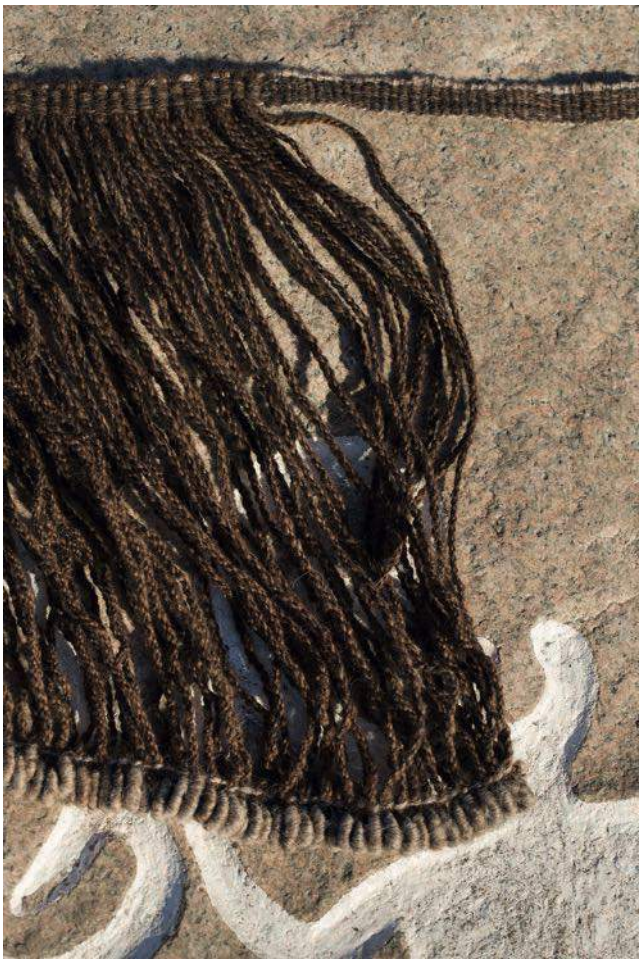

Fig. 11. The end of the finished skirt with the felted rings (Image: Sagnlandet Lejre).

had a firm lower edge and could function as a skirt (fig. 11).

Final remarks

The reconstruction work has shown that the process of creating the corded skirt can be performed in different ways: not only in relation to the direction of the warp in the waistband, and how it is set up, but also how to proceed with the next steps. The cords can be completely finished while weaving the waistband or each part can be finished before moving on to the next process. The choice will probably depend on how familiar the maker is with the weaving and plying processes. In the present project, weaving and twisting in one step, and finishing the lower loops afterwards was undertaken. Next time, it might be better to finish each cord in one step to speed up the working process even further.

It has already been stated that it was not a time-consuming task in the Bronze Age to make a corded skirt (Hvass 2000, 31). Calculations based on the work presented here show that it was possible to weave, twist and finish the rings of 11 cords, which is equivalent to approximately 5 cm of the skirt, in an hour. As the corded part of the skirt is 154 cm wide, (approximately 350 cords), excluding the woven ends of the waistband, it would take 30 to 35 hours of concentrated work to make this part, excluding the time necessary to set up the warp and weave the band ends. However, this would still be the fastest part of the work. In addition to this, it is necessary to consider the time spent on preparing and spinning the wool according to the method used in the Bronze Age.

Apart from investigating the process of production, making a one-to-one scale reconstruction of the clothing items also provides the possibility of examining how the outfit was worn. Since the discovery of the grave in 1921, the corded skirt in particular has inspired lively discussion on how it was worn. Was it worn on the waist or was it resting on the hips (Harald-Hansen 1949; 1952; Broholm 1950)? The fact that in the grave there was a clear distance between the skirt and the blouse has led to the interpretation that the corded skirt would have rested on the hips and that the blouse was so short because it was intended for the midriff to be visible (Harald Hansen 1978, 139). This has led to illustrations emphasising the naked midriff and even inspired a hypothesis that the outfit was used for belly dancing (Brøgger 2003). The model in fig. 12 wearing the present reconstruction has the same height as is estimated for the Egtved Woman, which is 160 cm (Broholm & Hald 1940, 81). If a model has the same body size as the Egtved Woman, her hip measurement would allow the corded skirt to be wrapped twice around the body. When standing in a relaxed position, with the arms down at the sides, only a small strip of naked skin is visible, even though the model is wearing the skirts on the hips. This demonstrates that even though the corded skirt is resting on the hips, the blouse would have been long enough to cover the midriff.

Fig. 12. The finished clothing items. Note that there is only a little naked skin visible between the blouse and the skirt (Image: Sagnlandet Lejre).

Furthermore, a precise analysis of the fibres used in the original is imperative to select the right type of fleece for the yarn. It is difficult today to find a type of sheep with a matching fleece. Sorting and mixing of wool will probably be necessary in future reconstruction work too in order to come close to the Danish Bronze Age wool.

The reconstructed blouse, belt and corded skirt are now on display in the exhibition room next to the barrow where once the Egtved Woman was buried. They look very much like the originals and are a fair representation of Bronze Age clothing (fig. 12). Making a reconstruction of the clothing items from

Egtved has been a very interesting experience, and the clothing items which represent a considerable investment in time and money can now, in their own way, demonstrate how Scandinavian Bronze Age textile technology was both advanced and aesthetic.

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The Red-Blue Conundrum:
an Archaeo-linguistic Approach to Red Dyes and Blue Flowers in Prehistory

Abstract
Plants from the Rubiaceae family (*Rubia*, *Galium*, and *Asperula*) are often grouped together as *madder* because they have been used for dyeing red since at least the Bronze Age. The English plant name *madder* can be traced through the Germanic language all the way back to Proto-Indo-European (PIE), as spoken by pastoralists on the Pontic-Caspian steppes c. 4500 to 2500 BC. The word can be reconstructed as PIE **mod*^{h}*-r-* by the comparative linguistic method. However, there is a difficulty with this. The other Indo-European language branches indicate an original meaning of 'blue' for this word, which is hard to reconcile with the appearance and use of Rubiaceae. In the search for the missing link between madder-red and the original PIE meaning of "blue", this paper widens the scope of dyeplants to others with pigmented roots. It suggests that the missing link could be a blue-flowered plant species from the Boraginaceae family which has red-pigmented roots, perhaps originally used for cosmetics.

Introduction
This study explores the linguistic origins of the English word *madder* in Proto-Indo-European (PIE). The reconstructed PIE language is the ancient mothertongue of such language branches as Germanic, Italic (with Latin), Greek, Celtic, Slavic, Baltic, Hittite, Tocharian and many others.
When investigating cultural words in the Indo-European languages and comparing them with archaeological findings, it is important to consider where and when the speakers of the Proto-Indo-European language, as well as its descendants, lived. This matter has been the subject of great debate. One group of archaeologists claimed an Indo-European "homeland" in Anatolia 8000 to 6000 BC (Renfrew 1995, but recently largely conceded, Renfrew 2017). Another group of comparative linguists (and other archaeologists) claimed a homeland in the Pontic-Caspian steppes 4500 to 2500 BC (Mallory 1989; Anthony 2007). Recently, two major independent studies (with more to follow) in the new field of ancient genomics have provided strong support for the steppe-hypothesis, and a large migration of Indo-European speakers of the Pontic-Caspian semi-nomadic pastoralist Yamnaya culture into Central and Northern Europe forming the Corded Ware culture around 3000 BC (Allentoft et al. 2015; Haak et al. 2015) (fig. 2).
This paper adopts the steppe hypothesis in order to discuss the etymological origins of the English plant name *madder*, and crossreference it with archaeological finds.
Proto-Germanic (the latest reconstructable stage of all the historical Germanic language branches) is thought by most linguists to have been spoken from c. 500 BC to AD 200, probably in southern Scandinavia (Ringe 2006, 67; Schrijver 2014, 158).
The main objective of this paper is to find the missing link between the English plant name *madder*, associated with the colour red, and the word's etymological origins, which point to an original meaning of 'blue'. Another family of red-pigmented plant roots, the Boraginaceae, could be important witnesses in explaining the semantic shift from blue to red.
Some of the Boraginaceae have blue or purple flowers

and their pigmented roots are known for their use as cosmetics. Most of these contain naphtoquinone pigments such as alkannin, shikonin and their many derivatives, but only some Boraginaceae genera have species with concentrations high enough to be used in dyeing. The best known are *Alkanna*, *Lithospermum*, *Onosma*, and *Arnebia* (Cardon 2007, 60–74). Dyed textiles exist from the southern end of the Pontic-Caspian region (late 4th millennium BC), but their specific dyestuffs are unknown. If people in this region dyed with Rubiaceae, Boraginaceae or completely different plants there is no evidence of which plants they used (Shishlina et al. 2003). The English word *madder* can be traced back to PIE through sound laws (see info box on p. 52 for an explaination of sound laws), which makes it worth exploring in the quest for the origins of early Indo-European dyestuffs.

Madder and its wild sisters

The madder-plant has been important across Eurasia for obtaining a red textile dye from different red anthraquinone dyestuffs, primarily alizarin, purpurin and rubiadin. "Madder-plants" and "madder-type plants" refer here to any of the dyestuffs or plants from the Rubiaceae family specifically *Rubia*, *Galium*, or *Asperula*.

There are different species of which one in particular has been cultivated (*Rubia tinctorum* containing primarily alizarin). It is native to the Middle East and the eastern Mediterranean, but also cultivated in southern and central Europe. Others have been gathered from the wild, and are also known as wild madder, bedstraw and woodruff (*Rubia peregrina*, *Galium* and *Asperula*). They contain primarily pseudopurpurin, purpurin and rubiadin. The wild species are native to most of Europe, and some to many parts of Asia (Cardon 2007, 108, 112, 122–28).

The roots of madder are usually harvested in early autumn when the plant is three years old, and then washed and dried. They are best used crushed or ground finely to free as much of the colourants as possible in the dye bath. A madder dyeing recipe is found on a Babylonian tablet as early as the 7th century BC, describing how red wool can be obtained by boiling it in water with alum, and then boiling it again with madder in water mixed with bran water. However, it is normally only heated slowly to 75 °C or 80 °C, because the wool can turn brown at too high a temperature. The use of alum opens the scales of the wool so the pigment is better fixed to the fibres (Cardon 2007, 113–14, 127).

A wide range of colours can be obtained with madder, depending on the age of the plant and the soil conditions and whether the roots are fresh, dried or fermented. Other factors such as the pH value, natural wool colour, dyeing method (heating, fermentation or double dyeing), and the choice of mordant (copper, iron, tin, chromium or aluminum from plants or minerals) also play a role in the final result. The colour range is especially wide when madder is combined with other dyes, such as weld (*Reseda luteola*) for orange yellows, with tannins for browns or with woad (*Isatis tinctoria*) for violets and blacks, as found in textiles from Masada, Israel (AD 66 to 74). The madder dye technology was especially refined by dyers in Medieval Europe with the rise of the wool cloth industry (Cardon 2007, 113–16).

Before the dyestuff alizarin was synthesised in the 19th century (Chenciner 2000, 258–66), the red dyes produced with madder were a luxury product, emphasising status and identity for hundreds of years. Apart from other subspecies of the *Rubia* genus, some of which have been detected through textile dye analyses (*Rubia cordifolia*, *Rubia peregrina* and *Rubia akane* in

Fig. 1. Textile from Hallstatt salt mine, dyed with madder, 1500 BC to 1200 BC (Image: Natural History Museum Vienna, A. Rausch).

Symbols and abbreviations

- * = reconstructed word in a proto-language
- ' ' = used for the translated meaning of a word
- " " = literal translation
- ( ) = botanical name
- > = developed into
- < = developed from
- >>> = borrowed into
- <<< = borrowed from
- PIE = Proto-Indo-European
- s.v. = Latin *sub verbo/voce* '(see) under the word X', used in database references

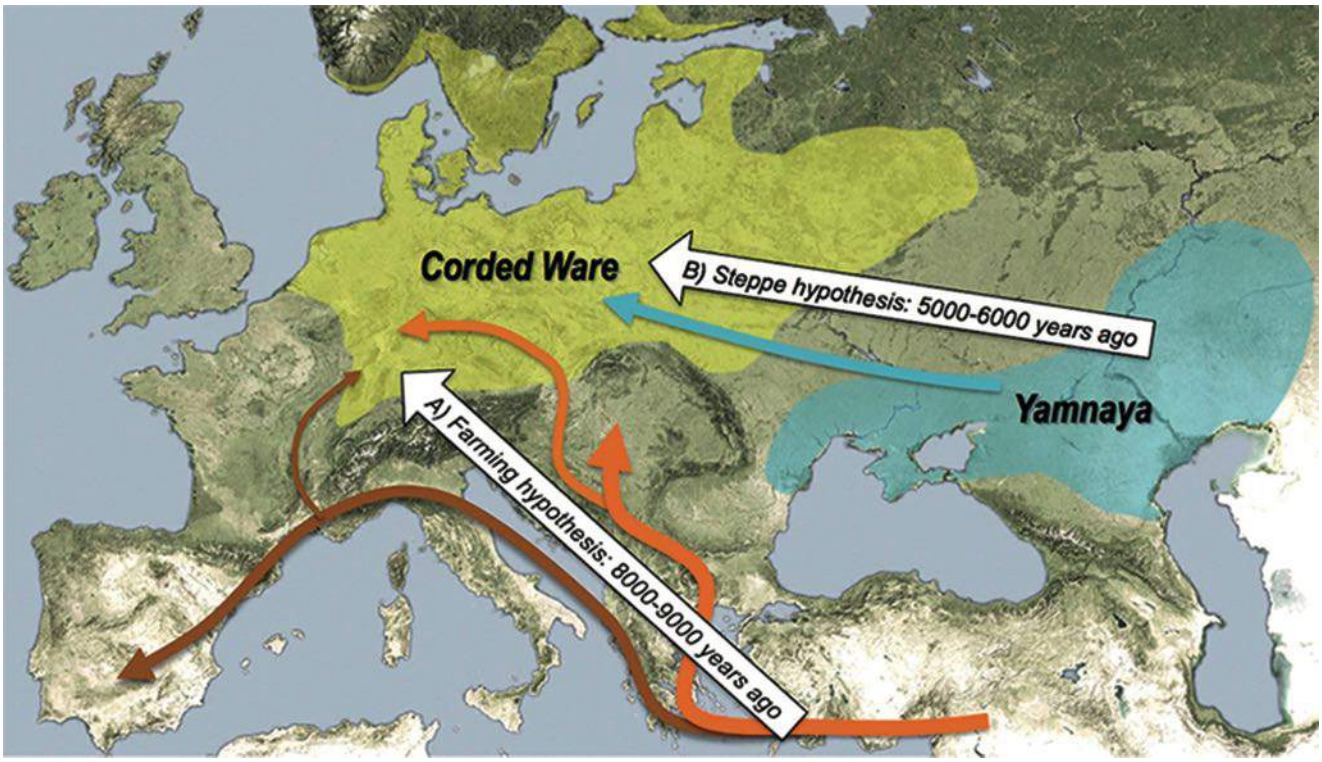

Fig. 2. The two competing hypotheses of the Indo-European homeland (After Haak et al. 2015).

Japan) (Mouri & Laursen 2012), also the wild genera *Galium* and *Asperula* have been used for dyeing red. These are characterised by their much lower alizarin content compared to purpurin and/or rubiadin (Cardon 2007, 127).

According to various literary and ethnographical sources, *Galium boreale* and *G. mollugo* are preferable as substitutes for the cultivated *Rubia tinctorum*. Others recommend *Galium verum* (fig. 3), *G. sylvaticum* or *G. aparine.* These options may depend on availability and soil conditions in different regions (Grierson 1986, 77; Cardon 2007, 127–28).

The use of woodruff (*Asperula* sp.) instead of *Rubia tinctorum* has also been reported (Don 1834, 638) and Linné has similar accounts for *Asperula* in 1742 (Anderberg & Anderberg 2016, s.v. "Asperula tinctoria") (fig. 4). An underinvestigated species in the Rubiaceae-family in terms of dyeing, is field madder (*Sherardia arvensis*) (fig. 5) which, according to one author, should give a pinkish dye (Riley 1997). Thus far, no further information about it as a dye plant and no chemical dye analysis has come to light. It grows across Europe and in the Caucasus (fig. 5). *Asperula arvensis*, native to southern Europe and *Asperula orientalis/azurea*, native to Mediterranean and Middle Eastern regions have blue flowers (fig. 6), but there is no evidence for either as a dye plant. Suggesting they were used for dyeing in prehistory is therefore problematic (Anderberg & Anderberg 2016, s.v. "Asperula").

Reddish dyes in prehistory

One method of determining whether prehistoric textiles were dyed with them or any other plant is by performing dye analyses such as high performance liquid chromatography (HPLC). These techniques have shown that, at least since the Early Iron Age in Scandinavia (c. 500 BC to AD 400), organic dyes from plants have been used to dye textiles (Vanden Berghe et al. 2009). Similar analyses have been carried out on textiles from the Iron Age in Hallstatt, Austria, and the Bronze Age in Xinjiang, China, both showing (among others) the dyestuff alizarin, which is predominant in *Rubia tinctorum* (Zhang et al. 2008; Grömer 2013, 193; Hoffmann-de Keijzer et al. 2013; Kramell et al. 2014). See table 1 for a list of madder-dye finds.

Apart from the many instances of alizarin detected in prehistoric textiles, some Hallstatt textiles from the Bronze Age (HallTex 205 (fig. 1) and HallTex 242), contain predominantly purpurin, indicating the use of other Rubiaceae, such as *Galium verum*, *Asperula* sp., or *Rubia peregrina* (Hoffmann-de Keijzer et al. 2013, 147–49). The same is true for a textile in Högom, Sweden from the Migration Period (AD 400 to 540) (Vanden Berghe et al. 2009, 1920) and for a silk rope from

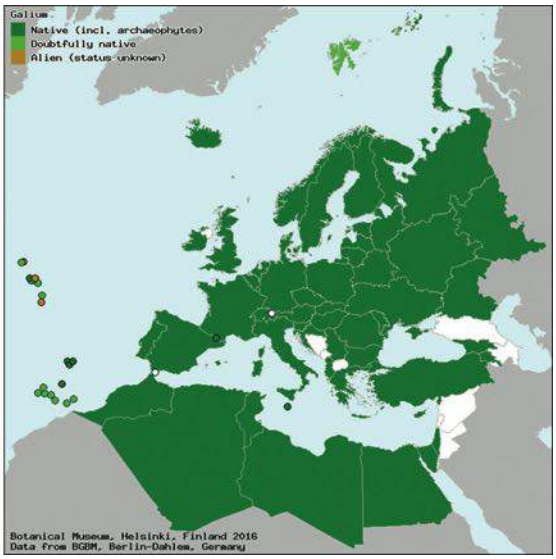

Fig. 3. *Galium* sp. and their distributions. *Galium verum* (Image: wiki-user Ţetcu Mircea Rareş). Distribution of *Galium* species in Europe (Euro+Med Plantbase).

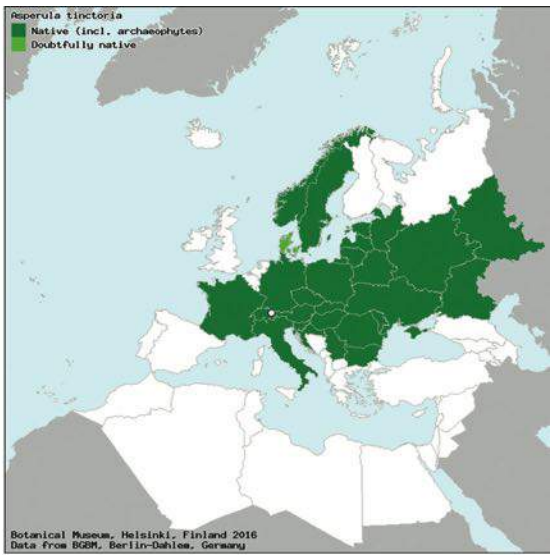

Fig. 4. *Asperula tinctoria* and its distribution. *Asperula tinctoria* (Image: wiki-user Nova). Distribution of *Asperula* species in Europe (Euro+Med Plantbase).

Yingpan (206 BC to AD 618), Xinjiang, China, which is (tentatively) assigned to a local species of madder, *Rubia cordifolia* or *Rubia peregrina* (Liu et al. 2013, 4445–4447). *Rubia cordifolia* was also detected in a Xiongnu silk textile from the 1st to 2nd centuries AD, which was probably imported from China as tribute, where the plant was cultivated for its dye at least 3,000 years ago (Mouri & Laursen 2012, 112). There is evidence for the gathering of *Galium* for dyeing in Scotland from the red-embroidered early 16th century Fetternear Banner (Cardon 2007, 128).

The earliest detectable example of any madder colour, however, is as madder lake on an Egyptian leather quiver from the Middle Kingdom, 2124 to 1981 BC (Leona 2009). The earliest securely dated madder-dyed textile, dyed without the use of alum mordant, is in Egypt from Tel-el-Amarna c. 1350 BC. A later find with madder fixed on alum-mordanted linen textiles from the royal hoard at Deir el-Bahri, Egypt, is dated to c. 1050 BC (Cardon 2007, 119).

The earliest madder-type dye in Scandinavia is from the Early Iron Age, in the Skærsø textile (1st century BC), but other unspecified red dyes, although heavily degraded were also detectable at trace level (Vanden Berghe et al. 2009, 1912, 1919). Further, ellagic acid, probably tannin, was detected in some of the textiles,

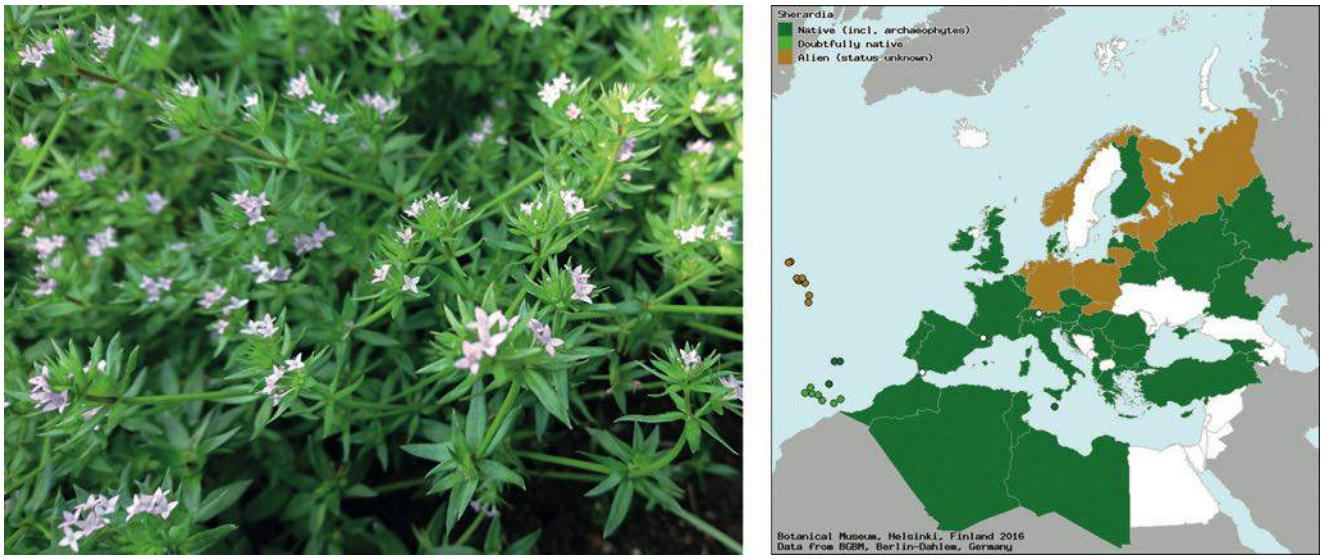

Fig. 5. *Sherardia arvensis* (Image: Mikkel Nørtoft) and its distribution in Europe (Euro+Med Plantbase).

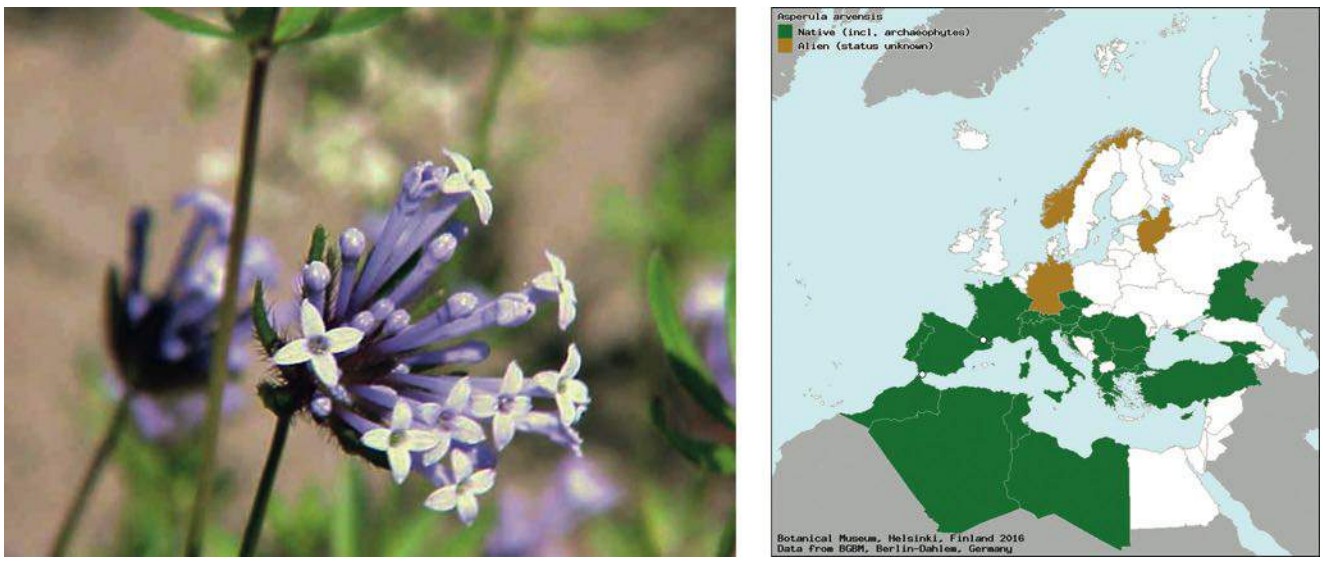

Fig. 6. *Asperula arvensis* (Image: biolib.de) and its distribution in Europe (Euro+Med Plantbase).

likely from a mordant or a dye. In one sample (Huldremose I), only ellagic acid was detected which could be because the original dye had degraded below trace level. Ellagic acid could also be attributed to the *Sphagnum* of the bog environment, but since it was only found sporadically, it is more likely to have been deliberately added as mordant or as dye (Vanden Berghe et al. 2009, 1913, 1918).

