

An Early Wool Textile from Pustopolje, Bosnia-Herzegovina

Karina Grömer, Prähistorische Abteilung, Naturhistorisches Museum Wien, Burgring 7, A-1010 Wien, Austria. Email karina.groemer@nhm-wien.ac.at

Lise Bender Jørgensen, Department of Archaeology, Norwegian University of Science and Technology, N-7491 Trondheim, Norway. Email lise.bender@ntnu.no

Marija Marić Baković, Franjevački muzej i galerija Gorica Livno, Bosnia. Email marija.maric.b@gmail.com

Introduction

In vol. 64 of the *Antiquity*, Alojz Benac (1914 -1992) presented a short note on a group of tumuli with exceptional organic preservation that he had excavated 1980-84 in the valley of Kupreško polje in southwestern Bosnia (Benac 1990). Only one of them, Pustopolje tumulus no. 16, contained a burial, with a wooden coffin, parts of a sledge, skin, grass, and the skeletal remains of a man that had been covered with a thick woven wool textile. Benac did not attempt to describe the textile except for a drawing illustrating how it covered the entire burial. In an earlier publication a detail of the border was also shown (Benac 1986: 109) (fig. 1). The textile did not quite elude the attention of scholars (Bender Jørgensen 1992: 103; Grömer 2010: 39) but as the Yugoslavian wars 1992-1995 made communications difficult, the Pustopolje textile has not been given the attention it deserves. This has recently been remedied. It has been examined, restored and re-dated, and is now on display in the Franciscan Museum and Gallery Gorica in Livno, Bosnia-Herzegovina (Marić Baković and Car 2014) In 2011, two of the present authors visited the museum in Livno to examine the textile (fig. 2). Dye analysis, wool analysis and radiocarbon dating have also been carried out.

The textile from Pustopolje has been radiocarbon dated to the fifteenth century BC which makes it the earliest major woolen textile in Europe. It is 170cm wide and 300cm long; although fragmented, almost all of the borders and selvages are preserved. It means that it is technically complete. This makes it an important source to the beginnings of wool production and to the use of textiles in the Bronze Age. This paper is the first presentation of the Pustopolje textile, supplying a technical description including information on dating,

fibre and colour, and discussing this magnificent item in the context of contemporary textiles, textile technology and possible use.

The Pustopolje textile in the Yugoslavian Wars

After excavation and initial restoration the textile was briefly on display in Kupres and was then transferred to the Hasan Brkić Museum in Livno. With the outbreak of war in April 1992, the finds had to be evacuated from the museum. Pieces of the coffin were stored in a wooden military chest and sheltered at the Orlovac Hydropower Plant in Podgradina near Livno; the textile and the remains of the deceased were placed in the basement of the Franciscan Monastery in Livno. At the end of the war, the collections of the Hasan Brkić Museum were merged with those of the Franciscan Monastery to create the Franciscan Museum and Gallery Gorica Livno.

Conservation, Reassessment and Restoration

Before being put on display, the Pustopolje textile was restored in the *Hrvatski Restauratorski Zavod* in Zagreb by textile conservator Gordana Car and her colleagues (Marić Baković and Car 2014). The textile had been stored between glass layers, in the form of two plates or “sandwiches”, each measuring 143x107cm. The now 596 fragments of the textile were cleaned, analysed and rearranged. This led to a surprise. Benac (1986) had assessed the size of the textile as 170x200cm; the conservators were able to confirm Benac’s assessment of the width of the fabric to 170cm as 103cm and 168cm of the two transverse borders were preserved, but they found that the fabric must have been at least 300cm long, as fragments of the two selvages make out no less than 570cm. After conservation, the fragments were laid out within the four woven borders according to nuances of colour, width and spots. They were then placed on boards of acid-free cardboard and covered with fine monofilament netting that was sewn with silk thread onto the beige cotton fabric chosen as background. During the restoration process, Professor Stana Kovačević from the University of Zagreb, Faculty of Textile Technology investigated the textile before the textile was covered with netting. The textile is catalogued as FMGG 6974.

