

## Hallstatt Period Fibre Analysis from Slovenian Burials

### Halštates perioda šķiedru analīze Slovēnijas teritorijas apbedījumos

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Multiple Slovenian cemeteries of the early Iron Age/Hallstatt period (800–400 BC) yield mineralised textile finds. Due to preservation of the textiles on metal objects, they can be contextualised and analysed using a variety of methods. The current paper discusses the applicable methods and information that can be acquired from very small textiles fragments. Difficulties arise particularly due to the lack of documentation of the old excavations and the past restoration work. It is not only modern excavated material that can be meaningful; the finds from the late 19<sup>th</sup> century are worth re-examining, especially since technology and methodology have evolved. Gaining information from microstratigraphy, comparing relevant finds and fibre analysis are just a few methods shown within this research. The work was a collaborative project with Karina Grömer and the National History Museum Vienna (Austria) and formed a part of my master's thesis.

**Keywords:** Iron Age, textile analysis, old excavation, Slovenia, fibres.

Slovēnijas teritorijā vairākos kapulaukos, kas datējami ar agro dzelzs/Halštates periodu (800.–400. g. p. m. ē.), ir atrastas mineralizējušās tekstilijas. Tā kā šīs tekstilijas ir saglabājušās uz metāla priekšmetiem, tās ir iespējams kontekstualizēt un analizēt ar dažādām metodēm. Šajā rakstā aplūkots, kādas metodes ir lietderīgi izmantot un ko iespējams uzzināt, analizējot sīkus tekstiliju fragmentus. Grūtības materiāla analizē radīja vājā arheoloģisko izrakumu dokumentācija un ziņu trūkums par iepriekš veiktajiem restaurācijas darbiem. Nozīmīgs ir ne vien mūsdienās iegūtais arheoloģiskais materiāls, bet arī atradumi no 19. gadsimta beigām, tos ir iespējams atkārtoti analizēt, jo izpētes metodes laika gaitā ir attīstījušās. Mikrostratigrāfija, salīdzinošā metode un šķiedru analīze ir vien dažas metodes, kas izmantotas šajā pētījumā, lai iegūtu jaunu informāciju par senajām tekstilijām. Šis darbs veikts kopīgā projektā ar Karīnu Grēmeri (*Karina Grömer*) un Vīnes

Nacionālo vēstures muzeju (Austrija) kā daļa no autores maģistra darba.

**Atslēgvārdi:** dzelzs laikmets, tekstiliju analīze, senie izrakumi, Slovēnija, šķiedras.

## Introduction

The archaeological sites Magdalenska Gora, Brezje and Podzemlj represent settlements and necropolises of the so-called Dolenjsko group in south-eastern Slovenia.<sup>1</sup> Large settlements such as Magdalenska Gora, as well as Stična or Vače developed into wealthy centres and reached their cultural peak between 725–600 BC according to the Hallstatt stages HA C1 to HA C2, which were named after the Iron Age cemetery and salt mine in Hallstatt, Austria.<sup>2</sup> Iron and salt mining generated wealth in the Hallstatt areas.<sup>3</sup> Most of these sites in Slovenia, which date from the Hallstatt period, were excavated from the end of the 19<sup>th</sup> century until the early 20<sup>th</sup> century.<sup>4</sup> Private excavators and noblewomen from Germany and Austria concentrated on the large tumuli, where they expected to discover jewellery and weapons.<sup>5</sup> These mounds had been in use until the early Latène period (450–380 BC), and each contained several burials, both urn graves and inhumations.<sup>6</sup>

Unfortunately, the acidic soil destroyed most of the skeletal material and other organic objects.<sup>7</sup> Characteristic grave goods for “rich” graves in Slovenia are weapons, jewellery, horse harnesses and drinking vessels, mostly in the form of *situlae*.<sup>8</sup>

The excessive late 19<sup>th</sup> century excavations were insufficiently documented.<sup>9</sup> Since Slovenia and the sites were part of the Austrian Monarchy, most of the objects were transferred to Vienna and are now part of the Natural History Museum’s

collections.<sup>10</sup> All three sites – Magdalenska Gora, Brezje and Podzemlj were published between 1960 and early 2000. These publications are useful for the interpretation of the textile finds.<sup>11</sup>

Lise Bender Jørgensen analysed some of the textiles in the 1980s and published her results in 2005.<sup>12</sup> She documented some details, such as fabric structure, thread twist and possible material. However, due to the means available at the time, no further data, for example, twist angle or similar, was recorded. For the most part, her data matched the current research. However, with today’s digital microscopes and photographs, more accurate data can be obtained simply because of the advanced technology. During my research, more unknown textiles were identified in the museum’s storage facilities.

A total of 26 textile fragments have been mineralised on different metal objects. The preservation varies from single threads in the millimetre range to fragments of several centimetres in size. Due to the preservation and conservation conditions, the textiles are rigid and no longer flexible, nor do they show any colouring, as the patina encloses everything. Depending on the metal, the colours change from green and blue to rusty red. The weave and thread structure can be recognised in most cases.

As the material consists of old finds, some of which lack context in addition to the outdated conservation, the question arises as to what information and data can be obtained from the analysis of these textiles and how these can be interpreted.