In contrast, the Danish Bronze Age oak coffin textiles show no dyes, but some of them tannins (Frei et al. 2017, supplementary data), which could also indicate a mordant or dye (Vanden Berghe et al. 2009, 1918). Therefore, as with Huldremose I, it is possible that they were dyed, but that the dyestuffs had been degraded enough to fall below trace level, since the oak coffins also have an acidic environment, and are considerably older. Thus, the dyeing of textiles could have taken place in Scandinavia contemporarily with the Hallstatt and Xinjiang textiles of the Bronze Age, although the specific dyestuffs in Bronze Age Scandinavia are unknown.

Occasionally, a red colour can be observed on a textile but with no dyestuff being detected in HPLC analysis, as is the case with the red textiles from Hammerum, c. AD 200 (Mannering & Ræder Knudsen 2013, 158) and Lønne Hede, 1st century AD (Scharff & Sommer

Early evidence for madder-type dyes on textiles in prehistory				
Site	**Region**	**Period/date**	**Comments**	**Reference**
el-Khokha, Thebes	Upper Egypt	Middle Kingdom, 2124-1981 BC	Madder lake on leather quiver, alizarin	Leona 2009
Tablet	Larsa region, Mesopotamia	c. 1900 BC	Akkadian *hurratu* 'madder'	Cardon 2007, 119
Tel-el-Amarna	Egypt	18th dynasty, c. 1350 BC	no alum mordant	Cardon 2007, 119
Yanghai graveyard	Turfan region, Xinjiang, China	Bronze Age, 1261-1041 BC	Alizarin, purpurin and rubiadin (Several Rubiaceae sp. possible)	Kramell et al. 2014
Hallstatt textiles	Austria	Bronze Age 1500-1200 BC	Only wild madder (*Rubia peregrina*) or bedstraw/woodruff (*Galium /Asperula*)	Grömer et al. 2013
Deir el-Bahri	Egypt	21st dynasty, c. 1050 BC	first alum mordant on linen	Cardon 2007, 119
Hallstatt textiles	Austria	Iron Age (800-400 BC)	Cultivated madder (*Rubia tinctorum*)	Grömer et al. 2013
Chärchän	Xinjiang, China	Bronze Age, c. 1000 BC	madder (probably *Rubia tinctorum*)	Zhang et al. 2007
Loulan	Xinjiang, China	Bronze Age, c. 1000 BC	Madder (*Rubia tinctorum*)	Mouri and Laursen 2012, 112
Neo-Babylonian tablets	Babylonia	7th century BC	Madder dyeing recipes, one combining woad and madder to imitate Tyrian purple, 3 different madder types	Cardon 2007, 119
Pazyryk textiles	Altai Mountains, Siberia	Iron Age, c. 500-200 BC	Alizarin, Purpurin (possibly *Rubia* sp.)	Balakina et al. 2005
South Stoa	Corinth, Greece	2nd century BC	Pink pigment, mostly purpurin	Leona 2009
Skærsø textile	Denmark	Pre-Roman Iron Age, 1st century BC	Mostly alizarin and some purpurin, probably *Rubia tinctorum* , perhaps imported	Vanden Berghe et al. 2009
Zanjan	Iran	Around the Common Era	Madder (*Rubia tinctorum*)	Mouri and Laursen 2012, 112
Masada	Israel	AD 66-74	Madder in combination with many other dyes	Cardon 2007, 115
Xiongnu tomb	Mongolia	1st-2nd centuries AD	Silk with purpurin and pseudopurpurin *(Rubia cordifolia* or *Rubia peregrina)*	Mouri and Laursen 2012, 112
Yingpan	China	206 BC-AD 618	Perhaps local species of madder (*Rubia cordifolia* , *Rubia peregrina*)	Liu et al. 2013
Högom	Sweden	Migration Period, AD 400-550	Mostly purpurin (wild Rubiaceae)	Vanden Berghe et al. 2009
Tegle	Norway	Migration Period, AD 400-575	Alizarin (*Rubia tinctorum*) together indigotin (woad, *Isatis tinctoria*)	Vanden Berghe et al. 2009
Earliest unspecified dyed textiles				
Cave of the Warrior	Jericho, Palestine	4th millennium BC	large linen textile dyed with a dark-brown colour dyed prior to weaving	Koren 2006, 182-184
Majkop/ Novosvobodnaya	Southern Russia	Late 4th millennum BC	Earliest wool textile. Unidentified dark-brown dyestuff	Shishlina et al. 2003
Oak log coffins	Denmark	Nordic Bronze Age	Only tannins detected	Frei et al. 2017 (supplementary data)
Hammerum	Denmark	c. AD 200	Red colour, but undetected dyestuff	Mannering and Ræder Knudsen 2013
Lønne Hede	Denmark	1st century AD	Red colour, but undetected dyestuff	Scharf and Sommer 2016

Table 1. Early evidence for madder-type dyes on textiles in prehistory.

2016). In these cases, it can be difficult to determine the source of the dyestuff (if present). However, an experiment with the roots of the tannin dye plant *Potentilla erecta* has been carried out in order to dye red by fermentation instead of boiling. This yielded a bright red colour, but only ellagic acid (and its equivalents) was detected in the dye analysis. Furthermore, *Potentilla erecta* has been known in ethnographical sources from Finland to be used as a source for dyeing and tanning red colours (Vajanto 2015, 49–50, 103, 104 (App. 5); Scharff & Sommer 2016). Thus, it is evident that a wide range of red dyestuffs, some still unknown, could have been used in prehistory.

It is possible to trace the practise of colouring and dyeing textiles back to the 4th millennium BC. In the Cave of the Warrior in Wadi el-Makkukh, near Jericho, Palestine, a large textile is sprinkled with red spots of haematite (red ochre) and iron oxide. It also has a decorative weft thread on the end of the warp with a dark brown colour that, although unidentified, was shown to have been dyed prior to weaving (Koren 2006, 182-84).

A similar find has been made in the Majkop/Novosvobodnaya textiles in the steppes of Southern Russia north of the Caucasus, i. e. on the edge of the Indo-European "homeland". These textiles are indirectly dated to c. 3400-3100 BC (Anthony 2007, 63). They contain the oldest wool found to date, dyed with an unidentified dark-brown tannin dyestuff in the fibres and a mineral (montroydite) red colour painted or sprinkled on the textile. There are, however, some indications that the textile could have been imported to northern Caucasus. The evidence for this is the spin direction, tablet-weaving technique, raw materials, and the similarity of this textile to the textiles of the Cave of the Warrior (Shishlina et al. 2003, 331, 337). Apart from wool, the finds from this site also contained linen fibres, as well as cotton-like fibres. Since cotton cultivation is not reported in the northern Caucasus for this period, but in Mehrghar, Pakistan (c. 5000 BC) and North Arabia (4450-3000 BC), it could be another indicator of import (Betts et al. 1994; Shishlina et al. 2003, 338–39). Although the specific dyestuff has not been tested in the early steppe textiles, it is clear that dyeing of textiles took place at least in the second half of the 4th millennium BC, whether or not it was local or imported to the northern Caucasus. Unfortunately, no dye analyses have been made on the dyed steppe textiles from Novosvobodnaya/Klady. A textile from Sugokleya Kurgan in Ukraine, examined by Margarita Gleba was unfortunately impregnated with acrilate (Gleba 2009, 7), which may present problems for dye analyses in the future.

Nevertheless, all of these examples demonstrate that dyeing with red plant roots was an established part of European prehistoric textile production

Plant name research

Plant names can be very difficult to research historically and etymologically. Wild plants often have many synonyms. A name for one species spreads to another species because of similarity in appearance, usage or folk tales. Sometimes, the spread of a plant name across species can originate from an earlier nomenclatural prototype. One example is the spread of the names *marzanilla/chamomilla* in Spain from an original group of "proto-species". These two names went from being used in Spain about species with similar flowers, of which some were herbal remedies, to being used about a total of 62 different species whether grouped by appearance or similar use (Morales & Pardo-de-Santayana 2010).

Another issue is the loss of local plant names due to the influence of literary tradition. Examples are the dominant literary languages Latin and Greek, which by means of great literary works from Dioscorides, Pliny and Theophrastus, influenced plant names in many languages, and were used by later authors such as Carl von Linné. Local plant names in languages with less literary traditions were often undocumented and forgotten when other more industrial plants were imported from other countries.

The best case for researching the deeper origins of a plant name occurs when a word apparently defies analysis. The name of a plant can retain and follow regular sound laws, or even retain older pronunciations. Such a word in English is *madder* and its cognates (= related words). Its name does not relate to any other original lexemes in Germanic vocabulary.

Cognates of English *madder*

Germanic cognates

The Germanic language branch comprises the sub branches:

- West Germanic (English, Dutch, Frisian, and the German dialects)
- North Germanic (Old Norse and its descendants Danish, Swedish, Norwegian, Icelandic, and Faroese)
- East Germanic (Gothic, now extinct).

The historical spread of the words in this section can be seen in fig. 7. English *madder* (*Rubia*) is recorded in Old English with the variants *mæddre*, *mædre*, *mædere*, *mæderu*, *medere*, *meder* (*Rubia* and *Galium*). The

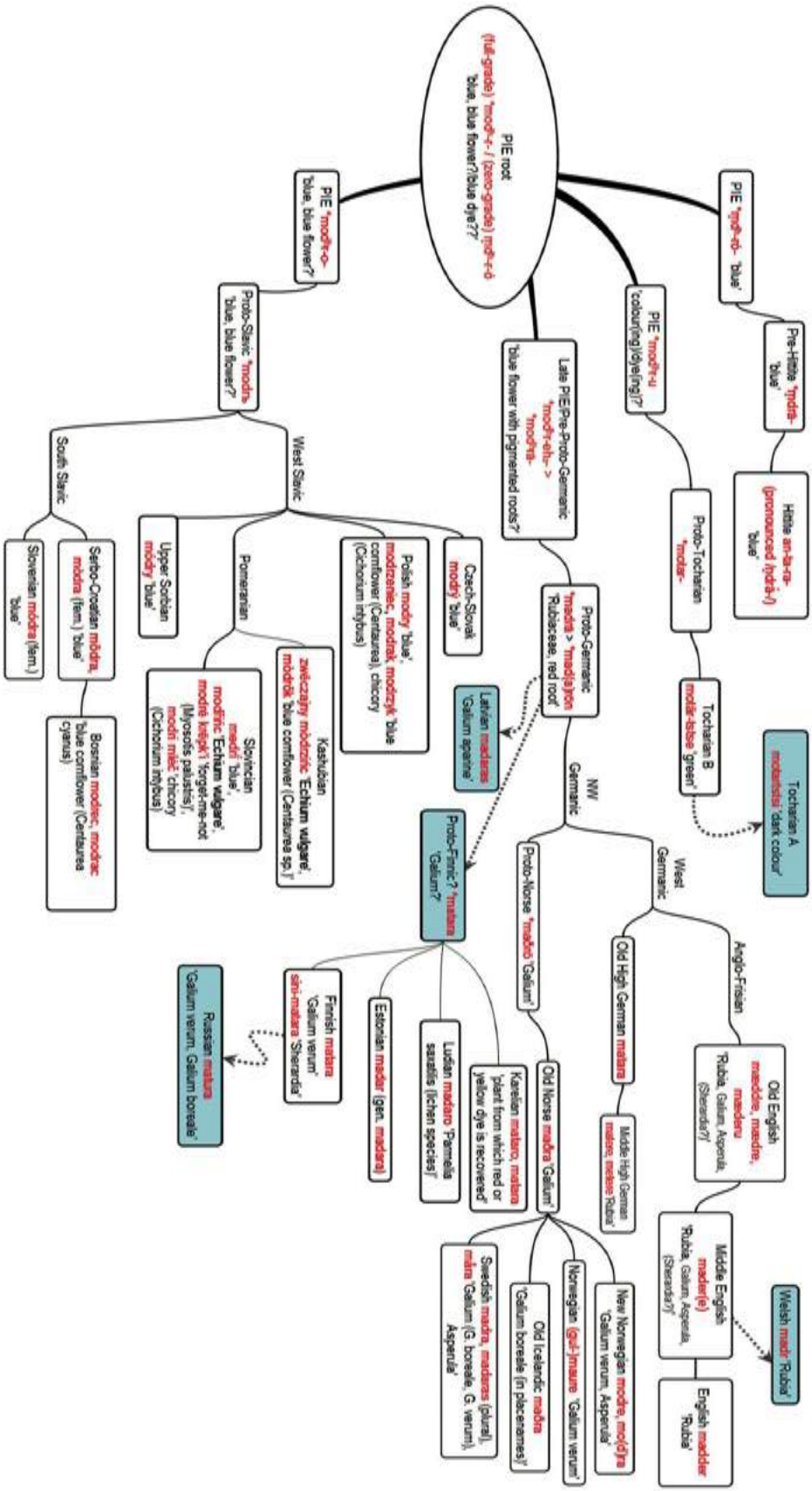

Fig. 7. Diagram of the proposed semantic and phonological development and spread of PIE **mod^{h}-r-*. Dotted lines into blue bubbles indicate a loanword exchange.

blue-flowered Rubiaceae *Sherardia arvensis*) is known in Modern English as *madderlen* (a term coined in 1786), and as *(blue) field madder* with older forms in Old English *fældmædere*, *feldmedere* (here with an unexplained mistranslation 'rosemary') (Bierbaumer & Sauer 2007, s.v. "madder", "feldmædere"). Old English is part of the West Germanic branch which also includes Old High German with the cognate *matara* (*Rubia*) (Britten & Holland 1886, 318; Toller & Bosworth 1921, 654; Vasmer 1955, II:106; De Vries 1962, 375; Holthausen 1974, 210; Orel 2003, 252). There could be an *r*-less variant in Proto-Germanic **madō-* to explain the problematic form in West Frisian *mīde* 'madder', which perhaps spread to Middle Low German and Middle Dutch *mēde,* 'madder', and Dutch *mee-krap* 'madder' (Kroonen 2013, 346). In the North Germanic branch, we have Norwegian *maure*, New Norwegian *modre*, *modra*, *mora*, Swedish *måra*, *madra* (*Galium*, *Asperula tinctoria)*, and *blå-madra* for another Rubiaceae (*Sherardia arvensis*). All these North Germanic names go back to Old Norse *maðra* (and in place names in Norway and Iceland) from an earlier Proto-Norse **maðrō* (Fritzner 1954, 618; Falk & Torp 1960, 705–6; De Vries 1962, 375; Kylstra et al. 1996, 2:254; Magnússon 2008, 597; Anderberg & Anderberg 2016, s.v. "Rubiaceae").

From all these, it is possible to reconstruct a Proto-Germanic **mad(a)rō-*, showing variants with (for West Germanic), or without (for North Germanic), an internal *-a-*. This variation is still seen in Old English *mædere*, *mædre*.

An internal Proto-Germanic **-a-* is also suggested by borrowings from Germanic to some Finno-Ugric languages in the Baltic area (Kroonen 2013, 346), perhaps already at a Proto-Germanic stage into the Iron Age Proto-Fennic **matara.* This developed into Finnish *matara* (*Galium*), *sini-matara* ("blue madder", *Sherardia arvensis*), Estonian *madar* (genitive *madara*) (*Galium*), *madarik* (the blue *Sherardia arvensis*), *lõhnav madar* ("scented madder", *Asperula*), Ludian *madaro* 'orange/reddish-dyeing lichen species (*Parmelia saxatalis)*' (Lönnrot 1802, 1047; Kujola 1944, 226; Tamm 1981, 286; Saagpakk 1982, 470; Grierson 1986, 186–87), Karelian *mataro, matara* 'plant, from which a red or yellow dyestuff is recovered', and Ingrian *mattāra* 'dyestuff (lichen or moss)' (Virtaranta & Virtaranta 1983, 278; Kylstra et al. 1996, 2:254). The name has been further borrowed into Latvian as *madaras* and into Russian as *matura* (*Galium boreale*) (Berneker 1913, 67). It is evident from the material presented here that this word has come to be associated with both Rubiaceae and lichen species in the languages of northern Europe.

As the evidence suggests, many of these names denote the cultivated *Rubia tinctorum*, but as the same name seems to appear for other Rubiaceae species, such as *Galium*, *Asperula* and *Sherardia*, it may be that the literary tradition produced the names for the cultivated *Rubia* species, and thus the prehistoric equivalent of the word could have been assigned to the wild Rubiaceae. Anthony Esposito (2003, 233) goes as far as stating: "The word in [Old English] and [Old Norse] could not originally have denoted the exotic Rubia, but probably belonged to various species of the allied genera Asperula and Galium, some of which are still used as substitutes for madder."

However, as the Iron Age textiles from Hallstatt and one of the Pre-Roman Iron Age textiles from Denmark show predominantly alizarin (= *Rubia tinctorum*) in one sample, as well as alizarin + purpurin (= *Galium*, *Asperula*, *Rubia peregrina* or similar) in a tassel (Vanden Berghe et al. 2009, 1917, 1918), it is likely that this word was used about both the wild and cultivated plants, in the sense 'red-dyeing plant/root' at the time of Proto-Germanic.

From Proto-Germanic **madrō-*, it is possible to work way backwards by means of sound laws to Pre-Proto-Germanic/late PIE **mod*^{h}*rā-* (regularly **a* < **o*, **ō* < **ā*, **d* < **d*^{h}) and further back to PIE **mod*^{h}*-r-eh*$_2$ (regularly **-ā* < **-eh*$_2$) (see e. g. Kroonen 2013, xv–xli (phonological introduction), and 2013, 346). The suffix **-eh*$_2$ is typical of feminine formations of masculine *o*-stem adjectives, e. g. in the suffix **-ro-* > feminine **-r-eh*$_2$ in the Proto-Indo-European system (Beekes & De Vaan 2011, 199, 220).

Sound laws

The historical linguist compares related languages systematically to set up a system of regular sound laws for the language changes in each language branch. The sound laws are applied to reconstruct proto-languages. The most famous of these (actually a set of sound laws) is called The Germanic Sound Shift, stating a set of developments from PIE to Proto-Germanic:

*p > *f, *t > *þ (pronounced *th* as in English *thorn*), *k > *h and *k^{w} > *h^{w} (^{w} = labial pronunciation), *b > *p, *d > *t, *g > *k, *b^{h} (^{h} = aspiration) > *b, *d^{h} > *d, g^{h} > g (Kroonen 2013, xvii–xxix).

Many other sound laws can be proven from PIE to Proto-Germanic and in the other Indo-European branches as well, and all these sound laws, applied together systematically, make up the basis for reconstructing their common mother-tongue, Proto-Indo-European (see for example Mallory and Adams 2006, 39–53.

Cognates to Proto-Germanic *madrō-

There are formal cognates (i. e. related words conforming to the sound laws) to the Proto-Germanic **mad(a)rō-* in the Slavic branch of Indo-European, e.g. in the West Slavic sub branch: Czech *modrý. However*, Slovakian *modrý*; Polish *modry*, Slovincian *mɵdrĩ*, Upper Sorbian *módry*, they all mean 'blue', and not 'red', which is problematic for the reconstructed meaning of the PIE word.

The same meaning can be seen in the South Slavic branch, e. g.: Serbo-Croatian *mȍdar*, f. *mȍdra*, n. *mȍdro*; *màdar* (Croatian), f. *màdra*, n. *màdro* and Slovene *móḍər*, f. *módra*, also meaning 'blue'. All these words would go back to a Proto-Slavic **modrъ* 'blue' (Berneker 1913, 66–67; Derksen 2008, 320–21).

More Indo-European branches can be identified. In the Tocharian branch: Tocharian B *motär-tstse* 'green' borrowed into Tocharian A as *motartstsi* 'some sort of dark colour'. The Tocharian suffix *-tstse* is secondary, so an original Proto-Tocharian **motar-* can be assumed, which, according to Douglas Adams (2013, 511–12), could go back to a Proto-Indo-European *u*-stem **mod*^{h}*-r-u-*, perhaps meaning 'colour(ing agent), dyestuff(?)' derived from a Proto-Indo-European verbal noun **mod*^{h}*r̥-* 'colour(ing)'.

In the oldest branch, Anatolian, there might also be a cognate in Hittite *an-ta-ra-* (pronounced with syllabic *n-*, i.e. *n̥drə̆-*). Again, the meaning is 'blue', and also exhibits a **-ro-*adjective, but here with a zero-grade in the PIE root. The development seems to have gone from (early) PIE **mn̥*^{h}*-ró-* > **mn̥d-rə̆-* > Hittite *an-ta-ra-* (i.e. /n̥drə̆-/) (Machek 1949, 131–32; Kloekhorst 2008, 186).

Thus, there is an **-r-* suffix in all four branches:

- Proto-Germanic **mad(a)r-ō* 'Rubiaceae species' < **mod*^{h}*-r-eh*$_2$*-* (feminine)
- Proto-Slavic **modrъ* 'blue' < **mod*^{h}*-r-o-* (masculine *o*-stem),
- Proto-Tocharian **motar-* 'green' < **mod*^{h}*-r-u-* (masculine *u*-stem)
- Hittite *antara* (n̥drə̆-) 'blue' < **mn̥d*^{h}*-r-ó-* (zero-grade).

According to the consensus model of the chronology of the split of the Indo-European languages, the Hittite branch broke off from the Indo-European proto-language and homeland around 700 to 1000 years (c. 4300 to 4000 BC) before Tocharian (c. 3300 BC), and the rest of the branches (c. 3300 to 2500 BC) (Mallory 1989; Anthony 2007; Allentoft et al. 2015; Haak et al. 2015). Therefore, it is perhaps not so problematic to accept that a secondary *o*-grade **mod*^{h}*-r-o/eh*$_2$ (masculine/feminine) could have formed in these intermediary 700 to 900 years from an earlier zero-grade **mn̥d*^{h}*-ró-*. On that basis, the most likely original meaning for this word is 'blue'.

The next, and much more difficult problem, is determining why this word went from meaning 'blue' to meaning 'red', or 'red-dyeing root, Rubiaceae'. Adams (2013, 512) suggests that: "It is possible the bedstraws were originally named for their characteristic yellow-green flowers". This has some problems: 1) yellow and green are perhaps the most common colours of plants in the wild, 2) *Galium* or *Asperula* species usually do not have green flowers (most plants have green stems and leaves), and 3) why would plants with yellow flowers be named after the colour blue?, and 4) only Tocharian has the meaning 'green'.

Other Indo-European Rubiaceae names

Two other widely used names for several Rubiaceae species are the French *garance* and Slavic *broč*. Their origins do not seem to go back to Indo-European, but to a confusion of words in Vulgar Latin *bractea/brattea/blattea* 'gold foil', from where it is not further traceable (Niedermann (1921, 436–40). Slavic also has the word *mareňa* (*Rubia tinctorum* or other Rubiaceae), which could be secondarily derived from a PIE root **mōr-* 'to smear' (Berneker 1913, 18).

Other names for the madder plants which seem to be secondary derivations are Old English *wrætte* and Old High German *rezza* 'madder' < PIE **u̯rod-i̯-eh*$_2$ 'root' (Kroonen 2013, 595). In Greek, *ereuthé-danon* 'red dye, *Rubia tinctorum*' and *eruthró-dano-* seem to be secondary derivations from a PIE root **h*$_1$*reud*^{h}*-* 'red', a widespread root in Indo-European. The same root is found in Old Irish *rúam* 'red dye' < Proto-Celtic **rowd-smon-* 'red dye' perhaps from PIE **h*$_1$*reud*^{h}*-smon-* (but this formation is only seen in Celtic), which could have been used about the red (possibly Celtic) Hallstatt textiles (Stifter 1998, 208, 211).

The fact that the dye-related names for the madder-plants in Indo-European languages have a variety of different origins could suggest that madder was only used as a dye-plant after the Indo-European languages split up. These names often seem to have been derived from existing and relatable PIE vocabulary such as colour-terms ('red'), or borrowed in historical times from unknown sources.

An alternative to Rubiaceae

If the Germanic names for Rubiaceae with dyeing abilities are only associated with 'red' in Germanic but other Indo-European language branches point to an original meaning 'blue', there is still a need for an explanation for this semantic change in the prehistory of Germanic. As it seems to have been associated with

Boraginaceae					
Species	**Flower colour (where available)**	**Root colourant (alkannin/shikonin and derivatives)**	**Vernacular name (English unless otherwise stated)**	**Distribution**	**Reference (all including Papageorgiou et al. 1999)**
Alkanna/Anchusa tinctoria	blue	alkannin (1.24-1.47%)	Alkanet	Mediterranean, Balkans, Middle East, Central Europe	Akgun et al. 2011
Arnebia hispidissima	yellow	alkannin, shikonin	Arabian primrose, Nigerian: Jinin mutum 'the blood of man'	North Africa to northern India	Cardon 2007, 73-74
Arnebia nobilis	purple/dark brown, later yellow	alkannin	Hindi: Ratanjot 'ruby red'	High mountains of eastern Afghanistan	Arora et al. 2012, 178; Cardon 2007, 65
Arnebia/Macrotomia densiflora/tinctoria	yellow	alkannin (57 mg/g, 5.7% of air-dry material)	Arnebia	Greece, Anatolia	Bozan et al. 1997
Arnebia euchroma	dark purple	shikonin (1.5 mg/g, 0.15%), acetylshikonin (19.7 mg/g, 1.97%)	Uigur: Soghagul, Chinese: Zicao	Central Asia	Hu 2007, 152; Cardon 2007, 65-67
Arnebia guttata	yellow	shikonin (0.078 mg/g, 0.0078%)	Purple herb (not official)	Central Asia to Mongolia	Hu 2007, 152; Cardon 2007, 65-67
Cynoglossum officinale	reddish-purple	shikonin	Hound's tongue	Most of Europe	
Echium plantagineum/lycopsis	purplish blue to purple	shikonin	Purple viper's bugloss, Paterson's curse, Salvation Jane	Western and southern Europe, Middle East and Crimea	
Echium rubrum/russicum	red	shikonin (0.0044-0.16 mg/g air-dry material, 0.00044-0.016%)	Red bugloss, Red-flowered viper's grass	Russia	Dresler et al. 2015, 700; Dresler et al. 2017, 693
Echium vulgare	blue	shikonin (0.0048-0.28 mg/g air-dry material, 0.00048-0.028%)	Viper's bugloss, Blueweed	Pontic-Caspian steppes, Europe, Anatolia	Dresler et al. 2015, 700; Dresler et al. 2017, 693
Lappula squarrosa	light blue	shikonin	Stickseed	Most of Europe, Russia, Anatolia	
Lithospermum arvense	white (with blue subsp.)	acetylshikonin	Field gromwell, German: Schminckwurz	Europe	
Lithospermum/Buglossoides purpurocaeruleum	blueish purple	maclurin-equivalent	Purple gromwell	Britain, Central Europe, South Russia, Mediterranean, Anatolia	Grömer et al. 2013, 263
Lithospermum erythrorhizon	white	shikonin (0.472-30 mg/g, 0.0472-3.0%)	Red-root gromwell, purple gromwell	Eastern Eurasia	Hu 2007, 152; Krivoshchekova et al. 1976;
Lithospermum officinale	white	shikonin (0.079 mg/g, 0.0079%)	Stone gromwell	Pontic-Caspian steppes, Europe, Mediterranean	Dresler et al. 2017
Onosma/Arnebia echioides	pale yellow	alkannin/shikonin (0.063-67.1 mg/g, 0.63-6.71%)	Prophet's flower, Hairy onosma	Mediterranean Europe, Iran, Himalayas, Kashmir, Siberia	Cardon 2007, 63-65
Onosma paniculata	purplish flowers	alkannin (0.057 mg/g, 0.0057%), acetylshikonin (2.86 mg/g, 0.286%)	Onosma, Chinese: Zicao	Southern China	Hu 2007, 152; Cardon 2007, 63-65
Onosma hookeri	blueish purple	shikonin (0.093 mg/g, 0.0093%), acetylshikonin (0.747 mg/g, 0.0747%)	Onosma, Chinese: Zicao, Hindi: Ratanjot	Afghanistan	Hu 2007, 152; Cardon 2007, 63-65

Table 2. Boraginaceae mentioned in the article with their respective dyestuffs (and concentration, as available), and flower colour.

a 'red dyeing root' in Proto-Germanic, another family of plants with similar red-pigmented roots, the Boraginaceae, offer some helpful evidence. These yield highly concentrated red/purple dye in species of the genera *Alkanna*/*Anchusa*, *Arnebia*, *Onosma*, and *Lithospermum* (Cardon 2007, 60–74).