Radiocarbon dating

Benac’s (1990: 331) dating of the Pustopolje burial (3660+/-120 BP cal.) had been carried out on samples of the wooden construction. In the meantime it has become possible to date textiles by radiocarbon. A sample of the Pustopolje textile was dated by Mark Van Strydonck of the KIK/IRPA in Brussels to 3195+/-30 BP cal., i.e. between 1495 and 1435 BC (fig. 3). It was pre-treated with chloroform twice by immersing it for 15 minutes in an ultrasonic bath to eliminate the Polyvinylacetate. Afterwards, the sample was pre-treated

with the solvents hexaneacetone-ethanol and Milli-Q water in the ultrasonic bath. Infra red spectroscopy did not detect any PVA after pre-treatment (Van Strydonck 2012).

The dating makes the Pustopolje textile approximately a century earlier than the famous well-preserved garments and textiles found in oak-log coffins in Denmark (Broholm & Hald 1940; Christensen 2006; Randsborg 2011: 139). **Table 1**.

Wool

Wool analysis and measurements have been carried out by Dr Antoinette Rast-Eicher, ArcheoTex, on four samples from the Pustopolje textile. All showed the same type of wool with very fine fibres combined with very coarse ones (**fig. 4**). This kind of wool is typical of the Bronze Age, although most other finds show evidence of wool sorting (Rast-Eicher & Bender Jørgensen in press). The coarse fibres (kemp) range around or over 100 µm in diameter. The scales of the kemp fibres are either polygonal-net-like or horizontal lines; longitudinal pleats and breaks indicate some shrinkage (**fig. 4**). The Pustopolje wools belong to category D as defined by Rast-Eicher (2008:155). The fine fibres were probably slightly pigmented, the kemp appear light with a large dark medulla.

The best comparison to the Pustopolje wool comes from muflon fibres from Sardinia. The European muflon (*Ovis ammon musimon*) is a wild remnant of early domesticated sheep (Rezaei et al. 2010). A sample of muflon fibres shows the same type of large fibres, some with net-like scales, others with fine horizontal lines. The wool of a textile from Lenk-Schnidejoch, dated 1891-1634 BC cal., resembles the Pustopolje wool (Rast-Eicher 2015). Further parallels are wools from Hochkönig-Mitterberg dated 1600-1500 BC (Grömer et al. **in press**) and Castione dei Marchesi in Italy dated 1600-1200 BC (Gleba 2012: 3645). All of these show indications of wool sorting as most of the coarse fibres have been removed.

Dyestuffs

Dyestuff-analyses have been performed by M. van Bommel and Ineke Joosten of the Cultural Heritage Agency of the Netherlands and R. Hoffmann-de Keizer of the University of Applied Arts in Vienna. The fibres of the textile fragments were examined by optical light microscopy (OLM) and scanning electron microscopy coupled to energy dispersive spectroscopy (SEM-EDS). The fibres are very clean, and the typical scales are still visible. The fibres show many tears and fractures indicating mechanical stress. The surface of the fibres contains holes which might be caused by microbes.

High Performance Liquid Chromatographic (HPLC) analysis indicated the presence of unknown yellow and red components in two samples. The yellow components belong to the flavonoid dye classes which are also found in weld, sawwort, dandelion and chamomile but an exact identification was not possible. The red components found could not be linked to any known plant species; they could be degradation products or indicating the presence of an unknown (local?) plant. It can not be excluded however, that the colouring components originate from the archaeological environment. The composition of the two samples was very similar, however in sample 5 an unknown orange component was found which is probably not a dye but could be a marker of peat bog or body fluids (Van Bommel et al. 2012 (I forget if they mention this elsewhere?)).

The Construction of the textile

The Pustopolje textile is woven in tabby. It is made with a repp starting border, a main web with simple selvages and an elaborate finishing border (fig. 5 and Table 2).