The first question is to what extent a material analysis can be carried out, and whether we can collect meaningful data to answer questions about textile quality, material (animal or plant fibres) and manufacturing techniques.

Furthermore, the questions to be answered concern clothing of the deceased, and whether utilitarian textiles are also to be found in the graves. All 26 textile fragments from the Slovenian graves were examined using the same methods, and the data collected is reflected in the examples presented here. The objects presented for this article showed us new aspects and the greatest possible application of technology and methodology to the old finds. The comprehensive analyses of all textiles are published in Vienna, Austria in 2021 and form the basis for the current article.<sup>13</sup>

## Methods

Over the past decades, the basis of textile research has adapted to a relatively uniform system.<sup>14</sup> Various types of methods and investigations were applied, some of which were more closely aligned with research in the natural sciences than that of the humanities. Consequently, the following methods are used: fibre analysis by scanning electron microscopy (SEM, used for the present work: JEOL, JSM-6610LV of the Central Research Laboratory of the Natural History Museum Vienna), microstratigraphy, wool fineness measurements, three-dimensional investigations, and reconstructions of whole garments.<sup>15</sup> In addition, recent examples can and should also help answer the previously formulated questions. With regard to fibre analysis, samples from modern animals are essential, as they can show differences or developments.<sup>16</sup>

Naming and interpreting the properties and the technical fibre details consistently are the basic approaches of the Creativity and Craft Production in Middle and Late Bronze Age Europe (CinBA) research project. The definitions and terminologies in English and German were developed by

Lise Bender Jørgensen, Karina Grömer and Helga Rösel-Mautendorfer as a research group for textiles.<sup>17</sup>

The presentation of the textile layers and objects in relation to each other is done in microstratigraphs, based on the guidelines of the Landesamt für Denkmalpflege in Bayern and the standards of the Natural History Museum Vienna.<sup>18</sup>

In addition to the textiles, all tools known in the tombs that are related to textile production were also recorded for this work. The data basis created here adopts the scheme of the Centre for Textile Research (CTR) in Copenhagen, which was designed, among others, by Eva Andersson Strand, Lone Gebauer Thomsen, and Joanne Cutler for the research projects in Denmark.

## Fibre analysis

Usually, no fibre samples can be taken from mineralised textiles. The fragments are no longer flexible and already have been conserved by the restorers. To identify the fibres of a mineralised textile, the whole object needs to be inserted into a Scanning Electron Microscope (SEM). In this case, the size of object 66.808 allowed it to be microscoped completely and non-destructively (Fig. 1).

The negative imprint of a fibre could be made visible through a chipped area on one of the threads. In comparison with mineralised sheep wool fibres from Iron Age objects found in Switzerland (Fig. 2), these fibres could be identified as sheep wool by their scale.<sup>19</sup>

## Škrilje, Tumulus I, Grave 16

The only textile find from Škrilje near Podzemlj is a three-button brooch, Inv.



Fig. 1. The corroded bundle of metal chains 66.808.

Photo: Alice Schumacher.

1. att. Korodējis metāla ķēžu saišķis 66.808.

Foto: Alise Šūmahere.

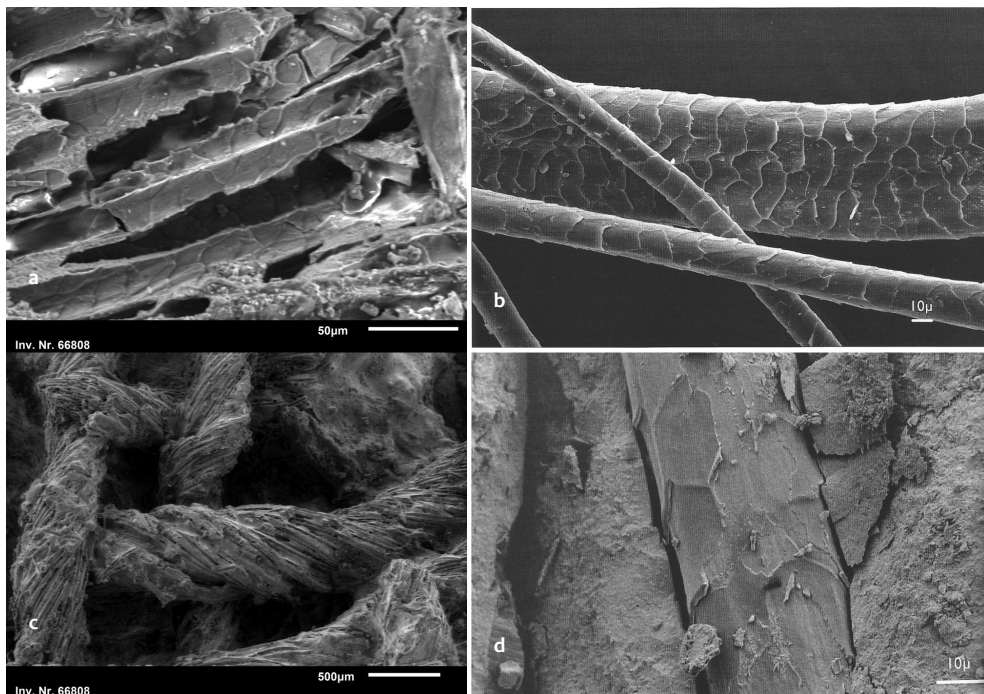


Fig. 2. On the left, SEM images of the fibres from 66.808. On the right, recent comparisons with sheepskin fibres and their scale shape.