Boraginaceae

One Boraginaceae species described for its red and purple root-pigment in antiquity is *Alkanna*, or *Anchusa* (Dioscorides, c. AD 77, Theophrastus, 4th to 3rd century BC), and for its medicinal uses by Hippocrates, c. 400 BC) (Papageorgiou et al. 1999, 271–73). The word *po-ni-ki-jo/a* in Mycenaean refers to a red colour or red plant substance, possibly madder or alkanet, suggesting it may have been used as a dyestuff in Europe in the Bronze Age (Bendall 2017, 315, note 55).

Other genera from the same family are used in different parts of Asia. *Arnebia nobilis,* for example, can dye textiles (Arora et al. 2012) and *Arnebia guttata* is still used for its pigment by Pamir nomads today (Soelberg 2016, 30–31). *Lithospermum eryhtrorhizon* ("red-root") was cultivated for its dye and medicinal properties in China, probably from the beginning of the Common Era (Papageorgiou et al. 1999, 274).

Alkanna/*Anchusa* is a main source of the dyestuff alkannin, and *Arnebia* sp., *Lithospermum erythrorhizon* and *Lithospermum officinale* are sources of shikonin, two dyestuffs that are red at pH 6.8, purple at pH 8.8, and blue at pH 10, or deep red in an oily or greasy media and violet in an alkaline media (Khattak et al. 2015, 903). The related species *Lithospermum arvense* contains acetylshikonin and other derivatives (Papageorgiou et al. 1999, 277). These, and many other plants in the Boraginaceae family are known to be used as dye, pigment, and cosmetics in history and folklore. A list of the many variants of alkannin and shikonin, and their occurences in Boraginaceae-species can be found in Papageorgiou et al. (1999, 276–78), and some of their reported dyestuff concentrations from the literature are compiled in table 2. A few other genera of Boraginaceae are *Onosma* sp., *Echium* sp., *Cynoglossum* sp., and *Lappula* sp. Some species of *Onosma* and *Arnebia* are grouped together in India as *ratanjot,* meaning 'ruby red', because of their red root pigment, and are imported to Indian markets from Afghanistan (Cardon 2007, 65; Arora et al. 2009).

The different genera are widespread in most of Eurasia, especially *Echium* and *Lithospermum* (figs 8-12).

Many of the names of these species are associated with cosmetic or red-colouring properties (Table 3) and seem to be grouped together and intertwined in the nomenclature as well, often taking each other's names, such as Danish *sminkerod*, Swedish *sminkrot*, German *Schminkwurz* ("cosmetic root"), *Bauernschminke* ("peasant cosmetic") about *Lithospermum arvense*, *Alkanna tinctoria,* and *Onosma paniculata*' (Marzell 1943, 193; 1951, 1341–42; 1963, 408). There are similar references to pigment shared between the red-rooted *Potentilla* sp. and Boraginaceae: such as *Blutkraut* "blood weed", *Rothwurz* "red wort", *Färwekraut* "dye weed", Spanish *sanguinaria* 'bloodroot' (*Lithospermum arvense*) (Marzell 1951, 1341–42; 1963, 183–94, 408).

The fresh roots of *Lithospermum arvense* were used as a cosmetic for its red-colouring by "country girls" in Finland and Lapland as described by Linné in *Flora*

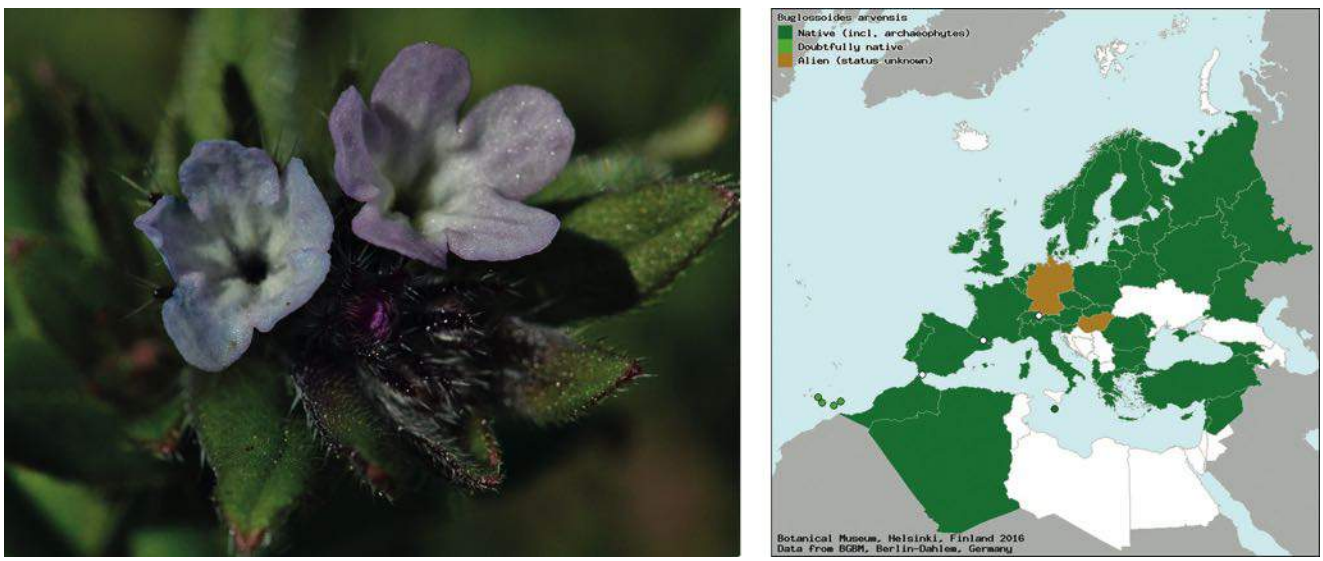

Fig. 8. *Lithospermum arvense/Buglossoides arvensis* var. *coerulescens*, southern Sweden (Image: Jan Thomas Johansson). Distribution of *Lithospermum arvense/Buglossoides arvensis* var. *coerulescens* in Europe (Euro+Med Plantbase).

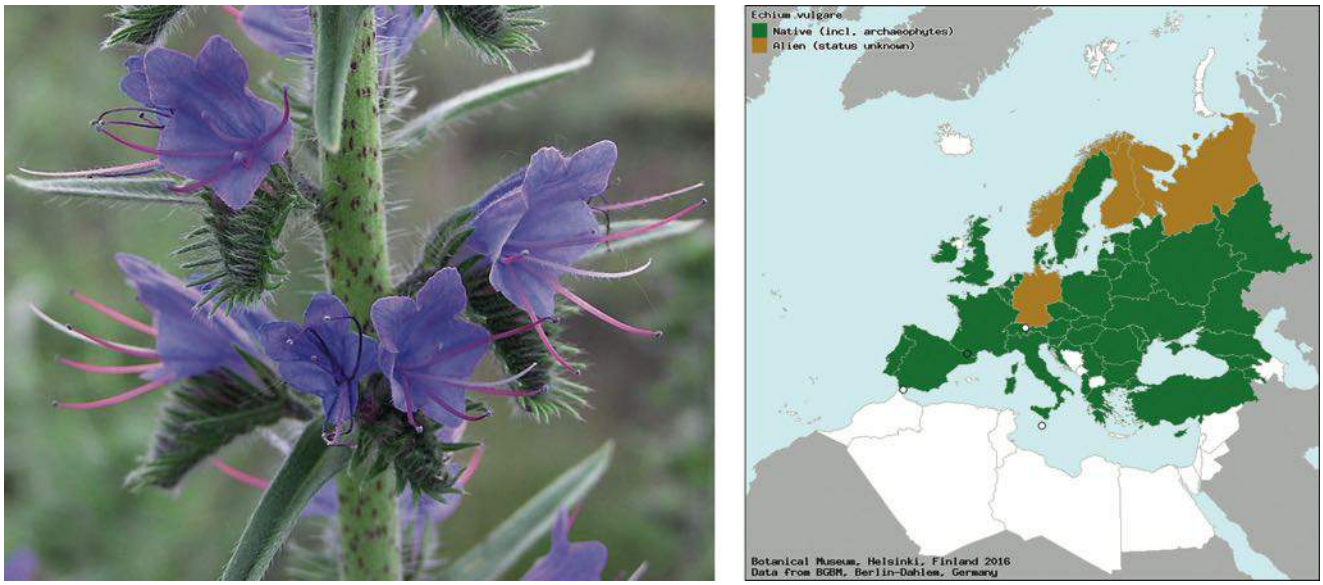

Fig. 9. *Echium vulgare* near Saratov, south-western Russia (Image: Wiki-user Le.Loup.Gris). Distribution of *Echium vulgare* in Europe (Euro+Med Plantbase).

Suecica, and witnessed by Marzell in 1936 in Krosno Odrzańskie in western Poland (Marzell 1951, 1342). In Missouri, the related *Lithospermum canescens* was called Indian-paint because the Native Americans used the root in this way (Marzell 1951, 1342). The German name *Schmink* for *Lithospermum arvense* indicates an association with cosmetics since 1590 (Svanberg 2000, 83). However, dyeing experiments with it have not yet been undertaken or remain undocumented.

One Early Iron Age sample from Huldremose II, Denmark, showed a dyestuff the authors termed "Unknown 3", which looked similar to alkannin (perhaps from alkanet, *Alkanna tinctoria*) or a lichen species called Scandinavian orchil (*Ochrolechia tartarea*). However, for historical reasons, and because of a probable parallel in Norway, the authors lean towards orchil (Vanden Berghe et al. 2009, 1913, 1918). The red pigment produced a deep red colour when it was extracted from 10 g of *Alkanna tinctoria* roots in a solution of 200 mL denatured alcohol (93%) in a bottle and left for three days. The extract was then put in a pot with alum-mordanted wool yarn and water until the yarn floated. The colour turned a "red cabbage violet". It was then heated and the

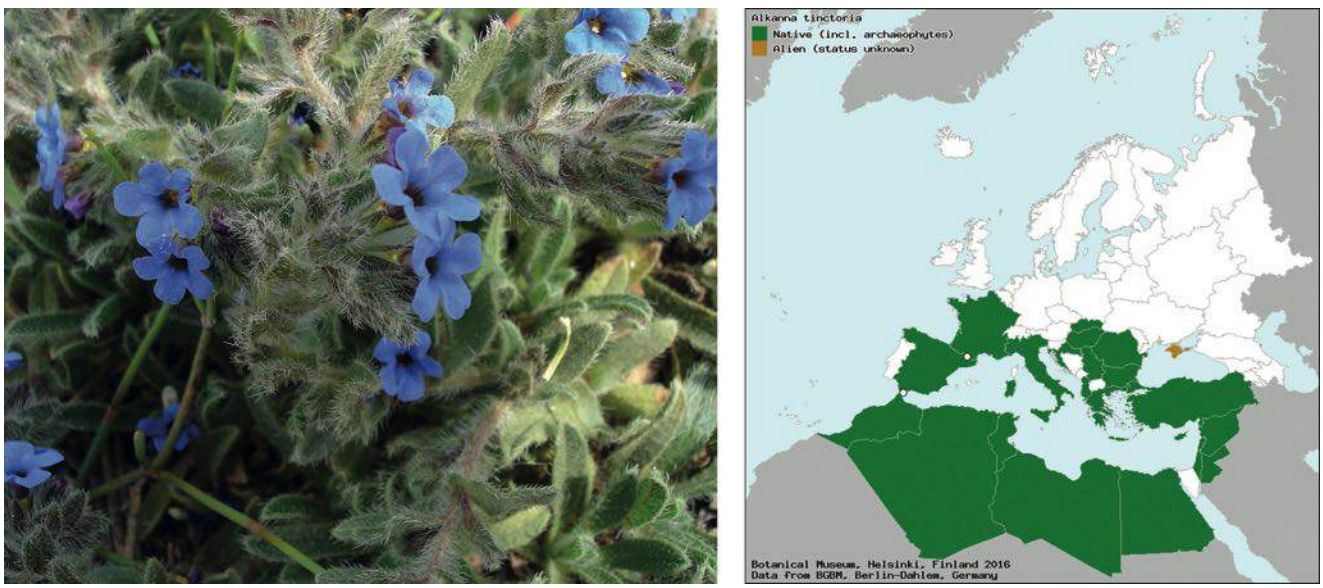

Fig. 10. *Alkanna tinctoria* in Torreilles, France (Image: Jean Tosti). Distribution of *Alkanna tinctoria* in Europe (Euro+Med Plantbase).

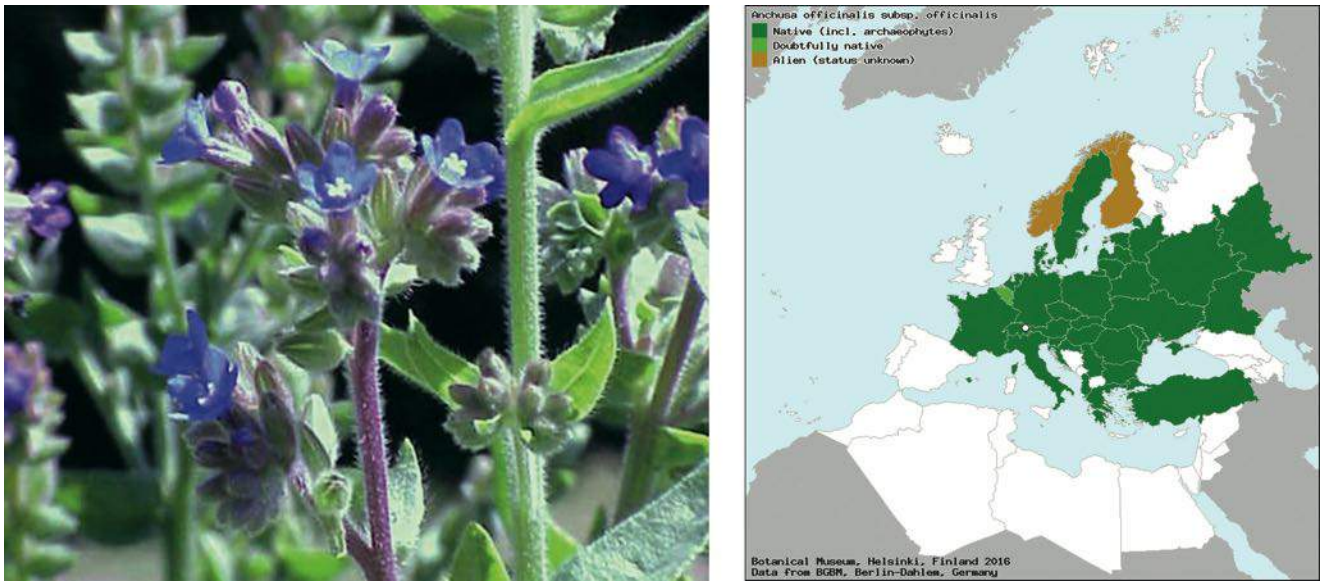

Fig. 11. *Anchusa officinalis* (Image: Kurt Stueber, www.biolib.de). Distribution of *Anchusa officinalis* (Euro+Med Plantbase).

colour changed to a deep violet or "eggplant colour" (fig. 13).

As denatured alcohol was not available in prehistory, another extraction method would be necessary. One method is extraction with fat or grease (Cardon 2007, 62) but this is probably not suitable for textile dyeing. According to Dominique Cardon (pers. comm. 24 November 2017), the extraction works well using mead, and Cardon has also had success with dyeing wool using the mead-extracted Boraginaceae pigment (from *Alkanna tinctoria* and *Onosma*. Cardon (2007, 62) also mentions the historical use of hydromel (low-alcohol mead, honey-water, or perhaps an English translation error from the French *hydromel* referring to regular mead) for this extraction.

Mead has been found widely in prehistoric containers, at least since the Bell Beakers (Guerra-Doce 2003), and the word is very securely reconstructed to PIE as **méd*^{h}*-u-* 'mead, honey', attested in nine branches: Germanic, Greek, Celtic, Baltic, Slavic, Indic, Iranian, Tocharian, Anatolian (Hyllested 2003, 49; Kroonen 2013, 361; Nørtoft 2017, 95). One blue Boraginaceae species, *Echium vulgare*, also native to the Pontic-Caspian steppe (fig. 9), is a key component in bees' honey production (Martín Arroyo et al. 2017). With these facts in mind, one might further speculate about

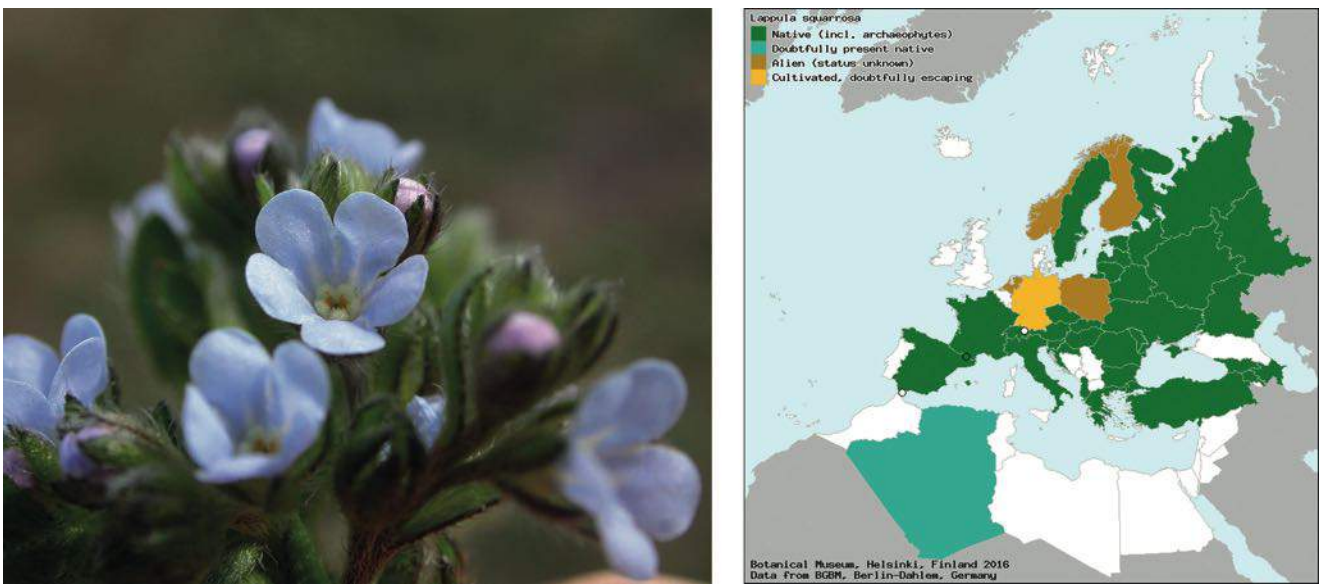

Fig. 12. *Lappula squarrosa* (Image: Matt Levin). Distribution of *Lappula squarrosa* (Euro+Med Plantbase).

a connection between PIE **méd^{h}-u-* 'mead, honey' and **mod^{h}-r-/*mḍ^{h}-ro-* 'blue, blue (dye) plant(?)'. However, that would be another study, entirely.

The shikonin content of the blue-flowered *Echium vulgare* (and its derivatives) is very low. It is measured to 4.8 mg/kg (= 0.0048 mg/g (0.00048%)) of air-dried material in one study (Dresler et al. 2015, 700), but 0.284 mg/g (0.0284%) in another (Dresler et al. 2017, 692–93). Further studies would be welcome. *Lithospermum officinale*'s shikonin content is measured as 0.079 mg/g (0.0079%, with 0.002 mg uncertainty) (Dresler, et al. 2017, 692–93). In comparison, *Alkanna tinctoria* yields 1.24 to 1.47% alkannin (Akgun et al. 2011), and *Lithospermum erythrorizon* c. 3% shikonin (Krivoshchekova et al. 1976, 652) (Table 2). However, the shikonin level of *Arnebia guttata*, still used as cosmetic by the wakhi-nomads of Afghanistan (see above), is measured at 0.078 mg/g (0.0078%), almost the same as *Lithospermum*

Fig. 13. The process of dyeing wool with *Alkanna tinctoria* by Jane Nøhr (with permission). a. Extracted dye solution from roots, b. Dye solution sample on cotton pad, c. Dye bath with wool, d. Fabric dyed with *Alkanna tinctoria*.

Fig. 14. *Lithospermum purpurocaeruleum*, a possible source of the maclurin-equivalent in HallTex 205.

officinale. Thus, the even higher shikonin measurement for *Echium vulgare* (up to 0.0284%) might also be enough to have been used as cosmetic in the steppes.
One of the Bronze Age Hallstatt textiles (HallTex 205) that contained purpurin (= *Galium* or *Rubia peregrina*) also contained a maclurin-equivalent (Grömer 2013, 263) that the authors suggest could be from the root of purple gromwell (*Lithospermum purpurocaeruleum*) bearing purple or bright blue flowers depending on the season (fig. 14). However, maclurin is typically connected with yellowish dyes, so a red-blue association is less probable. Nevertheless, it could testify to a knowledge of using textile dye from some Boraginaceae roots in Bronze Age Hallstatt.
Other Boraginaceae also have characteristic blue flowers, such as *Lithospermum arvense* var. *coerulescens*, *Echium vulgare*, *Alkanna tinctoria*, *Anchusa officinalis*, and *Lappula squarrosa* (figs 8-12).
The blue flowers are also reflected in some Boraginaceae names (Table 3), such as Swedish *blå sminkrot* about *Lithospermum arvense* var. *coerulescens* and Danish *blåfrue* ("blue-lady"), Swedish *blåeld* ("blue-fire"), Finnish *sini-kuntteri*, Russian *sinij cvet* (*sini(j)-* = "blue") and English *blueweed*, all used about *Echium vulgare* (Marzell 1951, 192-193).
In the Slavic languages, the PIE root **mod*^{h}*-r-* 'blue' appears in several plant names, some of them Boraginaceae (highlighted in bold): Slovincian *modřińc* (*Delphinium consolida*, ***Echium vulgare***), *modrė krëpk'i* 'forget-me-not (***Myosotis palustris***, another blue Boraginaceae sp.)', *modri mléč* 'chicory (*Cichorium intybus*), Kashubian *Zwëczajny mòdrzińc* (***Echium vulgare***), Kashubian *mòdrôk* 'blue cornflower (*Centaurea* sp.)',

Vernacular names of Boraginaceae mentioned in this article	
Names relating to cosmetic properties of (Lithospermum arvense, Alkanna tinctoria, Onosma paniculata)	
Danish	**sminke**rod
Swedish	**sminke**rot
German	**Schminke**wurz (**Lithospermum arvense**); Bauern**schminke** (**L. arvense**); **Schmink** (**L.**
Names relating to "blood/red/pigment" (Potentilla sp., and various Boraginaceae)	
German	Blutkraut
German	Rothwurz
German	Färbekraut
Spanish	sanguinaria (**Lithospermum arvense**)
American English (Missouri)	indian-paint (Lithospermum canescens)
Names relating to 'blue' (in blue font) for Boraginaceae (in bold) and other plants	
Swedish	blå sminkrot (**L. arvense var. coerulescens**); blåeld
Danish	blåfrue (**L. arvense var. coerulescens**)
Finnish	sinikuntteri (**Echium vulgare**)
Russian	Sinij cvet (**Echium vulgare**)
English	Blueweed (**Echium vulgare**)
Slovincian	modřińc (Delphinium consolida, **Echium vulgare**)
Slovincian	***modrė krëpk'i*** 'forget-me-not (***Myosotis palustris***)
Slovincian	*modri mléč* (*Cichorium intybus*)
Kashubian	Zwëczajny **mòdrzińc** (**Echium vulgare**)
Kashubian	*mòdrôk* (*Centaurea* sp.)
Polish	modrzeniec, modrzyk (Centaurea sp.)
Old Polish	*modrak*, *modrzyk* (*Centaurea cyanus, Cichorium intybus*)
Bosnian	modrec, modrac (Centaurea cyanus)

Table 3. Common names of Boraginaceae related to blue.

Polish *modrzeniec*, *modrzyk* 'cornflower (*Centaurea*)', and Old Polish *modrak*, *modrzyk* 'blue cornflower (*Centaurea cyanus*), chicory (*Cichorium intybus*)', Bosnian *modrec*, *modrac* 'blue cornflower (*Centaurea cyanus*) (Trubačev 1992, 96-99, 102, 104).
It is important to remember, however, that the Slavic plant names in *modr-* could be secondarily derived, as they are still identifiable as 'blue' to Slavic speakers to some extent. Most of the Slavic non-Boraginaceae plants are also found in the PIE homeland (see below). Perhaps the Indo-European word **mod*^{h}*-r-* was

Fig. 15. Prehistoric finds of different Boraginaceae in this survey of archaeobotanical literature by period/culture.

originally a descriptive term for blue-flowered plants, such as *Echium vulgare* until the Corded Ware/Bell Beaker/Unetice period and later referred to the pigmented roots of blue Boraginaceae sp. (*Echium vulgare*, *Lithospermum purpurocaeruleum*). It may have only later been assigned to the red-dyeing roots of the Rubiaceae species in the prehistory of Germanic (fig. 7).

Boraginaceae in archaeobotany

The archaebotanical record also merits study in order to assess what plants were present in the PIE homeland, and the target area of Indo-European peoples' migrations into Europe around 3000 BC. Archaeobotanical studies have often focused on domesticated crops, which makes looking for wild weeds in the literature difficult. In the case of steppe research, the excavations were often conducted without the benefit of flotation methods and other techniques for finding plant remains (Anthony 2007, 129). However, awareness of these methods is improving, and no doubt there will be more archaeobotanical data available in the future. Therefore, there is no current definitive evidence when comparing the linguistic and archaeobotanical data, but there is a likely indication of the availability and intentional collection of wild Boraginaceae in prehistory.