The starting border is c. 3.5 cm wide, and was constructed as a 1/2 repp band. The paired weft of the band turns into the warp of the main web (fig. 6; cf Hoffmann 1964: fig. 26, Grömer 2010: Abb. 59). Both yarn systems of the starting border are s-twisted. A fragment of the starting border currently misplaced displays the felted remains of a knot or tassel, and may represent one of the corners of the fabric (fig. 4). A further piece of the starting border, missing on the mounted fabric, is in the exhibition showcase with the remains of the deceased (Car, pers. comm.). No transitional features between the starting border and the main fabric could be observed, such as *croisage* (crossing of the threads) or cut-off threads.

The main web is a warp-faced tabby, made from s-twisted warp yarns and z-twisted weft yarns. The fabric appears to be very even and competently woven. The selvages are simple, i.e. each weft turns around and continues in the next shed without further ado. Occasionally, the turning threads interplay with the outermost warp thread, resulting in a corded appearance (fig. 6).

The finishing border is c. 9 cm wide, and begins with two opposed rows of twining made with paired yarns, concluding the main web, followed by a wide repp 4/1 border (fig. 7). The twining divides the end of the s-twisted warp threads of the main web into pairs that become the weft of the finishing border in two steps. Each pair of those threads was inserted into a shed of the finishing border, turned back into the next shed along with a fresh pair of warp ends and cut just below the twining. Remains of felted, cut warp threads appear regularly just below the twining. The warp yarns of the finishing border are z-twisted.

Stitching

A few stitches have been observed at various points of the textile, although without any discernible pattern. The sewing thread is S2z-ply, and is made from darker fibres than the yarns of the fabric. (fig. 8)

Dimensions

Large wool textiles including complete items of clothing from the Bronze Age have been found in a number of oak-log coffins from Denmark (Broholm & Hald 1940). A series of blankets and wraps/long skirts can be compared with the Pustopolje textile as regards dimensions and construction (fig. 9). A blanket from a male burial from Muldbjerg is the widest, 211cm across; as it has been cut at both ends we have no way of knowing how long it originally was. The longest are two wraps from the female burials of Skrydstrup and Borum Eshøj C. The Skrydstrup wrap is 390cm long and 145cm wide; the Borum Eshøj wrap is 330cm long and 122cm wide. Only one piece, a blanket from Trindhøj, is complete with all four edges preserved. It is 133cm wide and 184cm long (Broholm & Hald 1940). For datings, see table 1. The dimensions of the Pustopolje textile fit well into the overall pattern established by the Danish material. What makes it stand out is the finishing border that does not have parallels; it also appears to be more evenly woven than the Danish fabrics as the number of warp and weft threads per cm measured at various parts of the textile seem almost identical.

Technology

The Pustopolje textile is an important contribution to our knowledge of the textile technology of Bronze Age Europe. Due to the rarity and uneven distribution of both well-preserved textiles and textile tools, this is little understood (Bender Jørgensen 1992: 117-20; Grömer 2015: xx-xx; Rast-Eicher and Dietrich 2015: 114-118).

Starting borders like that found in the Pustopolje textile are generally assumed to indicate the warp-weighted loom (Hoffmann 1964: 151-83). The textiles and garments from the Danish oak coffins do, however, display two types of transverse borders: plaited borders and starting borders (for details see fig. 9); both appear in almost all finds with substantial textile remains (Broholm & Hald 1940: 122-3). The Trindhøj blanket ends in fringes at both ends, made from closed warp loops (Broholm & Hald 1940: 37-39).

In their discussion of the technology of the Danish Bronze Age textiles Broholm & Hald found that two loom types would fit with the available evidence if equipped with two or more short shed rods to divide the warp: the two-beam loom and the warp-weighted loom (Broholm & Hald 1940: 134-5). Recently the properties and peculiarities of these two looms, as well as of the two-beam loom with tubular warp and the ground loom of Pharaonic Egypt have been investigated by Martin Ciszuk and Lena Hammarlund (2008). In

an attempt to establish criteria that might serve to identify which loom that had be used to make specific archaeological textiles, they concluded that hardly any characteristics are distinctive for a single loom type. Regrouping with crossing warp threads could, however, not be done on the warp-weighted loom; and a twined starting cord excludes a loom with tubular warp, while an intact warp lock is proof of such a warp (Ciszuk & Hammarlund 2008: 130-1).