Limited access to archaeobotanical databases in this study identified finds of *Lithospermum* sp. (*arvense*, *officinale*, and *purpurocaeruleum*), *Alkanna/Anchusa* sp., a few (but some plentyful) finds of *Echium* sp., one find of *Lappula* sp., and one of *Arnebia* sp. (fig. 15). Supplementary data, further literature and maps of dye plants are available at:
http://prehistoricmap.com/Nortoft2017appendix.pdf.

Although the prehistoric distribution of the plants (fig. 15) seems to be widespread today in most of Eurasia (figs 8-12), they mostly appear in archaeobotany around the Mediterranean. This may be the result of a sample bias because of a poor archaeobotanical tradition in Russia. *Lithospermum officinale* seeds are found in large, concentrated numbers in the Cucuteni culture (phase A2, 4400 to 4200 BC) of Copper Age Romania (Solcan et al. 2014). These seeds have also been found in several finds from the Catacomb culture (2300 to 2200 BC), where there were local descendants of the Indo-European-speaking Yamnaya herders of the steppe

region. The seeds are also found on an orange-dyed headdress of the same culture (Shishlina et al. 2005), and in the Crimean Neolithic period as early as 5836 to 5358 BC (Salavert et al. 2014, 4). They are also found with a cataplasm in the late Mierzanowize culture (1750 to 1600 BC) of Poland, which shows the plants' association with medicine (Baczyńska & Lityńska-Zając 2005). However socially important this plant may have been, its flowers are not blue, but white, and its dye concentration (shikonin content c. 0.0079%) is quite low compared to some other Boraginaceae that are known to dye wool. Therefore, the blue or purple colour on wool dyed with *Alkanna tinctoria* is unlikely to have been achieved with *Lithospermum officinale*, which makes it a poor candidate for an association with the original meaning of PIE **mod*^{h}*-r-* 'blue'.

Fig. 16. Blue flowers found in the prehistoric steppe region. a. *Campanula rotundifolia* (Image: Andreas Eichler), b. *Centaurea cyanus* (and other flowers) (Image: Wiki-user Valen1988), c. *Cichorium intybus* (Image: Bruce Marlin), d. *Gentiana asclepiadea* (Image: Martin Kozák).

Nutlets of the blue-flowered *Lithospermum purpurocaeruleum* are found in abundance at two other Cututeni (Copper Age, phases A2-B: c. 4400 to 3350 BC) sites. They were found in two dwellings at Izvoare, Romania: 8,000 nutlets (half of them perforated) in one and 1,091 in the other. At Bodești, Romania, 75 nutlets were found. They were deposited in pots and goblets, demonstrating meticulous gathering and modification of these seeds, which the authors suggest had a social and ritual significance through a wide range of medical properties in this and many other Boraginaceae species (Solcan et al. 2014). There are no published studies on the shikonin/alkannin content of *Lithospermum purpurocaeruleum* known to date. Thus, the yellow-dyeing maclurin-equivalent (together with purpurin) in Bronze Age Hallstatt reported by Grömer et al. (2013, 263) is the only trace of its possible use as a textile dye. Perhaps this could be interpreted as a transition period using roots of both *Lithospermum* sp. and Rubiaceae for textile dyeing, and accordingly associating the plant names of *Lithospermum* and bedstraws.

Echium vulgare, with characteristic blue flowers, has been found in the Srubnaya-Albar phase (c. 1890 to 1650 BC) in the vegetation of Kammenyi Ambar, Trans Urals, Russia (Stobbe et al. 2016, 1694, 1699). Although this is the easternmost periphery of the proposed homeland area, the Srubnaya culture was mainly of Yamnaya descent, occupying largely the same area as their Yamnaya and Catacomb ancestors (Anthony et al. 2016, 13; Unterländer et al. 2017, 7). This plant has bright blue flowers, and despite its low concentration of shikonin (from 0.00048 to 0.0283% in different studies), it could provide enough red pigment for cosmetics or similar, despite its name still being attached to its prominent blue flowers.

It could also be a factor that some plant seeds are better preserved than others. *Lithospermum officinale* nutlets have very hard shells, which give its Latin name, meaning "stone seed" (Anderberg & Anderberg 2016, s.v. "Lithospermum officinale"). This might explain its predominance among Boraginaceae in the archaeobotanical record (fig. 15).

Alternatively, PIE **mod*^{h}*-r-* could have been used generally for blue flowers found in the prehistoric Pontic-Caspian steppes, such as *Campanula* sp., *Centaurea cyanus* in Bronze Age Samara (Popova 2016a, 340-346), and *Cichorium intybus*, and *Gentiana* sp., throughout the Holocene (fig. 16) (Kremenetski et al. 1997; Kremenetski et al. 1999; Popova 2016b, 95). However, their roots do not dye, making the term blue a purely descriptive one for the flowers. The name would thus only later be associated with blue-flowered Boraginaceae used as cosmetics, such as *Alkanna tinctoria*, and, according to ethnography, *Lithospermum arvense*, known as German *Schminckwurz*.

Conclusion

This paper provides a brief account of the historical and prehistoric evidence for the use of different Rubiaceae (madder plants) in textiles, with a survey of the cognates of English *madder*, and a reconstruction of its Proto-Indo-European root and adjectival formation. However, this word has a relationship with red dye alone in the Germanic languages, and seems to go back to a Proto-Indo-European adjective meaning 'blue', which the madder plants are not. Therefore, another family of plants associated with red-pigmented roots and with characteristic blue flowers has been identified and investigated. The Boraginaceae family, some of which were used as textile dye (*Alkanna*/*Anchusa* sp.), and some with red root pigment and found in the PIE homeland (perhaps *Echium vulgare*) are suggested as a source for the Germanic word. The semantic shift may have happened in a phase of (European) late PIE or Pre-Proto-Germanic (c. 2500 to 500 BC), when Indo-European speakers migrated to Central Europe with blue-flowered Boraginaceae better suited for dyeing.

The following three-step model explains the missing link between a plant name derived from PIE **mod*^{h}r- 'blue' and the red-associated English madder:

1) PIE **mod*^{h}*-r-* 'blue, blue flowers, or blue-flowered Boraginaceae with pigmented roots (Echium vulgare)'. This development occurs in the Pontic-Caspian steppes 4500 BC to 3000 BC before the Indo-Europeans migrate to Central Europe.

2) Pre-Proto-Germanic, Late PIE (perhaps also the Slavic branch?) **mod*^{h}*r-* 'blue flowered Boraginaceae with (red?) pigmented roots' designating *Echium vulgare, Alkanna*/*Anchusa* sp. (strong dyestuff), *Lithospermum purpurocaeruleum*, *Lithospermum arvense* (blue variant). This development occurs after 3000 BC following migration of Indo-European peoples to Central Europe.

3) Proto-Germanic **madrōn-* 'red-dyeing plants, Rubiaceae'. This development occurs in Scandinavia from 500 BC.

If more archaeobotanical blue-flowered and pigmented Boraginaceae such as *Echium vulgare* or *Lithospermum purpurocaeruleum* are found in the homeland in the PIE period, there would be even stronger evidence for these plants being the original designation of PIE **mod*^{h}*-r-*.

This development could be comparable to that of *Chamomila* in Spain, whereby the name of the

"proto-typical" species in Spain is grouped by the appearance of the flowers and its use as herbal tea, but later also associated with other plants with either similar flowers or the same use as a herbal (Morales & Pardo-de-Santayana 2010, 298–299).

This solution rests on circumstantial evidence from various disciplines and other explanations may be feasible. Nevertheless, the linguistic difficulty of 'blue' > 'red' presented here suggests that the dyeing properties and archaebotanical finds of Boraginaceae (and experimentation with dyeing methods) deserve more thorough exploration in the future, in addition to dyestuff analyses on prehistoric dyed textile finds from the Pontic-Caspian steppes.

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The Central Timna Valley Project:
5 Years of Ongoing Textile Research

In its initial five years of activity the Central Timna Valley Project has dedicated its efforts to the excavation of several Late Bronze and Iron Age sites (13th-9th centuries BC) in the southern Arabah Valley of Israel (fig. 1).[1] The project, headed by Erez Ben-Yosef of Tel Aviv University, explores the ancient exploitation of copper ores at Timna; these were utilised for the production of copper ingots that were traded throughout the southern Levant and possibly the greater Mediterranean region. It is within the strata of several newly excavated sites that a few hundred individual textile, cordage and rope fragments were uncovered. Furthermore, locally made, crude ceramic vessels bearing the negative impressions of woven textile materials were also collected during excavations and surveys in the valley. In light of these discoveries, the team launched multiple investigations into many aspects of production and consumption of textile goods using an interdisciplinary approach that combines archaeological and archaeometric methods with methodologies applied in historiographical and ethnographic research. These ongoing studies attempt to reconstruct the ancient journey of the textile fragments from fibre to archaeological deposition while considering their significance within the temporal, geographical and cultural setting. Additionally, the

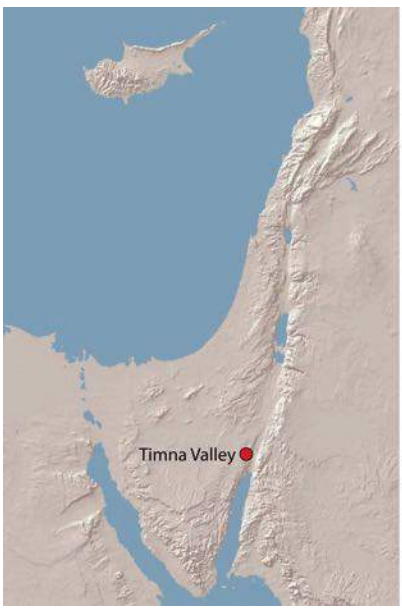

Fig. 1. Location of the Timna Valley just north of the Red Sea/Gulf of Aqaba (Image: Central Timna Valley Project)
Fig. 2. Site 34/"The Slaves' Hill": an Early Iron-Age smelting camp in the central Timna Valley (Image: Central Timna Valley Project).

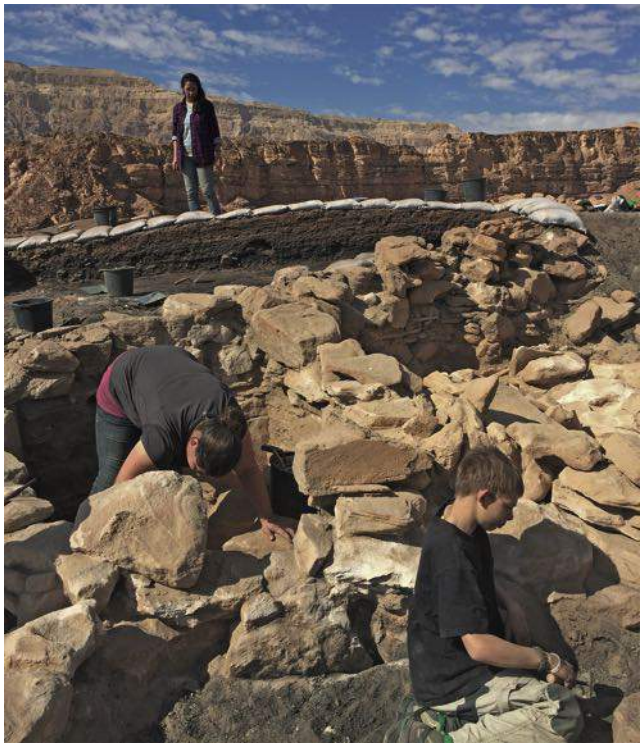

Fig. 3. Excavations of a copper smelting workshop at Site 34 (Image: Central Timna Valley Project).

project incorporates all available textile remains and data generated from studies performed during previous excavations within the valley (namely the Arabah Expedition directed by the late Beno Rothenberg; Rothenberg 1988; Sheffer & Tidhar 1988; Shamir & Baginski 1993) in order to provide an all-encompassing examination of ancient textiles utilised at Late Bronze and Iron Age Timna. The exceptional preservation conditions in the arid environment of the Timna Valley have permitted – for the first time – an extensive study of a large and unparalleled archaeological textile assemblage from this formative period in the southern Levantine region when Egyptian hegemony was replaced by the emergence of local polities such as the Edomite Kingdom and Ancient Israel.

The primary phase of this project commenced with comprehensive documentation of physical and technical aspects of the assemblage found during the 2013-2014 seasons of excavation at Site 34/"The Slaves' Hill", a large *mesa* in the central area of the valley covered with a dense network of structures related to the processing of copper ore (fig. 2). Nearly half of the objects were found in mounds of slag, the waste byproduct of the copper smelting process, and nearby workshop spaces (fig. 3). Others were found within well-preserved layers of dung and refuse accumulation situated on either side of a small gate complex that controlled the only entrance to the site. Fibre types, spinning and weaving methods, decorative techniques, production quality and level of preservation were all documented in order to record the technical abilities and customs of ancient craftspeople working with woven materials. Unfortunately, only small fragments of the original objects were recovered; however, the wealth of information extracted from these artefacts was vast. The collection features a range of materials, including wool, goat hair and bast fibers (probably linen). The objects range in fineness and quality with some fragments appearing to originate from utilitarian objects such as sacks, tents and saddles while others are finely-woven fragments of garments (figs 4 and 5). Several objects are decorated with unique weaving techniques used to aesthetically augment the fabrics, design elements that are often found at or along the selvedge of the garments. The most astounding finds are fragments featuring well-preserved decorative red- and blue-coloured bands created by incorporating alternating dyed weft threads into the weave. These were executed with a high degree of skill and attest to the level of speciality employed by dyers, spinners and weavers working in the late 2nd millennium BC. Results of this stage constitute the work of Vanessa Workman's MA thesis entitled *The Fabric of Copper Production: The Textile and Cordage Artifacts from Iron Age Timna,* under the supervision of Shamir and Ben-Yosef, which is currently being edited into a forthcoming publication. Various stages of the work were presented at international academic and professional conferences.[2]

Textiles from the previously excavated Hathor Temple (Sheffer & Tidhar 1988, 224-232; Rothenberg 1988), a small structure enclosing an abundance of New Kingdom Egyptian finds in the vicinity of Site 34, were reevaluated within this study as a means of making connections between the material culture of cultic

Fig. 4. Plied goat hair cord (Image: Clara Amit, Israel Antiquities Authority).

and industrial activity of the Timnaic metal workers. The reoccurring appearance of the Egyptian goddess Hathor with textile finds within archaeological contexts, either as cultic offerings or in connection with the praise and worship of the goddess, continues to be developed within the context of Late Bronze / Early Iron Age Timna. During the Late Bronze Age, for at least a portion of the inhabitants of Timna, the goddess played an integral role in the success of their mining and smelting endeavours. Our research aims at a better understanding of how the textiles found in and around the temple contributed to Hathor worship and how these activities might be detected within the copper processing camps nearby.

A second phase of analysis was initiated focusing on detailed facets of the collection: dyes and animal fibres. Research headed by Naama Sukenik, and recently published in PLOS ONE (Sukenik et al. 2017), investigated the still vividly visible hues of red and blues dyes found in finely-spun wool threads in several textiles. The study used HPLC-DAD (High Performance Liquid Chromatography with Diode Array Detector) to isolate chemical compounds in the colouration in order to understand the composition and methods used to execute dyeing in the Early Iron Age. This was a particularly exciting opportunity to contribute information on dyeing processes and materials for the 11th and 10th centuries BC, a historical epoch with very little information regarding these topics. The analysis revealed that two colours, blue and red, were achieved using chemical dyeing processes and were made from organic plant materials of madder and indigotin respectively (probably *Rubia tinctoria* L. and *Isatis tinctoria* L., which are native to the Mediterranean region). These plants are among the earliest known in historical documentation of the dyeing craft, but evidence of their use is still limited in the archaeological record. As of today, the dyed fabrics from Timna constitute the earliest known results of these techniques from the Levantine region (dated to the late 2nd millennium BC).

Archaeometric analysis of the fibres was performed by Margarita Gleba, whose work partially focuses on tracking the developments in wool quality throughout the Mediterranean and Near East via the introduction of sheep species and selective breeding. Samples taken from a variety of textile objects were analysed using a scanning electron microscope (SEM) to measure fibre diameters. This data was compared to both modern and ancient samples collected from across Europe, the Mediterranean basin and the Near East in order to understand preferences and technological revolutions in the selection and processing of raw materials for various classes of textile industries and

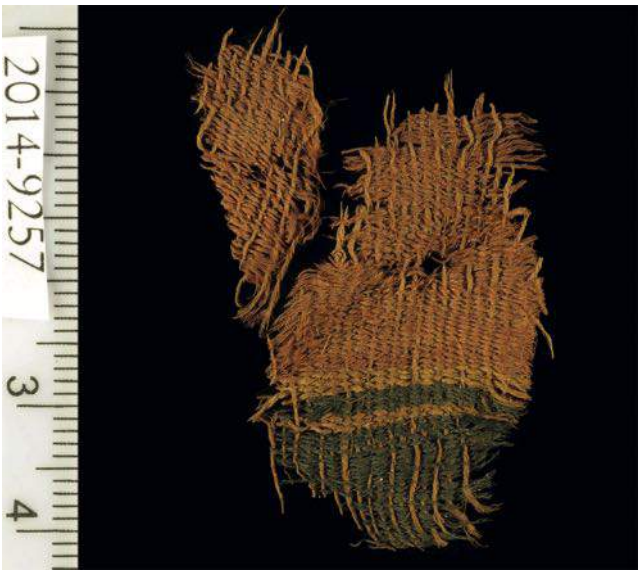

Fig. 5. Fragment of a well-preserved woollen textile with red and blue bands (After Sukenik et al. 2017: 6, fig. 4; Image: Clara Amit, Israel Antiquities Authority).

workshops. It was discovered that some of the textiles had highly-processed threads including combing and sorting practices applied to fibres prior to spinning. The results of this study were presented at the British Association of Near Eastern Archaeology conference in Glasgow this past January (Gleba, M., Shamir, O., Workman, V., Sukenik, N. and Ben-Yosef, E. Defining the value of wool in the Iron Age: the case of textiles from Timna (Israel). BANEA, Glasgow, 6 January 2017).

After several stages of analysis, we have begun to construct a picture of textile consumption and economy within the Timna Valley at the height of copper production there during the Late Bronze and Early Iron Ages. While the textile collection varies greatly in quality and workmanship, many of the artefacts were a product of highly-skilled craftspeople and were likely considered items of luxury at the time. As no spinning and weaving tools were discovered in excavations, the textile objects seem to have been brought into the valley by the people who came to work there or via the copper trade network. Together with faunal and archaeobotanical material from the sites, we infer that those operating the smelting furnaces and those responsible for copper production operations were not slaves as was once proposed (hence the moniker "The Slave's Hill"). These skilled workers with knowledge of advanced metalworking techniques achieved a commendable status worthy of imported fine goods such as choice cuts of meat (Sapir-Hen & Ben-Yosef 2014), fish and fruit originating from the

Mediterranean region (Ben-Yosef et al. 2017) and valuable, colourful textile goods. While the environment of the Timna Valley is neither hospitable nor suitable for sustained occupation, the local elite, including the metalworkers, appear to have enjoyed small luxuries in the form of imported goods, the likes of which are found among remains associated with persons of prominent stature in other archaeological contexts. We continue to research the way in which this hierarchal system came to be which enabled the maintenance of a large-scale enterprise in the mines and smelting camps; whether it may be attributed to the success of the copper commerce or perhaps that of a greater entity profiting from operations within the copper district of Timna.

During the current phase of research, we are proceeding to document and analyse textile finds from the 2015 to 2017 seasons, working towards a final publication of all Late Bronze- and Iron-Age objects from the Central Timna Valley Project's expedition thus far. As our understanding of the inhabitants and craftspeople in the valley evolves, the project continues to reevaluate the status of textile goods and their utilisation in all aspects of daily life, intertwined with subsistence and copper production.

Notes

1. The project is supported by the Israel Science Foundation (ISF) Grant #1880/17, and the Marie Curie FP7-PEOPLE-2012-CIG Grant #334274 (both to E. B.-Y.). For a general overview of the project see: Ben-Yosef (in press); for further information on the site see Ben-Yosef et al. 2012; Ben-Yosef 2016; for updates see: https://archaeology.tau.ac.il/ben-yosef/CTV/.
2. Shamir, O., Workman, V. and Ben-Yosef, E. Textiles and textile impressions on pottery from the Hathor Temple and Iron Age smelting sites at Timna, The Annual Meeting of the American Schools of Oriental Research (ASOR), San Diego, November 2014; ibid., Textiles and Textile Industries in the Near East and Eastern Mediterranean (5th-1st mill. BC): Recent Research, Loyola Marymount University, 24 November 2014; Workman, V., Shamir, O. and Ben-Yosef, E. Iron Age textile remains from a smelting site at Timna: A preliminary case study for the intangible, Traditional Textile Craft—an Intangible Cultural Heritage? The Jordan Museum and CTR, Amman, March 2014.
3. The authors are grateful to Mimi Lavi at the Institute of Archaeology at the Hebrew University of Jerusalem and Raisa Vinitzky of the Artifact Treatment Department of the Israel Antiquities Authority for the conservation work performed on the textile collection.

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The Gallo-Roman textile collection from Les Martres-de-Veyre in France

Introduction

A new project, called "ArchéoMartres", sponsored by the Maison des Sciences de l'Homme de Clermont-Ferrand and the Direction Générale des Affaires Culturelles (DRAC) Rhône-Alpes-Auvergne, aims to re-study the Gallo-Roman collections from Les Martres-de-Veyre stored in the Musée Bargoin in Clermont-Ferrand.

The site of Les Martres-de-Veyre, 15 km south of Augustonemetum (ancient Clermont-Ferrand), the capital of the Arverni, is known for its ancient pottery manufacturing centre (Terrisse 1968), its water mill (Romeuf & Romeuf 2000) and its graveyard. The burials date from the 1st to the 2nd centuries AD. They were excavated in the course of excavation seasons in 1851, 1893 and 1922-23 (Audollent 1922, 1923) and constitute several examples of clothed burials, especially female ones, in an exceptional state of preservation. In these burials, not only clothes but also all the organic material were well preserved: wooden coffins and *pyxides*, baskets, fruit and other vegetal offerings, hair, etc. Textiles represent a high percentage of the discoveries. Among them, a tunic associated with a so-called 'belt' (fig. 1a), a pair of stockings and a pair of leather shoes constitute a world-renowned assemblage. This has been manipulated and exhibited without damage in the museum from the time of discovery to the renovation of the museum: under a heavy glass bell in the 1950s (fig. 1b), hung between 1968 and 1985 (fig. 1c), on a mannequin for a special exhibition (fig. 1d) and exhibited flat from 1985. The preservation is supple, making this discovery unprecedented in France. Paradoxically, its extraordinary condition contributed to the find being perceived as trivial and hence little-studied. More recently, the tunic has not been on permanent display and instead was mostly kept away from direct light. This exceptional find is a small part of a wider collection which has not been extensively published but which includes more than 80 fragments of textiles (clothes, covers, socks, bands, etc.) in different techniques. These are currently being recorded (Breniquet et al. 2017).

The "ArchéoMartres" project is an interdisciplinary project which links together several main institutions: the Musée Bargoin, the University Clermont-Auvergne, the Maison des Sciences de l'Homme of Clermont-Ferrand and the Institut National de Recherches en Archéologie Préventive (Inrap). However, different specialists from other research centres may also collaborate. One of the main objectives of the project is to re-study the textile collection. We plan to enlarge the perspective to other aspects than the textiles such as the funerary practices (both inhumation and cremation burials), the other materials such as pottery or glass and, applying up-to-date methods, we aim to carry out a spatial analysis of the entire settlement and its environs. This is supported by the complete ongoing inventory being conducted by the museum and by the recent discovery of unpublished archaeological archives of the first excavations in the cemetery which provide new information.

First scholars

The first excavations at the site were conducted by several notable local scholars (G. L'Héritier, E. Kuhn and A. Audollent) and reported by many others (H. Dourif, G. Desbouis, P. P. Mathieu, F. Vazeilhes, E. Vimont). Most of them were fellows of the Académie des Sciences, Belles-Lettres et Arts of Clermont-Ferrand or of other local academies. Two, J.-B. Bouillet and E. Vimont were directors of the museum; the others

Fig. 1. a The 1893 tunic and its 'belt'; b as exhibited in the 1950s on a hanger; c as exhibited between 1968 and 1985; d on a mannequin for a special exhibition, no date (a Image: F. Giffard, Musée Bargoin, b-d © Musée Bargoin).

were physicians, teachers and one was the mayor of a small town near Clermont-Ferrand. As the occupation of Les Martres-de-Veyre covers a large part of history from the Palaeolithic to the modern period, their interest depended on the period or artefact, especially coins and pottery. However, they hardly published these remarkable finds, which found their way only into local journals of limited audience. Among them, Audollent deserves a special mention as he provided the most complete published report.

Audollent arrived as associate professor of classics in Clermont-Ferrand in 1893. He was previously a

member of the Ecole Française de Rome and developed a huge interest for the Roman world. He wrote a masterly thesis on *Carthage romaine*. His academic position in Clermont-Ferrand drove him quickly towards the local museum and allowed him to run excavations in the Temple of Mercury at the top of the Puy de Dôme and in Les Martres-de-Veyre. As a field archaeologist, epigrapher and historian (Dupont-Ferrier 1943), Audollent entertained a scientific network with other eminent scholars such as the famous prehistorian J. Déchelette, who advised him to take care of the textile discoveries from Les Martres-de-Veyre. He did so when he wrote the only detailed publication of the excavations of the Gallo-Roman cemetery (Audollent 1923) after collecting part of the available information and sending samples of textiles for study to Ch. Pagès (Pagès 1923). At present, their reports remain the only published sources of information on the textile collection. Audollent collected and organised the information, giving an inventory as consistently as possible for the entire collection (textile and material) and assigned to each tomb a letter: A, B for the 1851 discoveries, C to F for the later ones. As another publication was planned by other scholars, however, he did not give a full account of the discoveries. Details and photographs were missing and some descriptions remain unclear as he did not take part in the excavations. Audollent is also the only scholar who published the discoveries abroad, in the journal of the Royal Anthropological Institute of Great Britain and Ireland, *Man* (Audollent 1921). Most scholars still refer to Audollent's publications when discussing the finds (e. g. Roche-Bernard & Ferdière 1993, 11-14).

History of the excavations

The history of these excavations is difficult to write as the first discoveries were fortuitous and incompletely recorded. In 1851, workers from the Vazeilhes tile factory were digging to collect clay in an area called Le Lot (Le Lod or Le Laud are other possible orthographies of the place), between the railway and the river Allier. We believe that the old name "Les Chaumes d'Allios" used for a more specific place, actually refers to the area of the Gallo-Roman cemetery (Lauranson 2012, 89).

The first grave for which details are lacking was found and quickly "excavated" in June 1851. A second tomb (named D by Audollent), found in September, brought to light in a wooden coffin the remains of a young woman, lying on her belly, whose face was still apparent. She was apparently dressed in several layers of clothes, badly recorded in the field. She had worn a pair of leather sandals with cork soles. Her head lay

Fig. 2. Grave I during the excavations, 1922-23 (© Musée Bargoin).

on a checked fabric and her body was partially covered by another felt blanket woven in twill. A basket with nuts and apples was also in the grave. Since the 19th century, the exceptional preservation of the organic materials has been explained by the presence of hydrothermal springs which deliver carbon dioxide to the soil, inhibiting normal bacterial degradation (Audollent 1923, 54). The discovery of such preservation was so astonishing that people doubted that the burial was old and refuted the Gallo-Roman date. Several coins dating to the reigns of Nerva, Trajan, Hadrian and Antoninus Pius (Audollent 1923, 12-13), as well as Samian pottery, finally confirmed that the grave should be assigned to the first centuries of the Christian era. Bouillet succeeded in collecting several pieces of textile which were exhibited in the museum and published (1861, 105-106). After several decades, in 1893, other graves were discovered. They yielded more inhumation burials, with or without coffins, with the dead lying in various positions.

These burials also contained pottery, coins, glass flasks and vegetal offerings to the present state of knowledge (Blaizot et al. 2009a, 170; Blaizot et al. 2009b). The female Grave D is the masterpiece of the collection with its complete tunic, 'belt' and socks. Other tombs were female (D and E), Grave F was that of a little girl buried with a distaff, spindles, a hair comb, a basket and other vegetal offerings. All were coffin burials furnished with textiles and organic offerings except Grave C (a man without a coffin). No drawings or photographs were done in the field. As far as

we know from the excavation archives, other graves were found more or less in the same time frame, but except for oral and (sometimes uncertain) testimonies of the local inhabitants, we have no clear evidence of what was found. Finally, in 1922-23, Audollent started new excavations in the cemetery and brought to light cremation and inhumation burials in coffins; unfortunately, these were less spectacular than the first ones. This time, several pictures were taken in the field, providing some insight into the general environs of the excavations and the first and only photograph of a tomb (named I) (fig. 2). These last discoveries were published in a short paper but were never included in the general publication of the graveyard (Audollent 1922). The wooden coffin was exposed in the museum and finally dated by dendrochonology to 170 AD in 2014 (Blondel 2014).

First studies of textiles

Audollent was aware of the necessity to study the textile collection. The nearby city of Lyon, renowned for its textile industry, was regarded as the best place to find a specialist. But in the 1920s, textile archaeology was an uncommon branch of archaeology in France. Audollent solicited the help of Pagès who was professor at the Ecole de Commerce and sent him a selection of 13 samples from at least eight different textiles. Unfortunately, Pagès died soon after doing this work and Audollent chose to publish it as it was (Pagès 1923). The samples were cut with scissors and were supposed to be as representative as possible, but unfortunately they were not. Audollent chose probably what he recognised as "valuable" textiles from their apparent qualities, but they are beyond the statistical number of fabrics encountered in the graves because he made a selection of 13 pieces which are only woollen pieces. Currently, we can estimate the textiles fragments to number at least 80. Pagès' first account, however, is a good starting point as he provided most of the technical parameters: direction of twist, warp, weft, and structural variation, borders, fringes, hem, wear, damaged traces, etc. Some other observations were directly inspired by textile industry practices: yarn count, structure, estimated weight. More observations allowed him to make some hypotheses on the technical processes used in that time period, and help us to recognise the pieces that were originally dyed. Finally, he suggested uses for the fully-preserved fabrics (clothes, blanket, etc.).

After Pagès' pioneering work we hear nothing about the collection until the 1980s. Several scholars involved in textile archaeology received the authorisation from the museum to study parts of the collection. The first was H. Granger-Taylor who studied mostly the famous tunic and related pieces from Grave D in order to link her results with her work on Roman textiles. The last was F. Médard who made an inventory of most fragments. During the autumn of 1996 and the spring of 1997, S. Desrosiers had the opportunity to do a complete technical study of a large part of the collection. In a short paper that offered an overview of Gallo-Roman textiles from France (Desrosiers & Lorquin 1998), she alerted scholars to the immense size of the collection. Unfortunately, these studies remain unpublished. In 2015, Desrosiers graciously returned her complete archives to the museum, opening the way to carry out the "ArchéoMartres" project. After her preliminary study, the municipality of Clermont-Ferrand undertook the conservation of the collection, under the supervision of Girault-Kurzemann at Orange, France. It was thus possible to perform some dye identification analysis (Nowik et al. 2005).

The textile collection

It is not be possible here to give a complete overview of the textile collection for the inventory. A full re-eva-luation of all fragments is part of ongoing analyses[1]. We can, however, offer a more accurate survey. Using current techniques, this may help us to distinguish complete clothes and materials with a clear destination from pieces and fragments with an unclear use, as well as techniques. A set of shoes, at least three different pairs and a pair of soles complete the collection.

Tunics

The most famous item is without doubt the tunic from Grave D mentioned above. This tunic has large proportions (1.25 x 1.70 m with sleeves) and was reduced in length by a fold at the waistline, sewn with large stitches in a white thread. A pattern of the tunic was drawn by P.-F. Fournier in 1956: a large rectangular piece folded in two sewn on one side and on the shoulders, and two smaller rectangles added to it for the sleeves (Fournier 1956, 203). The shape still has to be confirmed as, strangely, it appears to show drooping shoulders.

Another tunic comes from the cemetery. It is complete but it was probably extracted in fragments through a narrow hole made by the pickaxe of the excavators in the coffin (Mathieu 1856, 362). Unfortunately, its exact provenience has not been ascertained as Audollent's excavation report is inconsistent. Audollent suggested it came from Grave A, but crushed glass has been found in the folds of the fabric and none is recorded from that grave. Crushed glass is present in Grave E

Fig. 3. The most complete band from Grave I (3 x 60 cm) with detail (Image: M. Veschambre, Musée Bargoin).

(Audollent 1923, 18). So both possibilities exist and all the information gathered from Audollent's publication and the unpublished archive material therefore require cross-checking. The second tunic has been reconstructed by Desrosiers from the many fragments. Its pattern seems different from the first one: cross-shaped, folded and sewn under the arms and on the sides. This tunic shows also *clavus* decoration in red on the shoulders.

Bands

The tunic from Grave D was found with a long and narrow band woven in warp-faced tabby (4.30 x 0.12 m), decorated in several places with plaited designs. The common-sense interpretation was that this band was a belt, probably based on the depiction by Vimont and reported by Audollent (1923, 45). But Granger-Taylor convincingly suggests that it is a *strophion*, i. e. a long and narrow band that was wrapped around the chest (fig. 3a). It has to be compared with the bands found at Masada, especially no. 92-113/3 (Granger-Taylor, pers. comm. and forthcoming). A black Samian pot from Les Martres-de-Veyre kept in the Musée Bargoin (inv. no. 5126) depicts how such a band was worn. We hope to find other fragments associated with the other tunic.

Other bands come from Grave I. They are different in both shape (being narrower: 3 x 60 cm for the longest fragment) and use. They are wrapping bands in tabby technique for the ankles and the knees (fig. 3b), visible *in situ* on the only photograph available for the whole cemetery (fig. 2).

Stockings

The young girl from Grave D wore fringed stockings made from several sewn parts, probably initially held up using garters at the knees. One of the stockings was embroidered with three letters: PRI. Another pair of inner boots are supposed to have been part of the funeral arrangement of the grave, but their provenance is far from certain. However, their shape and material recall those from Iron-Age Riesenferner/ Vedretta di Ries worn with leggings (Bazzanella et al. 2005, fig. 9 and 10, 156-157; Grömer 2016, fig. 215, 388) (fig. 4a and 4b). Both pairs, stockings and boots, are tailored and woven in twill.

Other clothes or fabrics

The woman in Grave E was discovered with a fringed shawl on the shoulders (fig. 5a) which was repaired in antiquity: a carefully-sewn tear is visible (fig. 5b).

Other fragments with *gamma* figures in tapestry technique are recorded in the catalogue of the museum and came possibly from Grave A, according to Audollent (1923, 47-48). Some textiles are difficult to identify: the checked fabric from Grave A[2] (fig. 5c), the "felted" one from the same tomb and the white "blanket" from Grave F (fig. 5d). They may have been real blankets or rectangular mantles in twill or tabby technique for wrapping the body during winter time, held using *fibulae*.

Grave F yielded several fragments identified by Audollent as folded shrouds in vegetal fibres used as mattresses. Grave E provided many fragments of vegetal fibres which may have belonged to underwear. These need to be subjected to new analysis.

Fig. 4. a Stockings from Grave D; b Woollen boots, possibly from Grave D (© M. Veschambre, Musée Bagoin).

Open fabrics (gauze or more probably sprang) are also listed from Grave I.

Shoes

As part of the Roman costume, shoes should be mentioned. At least three different types are recorded in Les Martres-de-Veyre: leather shoes with nailed soles from Grave A (and possibly I), leather slippers with cork soles from Grave A, wooden clogs with inside soles of sheep skin and leather straps (unfortunately lost) from Grave E. All the leather items have been studied by M. Leguilloux and will be published in a wider study (Leguilloux & Médard forthcoming).

Raw materials

The clothes and fabrics from Les Martres-de-Veyre are mostly wool, the quality of which has to be explored further. However, as stated above, vegetal fibre fragments have been recorded. Further investigations are planned to identify the quality of the wools and the nature of the other fibres. Flax or hemp are of course possible, and cotton too, as it has been attested for the same period in central France in Vareilles, Creuse, (Dussot et al. 2001-2002) and in Damblain, Vosges (Schluck et al. 2012). Cotton was a rare and imported fibre in antiquity and was not locally cultivated. It probably came from the Mediterranean (Egypt?). Despite a description by local inhabitants in the 19th century (Mathieu 1856, 362), no trace of silk or gold threads have been found (yet?) in the collection kept in the museum. These fibres exist, nevertheless, in other contemporary contexts (Bédat et al. 1999, 7). We plan to complete the first deeper analysis of the fibres in order to have a better overview of the raw materials and to study, as far as possible, the qualities of the wool and its preparation. Preliminary examination suggests that the wool from the main tunic was combed as the fibres seem very regular and parallel, and quite different from the wool of the *strophion* which appears soft (possibly carded).

Techniques

Except for the open-work fragments, all the textiles from Les Martres-de-Veyre are real fabrics, mostly Z-twisted. Different weaves are attested according to different uses: tabby, warp-faced tabby, extended tabby, 2/2 twill, tapestry[3] (Fig. 6a), with a high variation of threads per cm and thread diameters. All of them are rather high-standard products, but with the exception of the stockings and boots, tailoring is minimal.

According to the dye analysis (High-Performance Liquid Chromatography with Photodiod Array

Fig. 5. a-b: Shawl from Grave E, length 1.2 m, detail of the shawl showing a repaired tear; c Fragment of a checked fabric from Grave A; d Fragment of a blanket or a coat from Grave A (Image: M. Veschambre, Musée Bargoin).

Detection, HPLC-PDA) done by W. Nowik at the Laboratoire de Recherche des Monuments Historiques at Champs-sur-Marne, the dye sources are vegetal: *Rubiaceae* family for red, luteolin (from weld, dyer's brown or sawwort) for yellow, ellagitannins for brown and indigo for blue (Nowik et al. 2005). However, part of the textile collection is not dyed and has the natural colours of the fibres. Some samples may have been dyed but are now impossible to identify due to alteration of the dyestuffs. Some blue spots are visible on the neckline of main tunic. Audollent interpreted them as a possible design printed on the fabric (1923, 45), but this is perhaps questionable, as holes and remains of an altered material are present in and around the coloured staining (fig. 6b). We suggest they are the remains of metallic objects, possibly coins or fibulae, undetected or unrecorded during the excavations (see also Nowik et al. 2005, 845).

As for every old collection, a lot of issues remain unsolved. Hopefully, answers will emerge with new investigations. Leaving the technical observation of the textiles aside, we have to consider several main questions: Les Martres-de-Veyre was a small town during the Gallo-Roman period. The settlement has

Fig. 6. a: Fragment of a *gamma* figure in tapestry technique, length c. 20 cm; b Detail of the collar of the tunic from Grave D with stains, length c. 20 cm (Images: M. Veschambre, Musée Bargoin).

not been well documented by archaeological studies. The relations between the inhabited area, the pottery workshop and the graveyard are still poorly understood. Many signatures on the Samian ware pots attest to the presence of more than 140 master potters at the site (Terrisse 1963; Provost & Mennessier-Jouannet 1994, 181). Were the people buried here potters? Were they related? DNA analysis of hairs and bones may give an answer despite the fact that the samples are old and have been manipulated without regard for standard archeological precautions in the past. The domestic areas are not documented; the houses and workshops used at the time are still unknown.

Where did the raw materials come from? We plan to compare the local wool on the distaff from the little girl's coffin to the other wools from the clothes. For the moment, it is impossible to say if the garments were made or bought in the town or in another main city (Augustonemetum or Lugdunum for instance). Was textile production a rural craft or an urban industry (Wild 1999, 30)? Probably, our answer will have to be nuanced. If part of the textile collection was home-made, the typological connections for tunics drive us to Bourges (Ferdière 1984, fig. 42 and 55), ancient Avaricum (200 km to the north) and far away to the Near East to Didymoi (Cardon et al. 2011), Qasr Ibrim (Adams & Crowfoot 2001), Masada (Granger-Taylor forthcoming) and Qumran (Shamir 2006). This is probably the result of an unrepresentative survival of textiles.

Some garments have the appearance of being constructed to a good standard. Are we looking at household production or (perhaps, more probably) a workshop-based one? Most of the fabrics are not new and show traces of wear (felting, holes), but we have no information about the date of production. They seem to be everyday garments but may have been arranged specifically for the funeral. Several studies suggest that burials may not give a perfect impression of the contemporary costume used at the time. For instance, the main tunic is not in itself a gendered garment, but it comes from a female burial. It was found in association with stockings with the three letters on them: PRI. It has been suggested that this embroidered mark could be related to the *tria nomina* (van Driel-Murray 1999, 11). It is hard to believe, however, that our potters were so high-ranking, as the rest of the funerary assemblage seems modest. Other readings cause us to speculate that 'PRI' constitutes either the maker's name or more probably the owner's (i. e. PRI(MA)) (Wild 2012, 246). Both explanations suggest that the clothes were second-hand products, bought or given for specific (unknown) circumstances.

Some parts of the slothing such as the shoes (or other small items like belts) could have been introduced in the coffin as part of the funerary practice (as attested elsewhere by Graenert & Schönenberger 2007, 56). The leather shoes from Grave D are thought to have been worn by the young girl. However, their size (comparable to our size 34) made it impossible with the stockings and the woollen boots. Observations made on other graves (Grave I for instance, or those excavated in Lyon recently) show shoes or soles close to the body, but not on feet (Blaizot et al. 2009a , 120). Audollent may not have been aware of this possibility, and without drawings showing the objects *in situ*, may have described what he understood from his own perspective at the time. Despite the remarkable value of his initial report, it is reasonable to consider some modifications to the findings and interpretation of his original publication based on our forthcoming new studies.

Once again, textile archaeology interweaves together many fields of research in an interdisciplinary way. We hope that the ongoing studies will yield a new understanding and shed new light on this exceptional site and its collections.

Ackowledgements

The authors wish to express their warmest thanks to S. Desrosiers, H. Granger-Taylor, M. Dacko and B. Dousteyssier for their help and assistance to the entire project and to A. Marath for correcting the English.

Notes

1. For this reason, we choose not to include inventory numbers here.
2. The fragment belongs to the same fabric illustrated in Breniquet et al. 2017, fig. 26c.
3. The fragment shown here belongs to the same fabric as the one illustrated in Breniquet et al. 2017, fig. 26a.

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Ulla Mannering

The textile from Tvis in Denmark

Introduction

In 1955 Margrethe Hald from the National Museum of Denmark presented in an article the textile from Tvis (C37919, Journal No. 556/55) which was found in a bog in western Jutland in Denmark (Hald 1955). The textile had the same year been given to the museum by Jens Jensen from Holstebro who had found the textile during a walk in a bog belonging to a farm called Villemosegård some 20 years earlier. As Hald was familiar with all the Iron Age textiles recovered in the Danish bog, it was clear to her that this textile had a slightly different design, and therefore she was not fully convinced that this in fact was a prehistoric textile.

During the work with all the Danish Iron Age bog textiles the piece was at first also included in the analysis, until a ^{14}C-dating confirmed the suspicion that Hald had already expressed, that the textile was not prehistoric. The dating now shows that the textile in fact belongs to the Early Modern Period (AD 1700-1800) (fig. 1). Thus, with this secure dating, the textile was moved from the Danish Prehistory collection to the Modern History department (it is now labelled 1721/2017).

To my knowledge, this textile has never been on display in the museum, but with this short presentation the textile will hopefully become available and interesting to a wider audience.

The textile

In 1955 Hald wrote about the textile: "Nearly 20 years ago cutting of peat in Tvis Mose, the western part of Jutland, revealed a piece of cloth, which is rather torn and of irregular shape. It measures up to 60 by 65 cm. The threads, which are rather thick and hard, are two-ply, s-spun, and twisted to the right (Z-twisted) in both warp and weft. Counting of the threads in a square of 10 by 10 cm gave 55 warp threads and 46 weft threads. The colour is brown, but of different shades, the fabric having a checkered pattern formed by reddish brown stripes on a yellowish brown bottom. Threads with a greyish tinge also occur, but apparently more irregularly. The weave is that of twill, which, strangely enough, is broken in the way that the longitudinal system gives crystal twill, i.e. with irregular meeting of the diagonals, whereas the weft threads meet in regular points, as seen in bird-eye twill. Part of the natural edge is preserved, but of no special arrangement. The weft bends normally in the lateral border, and the pattern continues right out to the edge. One transverse edge is likewise closed, but this seems to be a secondary phenomenon. Unfortunately analysis of the edge is practically impossible owing to weakness

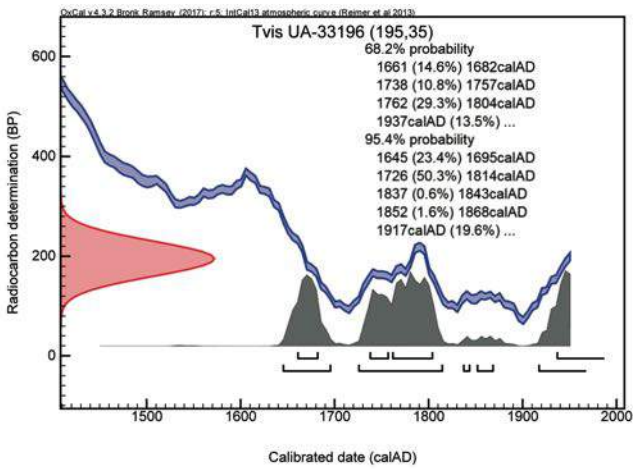

Fig. 1. ^{14}C-dating of the textile from Tvis (UA33196). The calibrated date indicates a production time between AD 1700 and 1800 (Image: Marie Kanstrup).

Fig. 2. The textile found in a bog near Tvis in Western Jutland in Denmark (Image: Ulla Mannering).

of the threads. However, a thickening is seen in the edge, formed of several thick threads and oversewn with rather coarse over-cast stitches. We shall at present have to leave open the question of dating."

To this description can be added that the dark brown wool textile today measures 60 x 62 cm. The textile has two torn and two finished edges. One of these edges preserves parts of a simple selvedge in a length of approximately 50 cm (fig. 2). A transverse edge is hemmed in coarse over-cast stitches while the other is badly torn.

A nice detail of this textile is that it has a regular

checkered colour pattern, which is probably also why it was originally placed together with the other Danish bog textiles. The now brownish pattern may at first glance be difficult to discern but consists of an originally yellowish ground with narrower red and greenish sections (fig. 3). In the warp direction the preserved part of the pattern counts from left to right > 9 cm ground, 4.5 cm red, 4 cm greenish, 9 cm ground, 4.5 cm red, 4 cm greenish, 8.7 cm ground, 4 cm red, 4.5 cm greenish, 8.5 cm ground. In the weft direction the pattern counts from bottom to top 1.5 cm ground, 6 cm red, 17 cm ground, 5.5 cm red, 17.5 ground, 5.5 cm red, > 9.5 cm ground. All yarns are made in a quite thick 2-ply, Z2s yarn in both thread directions and all colours. Even though there is a minor difference in the thickness of the three yarns, the surface appears homogeneous with an average thread density of approximately five threads per cm in both thread directions.

The textile is woven in a 2/2 diamond twill which is broken in one direction and has a point repeat in the other (fig. 4). Thus, the regular diamond weaving pattern does not underline the colour pattern but is still clearly visible on the surface due to the change in light and dark yarns. Further, it is clear from the reoccurring weaving mistake that this was a locally home-made textile. Judging by the overall appearance it is most likely that the textile was originally a scarf. But, as the textile has been in the bog at most for just over 300 years, the damage seen most likely represents what it looked like when it was lost. Especially the roughly hemmed edge seems to support this interpretation. Possibly the textile was in its secondary use, maybe as a kind of wrapping, lost or forgotten by a local peat cutter sometime in the 18th or 19th century. We can only guess about its life story, and even though the National Museum of Denmark contains many much more complete, beautiful and exotic textiles from this period, it represents an interesting and important link to our farming and peat cutting history which we should not forget.

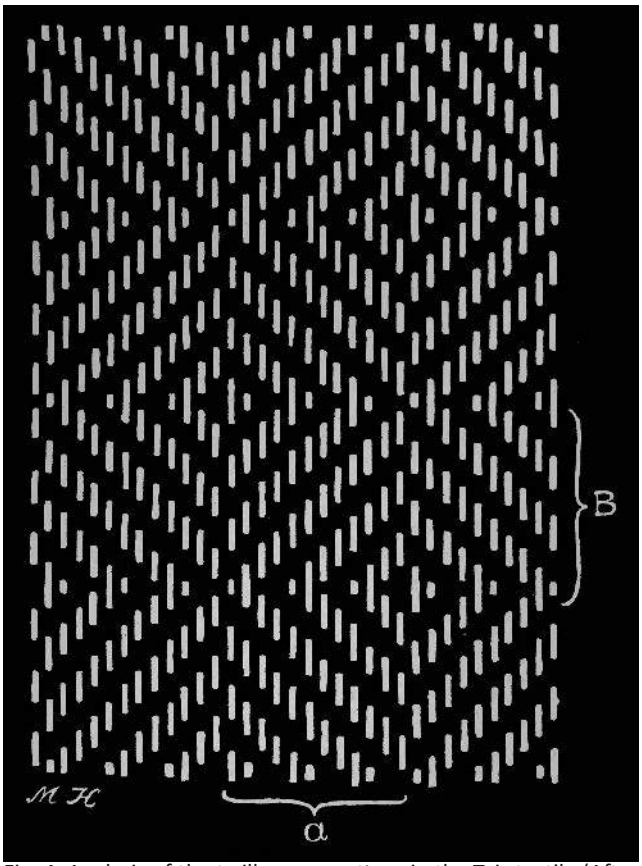

Fig. 4. Analysis of the twill weave pattern in the Tvis textile (After Hald 1955, fig. 23).

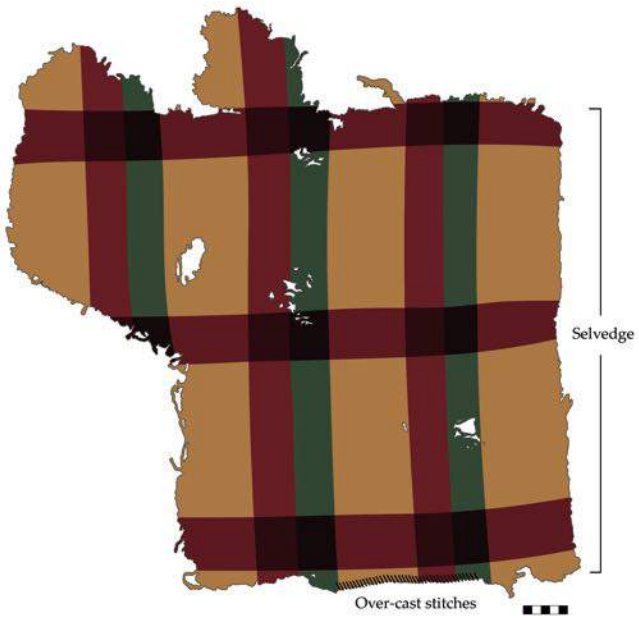

Fig. 3. Drawing of the textile from Tvis indicating the warp and weft directions, edges and the colour pattern (Image: Sidsel Frisch).

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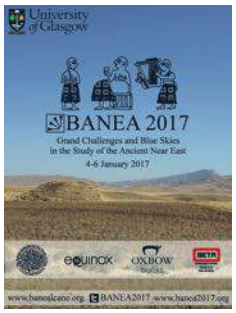


Consuming Clothes

4-6 January 2017, Glasgow, UK

The workshop session "Consuming clothes: textile values in the Near East and adjoining regions (9000 to 500 BCE)", organised by Susanna Harris (University of Glasgow) and Toby C. Wilkinson (University of Cambridge), took place during the annual British Association of Near Eastern Archaeology (BANEA) Conference at the University of Glasgow. The session brought together eight presenters to explore textile consumption and the wider role and value of fabrics in past societies. Conceived within the broader conference theme "Grand Challenges and Blue Skies in the Study of the Ancient Near East", the session aimed to provide a forum where textile specialists could interact with non-specialists to explore new ways in which textiles studies can be brought to bear on long-standing questions about the nature of human societies. A number of topics were covered including connections between textiles and urban development, the manifold dimensions affecting textile value and wealth, approaches to the archaeological identification of textile materials, and perspectives on acts of consumption that take place as part of the production textiles.

In her paper "Woven wealth: what is a valuable textile and how do we identify it?", Susanna Harris considered current economic approaches to the question of textile value and suggested five ways in which researchers can explore an expanded social concept of value in the material record. Such an approach promises to move beyond strictly economic perspectives typically provided by a focus on labour and resources alone.

Sarah Dermech explored the role of coloured textiles as social markers and wealth objects by examining the changing use of colour across several different media in her paper "Where did colors go? Looking for the colorization of textiles and its implications between the Neolithic and the urbanization in the ANE (Early Halaf - Late Chalcolithic period)". Her work noted correlations between an apparent reduction in the use of colour in several media (architecture, graves and material culture) and the concomitant increase in the importance of coloured textiles.

In his paper "Dressing up the town: textiles and the spatial expansion of urban life", Toby C. Wilkinson made the case for a deeper and more active role for textiles in the long-term transformations of past societies and examined evidence suggesting that the production, exchange, and consumption of textiles played a significant part in the spread of urban life in the ancient Near East.

Dan Lawrence connected settlement pattern and environmental data with textual sources to explore connections between textile production, risk bearing institutions and agro-pastoral activities in his paper "Urbanism, landscape archaeology and … textiles? Settlement patterns and social organisation during the Late Chalcolithic and Early Bronze Age in the Northern Fertile Crescent". The central importance of textile industries as contributing factors in the development of large urban centres was again brought to the fore.