Loom weights are another, more unequivocal indicator of the warp-weighted loom. In Bosnia-Herzegovina, loom weights have been recovered from Bronze Age hillforts in the Livno, Duvno, Glamoč and Kupres areas. They are made of fired clay and are red-brown in colour, pyramid-shaped, with a hole at the top. Specimens in the Franciscan Museum and Gallery Gorica range in height from 9 to 11 cm. Similar loom weights have been found in Dalmatia (Barbarić 2006: 62; and Barbarić pers. comm.). Spindle whorls from Middle Bronze Age hillforts in south-west Bosnia are circular, 4-5 cm in diameter and appear as flat, or rounded, and with smooth-surfaced or ribbed surfaces.

In Scandinavia, Bronze Age loom weights are rare. Very few have been found, e.g. in the remains of a building excavated near the Skrydstrup burial (Ethelberg et al. 2000: 232). Spindle whorls are even rarer. As yet, only one specimen, dated to the end of the Scandinavian Bronze Age (750-500 BC), has been recovered (Mannering et al. 2012: 102).

In the Balkans, loom weights first appear in the Early Neolithic and continue throughout Prehistory although with changing sizes and shapes (Petrova 2015: 217-18). Loom weights, and spindle whorls made of fired or unfired clay or recycled pieces of pottery are well-known features of Neolithic settlements in Central Europe, starting with the Starčevo and LBK cultures (6000-4400 BC). In the Early and Middle Bronze Age, cylindrical loom weights of the Neolithic type are relatively common (Gleser 2007), but there is a lack of spindle whorls. With the advent of the Urnfield Culture in the Late Bronze Age and in the Hallstatt Period (1300-750 BC), loom weights and spindle whorls –but of different shapes – recur and are very frequent in settlements and even in graves (Grömer 2015: xxx-xxx?).

The warp yarns of the Pustopolje textile are between 0.7 and 0.9 mm in diameter, the weft yarns 0.9-1.3mm. In comparison, yarns of the Danish Bronze Age textiles are thicker, usually 1.0-1.5mm, and vary much more, even within individual textiles (Fossøy forthcoming). One item, the kilt of Borum Eshøj grave B, has warp yarns with diameters ranging between 3.5mm and 4.9mm (Broholm & Hald 1940:161-2). This and the absence of Bronze Age spindle whorls in Denmark suggest that a different kind of spindle or spinning technique was employed here. Spinning does not necessarily require a spindle but can be done solely by using the hands; or it may be carried out on a spindle without a whorl, rotating it in the hand or rolling it down the thigh. A simple crooked stick may also serve as

a spindle. Spinning performed by rotating a spindle in the hand was particularly suited for short-stapled wool (Crowfoot 1931: 44-5).

We may conclude that it is most likely that the Pustopolje textile was made on a warp-weighted loom, due to the starting border and contemporary finds of loom weights. The presence of spindle whorls of the same date in the region indicates that the yarn probably made on a drop spindle. This suggests that Bronze Age textile technology and craft traditions of the Balkans differed from those represented by the textiles and garments from the oak-log coffins in Denmark.

Use

According to Benac, the Pustopolje textile was wrapped around the naked body of the deceased, a man of about 60 years of age and 1.70 m tall (Benac 1986). Apart from the fabric, no artefacts were found in association with the body. The textile was folded in half, and further folded in the shape of an S to fit into the burial chest where it was deposited on top of a layer of skin. The deceased was placed under the top layer (Car 2010: 26-7), see [fig. 10](#). The textile appears to have been used before it was deposited in the grave. Parts of the surface appear felted (fig. 4), and this also applies to the fuzzy ends of cut wool threads at the finishing border and the tassel. This is caused by use-wear or washing, although some may be due to the process of decomposition of the deceased. The size and shape of the textile suggests that it was a blanket, but it may, perhaps, originally have been a draped garment.

The use of the large wool textiles of the Danish oak-log coffins have been much discussed. This especially applies to the wraps in the Skrydstrup and Borum Eshøj burials that have been explained either as long skirts worn in a variety of ways, or as draped or wrapped around the body as an outer garment (Bergerbrant 2007: 56-8; Broholm & Hald 1940: 155, fig. 197; Hansen 1980; Henning-Almgren 1949-51; Kristiansen 1974; Munksgaard 1974: fig. 52; Randsborg 2011: 41-45, fig. 14). Items designated as blankets have generally been assumed to be unspecified textiles or a form of bedding; recently, Klavs Randsborg has suggested that those from the Skrydstrup grave are long skirts (2011: 41).

Further sources of complete early textiles are in the Middle East, in particular Pharaonic Egypt, although all of these are made of flax and belong to entirely different technological traditions. A fourth Millennium burial in the Cave of the Warrior in the Judean Desert contained several items (Schick 2003). The largest piece deserves some attention in comparison with the Pustopolje textile. It was 196 cm wide and 690 cm long, with warp fringes at either end, and a weft fringe along one selvedge. It was folded in half across its long axis, and then folded again in half, forming a four-layered wrapping enclosing the

deceased, much like in the Pustopolje burial. According to Tamar Schick (2003: frontespice), it had served as a long kilt, held in place by a sash.

Pharaonic Egyptian textiles appear in a great variety of lengths; Petrie mentions sheets from Deshasheh dated to the Old Kingdom that are around 9m long (Petrie 1898: 32); another group of Old Kingdom textiles from Asyut are even longer, measuring more than 20 m in length (British Museum EA 46632/3). The width is however rarely more than 130 cm (Vogelsang-Eastwood 1993: 6). Most pharaonic Egyptian clothing was wrap-around garments, consisting of lengths of cloth wrapped around the body in a variety of ways such as kilts, skirts, cloaks, shawls, and some forms of dresses. Loincloths, bag-tunics and some dresses were cut-to-shape (Vogelsang-Eastwood 1993: 5-6).

The stitches observed in the Pustopolje textile suggest that they had served to hold the textile in place, either for the burial or during its earlier use. Unfortunately, except for one stitch the position of these stitches has not been documented, complicating interpretation. No pin holes have been detected; as early Bronze Age pins have thick shafts, we would expect traces of pin holes if the textiles had been used as a pinned garment. Experiments based on the dress depicted on a Bronze Age figurine from the Lower Danube have been carried out in an attempt to find a way the Pustopolje textile could have been worn as a draped garment (Grömer & Rösel-Mautendorfer 2011). Results were inconclusive, leaving us with without a clear answer to the question of use. We may however conclude that the Pustopolje textile was used as it came off the loom, as a large blanket or coverlet, or as a draped garment. It bears no evidence of tailoring.

Conclusion

The Pustopolje textile fits well into the context of contemporary Bronze Age textiles, except for the end border. The size and shape corresponds to the well-preserved textiles and garments found in Denmark, but it appear more even and competently made than these. Technologically, the Pustopolje textile is closer related to contemporary textiles in Central Europe. As we have seen, the warp-weighted loom is well testified here, while the Scandinavia evidence suggests another, or perhaps several different looms. Similarly, the lack of spindle whorls in Scandinavia suggests a different technology that may explain why Scandinavian yarns are coarser and less even. The wool, too, is comparable to wools from Central Europe, while Scandinavia wools differ (Rast-Eicher & Bender Jørgensen in press). It belongs to the earliest known examples of dyed textiles in Europe, and offer us an enticing glimpse of Bronze Age textile colours other than those of various shades of naturally pigmented wool.