Jan Picton, in her paper "Egyptian textile production, the view from Gurob: a 'harem palace' or a royal administrative and distribution centre in the Faiyum?", presented a re-examination of the role of local textile workers in continuance of earlier attempts to address questions of site function and identity. Her assessment in support of an industrial scale textile production facility emphasized the high quality of recovered textiles and the quantity of fine blue-banded cloth, and prompted further reflections on the broader significance of Egyptian 'royal-linen' from the 18th Dynasty to the end of the New Kingdom.

David Lumb considered the interactions between multiple craft industries that took place during the production of textiles in his paper "The manufacture and use of textile production tools at Tell Tayinat: reconstructing an Early Iron Age production system". By highlighting the active consumption of multiple craft products, in the form of specialised textile production tools, he emphasised that textile producers did not operate in isolation and that they interacted with other crafts and other producers.

In his paper "Making meaning and reinforcing roles: the consumption of manufacturing experiences as

a mechanism for social reproduction", Neil Erskine investigated specific craftsperson experiences during the consumption of raw materials, time and meaningful experiences that took place in textile production. His approach aimed to go beyond studies traditionally limited to assessments of identity and showed how meaning embedded in textile production served as a mechanism for social reproduction.
Finally, Margarita Gleba, Orit Shamir, Vanessa Workman, Naama Sukenik and Erez Ben-Yosef, in their paper "Defining the value of wool in the Iron Age: the case of textiles from Timna (Israel)", considered differences in raw material quality and value while presenting a preliminary analysis of old and new preserved textile samples. Their identification of distinct sheep wool and goat hair profiles, which differed from contemporary profiles analysed across Europe and the Near East, highlighted the potential for this promising direction of comparative research to add depth to our understanding of the material culture.
Overall, the papers presented a wide array of subjects and approaches that all served to broaden the scope and depth of textile related research. The session was well organised and comfortably situated in Seminar Room B of the Sir Charles Wilson Building (University of Glasgow) where seating for 40 was filled at near capacity for the duration of the day.

By David Lumb

Interweaving Cultures

17-18 February 2017, Madrid, Spain

The scientific coordinators of the workshop "Interweaving Cultures: Fabric production, rituality and commerce in the Late Bronze Age and the beginning of the Iron Age in both the Iberian Peninsula and the Balearic Islands", which took place in the Museo Arqueológico Nacional (MAN), were Margarita Gleba and Beatriz Marín Aguilera (University of Cambridge, UK). Fifteen speakers presented their work on different areas and archaeological sites located in the Iberian Peninsula.
The workshop was divided into five sessions beginning with an introduction by Margarita Gleba, as the principal investigator of the project PROCON (2013-2018). She explained that the team was trying to analyse a hypothesis, which states that the production and consumption of textiles were important promoters of the economy as well as the creation and acquisition of wealth in the Mediterranean Europe during the beginning of the urbanisation period (c. 1000-500 BC). The bases of the project's structure are formed by four lines of research within the operating chain of the textile industry: the resources, the production, the product and, finally, the consumption and the exchange.
Later, Beatriz Marin presented the last phase of the project (PROCON) that includes a study of the Iberian Peninsula (after having successfully collected data in both Italy and Greece). In order to attain this, it was necessary to lower the chronology to 400 BC, since the textile production here shows a later development in relation to other areas of the Mediterranean. The analysis consists of 22 archaeological sites that are spread over four regions: Catalunya, Alacant, Extremadura and Seville. The fieldwork has been carried out by a team from the University of Barcelona led by David García i Rubert (Sant Jaume-Mas d'en Sarrà), Ana Navarro and Manuel Camacho from the Archaeological Museum of Seville (El Carambolo, Setefilla, Cruz del Negro, Cerro Macareno) and Sebastián Celestino and Esther Rodríguez from the Archaeological Museum of Merida, CSIC (El Turuñuelo). The data that has been analysed until now shows an increase in textile production during the Iberian period (c. 4th century BC – 1st century AD) after some findings that pointed to an increase of loomweights and spindle whorls used. The most used fabrics in the Iberian Peninsula were linen, esparto and wool. There exists as well a certain specialisation in the textile production differentiating what is fabric (Sant Jaume) from spinning (Moleta del Remei). The project will finish with a comparative study on three levels: first, the Peninsula and its regional differences; second, the entire Mediterranean sphere contrasting Greece, Italy and Spain; and third, a local-colonial comparison.
The second session treated the three sources used in the study. Marisa Ruiz (Universidad Complutense de

Madrid) related the rise of geometric-style pottery with the decentralisation of political systems in connection with changes in dress. After this, Julia Martínez (Universidad de Valencia) showed both the textual sources and the textile remains that provide information on the purple dye of vegetal origin known since the Bronze Age for dying textiles, although there is only evidence of the *Rubia tintorum*. Finally, the curators of the MAN, Ruth Maicas and Eduardo Galán, stressed the importance of the collections within the Department of Prehistory.

In the third session, which was dedicated to raw materials, Ramón Buixó (Museo de Arqueología de Cataluña) talked about the exploitation of both linen and esparto on the Peninsula, focusing on his archeobotanic view in comparing records with environmental conditions. Enrique García (Universidad de Sevilla) delivered a paper, based on the archeological documentation, on *murex* and the production of purple as a sign of luxury that was reduced and diversified from the 5th century BC onwards along with the birth of ethnic awareness related to the expansion of new forms of community life. José Yravedra (Universidad Complutense de Madrid) presented a paper on the data collected from the Phoenician archeological site of the Teatro Cómico in Cadiz (in the area identified as the Erytheia island mentioned in some literary sources), asserting that it was related to both the production of purple and the secondary use of bovine and ovine for textile production. Verónica Estaca-Gómez showed the functionality and economic purpose of cattle in the Early Iron Age through the systematisation of data coming from five archeological sites. She explained the composition of the livestock, the contextualisation of its remains and the exploitation of animals, dead and alive.

In the fourth session, Carmen Risquez and Carmen Rueda (Universidad de Jaén) looked at textile production and maintenance activities in the Iberian societies of the archeological site of Cerro de Armas in Puente Tablas, Jaén, from the location of the houses to the *oppidum*, passing by the sanctuaries and the necropolis. They assert that identity (gender, age, role in the cult) is transmitted through dress and that it is necessary to identify the crucial significance of fabric within the production sphere of a society associated with a domestic, economic and social environment, its role as a marker of gender and status, and its importance in the creation of structures of prestige for aristocratic women.

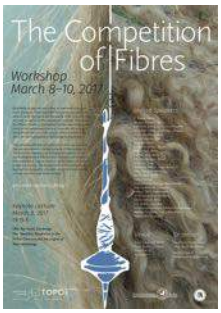
Further, Irene Ruiz (Universidad de Granada) presented her PhD dissertation topic supporting the idea that textile production in the Peninsula was at the same level as surrounding territories and that it had its own unique production. Juan Antonio López (Museo Arqueológico de Alicante) and Javier Jover (Universidad de Almería) underlined the changes that took place at the archeological site of El Argar since 1750 BC and by means of anthropological dental evidence, they showed special groups of women controlled textile manufacture, distribution and exchange.

In the fifth session dedicated to fabrics and ritual, Assumpció Malgosa (Universidad Autónoma de Barcelona) showed the singularity of the funerary rituals associated with the Cueva des Pas, Menorca (1100-900/800 BC), with 66 exhumed individuals with maximum flexion and wrapped up in funerary bundles that alternate tie-wrapping with leather-ties. Luis Berrocal (Universidad Autónoma Madrid), after analysing several archaeological sites of the late Tartessic culture located in Extremadura (Cancho Roano, La Mata, etc.), proposed that whenever there are significant concentrations of loomweights, these are indicators of the presence of several looms used to weave different types of fabric using the same loom. He concluded that in the 6th century BC the vertical loom was introduced, but it was not until the 5th century BC that its use became widespread. After this, Lourdes Prados (Universidad Autónoma Madrid) spoke about the archeological evidence related to textile production in the Iberian period that displays not only a marked economic nature, but also a symbolic value in the construction of gender, being decisive in the status and social prestige among women that possess these skills. Prados asserted that it is not always possible to attribute in funerary contexts the textile grave goods to the female gender, following the case of La Dama de Baza.

Carmen Alfaro (Universidad de Valencia) staged the closing ceremony and presented the classical sources, highlighting the importance of experimentation in increasing our knowledge of activities in the past, and citing several experimental workshops around Europe. She pointed out that spindle whorls are not the only proof that spinning took place and that they may have been made of wood and, therefore, may not have been preserved.

The following day a guided tour took place at the Museo Arqueológico Nacional, where the scholarly debate and exchange of ideas continued. The workshop was an excellent reunion of textile specialists and a great opportunity to get in touch and interchange data, providing an interdisciplinary approach to the study of textile activity in the Iberian Peninsula.

By María Consuelo Escandell Ferrando



The Competition of Fibres

8-10 March 2017, Berlin, Germany

The workshop "The Competition of Fibres", hosted by the Excellence Cluster Topoi at the Freie Universität Berlin, marks the end of a research project that began in 2013. The research group (A-4) provocatively named "Textile Revolution" set out to investigate the introduction of the woolly sheep to western Asia and south-eastern Europe with methods from different scientific perspectives, namely archaeology, archaeozoology, geography and philology. The aim of the three-day workshop was to present the main results of the project and to discuss with the scientific community both the potential and the limitations of the methods applied. The title of the conference was chosen to inspire the concern about "competing" textile fibre resources. The main intention was to discuss whether prehistoric raw materials replaced or complemented each other and to what extent this can be recognised in the archaeological record.

The conference started on Wednesday afternoon with papers concerning western Asia. The first paper was presented by Catherine Bréniquet on "Early wool of Mesopotamia c. 7000-3000 BC. Between prestige and economy", in which she discussed the very scarce archaeological evidence for early wool from southern Mesopotamia. Following this was Orit Shamir with "Linen textile production – continuity and discontinuity from the Neolithic period to the Chalcolithic period in the southern Levant", who showed the amazing preservation of plant fibre textiles in the dry deserts of the southern Levant. The paper of Thaddeus Nelson on "Fibers, fabrics, and looms: a link between animal fibers and warp weighted looms in the Iron Age Levant" methodologically inspired to think about the connection between the warp-weighted loom and wool, while Janet Levy's contribution on "Archaic, male exclusive, loom from Oman" was an ethnographic as well as an experimental excursus. The keynote lecture by Ofer Bar Yosef on "The Neolithic Revolution in the Fertile Crescent and the origins of fibre technology" inspired us to think about the adoption process of innovations, a topic that continued to rise throughout the workshop.

On Thursday the members of the Topoi Research group presented four papers. First, Wolfram Schier presented "The Research Group 'Textile Revolution' – archaeological background and multi-proxy approach", followed by Chiara Schoch who presented a joint paper with Ana Grabundzjia on "Fibres to fibres. Thread to thread. Comparing diachronic changes in large spindle-whorl samples" with an overview on the spindle-whorl data collected for the two doctoral thesis. The archaeozoological project by Christian Küchelmann, Norbert Bennecke and Cornelia Becker was presented by Cornelia Becker with the title "Finding the woolly sheep: meta-analyses of archaeozoological data from SE Europe and the Near East". Finally, the geographical methodology was presented by Martin Park in "Proxy evidence for early pastoral subsistence following an environmental approach", explaining how pollen analysis might contribute to the research question.

The following session was focused on Greece, covering the period from the Neolithic to the Bronze Age. The paper by Kalliope Sarri "Taming the fibers. Tradition

and innovations in the textile cultures of Neolithic Greece" drew on spindle whorl data and textile tools from ancient Greek sites, in addition to ethnographic analogies. In her paper "Ex Oriente Ars? Anatolianizing spindle whorls in the Early Bronze Age Aegean and their implications for fiber crafts", Sophia Vakirtzi focused on a peculiar type of spindle whorl appearing in the Bronze Age Aegean islands. The paper by Malgorzata Siennicka-Rahmstorf was concerned with "Flax, wool or both? Evidence for different types of fibres in Early Bronze Age Greece (3rd Millennium BC)" and relied mainly on spindle whorl data. Agata Ulanowska presented an interesting comparison of the advantages of flax and wool and an experience archaeology approach in "Different skills for different fibres? The use of flax and wool in textile technology of Bronze Age Greece in light of archaeological experiments".

In the afternoon, the session started with Margarita Gleba who presented a joint paper with Susanna Harris on "Fibres for splicing – technology and technique in the ancient Mediterranean" and asked for more analysed experimental data on splicing. Due to changes in the programme, Virginija Rimkuté's talk on "Plants and plant fibres of the Eastern Baltic Littoral in the Neolithic and Bronze Age: experiments on processing and textile production" followed. She presented an extraordinary amount of hands-on material from her experiments. Sabine Karg finished the session presenting her project on the "Know-how about flax production of Neolithic farmers in the circum-alpine region".

The second day ended at the Freie Univerität's Holzlaube building in Dahlem Dorf, where numerous colleagues and friends organised a soiree in honour of Cornelia Becker's retirement from working and teaching at the Institute for Prehistoric Archaeology. Workshop participants joined the reception, opened by Helmut Kroll's talk on the 20th-century archaeology methods and the impact of advancements in bioarcheological research.

In the morning of the third day Johanna Banck-Burgess presented on the "Verkannte Revolution: Bedeutung von Gehölzbast im Kontext neolithischer und frühbronzezeitlicher Textilien aus Feuchtbodensiedlungen", followed by very interesting accounts of experimental reconstruction of Neolithic textiles by Anne Reichert ("Wettbewerb der Fasern – Textile Materialien der Steinzeit und ihre Verarbeitung"). Vanya Petrova reported on spindle whorls from recent excavations in Bulgaria in her paper on "The travelling spinners of the 4th millennium BC in the Balkans". The amazing organic preservation in the Hallstatt salt mines was presented by Karina Grömer in "Hallstatt textiles – raw materials, textile technologies, innovations and cultural response in Central Europe in the 2nd and 1st mill. BC". The methodology of ancient DNA extraction and examination was investigated by Ulrich Schmölcke and Elena Nikulina in "Microscopic and archaeogenetic studies of hair". The last contribution was presented by Linda Hurcombe with a lecture on "Competing fibres: the plurality of clothing solutions".

The final discussion made it obvious that clear-cut results in the identification of early fibre materials are difficult to obtain with the available evidence. Workshop participants agreed that we might have to shift our research focus from investigating the initial steps of the introduction of "new" raw materials to understanding their widespread adoption. Further, all participants agreed on the importance of further investigation of the topic and of the application of new approaches and methods. The discussions were lively throughout the whole of the three days, especially in the coffee and lunch breaks. Thanks are due to Virginija Rimkuté and Anne Reichert for providing a lot of things to touch and look at: they both brought beautiful examples of their reconstructions of Neolithic textiles, along with fibre samples for examination.

By Ana Grabundzjia and Chiara Schoch

Mixtura Texturalis. People and Textiles in the Carpathian Basin

19 April 2017, Budapest, Hungary

The conference was organised by the Lendület/Momentum Mobility Research Group hosted by the Institute of Archaeology, Hungarian Academy of Sciences, Research Centre for the Humanities (HAS RCH) (http://mobilitas.ri.btk.mta.hu/?lang=en) and the Lendület/Momentum Medieval Hungarian Economic History Research Group in the Institute of History (http://www.tti.hu/en/events/1868-rch-lendulet-medieval-hungarian-economic-history-research-team.html) and in their short introductions Viktória Kiss and Boglárka Weisz presented an overall view of the general research of the Momentum Research Groups with emphasis on the role of the Prehistoric and Medieval textile economy.

During the morning session, the first four papers were devoted to the archaeology of textile crafts and production during the Middle Bronze Age, the Roman period, and the Early and Late Middle Ages in the Carpathian Basin, while in the afternoon the Medieval textile economy of this region was presented in four other presentations.

In the first paper "Textiles capsulated in clay: tools, imprints and textile production in the 2nd millenium BCE", J. Pásztókai-Szeőke, V. Kiss, G. Kulcsár and I. Szathmári pointed out that beside the valuable evidence of the anthropomorphic figurines and a few archaeological textiles from the Bronze Age, much more attention should be given in future to the numerous textile tools and imprints. The focus was on potsherds with textile impressions on the surface found in Bronze Age settlements in eastern Hungary dated between 2000 and 1500 BC. The imprints are from textiles of different vegetal materials (no wool or other animal hair has been identified so far) and attest the use of textile techniques such as twining and (coiled?) looping.

The following paper "The Romans' dirty laundry: textile refurbishing workshops from Pannonia" by J. Pásztókai-Szeőke and I. Radman-Livaja introduced the audience to Roman period textile refurbishing workshops in Pannonia. Recent excavations in the southern suburb of the Roman colony of Savaria have yielded an abundant corpus of textile tools and inscribed commercial lead tags belonging to a workshop dated between AD 80 and 120. Most of these tools have no local indigenous predecessors, and the only parallels are in Italy. The lead tags had abbreviated inscriptions in Latin and were probably used as labels for wool and garments entrusted by clients

to the care of this workshop for mending, (re)dying and/or fulling. Initial research results show there is a strong interpretive possibility that this Roman workshop refurbished used clothes. This establishment may have been required to fulfil the demands of Roman citizens new to this colonial territory for the Roman-style maintenance of their clothes (These might have differed from the local indigenous ways).

The third presentation "Early Medieval textile finds from the Carpathian Basin – recent state of research" by Á. Bollók, Zs. Básti, Zs. Masek, Sz. Merva and A. Miháczi-Pálfi gave a rich summary of local textile production in this region during the Migration Period. Various peoples, e. g. Huns, Germans, Avars and Hungarians, who found their new home time after time in the Carpathian Basin, probably brought their own textile-making traditions and clothing cultures with them. Further, it was pointed out that a complementary examination of the textile workshops, pseudomorphic textile fragments preserved by metal corrosion, as well as the available iconographic evidence (e. g. in Byzantine mosaics) is needed to make further conclusions about local consumption of the different textile materials.

The fourth paper "About textiles without textiles: lead seals and their interpretations within the Medieaval textile economy" by M. Mordovin focused on lead cloth-seals recently found in excavations in Late Medieval cities and market towns. These exquisite finds document the location of western European textile manufacturers where the sealed textile products (so-called "broadcloth") were made. The presentation gave a thorough analysis of the lead cloth-seals found in the Carpathian Basin and mapped out the wide-ranging commercial and textile economic network of Late Medieval Hungary.

During the afternoon session, the historical aspects of the medieval textile economy were outlined by the three following presentations "Predators of the weaving industry" by R. Skorka, "Social history and topography of the trimmers in the Late Medieval period" by J. Majorossy and "Routes' of textile" by B. Weisz. The weaving industry, which is considered by economic historians as the most important branch of Medieval industry, also stood in a high position in the hierarchy of handcraft activities according to Medieval assessments. The work of the masters employed in the weaving industry was connected in a chain of activities that built on one another. The masters performing the final phases of finishing the cloth (bleachers, dyers and shearers) became the greatest beneficiaries of the textile industry, since it was in their workshops that the cloth was completed and put on the market at great profit. Therefore, in the Late Middle Ages the distinction between cloth cutters and cloth merchants blurred. Further, the social groups in the city of Bratislava, their social and topographic status and the regulation of their activities were introduced to the audience of the conference.

At the conference we also became familiar with the central role of foreign textiles in the world of commercial goods – clearly shown by the fact that they were regularly used as currency in the Middle Ages. It was not only wages, commercial goods, real estate and fines that were paid off in textiles, but the New Year's Gift (*strennalia munera*) to the king had to be paid partly in cloth as well.

The final presentation ("Possible causes of a colour-change in archaeological textiles and the limits in reconstructing their colour") by M. Békési-Gardánfalvi and A. Várfalvi summarised their experience in the restoration of archaeological textile remains, particularly in the identification of different dyes.

It was the first time a conference made it possible for Hungarian experts from different disciplines (e. g. conservation studies, archaeology and history etc.) to discuss topics related to archaeological and historical textile studies. It is the wish of the organisers to establish a new tradition for *Mixtura texturalis* conferences in the future by creating a cross-disciplinary academic pool where the researchers of archaeological and historical textiles can gather periodically for vivid academic discussions.

By Viktória Kiss, Judit Pásztókai-Szeőke and Boglárka Weisz

NESAT XIII

22-26 May 2017, Liberec and Prague, Czech Republic

When Milena Bramermanová attended her first NESAT (North European Symposium for Archaeological Textiles) conference, she issued a pressing general invitation to the organisation: "Come to Prague Castle!" And now, at last, NESAT has made the trip, and had the privilege of viewing the vast and wonderful collection of precious medieval silks in her care in the Castle.

The five-day meeting was based, not in Prague itself, but in the delightful historic town of Liberec at the foot of the mountains some 90 minutes' drive north of the capital. Liberec was an inspired choice of venue:

it is home to a young and dynamic technical university, with a flourishing Faculty of Textile Engineering, and it was this department that hosted the event. The organising team was led by Helena Březinová from the Institute of Archaeology of the CAS in Prague, whose management skills were evident in every aspect of the symposium, from raising sponsorship from a wide range of generous donors, to seeing that participants were well fed and watered from the moment they crossed the threshold.

The exponential rise in interest in archaeological textiles since the first NESAT symposium in 1981, though very welcome, meant that, for the first time, there had to be a cap on numbers attending and wishing to speak. The Programme Committee had some difficult choices to make. The programme that emerged covered in twelve sections a complete chronological spectrum from earliest prehistory to modern times, including two sessions on experimental archaeology. Twenty-two posters were also on display. Consequently, the programme was tightly timed and fast-moving – and for a reviewer simply impossible to summarise, let alone pick out individual papers for comment! The standard of presentation in general was high, and a multitude of new topics was introduced.

Nevertheless, the reviewer *will* highlight one lecture: the keynote, 'festive', address of Milena Bramermanová on the first evening. She gave the symposiasts a masterly, thorough and fascinating introduction to the textiles in Prague Castle, a selection of which they would have the opportunity to see *in situ* on the final day of the meeting. Those textiles did not disappoint! In a feat of meticulous planning the organising committee conveyed the entire symposium to Prague for the day, so that they could visit the textile holdings and displays within the Castle precinct, and also view an exhibition in the City of Prague Museum.

At intervals the organising committee took the pressure off. There were enjoyable social occasions, both within Liberec University and in the impressive North Bohemian Museum not far away – opportunities for "networking" in new-speak, but really just occasions

for greeting old friends and making new ones.
The symposium was, sadly, Milena's swansong in a formal curatorial context; for she is about to retire – though hopefully not from the ancient textile scene! NESAT reached Prague Castle in the nick of time. The floral tributes and speeches on the final evening were a mark of personal affection and respect for her, as well as an expression of gratitude to the organising team for their sheer hard work. But that is not yet quite at an end; for publication of the papers is promised, and sharp deadlines have been set. Watch this space!

By John Peter Wild

Dynamics and Organisation of Textile Production in Past Societies in Europe and the Mediterranean

21-22 June 2017, Łódź, Poland

The aim of the conference "Dynamics and organisation of textile production in past societies in Europe and the Mediterranean" was to scrutinise the mechanisms and conceptual frameworks of textile production by investigating the combined evidence of archaeological textiles, textile tools and equipment, remains of textile workshops and dye-works, as well as written and iconographic sources.
The conference was organised by Agata Ulanowska from the Centre for Research on Ancient Technologies of the Institute of Archaeology and Ethnology in Łódź, Polish Academy of Sciences, Małgorzata Grupa from the Institute of Archaeology, Nicolaus Copernicus University in Torun and Małgorzata Siennicka from the Centre for Textile Research at the University of Copenhagen. The organisers would like to express their gratitude to the Institute of Archaeology and Ethnology, and especially Jerzy Maik and the colleagues from the Centre for Research on Ancient Technologies and Łódź Department of the Polish Academy of Sciences for their organisational help and financial support. Two days of the conference were held in a remarkable art deco building, the former palace of Juliusz Kindermann at Piotrkowska Street in Łódź, and included a guided tour of the Central Museum of Textiles in Łódź.
The conference had six sessions with altogether 23 presentations. After a welcome by the organisers and a short introduction by Jerzy Maik, Małgorzata Siennicka presented results of her Marie Skłodowska-Curie research project "Greek Textile

Tools" and discussed changes in spinning and weaving, the introduction of new textile implements and techniques, the dynamics in exploitation of plant and animal fibres, and the organisation of production during the Early Bronze Age in Greece. Melissa Vetters (University of Salzburg) focused on methodological approaches and showed how data available from Middle Bronze Age mainland Greece could be compared, which techniques and *chaîne opératoires* can be reconstructed and how this evidence fits into suggested production modes in this period. Agata Ulanowska re-examined Aegean iconography of patterned textiles and reviewed the technical possibilities of making textiles similar to those apparently rendered in art, illustrating methodological problems with translating textile iconography into specific weaves and techniques by a few experimentally woven samples of fabrics. Katarzyna Żebrowska (University of Warsaw) presented the main objectives of her research project which investigates Sicilian textile tools from the Bronze Age, and discussed the general framework for comparative studies of textile production in Bronze-Age Sicily. Giulia Muti (University of Manchester, in collaboration with Luca Bombardieri, University of Torino) discussed the organisation of textile production and the array of social dynamics connected to textile work at the Middle Bronze Age site of Erimi Laonin tou Porakou on Cyprus, and its importance for constructing the community's identity. Deborah Cassuto (Bar Ilan University, Albright Institute of Archaeological Research) identified areas of textile production at the Iron Age site of Tell eṣ-Ṣâfī/Gath, and examined how the different modes of textile production entwined with the social, economic and ritual implications of textile making for this community. Dominika Kossowska-Janik (University of Warsaw) analysed the relationship between changes in spindle whorls from Central Asian sites and both the spread of cotton crops from Near East to Central Asia, and the scale of cotton cultivation in the mid-Sassanian period. Elsa Yvanez (University of Lille) presented abundant evidence of the unique textile tradition developed in the kingdom of Meroe in Nubia, and proposed textile studies as an innovative method of examining the economic resources and social agency of the Meroitic kingdom. In her presentation, María Irene Ruiz de Haro (University of Granada) discussed the so far unparalleled textile workshop at the sanctuary of Baal and Astarte at El Carambolo, Spain, and the sacral and ritual dimensions of the textile production carried out by the sanctuary. The modes of transmission of textile skills through women in the ancient Greek world were examined by Alina Ciobotaru (University of Bucharest) based on iconography as well as historic and literary sources. Textile imprints on pottery in Central and Northern Europe, from the Mesolithic to Iron Age, defined for their special surface treatment as "textile ceramics", were systematically analysed by Stefanie Schaefer (University of Kiel).