Acknowledgements

The investigation of the Pustopolje textile has been carried out as part of the HERA-funded project Creativity in Craft Production in Middle and Late Bronze Age Europe (CinBA). Thanks are due to Sanjin Mihelić, Zagreb Archaeological Museum, who helped us locating the whereabouts of the Pustopolje textile, sent us the conservation report by the Hrvatski Restauratorski Zavod and took us on a memorable visit to Bosnia-Herzegovina to investigate it. At a later occasion he arranged a meeting with textile conservator Gordana Car who had led the restoration of the textile.

Our heartfelt thanks to the Director and staff at the Franjevački Muzej i Galerija Gorica in Livno generously put the Pustopolje textile at our disposal, permitting us to take samples for fibre and dyestuff analyses and for a new radiocarbon dating, and access to documentation made before and during the conservation process. Gordana Car of the *Hrvatski Restauratorski Zavod* graciously answered all our questions and helped us in many ways. She has contributed important information to the present paper. Our thanks also due to Dr Antoinette Rast-Eicher, ArcheoTex who carried out the fibre analysis, to Mark Van Strydonck who performed the new radiocarbon dating, and to Maarten van Bommel, Ineke Joosten and Regina Hoffmann-de Keijzer, who did the dyestuff analysis. Vedran Barbarić of the University of Split kindly supplied information on textile tools from Dalmatia, and Hero Granger-Taylor, London, helped with information on Near Eastern textiles.

Bibliography

- BARBARIĆ, V. 2006. Nekropola u Vičjoj luci i gradina Rat na otoku Braču - nova razmatranja. *Vjesnik za Arheologiju i Povijest Dalmatinsku*, 99: 43-62.
- BARBER, E.J.W. 1991. *Prehistoric Textiles*. Princeton/Oxford: Princeton University Press.
- BENAC, A., 1986. Praistorijski tumuli na Kupreškom Polju, *Centar za balkano loška ispitivanja Akadenije nauka I umjetnosti Bosne I Hercegovine* 64(5). Sarajevo.
- BENAC, A., 1990. Recently excavated Bronze Age tumuli in the Kupreško polje, Bosnia, Yugoslavia. *Antiquity* 64 (1990): 327-33.
- BENDER JØRGENSEN, L. 1992. *North European Textiles until AD 1000*. Aarhus: Aarhus University Press,.
- BERGERBRANT, S. 2007. *Bronze Age Identities: Costume, Conflict and Contact in Northern Europe 1600-1300 BC* (Stockholm Studies in Archaeology No. 13). Lindome: Bricoleur Press.
- BROHOLM, H.C. & HALD, M. 1940. *Costumes of the Bronze Age in Denmark*. Copenhagen: Nyt Nordisk Forlag/Arnold Busck.
- CHRISTENSEN, K. 2006. Dendrochronological Dating of Bronze Age Oak Coffins from Denmark & Schleswig. *Bronze Age Oak-Coffin Graves. Acta Archaeologica* 27: 163-246.
- CISZUK, M. AND HAMMARLUND, L. 2008. Roman looms – a study of craftsmanship and technology in the Mons Claudianus project. In Alfaro, C, & Karali, L. (eds), *PURPUREAE VESTES II. Vestidos, textiles y tintes*, 119-133. Valencia: PUV (University of Valencia Press).
- CROWFOOT, G.M. 1931. *Methods of Hand Spinning in Egypt and the Sudan* (Bankfield Museum Notes, Second Series, No. 42). Halifax: Bankfield Museum.
- ETHELBERG, P., JØRGENSEN, E., MEIER, D. AND D. ROBINSON 2000. *Det Sønderjyske landbrugs historie vol. 1: sten- og bronzealder*. Haderslev: Haderslev Museum og Historisk Samfund for Sønderjylland
- FOSSØY, S.H. Forthcoming. The Production of Scandinavian Bronze Age Textiles: Skill and Creativity. In: L. Bender Jørgensen, J. Sofaer and M.L.S. Sørensen. *Bronze Age Creativity: Textiles, Clay and Metalwork*. Cambridge University Press.