The organisation of textile production in the Lusatial culture was discussed in two papers. Anna Grossman (Biskupin Archaeological Museum) examined the organisation and specialisation of textile production at Biskupin in Poland, based on the preserved evidence of raw materials, textile tools and work places. Magdalena Przymorska-Sztuczka (University of Toruń) presented the spatial distribution of textile tools as well as botanical remains found in the households from the settlement at Ruda in Poland. The diachronic and spatial distribution of textile tools discovered on Gotland, dated to the Migration and Vendel Periods, was analysed by Barbara Klessig (Humboldt State University). Penelope Walton Rogers (Anglo-Saxon Laboratory) who participated in the conference via Skype, presented a paper about the changing patterns of textile production in the Anglo-Saxon period, especially concentrating on the development of some large estate centres of production which developed alongside the original small, farm-based centres. Riina Rammo (in collaboration with Jaana Ratas, University of Tartu) debated the possible social status of the skilled woman who was the owner of a craft box discovered at the Lõhavere hillfort in Estonia, in which such treasured items as standardised decorations and prefabricating products for making

clothing items were kept. The medieval evidence of looms and weaving implements from Poland was discussed in two presentations. The first, by Joanna Słomska and Łukasz Antosik (Polish Academy of Sciences) examined the development of weaving techniques by diachronically analysing the remains of big looms, e. g. a warp-weighted loom, a horizontal pit loom and a treadle loom that were discovered at Early Medieval sites in Poland. The second, by Małgorzata Grupa, discussed changes in the organisation of textile production, focusing on the preserved wooden implements. Anna Rybarczyk (Polish Academy of Sciences) examined the role of luxurious fabrics as markers of social status for the citizens of Late Medieval Elbing by considering the combined evidence of archaeological textiles and historical sources from this Hanseatic city.

Textile production in the modern era was the subject of the next three presentations. The archaeological evidence of production techniques of secular textile scapulars from the 18th and 19th centuries AD in Poland, was compared with church regulations, church guidelines, and the iconography of the scapulars by Marcin Nowak (University of Toruń). Dawid Grupa (University of Toruń) discussed the variations of liturgical vestments found in priests' burials, comparing the formal regulations with a practice of recycling old chasubles and silk fabrics for making economic funeral vestments. Magdalena Majorek (University of Toruń) examined the textile upholstery of coffins in the 18th and 19th centuries AD in Poland in relation to strategies of decorating the coffins according to the age, gender and social status of the deceased. In the last presentation, Beata Miazga (University of Wrocław) demonstrated non-destructive methods of analysing metal threads, e. g. energy-dispersive X-ray fluorescence and microscopic observations, and presented the results of an investigation of archaeological textiles dating to the post-medieval period.

Each session was followed by vivid discussions and a follow-up conference is planned for 2019 in Toruń. The proceedings of the conference will be published in 2018 in a peer-reviewed special issue of the journal *Fasciculi Archaeologiae Historicae*.

By Agata Ulanowska, Małgorzata Siennicka and Małgorzata Grupa

Plants as Fibre Resources: Approaches from the Science and Art Perspectives

2 September 2017, EAA, Maastricht, Netherlands

The 23rd "Annual Meeting of the European Association of Archaeologists" took place from 30th August to 2nd September 2017. It gathered archaeologists and researchers from related fields to share and discuss the results and latest findings from all fields of archaeology. The programme consisted of 1800 lectures, divided into more than 175 sessions. On the Saturday, 2nd of September the session called "Plants as Fibre Resources: Approaches from the Science and Art Perspectives" was held, where altogether nine extremely interesting papers were presented. The session was chaired by plant fibre specialists Sabine Karg, Otto Brinkkemper and Susanna Harris. It attracted such wide attention that extra seats needed to be acquired to accommodate the audience.

Even though the conference was enormous and all-inclusive, this particular session gathered together specialists in the fairly small field of plant fibre studies in textile archaeology. This ensured lively debate and discussion, as the researchers around Europe are not often able to share their views in person. Due to the fast development and implementation of natural scientific methods, many plant-fibre related issues have recently been raised for new interpretation and discussion. As a result, several fundamental questions are currently under debate. Some of these were highlighted in the session, and three of them are discussed here: the early production of flax fibre, textile research through related artefacts, and challenges in the methodology of bast fibre identification.

The early production and processing methods of flax was the subject of several presentations. These included new findings concerning textile technology and flax varieties used. Recent research proves that before the development of spinning techniques, flax yarns were produced by splicing rather than spinning. The evidence for this conclusion was presented and it was clear and plausible. Related to this was the idea that a new variety of flax, commonly known as *Linum usitatissimum L.*, emerged synchronously with spinning. The hypothesis was that spinning whorls were originally used to spin wool, and as a result of the introduction of the new variety of flax, spinning also began to be used for flax processing.

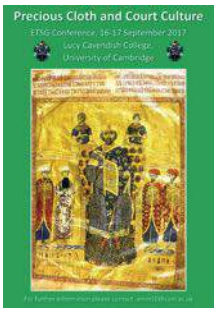
As textiles degrade easily, the presence and nature of textiles often needs to be studied through secondary evidence. The session included interesting presentations on this topic, concerning for example the use of spinning bowls, and interpretations of textile casts in clay. Sometimes the use of supplementary information can be more revealing than studying actual textiles. Studying textiles as such can reveal certain things, but understanding the textile techniques also demands research on the processing tools.

It is generally agreed that bast fibres cannot be distinguished using only a single method. A multi-methodological approach is essential. The components of the identification process are under severe debate at the moment, and this generated abundant discussion both during and after the session. In addition to the observation of surface characteristics, most of the researchers at the moment use the modified Herzog test to determine the orientation of the fibres. Even though the method has its faults, it is considered to be the best one available at the moment, by being both cost-effective and relatively reliable.

Some researchers rely on the presence of calcium oxalate crystals and others on cross-sectional observation. Both methods have advantages and disadvantages. The growth conditions and the maturity stage of plants may affect the cross-sectional features of the fibres. Processing, context, and state of degradation of the archaeological bast fibre sample may diminish the possible presence of crystals. As a result, a new analysis method, or a combination of methods, are a desideratum in the quest for reliable flax, hemp and nettle identification.

Altogether, the session provided fresh insights into current themes in textile archaeology, and on behalf of all participants I would like to say that it gave us a great deal of inspiration and encouragement for future studies.

By Jenni A. Suomela



Early Textiles Study Group

16-17 September 2017, Cambridge, UK

The theme for the 2017 ETSG conference was "Precious Cloth and Court Culture." The conference convened at Lucy Cavendish College and featured a range of speakers from both near and far. The conference convener, Anna Muthesius, organised a range of speakers from five countries, who covered a wide array of topics within the scope of court culture. There was a clear sentiment of celebrating international connections, with a particular interest in exploring textiles from geographic regions beyond Europe and the Mediterranean.

The theme of court culture presented the opportunity for the celebration of sumptuous textiles from across the globe, which was a visual treat. Sibel Alpaslan Arça from Istanbul entertained us with magnificent imagery of costume and furnishing textiles of the Ottoman court, and it worked beautifully as a contrast to Muthesius' paper on equally opulent Byzantine court textiles, which provided an excellent long-ranging view of textiles from the same geographic region but with very different cultural contexts. Maria Barrigón Montañés from Madrid introduced us to 12th and 13th century precious textiles from the Castillian court, including images of some beautiful extant garments from this time period. There was palpable excitement to hear Lesley Pullen's paper on Javanese court cloth during the reign of King Krtanagara, which introduced the conference to a fascinating (and, to most of us, an unfamiliar) subject.

An additional recurring theme throughout the conference was the use of courtly textiles for purposes beyond that of personal adornment. Lisa Monnas' paper on English court textiles during the 14th and 15th centuries, and Maria Hayward's discussion of the use of cushions as status symbols during the reign of Henry VII, emphasised the sometimes overlooked uses of textiles as furnishings in English court culture. This connected beautifully to a number of other talks where furnishing textiles were mentioned and served to highlight this equally important use of cloth as a mark of status.

The wide-ranging expertise of the conference speakers allowed for both breadth and depth of subject matter, which drew many interesting connections between the various papers. Penelope Walton Roger's paper "Clothing the Warrior King" presented the fascinating archaeological evidence for elite clothing, and the importance of textiles as an expression of status during the Anglo-Saxon period. The inclusion of papers discussing both early and late medieval England provided interesting scope and demonstrated the diversity of elite expression, even within a single country viewed from different points in time. Christopher Hall presented beautiful images of Ming dynasty robe badges from his collection, while Sally Yu Leung expanded on the context in which these badges would be worn in her lecture discussing changing motifs on these court robes. Lena Dahrén's work tracing the provenance of 16th century gold lace through portraiture, extant pieces and genealogy, demonstrated a clear connection between Sweden and England, further underlining the importance of understanding global connections in the field of textile research.

Practical demonstrations on the second day of the conference tied nicely with lecture topics, and provided a wonderful opportunity for artisans who were not speakers (myself included) to share their knowledge and skills. Helen M. Stevens demonstrated Anglo-Saxon embroidery techniques, Ros Tyrrell demonstrated a technique for making gold lace, and I presented photo and video documentation of work I had previously done rearing silkworms and processing silk. This provided the opportunity to discuss textile techniques informally in a way that suited the tactile nature of this sort of work.

Fascinating conversation continued outside of the conference program, during coffee breaks and over delicious meals, which created a welcoming atmosphere. Overall, the friendly yet thought-provoking environment of the conference was an excellent experience for a newcomer, and I would highly recommend any future ETSG conferences to anyone who has a passion for early textiles.

By Gwendoline Pepper

CIETA (Centre d'Etudes des Textiles Anciens) Conference

25-27 September 2017, St Petersburg, Russia

CIETA assemblies and conferences take place on a biannual basis, always at venues with major textile collections. This year the conference took place at the State Hermitage Museum in Saint Petersburg and the theme of the conference was "Power, Rank and Status – Textiles and Representation". The Hermitage Museum has an important collection of prehistoric fabrics from Pazyruk, Moshchevayay Balka and Noin-Ulla – with exhibits of items which cannot be found anywhere else in the world. The Hermitage also has collections of costume, Eastern carpets, and Russian and European tapestries and fabrics. The Hermitage had prepared two exhibitions especially for the CIETA conference: "The Hermitage encyclopedia of textiles. History", with masterpieces from the collection, and "The Hermitage encyclopedia of textiles. Conservation", which presented the highlights of work by the museum's laboratory staff. The Hermitage prides itself on its Laboratory for the Scientific Restoration of Fabrics and Water-based Paintings, with expertise on a variety of materials, from the restoration of palace interiors to work on a microscopic level with archeological artefacts.

Around 200 specialists took part in the conference, curators of museum collections, researchers from universities and other institutions, and conservators from Russia, France, Switzerland, Belgium, Italy, Spain, Portugal, Denmark, Sweden, Finland, the United Kingdom, the Netherlands, Germany, Austria, Poland, Croatia, the United States, Canada and Japan.

The first session held at the Winter Palace was "Textiles and representation – early documents". Agata Ulanowska presented "Textile knowledge and skills as a possible marker of status in societies of Bronze Age, Greece" and Elena Tsareva spoke about "Levels of status – representational textiles in burial mounds of early nomads in southern Siberia".

The second session was on textiles in the Hermitage collections with special presentations and guided tours. They were private because there is no public access to the museum on Monday. To be special guests undisturbed in the Winter Palace was an amazing experience.

Anna Maria Colombo presented "Un damas Italien au service du tsar" and Kirsten Toftegaard spoke on "Early Modern printed textiles in the western European collection of the state Hermitage Museum – A question of power, rank and status?" The very important collaboration on silk textiles between France (Lyon) and Russia were shown in Titiana Lekhovich and Marie Bouzard's talk on "Lyon et les commandes russes de soieries Lyonnaises dans la seconde moitié

du 19 siècles." Ekaterina Polyakova discussed "Textile designers from Lyon at the Russian court in the second half of the 18th century" and Cocha H. Carretero gave her "L'histoire de Don Quichotte". Finally, Nina Tarasova showed "Ceremonial costumes of the Russian imperial court: A life of regulations". The other sessions were about textiles and representations in sacred spaces and in a global context. There was also a discussion about "Visual social media platforms – as new applications in scholarly publishing" from Christina B. Carr from the Metropolitan Museum, New York.

The third day of the conference took place at the Hermitage Conservation Centre Staraya Derevnya in the old village. Themes included "Textile and representation of European courts" and there were some case studies on techniques. All in all, it was very impressive programme and presentation of the rich textile collections in St Petersburg – Inoubliable!

Tatiana Lekhovich – curator at the Hermitage, member of CIETA steering committee, and organiser of the conference.

By Susanne Lervad

Egyptian Textiles and their Production: Word and Object

24 November 2017, Copenhagen, Denmark

The conference was convened by archaeologist and historian Maria Mossakowska-Gaubert as part of her Marie Sklodowska Cuire project MONTEX - Monks, nuns, and textiles: Production, Circulation, and Distribution of Textiles in the Monastic Environment in Egypt (4th-8th Centuries AD) at the Centre for Textile Research (CTR), University of Copenhagen. The conference was designed to unite research on textile words and textile materials, thus bridging philology and archaeology. A second goal was to embed the discussion of textiles in Egypt within different scholarly traditions of textile research, in other parts of the world.

In the first session, chaired by tapestry weaver and art historian Ulrikka Mokdad (CTR), focus was on the technical aspects of weaving: looms and tools. The first two brief presentations gave insights into the current textile research trends in the Scandinavian area. CTR director Eva Andersson Strand introduced the "Early textile production in Scandinavia", and textile conservator Lena Bjerregaard (CTR) introduced the research field and finds range of "Pre-Columbian looms of South America". In her own presentation, Maria Mossakowska-Gaubert discussed the latest results of her research on "Loom types in Roman Egypt". She combined iconography and papyrological evidence to suggest the simultaneous existence of different looms. Conservator Anne Kwaspen (independent researcher, Antwerpen, Belgium) showed convincingly in her presentation how the precise study of details in *woven-to-shape* tunics can help identify types, and that linen and wool tunics, respectively, feature a specific range of decorative and functional elements. Thus, such detailed studies are necessary in order to explain and identify types.

In the session "Technical aspects of weaving: looms and tools", chaired by archaeologist and historian Pascale Ballet (Université Paris X, France), textile archaeologist Lise Bender Jørgensen (NTNU, Norway), took up the thread of the excavations of 'Abu Sha'ar, and displayed the technical aspects of the textiles found in the monastery at 'Abu Sha'ar, both those for clothing and furnishing. Likewise, Barbara Köstner (University of Bonn, Germany) presented the research in her current PhD project. She has examined the flaws and weaving mistakes identified in Late Roman compound fabrics from Egypt, and illustrated how these are a technical key to how the weavers worked.

Fleur Letellier (Université de Limoges, France) gave a presentation of the extremely rich archaeological evidence of textiles in el-Deir, Kharga Oasis in the western Egyptian desert, which includes fabrics of cotton, wool and linen. Papyrologist Jennifer Cromwell (University of Copenhagen), surveyed all Coptic and Greek texts from 4th-century Kellis in order to find textual evidence for the textile production in the Dakhla Oasis. This includes descriptions of yarn, dyes, fabrics, garments and furnishings, weavers and looms. It is an exciting glimpse into the negotiations between traders and producers, hiring of textile workers, and garment prices, which vary between the different areas in Egypt and reach the extreme heights of a luxury 5000-talents tunic *sticharion*. There are hints at trade competition and choices made by producers and consumers. An account book states that warp thread is more expensive and more time consuming than weft thread.

The last session, "Dyeing technology: dyestuffs, mordants and installations", was chaired by Latinist Magdalena Öhrman (CTR). First, she introduced prehistoric archaeologist Ulla Mannering (CTR/National Museum of Denmark) who presented the many systematic dye analyses conducted since 2005 on the Danish archaeological textiles of the Bronze and Early Iron Ages. While the Bronze Age fabrics contain no traces of dyes, the Iron Age samples are rich in dyes, mostly in yellow hues, but also occasionally reds and blues. They all come from plant dyes.

Historian and dye expert Dominique Cardon (CNRS/Université Lyon 2, France) gave a lecture on the dye analyses of textiles from six *praesidia* of the Eastern Desert of Egypt (1st-3rd century AD). She combined iconography with dye analyses of textiles, often looking purple but containing a blend of indigotine dye and madder or kermes, thus not true purple. Occasionally, true purple was identified on Roman *clavi* in Didymoi, sometimes combined with red plant or insect dyes. She suggested that purple in the first three centuries AD had become more widespread than before and was therefore seen on clothing beyond the elite. The ancient dyeing technology was then explored in a joint multidisciplinary paper by Ines Bogensperger and Helga Rösel-Mautendorfer (Papyrussammlung, Vienna, Austria). They have studied dye recipes in texts and discussed who would request such documents in a culture where craft and knowledge is primarily communicated orally. Textiles in the Papyrus Collection underwent dye analysis and the results showed a dominance of madder as a source of dye; and experimental dyeing was conducted in order to test both the recipes and the results of dye analysis. The authors concluded that the textiles testify to a highly specialised trade and well organised logistics. Classical philologist Peder Flemestad (Lund University, Sweden) surveyed an impressive number of lexicographical sources for ancient Greek dye terminology. While the default verb is *baptein*, meaning to immerse/dye, a great number of other dye terms exist. These are also related to the semantic fields of medicine, poison, spices, cosmetics, and drugs in various Indo-European languages. Moreover, dye terms also often carry moral values, and, for example, have a (negative) connotation of staining or deceiving. The dye terms also reveal technological aspects, and these are important to take into account from both a terminological, as well as a craft perspective.

The final section, "Textile production: organisation and economy", was led by ancient historian Claire Taylor (University of Wisconsin-Madison, USA). In this section, the wider picture of ancient textiles in manufacture and in agriculture in Egypt was in focus. Classical philologist Katerina Koroli (Papyrussammlung, Vienna) used the private papyrus letters to explore the textile production. They are dated to the Roman and Byzantine periods and accumulate information and request exchanges between the letter writers and the receivers. She exemplified some relevant complex technical textile terms, such as *synerga* and *ergaleia*, with multiple meanings but close affinities to the textile production. The agricultural aspects of textile fibre production was also examined by Isabelle Marthot (University of Basel, Switzerland) in her paper on "Flax growing in Late Antique Egypt: evidence from the papyri". Finally, the day's themes and questions were summarised by the session chairs.

By Marie-Louise Nosch

Recent publications

***Clothes Make the Man: Early Medieval Textiles from the Netherlands* (2017) by Chrystel R. Brandenburgh. Leiden: Archaeological Studies Leiden University**

Textiles from the early medieval period that are occasionally found in excavations are the scarce remains of garments, household fabrics, sails etc. Although several authors have published textile finds from the Netherlands in the past, systematic research of these finds has not been conducted yet. Where the surrounding countries have witnessed a development in which textile archaeology has become a fundamental part of archaeological research, a similar development has been lacking in the Netherlands. As a result our knowledge of the production and use of textiles is mainly derived from the surrounding countries, where more research has been carried out. In this book Chrystel Brandenburgh has focused on the use of cloth and clothing in the area now defined as the Netherlands, in the period between 400 and 1000 AD. For this purpose textile remains from both settlements and cemeteries have been analysed from different parts of the country. This geographical distribution, the large timespan of the dataset as well as the obvious differences in site context result in a very varied picture of the use of fabrics in this period.

Using the textile remains from the Dutch cemeteries it was nevertheless possible to reconstruct the way people were dressed when buried, as well as to establish the differences between cemeteries and groups of individuals within these cemeteries. Moreover, by studying the fabrics from the settlements insight was gained into the production process and techniques used in this period. Chrystel Brandenburgh obtained her degree in archaeology in 1997 at the Faculty of Archaeology of Leiden University. From 2003 onwards she has been working as a municipality archaeologist of Leiden. In 2008 Chrystel registered as a PhD extramural at Leiden University. During subsequent years she combined her job in Leiden with her PhD-research on early medieval textiles from the Netherlands.

ISBN-10: 9087282605
ISBN-13: 978-9087282608
Price: EUR 50.28
https://www.lup.nl/product/clothes-make-the-man/

***Designing Identity: The Power of Textiles in Late Antiquity* (2016) edited by Thelma K. Thomas. Princeton: Princeton University Press**

Ideals of character and beauty, and conceptions of self and society, were in flux during Late Antiquity, a period of extensive dramatic cultural upheaval for the Roman world, as the extraordinary growth of Christianity eclipsed paganism. Textiles from Late Antiquity document transformations of cultural traditions and societal values at the most intimate level of the individual body and the home. These textile artifacts are fragile, preserved only in arid conditions, often in fragments, and only rarely intact.

The textiles selected for the exhibition "Designing Identity" at New York University's Institute for the Study of the Ancient World present an aesthetic of vibrant colors, fine materials, technical virtuosity of professional production, and variations on designs that display personal identity in the clothing of men, women, and children, as well as hopes for prosperity and protection in the textile furnishings of households. Prized for their artistry since the earliest discoveries beginning at the turn of the nineteenth century, such textiles were eagerly collected by designers, artists, scholars, museums, and captains of industry. This exhibition catalogue explores the parallel histories of ancient textile production and consumption, and the modern business of collecting Late Antique textiles.

Contributors include Jennifer Ball, Edward Bleiberg, Kathrin Colburn, Helen Evans, Christine Kondoleon, Brandie Ratliff, Thelma Thomas, and Elizabeth Williams.

ISBN-10: 069116942X
ISBN-13: 978-0691169422
Price: EUR 36.92
https://www.amazon.com/Designing-Identity-Power-Textiles-Antiquity/ dp/069116942X

***Die frühbyzantinischen Textilien des Römisch-Germanischen Zentralmuseums* (2016) by Petra Linscheid, mit einem Beitrag von Ina Vanden Berghe. Mainz: Schnell & Steiner**

Textilfunde aus Ägypten sind unsere wichtigste Quelle zur Erforschung frühbyzantinischer Kleidung und Ausstattungstextilien. Das Römisch-Germanische Zentralmuseum besitzt über 200 meist fragmentarische, aber auch zahlreiche vollständige Textilien dieser Zeit.

Hier werden sie in einem wissenschaftlichen Bestandskatalog mit ausführlichen einleitenden Kapiteln und einem detaillierten Katalogteil vorgelegt. Besondere Beachtung finden dabei Herstellungstechnik und Funktionsbestimmung der Stücke. Das Wissen um Aussehen und Verwendung der verschiedenen Tuniken, Manteltücher, Kopfbedeckungen sowie Decken, Polsterstoffen, Behängen und textilen Gerätschaften machen diese Objekte über die Textilkunde hinaus zu archäologisch und historisch relevanten Zeugnissen.

ISBN: 978-3-7954-3037-5

Preis: EUR 55.00

https://www.schnell-und-steiner.de/artikel_8557.ahtml

***Dress and Society: Contributions from Archaeology* (2017) edited by T. F. Martin and R. Weech. Oxford: Oxbow books**

While traditional studies of dress and jewellery have tended to focus purely on reconstruction or descriptions of style, chronology and typology, the social context of costume is now a major research area in archaeology. This refocusing is largely a result of the close relationship between dress and three currently popular topics: identity, bodies and material culture. Not only does dress constitute an important means by which people integrate and segregate to form group identities, but interactions between objects and bodies, quintessentially illustrated by dress, can also form the basis of much wider symbolic systems. Consequently, archaeological understandings of clothing shed light on some of the fundamental aspects of society, hence our intentionally unconditional title. Dress and Society illustrates the range of current archaeological approaches to dress using a number of case studies drawn from prehistoric to post-medieval Europe. Individually, each chapter makes a strong contribution in its own field whether through the discussion of new evidence or new approaches to classic material. Presenting the eight papers together creates a strong argument for a theoretically informed and integrated approach to dress as a specific category of archaeological evidence, emphasising that the study of dress not only draws openly on other disciplines, but is also a sub-discipline in its own right. However, rather than delimiting dress to a specialist area of research we seek to promote it as fundamental to any holistic archaeological understanding of past societies.

ASIN: B06W9JQSNV

Preis: EUR 41.49

https://www.oxbowbooks.com/oxbow/dress-and-society.html

***Dressing the Part: Power, Dress, Gender, and Representation in the Pre-Columbian Americas* (2017) edited by Sarah Scher and Billie J. Follensbee. University Press of Florida**

From Olmec costume switching to Peruvian bundle burials we see which types of power were gendered, which symbols or motifs were power filled, and how these symbols were borne by the living and the dead. This collection showcases a mature gendered archaeology. Cheryl Claassen, author of Beliefs and Rituals in Archaic Eastern North America: An Interpretive Guide Costume can reveal a wealth of information about an individual's identity within society. "Dressing the Part" looks at the ways individuals in the ancient Americas used clothing, hairstyle, and personal ornaments to express status and power, gender identity, and group affiliations, even from the grave. While most gender studies of pre-Columbian societies focus on women, these essays also foreground men and persons of multiple or ambiguous gender, exploring how these various identities are part of the greater fabric of social relations, political power, and religious authority. The contributors to this volume discuss how costume elements represented empowered identities, how different costumes expressed gender and power, and how elite gendered costume elements may have been appropriated by people of other genders as symbols of power. Dressing the Part examines how individual identity played a role in larger schemes of social relationship in the ancient Americas. Employing a variety of theories and methodologies from art history, anthropology, ethnography, semiotics, and material science, this volume considers not only how authority is gendered or related to gender but also how the dynamics between power and gender are negotiated through costume.

ISBN-10: 0813062217

ISBN-13: 978-0813062211

Price: US$ 114.10

https://www.amazon.com/Dressing-Part-Representation-Pre-Columbian-Americas/ dp/0813062217

***Europe's Rich Fabric: The Consumption, Commercialisation, and Production of Luxury Textiles in Italy, the Low Countries and Neighbouring Territories (Fourteenth-Sixteenth Centuries)* (2016) by Bart Lambert. Oxford: Taylor & Francis Ltd**

Throughout human history luxury textiles have been used as a marker of importance, power and distinction. Yet, as the essays in this collection make clear, the term 'luxury' is one that can be fraught with difficulties for historians. Focusing upon the consumption, commercialisation and production of luxury textiles in Italy and the Low Countries during the late medieval and early modern period, this volume offers a fascinating exploration of the varied and subtle ways that luxury could be interpreted and understood in the past. Beginning with the consumption of luxury textiles, it takes the reader on a journey back from the market place, to the commercialisation of rich fabrics by an international network of traders, before arriving at the workshop to explore the Italian and Burgundian world of production of damasks, silks and tapestries. The first part of the volume deals with the consumption of luxury textiles, through an investigation of courtly purchases, as well as urban and clerical markets, before the chapters in part two move on to explore the commercialisation of luxury textiles by merchants who facilitated their trade from the cities of Lucca, Florence and Venice. The third part then focusses upon manufacture, encouraging consideration of the concept of luxury during this period through the Italian silk industry and the production of high-quality woollens in the Low Countries. Graeme Small draws the various themes of the volume together in a conclusion that suggests future avenues of research.

ISBN-10: 1409444422

Price: EUR 115.74

http://www.tandfonline.com/doi/abs/10.1080/00404969.2017.1295658

***Excavations at Francavilla Marittima 1991–2004. Finds Related to Textile Production from the Timpone della Motta. Volume 6: Loom Weights*. British Archaeological Reports Series S2848 (2017) by Marianne Kleibrink. Oxford: British Archaeological Reports Oxford Ltd**

This is the sixth volume in a series of publications dealing with the excavations by Groningen University in 1991-2004 on the Timpone della Motta, Francavilla Marittima, Calabria (Italy), under the direction of the author. It is preceded by five BAR volumes on the Oenotrian production of Matt-painted pottery and one on spindle whorls. The locally produced material, together with impasto pottery, loom weights, cooking stove fragments, etc. was associated with an indigenous, Oenotrian apsidal building dating from the 8th century BC. Judging from the presence of an altar and a huge ash layer - alongside the many bone fragments of adult and sub-adult domestic animals, as well as those of foetal and neonatal specimens - this was not only the residence of female spinners and weavers, but also fulfilled a sacred function. The present volume largely consists of a catalogue of loom weights of various types, among them nicely decorated ones, and a description of their find circumstances. The book also contains a description of the loom weights and spindle whorls and their provenances from the excavations of Zancani Montuoro/Stoop 1963-69 and a chapter on the extraordinary solar iconography of the large 8th century BC loom weights from Francavilla Marittima.

ISBN:9781407315423

Price: £48.00

http://www.barpublishing.com/excavations-at-francavilla-marittima-1991-2004-en.html

***Excavations at Francavilla Marittima 1991–2004. Finds Related to Textile Production from the Timpone della Motta, Volume 5: Spindle Whorls*. British Archaeological Reports Series S2806 (2016) by Marianne Kleibrink. Oxford: British Archaeological Reports Oxford Ltd**

This fifth volume in a series of publications dealing with the excavations by Groningen University in 1991-2004 on the Timpone della Motta, Francavilla Marittima, Calabria (Italy), under the direction of the author, is preceded by four BAR volumes on the Oenotrian production of Matt-painted pottery. That pottery, together with impasto pottery fragments, loom weights and spindle whorls, was associated with an indigenous Oenotrian apsidal building, which, judging from the presence of animal bones (a relatively high percentage of which were fetal and neonatal bones of pigs, sheep and goats), an altar and ash, was not only a residence of female spinners and weavers, but also fulfilled a sacred function. The present volume largely consists of a catalogue of 300 spindle whorls of various types. Their weights and types are compared with spindle whorls from other Calabrian find spots (mainly graves) and conclusions as to the development in indigenous Oenotrian spinning practices are suggested.

ISBN: 9781407315409

Price: £37.00

http://www.barpublishing.com/excavations-at-francavilla-marittima-1991-2004.html

***Iconic Costumes: Scandinavian Late Iron Age Costume Iconography*. Ancient Textiles Series 25 (2017) by Ulla Mannering. Oxford: Oxbow Books.**

This richly illustrated book presents a selection of the rich and varied iconographic material from the Scandinavian Late Iron Age (AD 400-1050) depicting clothed human figures, from an archaeological textile and clothing perspective. The source material consists of five object categories: gold foils, gold bracteates, helmet plaques, jewelry, and textile tapestries and comprises over 1000 different images of male and female costumes which are then systematically examined in conjunction with our present knowledge of archaeological textiles. In particular, the study explores the question of whether the selected images complement the archaeological clothing sources, through a new analytical tool which enables us to compare and contrast the object categories in regard to material, function, chronology, context and interpretation. The tool is used to record and analyze the numerous details of the iconographic costumes, and to facilitate a clear and easy description. This deliberate use of explicit costume shapes enhances our interpretation and understanding of the Late Iron Age clothing tradition. Thus, the majority of the costumes depicted are identified in the Scandinavian archaeological textile record, demonstrating that the depictions are a reliable source of research for both iconographical costume and archaeological clothing. The book contributes with new information on social, regional and chronological differences in clothing traditions from ca. AD 400 to the Viking Age.

ISBN: 9781785702181

Price: £19.00

www.oxbowbooks.com/oxbow/iconic-costumes-51065.html

***Gods and Garments: Textiles in Greek Sanctuaries in the 7th to the 1st Centuries BC*. Ancient Textiles Series 28 (2017) by Cecilie Brøns. Oxford: Oxbow Books.**

Textiles comprise a vast and wide category of material culture and constitute a crucial part of the ancient economy. Yet, studies of classical antiquity still often leave out this important category of material culture, partly due to the textiles themselves being only rarely preserved in the archaeological record. This neglect is also prevalent in scholarship on ancient Greek religion and ritual, although it is one of the most vibrant and rapidly developing branches of classical scholarship. The aim of the present enquiry is, therefore, to introduce textiles into the study of ancient Greek religion and thereby illuminate the roles textiles played in the performance of Greek ritual and their wider consequences. Among the questions posed are how and where we can detect the use of textiles in the sanctuaries, and how they were used in rituals including their impact on the performance of these rituals and the people involved. Chapters centre on three themes: first, the dedication of textiles and clothing accessories in Greek sanctuaries is investigated through a thorough examination of the temple inventories. Second, the use of textiles to dress ancient cult images is explored. The examination of Hellenistic and Roman copies of ancient cult images from Asia Minor as well as depictions of cult images in vase-painting in collocation with written sources illustrates the existence of this particular ritual custom in ancient Greece. Third, the existence of dress codes in the Greek sanctuaries is addressed through an investigation of the existence of particular attire for ritual personnel as well as visitors to the sanctuaries with the help of iconography and written sources. By merging the study of Greek religion and the study of textiles, the current study illustrates how textiles are, indeed, central materialisations of Greek cult, by reason of their capacity to accentuate and epitomize aspects of identity, spirituality, position in the religious system, by their forms as links between the maker, user, wearer, but also as key material agents in the performance of rituals and communication with the divine.

ISBN: 9781785703584

Price: £20.00

https://www.oxbowbooks.com/oxbow/gods-and-garments-51057.html

***L'homme et les mailles: Histoire critique des mailles textiles: filets, réseaux, tricot, crochet* (2016) by Marguerite Gagneux-Granade. Bordeaux: Editions Insensées**

Since few decades, textile archaeology has opened a large field of research and has driven attention to its huge potentiality. Textile is not only fabrics made with two systems of threads on a loom. Textiles are also all the supple artifacts involving fibres made with primary techniques. This book, written in french, brings up a wide study about "knitting". Everyone thinks about the real knitting with two needles, but the author shows that other techniques have existed in the past and still exist, as for instance the needle-looping technique. This technique, performed in a more or less complex way, is attested all over the world (probably very early in date) and usually is not recognized or badly described by archaeologists or in the museums, especially in France. The different knitting techniques

are presented here with related examples.
The author, Marguerite Gagneux-Granade, studied at the Ecole normale supérieure and is agrégée de lettres classiques. She taught in Mulhouse and Lyons, France. During her free time, she developed a research on knitting, past and present. She visited a lot of museums which keep textile collections and attended to many conferences in order to gather the information presented in this book. She worked in an interdisciplinary perspective including textiles, texts, iconography, experimentation.
ISBN : 978-2955809501
Price: EUR 25
https://www.amazon.fr/Lhomme-mailles-Histoire-critique-textiles/dp/2955809500

***Kapuzenmäntel in Italien und den Nordwestprovinzen des Römischen Reiches: Gebrauch – Bedeutung – Habitus* (2017) by Jutta Zerres. Kerpen-Loogh: DGUF-Verlag**
"Kapuzenmäntel" waren in römischer Zeit wegen ihrer Wetterfestigkeit geschätzte und weit verbreitete Kleidungsstücke. Die Studie beleuchtet mehr als die gängigen Fragen altertumskundlicher Analysen wie Typologie, Chronologie, Material und Verbreitung, sondern sie fokussiert auf einen bislang wenig beachteten Aspekt dieses Alltagsgegenstandes: seine Rolle innerhalb der gesellschaftlichen Kommunikation. Das historische und archäologische Quellenmaterial wird im Hinblick auf folgende Fragen analysiert: Gibt es Personen, zu deren Habitus (im Sinne des französischen Soziologen P. Bourdieu) Kapuzenmäntel zählen? Welche Personen (-gruppen) lassen sich identifizieren? Verwenden sie dabei spezielle Formen von Mänteln? In welchen Situationen tragen sie das Kleidungsstück und welche Botschaften transportieren sie damit? Woher stammen die verwendeten Bedeutungszuweisungen an die Mäntel? Wie gestaltet sich der Umgang der Akteure damit? Das Untersuchungsgebiet der Studie sind Italien und die Nordwestprovinzen des römischen Reiches in der Zeit der späten Republik bis in die Spätantike.
ISBN-10: 3945663083
ISBN-13: 978-3945663080
Price: EUR 29.80
http://www.dguf.de/437.html

***Le Costume Medievale au Xiiieme Siecle (1180-1320)* (2015) by Tina Anderlini. Editions Heimdal**
French Text "L'OUVRAGE Apres le succes du Costume medieval de 1320 a 1480, par Florent Veniel, voici un autre volume tres attendu. La encore, nous decouvrirons les matieres, les accessoires (dont les bijoux), les chaussures, les costumes de l'homme, de la femme et de l'enfant, avec de nombreux patrons, mais aussi (en annexe dans le volume relie) l'equipement militaire."
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ISBN-13: 978-2840483618
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https://www.abebooks.com/9782840483618/Costume-Médiévale-XIIIème-Siècle-1180-1320-2840483610/plp

***Pracht und Herrlichkeit - Bewaffnung und Bekleidung keltischer Männer im Hunsrück*. Schriften des Archäologieparks Belginum (2017) edited by Rosemarie Cordie. Morbach. Verlag Archäologiepark Belginum**
Wie prunkvoll und farbenfreudig die Bewaffnung und die Kleidung keltischer Männer waren, zeigen Originale und Rekonstruktionen von Waffen und Gürteln im Vergleich. Nachgewebte Stoffe spiegeln auch in der Bekleidung die Prachtliebe keltischer Männer wieder. Mit den kunstvoll geschmiedeten Waffen und den bunt gewebten Stoffen wurde der Status des Trägers in der Gesellschaft dokumentiert und hervorgehoben. Beiträge zu ausgewählten Prunkgräbern im Hunsrück (Belginum, Haag, Heinzerath, Hochscheid, Horath, Hundheim, Siesbach, Wintrich) vermitteln die verschiedenen Aspekte archäologischer Forschungen, u. a. auch im textilarchäologischen Bereich.
ISBN-10: 3981180275
ISBN-13: 978-3981180275
Price: EUR 20.50
http://www.manz.at/list.html?isbn=978-3-9811802-7-5

***Queen Elizabeth's Wardrobe Unlock'd* (2015) by Janet Arnold. Leeds: Maney Publishing**
The vast wardrobe of Queen Elizabeth I is legendary: in her own time some of the richly embroidered gowns were displayed with other treasures to dazzle the eyes of foreign visitors to the Tower of London. The quantity of clothes recorded in the inventories taken in 1600 would seem to suggest sheer vanity, but a survey of work carried out in the Wardrobe of Robes throughout the reign reveals a different picture. It is one of careful organisation and economy. This copiously annotated work is illustrated with photographs of portraits, miniatures, tomb sculptures, engravings, woven textiles and embroideries. Two indexes are provided, the first of paintings, persons, places, and

events, while the second, partly a glossary, enables the reader to quickly trace information on fashionable dress and accessories. An invaluable reference for students of the history of dress and embroidery, for social historians, for art historians working in the field of portraiture, and those with a general interest in the period.
ISBN-10: 1909662534
ISBN-13: 978-1909662537
Price: EUR 59.99
https://www.abebooks.co.uk/book-search/title/queen-elizabeth's-wardrobe-unlock'd/author/arnold-janet/

***Silk: Trade and Exchange along the Silk Roads between Rome and China in Antiquity.* Ancient Textiles Series 20 (2017) edited by Berit Hildebrandt. Oxford: Oxbow Books**

Already in Greek and Roman antiquity a vibrant series of exchange relationships existed between the Mediterranean regions and China, including the Indian subcontinent, along well-defined routes we call the Silk Roads. Among the many goods that found their way from East to West and vice versa were glass, wine spices, metals and precious stones as well as textile raw materials and fabrics of wool and silk, a precious fibre that was highly appreciated in many of the cultures along the roads that were named after it by modern scholars.

These collected papers bring together current historical, philological and archaeological research from different areas and disciplines in order highlight the use, circulation and meaning of silk as a commodity, gift, tribute , booty, and status symbol in varying cultural and chronological contexts between East and West, including technological aspects of silk production. Rome and China in antiquity provide the geographical and chronological frame for this volume (c. from the third century BCE to the fifth century CE), but also earlier and later epochs and cultures in between these empires are considered in order to build and intercultural and diachronic understanding of long-distance relations that involved silk.

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Berit Hildebrandt: Looking towards the West – how the Chinese viewed the Romans
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Lillian Lan-ying Tseng: Domestic, wild or unravelled? A study on tabby, taqueté and jin with spun silk from Yingpan, Xinjiand, thierd-fourth centuries
Zhao Feng: Chinese silks that circulated among people north and west: implications for technological exchanges in early times?
ISBN: 9781785702792
Price: £40.00
https://www.oxbowbooks.com/oxbow/silk.html

***Spätantike und Byzanz. Bestandskatalog Badisches Landesmuseum Karlsruhe Textilien* (2017) by Petra Linscheid. Mainz: Schnell&Steiner**

Die umfangreichste Gattung unter den byzantinischen Altertümern des Badischen Landesmuseums Karlsruhe stellen Textilfunde aus dem frühbyzantinischen Ägypten.

Insgesamt 207 Objekte, darunter Tuniken, Kopfbedeckungen, Polsterstoffe, Decken und Vorhänge, vermitteln einen lebendigen Eindruck vom Aussehen frühbyzantinischer Kleidung und textiler Raumausstattung. In einem ausführlichen Katalogteil und einleitenden Kapiteln finden besonders die Herstellungstechnik und die Funktionsbestimmung der Textilien Beachtung. Mit wenigen Ausnahmen waren die Objekte bisher unveröffentlicht.
ISBN: 978-3-7954-3280-5
Price: EUR 45.00
https://www.schnell-und-steiner.de/artikel_9182.ahtml

***Spinning Fates and the Song of the Loom: The Use of Textiles, Clothing and Cloth Production as Metaphor, Symbol and Narrative Device in Greek and Latin Literature.* Ancient Textiles Series 24 (2016) edited by Marie Louise Nosch, Mary Harlow and Giovanni Fanfani. Oxford: Oxbow Books**

Textile imagery is pervasive in classical literature. An awareness of the craft and technology of weaving and spinning, of the production and consumption of clothing items, and of the social and religious significance of garments is key to the appreciation of how textile and cloth metaphors work as literary devices, their suitability to conceptualise human activities and represent cosmic realities, and their potential to evoke symbolic associations and generic expectations. Spanning mainly Greek and Latin poetic genres, yet

encompassing comparative evidence from other Indo-European languages and literatures, these 18 chapters draw a various yet consistent picture of the literary exploitation of the imagery, concepts and symbolism of ancient textiles and clothing. Topics include refreshing readings of tragic instances of deadly peploi and fatal fabrics, situate them within a Near Eastern tradition of course a garment, explore female agency in the narrative of their production, and argue for broader symbolic implications of textile-making within the sphere of natural wealth. The concepts and technological principles of ancient weaving emerge as cognitive patterns that, by means of analogy rather than metaphor, are reflected in early Greek mathematic and logical thinking, and in archaic poetics. The significance of weaving technology in early philosophical conceptions of cosmic order is revived by Lucretius' account of atomic compound structure, where he makes extensive use of textile imagery, whilst clothing imagery is at the centre of the sustained intertextual strategy built by Statius in his epic poem, where recurrent cloaks activate a multi-layered poetic memory.
ISBN: 9781785701603
Price: £40.00
https://www.oxbowbooks.com/oxbow/spinning-fates-and-songs-of-the-loom.html

Textile Conservator's Manual **(Second edition, 2016) by Sheila Landi. Routledge**
This second edition of 'Textile Conservator's Manual', now revised and available in paperback, provides an in-depth review of the current practice, ethics and materials used in textile conservation. Concentrating on decorative art objects from the major cultures, the book gives practical instruction and a wide variety of case histories. While the format has been simplified, the text has been expanded and updated to include changes brought about by recent developments in the conservation of material. This new information will increase the reader's ability to interpret signs of ageing and past activity on the object. New case histories in Part Two represent major investigations into the technical history. A basis is provided from which to develop practical skills, taking into account the needs of the object, its essential characteristics of appearance and, above all, its structure. The book covers a wide range of decorative objects, from a fragment of linen 4000 years old to a theatrical backcloth of the twentieth century. This book is practical and thought-provoking, not only about what is being done and how, but also why.
ISBN-10: 1138169366
ISBN-13: 978-11381693
Price: EUR 188.12
https://www.amazon.com/Textile-Conservators-Manual-Sheila-Landi/ dp/1138169366

Textiles, Tools and Techniques: Of the 1st Millennium AD from Egypt and Neighbouring Countries **(2016) edited by Antoine De Moor and Cecilia Fluck. Lannoo Publishers**
Proceedings of the 8th conference of the research group 'Textiles from the Nile Valley', Antwerp, 4-6 October 2013
As one of the very few books exclusively devoted to Late Roman, Early Byzantine and Early Islamic textiles from Egypt, this book serves both as a sourcebook for scholars as well as a stimulation for non-specialists. With 15 essays written by specialists on detailed studies such as the technology of pleating, the radiocarbon dating of well-known textiles, the fittings of child tunics..
ISBN-10: 9401432406
ISBN-13: 978-9401432405
https://www.amazon.de/Textiles-Tools-Techniques-Millennium-Neighbouring/dp/B01JXRUV2C

Textile Production in Classical Athens. **Ancient Textiles Series 27 (2016) by Stella Spantidaki. Oxford: Oxbow Books**
Textile technology is older than any other ancient craft and is an instance of cognitive archaeology that provides vital information about society. In ancient Greece, textiles were considered among the principal and most fundamental cultural expressions. Athena, the goddess of the city, of intelligence and of skill was also the patron goddess of weaving. She taught the craft of textile production to women thus making them conduits of civilisation. During Classical times, textile production was a fundamental part of the economy and was practised also by men in both the domestic and artisanal spheres. The resulting technological sophistication is reflected in depictions of discrete or elaborate patterns, in the rich diversity of textile implements and in the variety in the quality of the extant textiles. In "Textile Production in Classical Athens" Stella Spantidaki provides the first synthesis of the available evidence from textual, iconographic and archaeological sources on textile production in 5th and 4th century BC Athens, employing an interdisciplinary perspective that sets the frame for future research in the field. As such this study is of special importance for textile specialists, ancient history

scholars, historians of technology and students and will lead to a better understanding of ancient Greek textile production and Classical Athenian society. It presents a detailed consideration of the historical and social context of textile production in classical Athens; examines and discusses evidence for the equipment, materials, processes and techniques employed at each stage of the full production sequence; discusses the organisation of production and trade.
ISBN: 9781785702525
Price: £40.00
https://www.oxbowbooks.com/oxbow/textile-production-in-classical-athens.html

***Textiles and Cult in the Ancient Mediterranean.* Ancient Textiles Series 31 (2017) edited by Cecilie Brøns and Marie-Louise Nosch.Oxford. Oxbow Books**
Twenty-four experts from the fields of Ancient History, Semitic philology, Assyriology, Classical Archaeology, and Classical Philology come together in this volume to explore the role of textiles in ancient religion in Greece, Italy, The Levant and the Near East. Recent scholarship has illustrated how textiles played a large and very important role in the ancient Mediterranean sanctuaries. In Greece, the so-called temple inventories testify to the use of textiles as votive offerings, in particular to female divinities. Furthermore, in several cults, textiles were used to dress the images of different deities. Textiles played an important role in the dress of priests and priestesses, who often wore specific garments designated by particular colours. Clothing regulations in order to enter or participate in certain rituals from several Greek sanctuaries also testify to the importance of dress of ordinary visitors. Textiles were used for the furnishings of the temples, for example in the form of curtains, draperies, wall-hangings, sun-shields, and carpets. This illustrates how the sanctuaries were potential major consumers of textiles; nevertheless, this particular topic has so far not received much attention in modern scholarship. Furthermore, our knowledge of where the textiles consumed in the sanctuaries came from, where they were produced, and by who is extremely limited. Textiles and Cult in the Ancient Mediterranean examines the topics of textile production in sanctuaries, the use of textiles as votive offerings and ritual dress using epigraphy, literary sources, iconography and the archaeological material itself.
ISBN: 9781785706721
Price: £48.00
https://www.oxbowbooks.com/oxbow/textiles-and-cult-in-the-ancient-mediterranean.html

***The Diversity of Dyes in History and Archaeology* (2017) by Jo Kirby Atkinson. Archetype Publications Ltd**
Natural and synthetic dyes have been used to color textiles, wood, leather, bone, paper, stone and other substrates from the earliest times. They have also been used for inks and in pigment preparation and therefore have also been used in painting. The history of the use of dyes can be approached from many different points of view: the technology of dyeing; the cultural significance and importance of different colors or different dyes; the trade in dyes between countries and continents; the economics of dyes; the cultivation or husbandry of the plant and animal sources of dyes; the discovery of the early synthetic dyes and the growth of chemical industries; the use of dyes in pigment making; the deterioration and conservation of dyes; the scientific analysis of dyes. The papers published here (presented at recent Dyes in History and Archaeology meetings) have set out to capture this variety and breadth of content and approach to the subject of dyes and dyeing.
ISBN-10: 1909492531
ISBN-13: 978-1909492530
Price: £55.00
https://www.waterstones.com/book/the-diversity-of-dyes-in-history-and-archaeology/jo-kirby-atkinson/9781909492530

***Treasures from the Sea: Sea Silk and Shellfish Purple Dye in Antiquity*. Ancient Textiles Series 30 (2017) edited by Hedvig Landenius Enegren and Francesco Meo**
This interdisciplinary volume presents a collection of 17 papers which treat the current state of research on two marine resources used in ancient textile manufacture, shellfish purple dye and sea silk. Purple dye is extracted from the glands of the molluscs Hexaplex trunculus, Bolinus Brandaris and Stramonita Haemastoma which through a chemical reaction of photosynthesis produces hues ranging from dark red to bluish purple colour. The importance of purple dye since ancient times as a status symbol, a sign of royal and religious power is well documented. Papers include the study of epigraphical and historical sources, practical experiments as well as, highlighting the presence of purple dye in the Mediterranean area in

select archaeological data. Less well known is sea silk, a precious fibre derived from the tufts of the pen shell, Pinna nobilis, with which the mollusc anchors itself to the seabed. These tufts once cleaned and bleached take the aspect of golden thread. Only a handful of artisans on Sardinia still have the knowledge of how to work these fibres from the pen shell, a species protected by the EU Habitats Directive, the knowledge having been transmitted orally for generations. Papers include linguistic issues pertaining to terminology, archaeological investigation, the study of the physical and chemical properties of sea silk and the step-by-step practical working of sea silk fibres. The comprehensive multifaceted overview makes this book a valuable resource for anyone interested in ancient textiles, dyes and textile technology.
ISBN: 9781785704352
Price: £38.00
https://www.oxbowbooks.com/oxbow/treasures-from-the-sea.html

***What Shall I Say of Clothes? Theoretical and Methodological Approaches to the Study of Dress in Antiquity. Selected Papers on Ancient Art and Architecture* (2017) edited by Laura Gawlinski. Oxford: Oxbow Books**

The essays in this volume engage explicitly in a variety of theoretical and methodological strategies for the interpretation of dress, dressed bodies, and their representations in the ancient world. Focusing on personal ornaments, portraiture, and architectural sculpture, the collected papers investigate the visual, somatic, and semantic significance of the act of getting dressed, what it meant to be dressed in various ways, and how dress contributed to and shaped identities in antiquity. Authors draw from a wide range of disciplinary frameworks, integrating literary and archaeological evidence, experimental archaeology, social theory and the study of iconography.

This volume spans a broad area both geographically and chronologically, bringing the ancient Near East into dialogue with the classical world from prehistory through late antiquity. The breadth and inclusivity of this volume provide a strong theoretical and methodological foundation for the collaborative study of the dynamic role of dressed bodies and images that depict them. Contributors are Emma L. Baysal, Eric Beckmann, Ayse Bursali, Alexis Q. Castor, Megan Cifarelli, Laura Gawlinski, Maura Heyn, Neville McFerrin, Kiersten Neumann, Hadi Ozbal, Rana Ozbal, Josephine Verduci, Alissa Whitmore, Elizabeth Wueste, and Baris Yagci.
ISBN-10: 1931909342
ISBN-13: 978-1931909341
Price: EUR 34.10
https://www.oxbowbooks.com/oxbow/what-shall-i-say-of-clothes.html

PhDs

Vivi Lena Andersen was awarded a PhD by the SAXO-Institute, University of Copenhagen, Denmark, for her dissertation/thesis "Between Cobbles, Bunion, Shoelast and Fashion. Shoes from 1300-1800 from Archaeological Excavations in Copenhagen".

Ana Grabundzija was awarded a PhD by Institut für Prähistorische Archäologie, Freie Universität Berlin, Germany, for her dissertation "Archaeological Evidence for Early Wool Processing in South East and Central Europe".

Delphine Henri was awarded a PhD by the University of Tours, France for her dissertation "Production et consommation textiles à Tours aux XV^{e} et XVI^{e} siècles: approche archéologique" ("Textile production and consumption in Tours in the 15th and 16th centuries: an archaeological approach").

Vibe Maria Martens was awarded a PhD by the European University Institute in Florence, Italy, for her dissertation "Indian textiles in seventeenth- and eighteenth-century Denmark. Trade and the rise of a global consumer culture".

Krista Vajanto was awarded a PhD by University of Helsinki, Finland, for her dissertation "Dyes and Dyeing Methods in Late Iron Age Finland". Full text with all papers are free to be downloaded from: https://helda.helsinki.fi/handle/10138/159210

General Information

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

1. Contributions can be in English, German or French.

2. Contributions may include accounts of work in progress. This general category includes research/ activities related to archaeological textiles from recent excavations or in museums/galleries. Projects may encompass technology and analysis, experimental archaeology, documentation, exhibition, conservation and storage. These contributions can be in the form of notes or longer feature articles.

3. Contributions may include announcements and reviews of exhibitions, seminars, conferences, special courses and lectures, information relating to current projects and any queries concerning the study of archaeological textiles. Bibliographical information on new books is particularly welcome.

4. Authors' guidelines can be found at www.atnfriends.com

5. All submissions are to be made in electronic text file format (preferably Microsoft Word) and are to be sent electronically.

6. Illustrations should be electronic (digital images or scanned copies at 600dpi resolution or higher). Preferred format is TIFF (maximum size is 17.4 x 21.6 cm). Illustrations should be sent as separate files and not imbedded in text. Colour images are welcome.

7. All contributions are peer-reviewed by invited specialists.

8. The editors reserve the right to suggest alterations in the wording of manuscripts sent for publication.

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DK 2300 Copenhagen S,
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