GLEBA, M. 2012. From textiles to sheep: investigating wool fibre development in pre-Roman Italy using scanning electron microscopy (SEM). *Journal of Archaeological Science* 39: 3643-3661.

GLER, R. 2007. Zylindrisches Webgewicht der Bronzezeit von Büschdorf, Kr. Merzig-Wadern, und vergleichbare Funde in Mitteleuropa, in Gleser, R. (ed) 2007. Zwischen Mosel und Morava – Neue Grabungen und Forschungen zur Vor- und Frühgeschichte Mitteleuropas: 127-73. Bonn: Dr. Rudolf Habelt Verlag.

GRÖMER, K. 2015. *Prähistorische Textilkunst in Mitteleuropa. Geschichte des Handwerkes und der Kleidung vor den Römern*. Wien: Verlag Naturhistorisches Museum Wien.

GRÖMER, K. 2012. Austria: Bronze and Iron Ages. In: Gleba, M, Mannering, U. (eds): *Textiles and Textile Production in Europe. From Prehistory to AD 400*, 27-64. Oxford: Oxbow Books.

GRÖMER, K. & RÖSEL-MAUTENDORFER, H. 2011. Rekonstruktion des Ensembles von Winklarn, Grab 12. *Archäologie Österreichs* 22/2: 2-11.

GRÖMER, K., C. EIBNER, M. MEHOFER & A. RAST-EICHER forthcoming. Missing link – Textilfunde der Bronzezeit aus dem Mitterberger Revier von Mühlbach am Hochköning, Salzburg.

HANSEN, H.H. 1980. Skrydstrup-kvindens dragt. *Aarbøger for Nordisk Oldkyndighed og Historie* 1978: 139-149.

HENNING-ALMGREN, I. 1952. Hängkärl och bronsåldersdräkt. *Tor* 1949-1951: 46-50.

HOFFMANN, M. 1964. *The Warp-Weighted Loom: studies in the history and technology of an ancient implement* (Studia Norvegica No 14). Oslo: Universitetsforlaget.

KRISTIANSEN, K. 1974. Glerupfundet. *Hikuin* 1: 7-38.

MANNERING, U., M. GLEBA & M. BLOCH HANSEN. 2012. Denmark. In, Gleba, M & U. Mannering (eds): *Textiles and Textile Production in Europe. From Prehistory to AD 400*: 91-118. Oxford: Oxbow Books.

MARIĆ BAKOVIĆ, M. AND G. CAR. 2014. Konzervatorsko-restauratorski radovi I rezultati najnovijih analiza na tekstilnome plaštu is prapovijesnoga zemljanog tumula Br. 16, Pustopolje, Kupres. *Cleuna* 1, 30-47

MUNKSGAARD, E. 1974. *Oldtidsdragter*. København: Nationalmuseet.

PETRIE, W.M.F. 1898. *Deshasheh*. The Egypt Exploration Fund, Memoir 15, London: The Egypt Exploration Society.

- PETROVA, V. 2015. History of the Warp-Weighted Loom from the Neolithic till the end of Antiquity (according to archaeological data from the Present-day Bulgarian Lands). *Studia Archaeologica Universitatis Serdicensis*, Tome 5, 115-218.
- RANDBORG, K. 2011. *Bronze Age Textiles. Men, Women and Wealth*. London: Bristol Classical Press.
- RAST-EICHER, A. 2008. *Textilien, Wolle, Schafe der Eisenzeit in der Schweiz* (Antiqua 44). Basel: Archäologie Schweiz.
- RAST-EICHER, A. 2015. Schnidejoch: Neolithische, bronzezeitliche und römische Geflechte und Gewebe. In: Hafner, A. (ed), *Schnidejoch und Lötschenpass. Archäologie der prähistorischen, römischen und mittelalterlichen Passübergänge in den Berner Alpen*. Bd. 1, 30-38 Bern.
- RAST-EICHER, A. AND L. BENDER JØRGENSEN 2013. Sheep wool in Bronze Age and Iron Age Europe. *Journal of Archaeological Science* 40, 1224-1241.
- Rast-Eicher, A. and A. Dietrich 2015. *Neolitische und bronzezeitliche Gewebe und Geflechte. Die Funde aus den Seeufersiedlungen im Kanton Zürich*. Zürich and Egg: Kanton Zürich Baudirektion.
- REZAEI, H.R., NADERI, S., CHINTAUAN-MARQUIER I.C., ET AL., 2010. Evolution and taxonomy of the wild species of the genus *Ovis* (Mammalia, Artiodactyla, Bovidae), *Molecular Polygenetics and Evolution* 54 (2010): 315-326.
- SCHICK, T. 2003. *A 6000 Year Old Nobleman - Finds from the Cave of the Warrior*. Jerusalem: The Israel Museum
- Van Bommel, M.R. Joosten, I., Hofmann-de Keijzer, R. 2012. Dyestuff, mordant and condition of an early wool textile from Pustopolje, Bosnia-Herzegovina. Internal report 2012.
- VAN STRYDONCK, M. 2012. Radiocarbon dating report: Kupres – Bosnia Herzegovina, in the archives of the Hrvatski Restauratorski Zavod and the Franjevačkog muzeja i galerije Gorica, Livno
- VOGELSANG-EASTWOOD, G. 1993. *Pharaonic Egyptian Clothing*. Leiden/New York/Köln: E.J. Brill.

Captions

Fig 1. The Pustopolje Burial and detail of the textile (after Benac 1986)

Fig. 2. Overview of the Pustopolje textile. Points of examination are marked in red, felting in blue. Important constructional features marked with arrows. Photo: Hrvatski Restauratorski Zavod.

Fig 3. Radiocarbon dating of the Pustopolje textile. Copyright KIK/IRPA Brussels.

Fig. 4. Wool from the Pustopolje textile. Top: Pustopolje sample 11/147. Large fibres with net-like or horizontal scale pattern. Photo: Antoinette Rast-Eicher. Bottom: Pustopolje sample 11/144. Histogram of wool measurements. Inserted: Detail of the textile's surface showing coarse kemp fibers sticking out. Photo: Hrvatski Restauratorski Zavod.

Fig. 5. The overall construction of the Pustopolje textile. Arrows indicate the direction of weaving in each of the three stages of production: the starting border, the main web, and the finishing border. The weft of the starting border becomes the warp of the main web, and turns into the weft of the finishing border. Drawing: Karina Grömer.

Fig. 6. The starting border and selvages of the Pustopolje textile. Graphics: Karina Grömer, photos Hrvatski Restauratorski Zavod.

Fig. 7. The finishing border of the Pustopolje textile. Graphics: Karina Grömer.

Fig. 8. Stitch in the Pustopolje textile. Photo: Hrvatski Restauratorski Zavod.

Fig. 9. Dimensions and constructional details of large Bronze Age textiles from Pustopolje, Borum Eshøj C, Skrydstrup, Muldbjerg and Egtved. Measurements of the Danish finds are based on Broholm & Hald 1940 but simplified and do not show minor irregularities in shape. Graphics: Karina Grömer.

Fig. 10. The folding of the Pustopolje textile during burial. Drawing: Branka Regović, Hrvatski Restauratorski Zavod.

Table Captions

Table 1: Dates of Bronze Age graves with large textiles, based on Christiansen 2006 for Danish finds. A female grave in the Borum Eshøj mound (grave C) has not been dated by dendrochronology as the oak coffin has not been preserved. Like Borum Eshøj graves A and B it can be dated to Montelius Period II. Its placement in the mound indicates that it was deposited after graves A and B.

Table 2: Technical data of the Pustopolje textile. Please notice that the warp* of the main web is the weft of the starting border, and that weft** of the finishing border is the warp of the main web.