Left SEM images: Angelika Rudelics. Right – RAST-EICHER. Fibres, pp. 267, 272.

2. att. Pa kreisi – šķiedras attēls SEM mikroskopā no parauga 66.808. Pa labi – mūsdienai vilnas šķiedras un to zvīņojuma forma.

Foto 2.a, c: Angelika Rudeliksa; 2.b, d: RAST-EICHER. Fibres, pp. 267, 272.

No. 67.423 (Fig. 3) from a cremation burial. According to the excavators' notes, a black urn full of charcoal was discovered, and next to the urn laid a fibula, a ring and a lance tip. The urn does not appear to have been preserved. Fritz E. Barth also lists a bronze arm ring to this complex.<sup>20</sup>

A larger textile fragment adheres to the side of the needle holder of the fragmented fibula. The preservation is quite good and the 2/2 twill weave is clearly visible. L. Bender Jørgensen worked on this object for the first time in the 1980s. She observed that there is a relatively regular spinning direction pattern in one of the thread systems.<sup>21</sup>

The technical data collected in the current analyses agrees well with the older investigations.

The spinning pattern could be analysed even better under the microscope and can be read as follows, as also shown in Table 1: / 1s, 4z, 1s, 3z, 1s, 4z, 1s, 5z, 1s, 4z, 1s/.

The pattern can only be detected in one system, in system two we only have s twisted yarns. Twist angles of about 30 degrees are quite common in the finds from the Slovenian graves<sup>22</sup> and can be spun even steeper with up to 40 and 50 degrees. With the diameter of the threads ranging from 0.4 to 0.5 mm, very evenly spun and fine threads can be detected in the fabric.

The fabric is slightly warped, but otherwise in such good condition that an attempt was made to take SEM images. However, it turned out that the preservatives on top of the fabric stuck the yarns together too much, which meant that no fibre analysis was possible.

Since the fibula obviously had not been placed in the urn and the condition of the textile is good, it can be ruled out that the object has been on the pyre during the fire. Different possibilities are conceivable as to how the textile got to the fibula. Everything seems plausible regarding



Fig. 3. 67.423 is a fragmented three-button brooch with a strip of twill fabric preserved on its needle holder.

Photo: Alice Schumacher.

3. att. Paraugs 67.423 – fragmentāra trīs pogu sakta, kurai pie adatas turētāja saglabājies sarža audums.

Foto: Alise Šūmahere.

Table

Table of technical data for textile 66808.  
The spinning pattern is: 1: / 1s, 4z, 1s, 3z, 1s, 4z, 1s, 5z, 1s, 4z, 1s/.

Tabula

Tehnisko datu tabula tekstila paraugam Nr. 66808. Vērpums: 1: / 1s, 4z, 1s, 3z, 1s, 4z, 1s, 5z, 1s, 4z, 1s/.

	System 1	System 2
Yarn/ply	Yarn	Yarn
Twist direction	s/z	s
Twist angle	Ca. 30°	Ca. 30°
Twist diameter	Ca. 0.4 mm	Ca. 0.5 mm
Thread count (thread per cm)	Ca. 10 t/cm	Ca. 12 t/cm



separately laid down fabric that was sealed by a fibula to the wrapping of the urn.<sup>23</sup>

Three-knob brooches are usually discovered as burial objects in women's graves and found in various positions in inhumations. In a find from Loreto Apruntino in Italy, several such brooches have been discovered on the back of the head and are interpreted as decorative elements for a veil.<sup>24</sup> The question whether, on the basis of this fact, a woman's grave can also be assumed here, cannot be answered unequivocally.

### Iron Age sheep

On object 66.808 from Podzemlj, Grm, Tumulus XXXVIII, Grave 4 (d), sheep's wool was clearly detected by analysis using a scanning electron microscope in comparison with mineralised sheep wool fibres from Iron Age samples as seen in Fig. 2.<sup>25</sup> Sheep's wool is also frequently found in contemporaneous textile finds of the Hallstatt Culture, not least at the Hallstatt site itself.<sup>26</sup>

In the course of the Bronze Age up to the Iron Age, the breeds of sheep and the way in which handling of these animals changed. Both the size of the sheep and the quality of the wool changed.

The larger Iron Age sheep had lighter-coloured coats and long, curly fibres.<sup>27</sup> With the help of archaeozoological investigations, several sheep breeds can be identified for the Iron Age. In the case of preserved fibres, the differentiation of breeds can sometimes also be made on the basis of the diameter of the fibres by means of wool fineness measurements.<sup>28</sup> Since domestication meant that sheep could no longer shed their winter coat on their own accord, the winter coat shearing had to be done by humans with iron shears.<sup>29</sup>

Textile finds from archaeological contexts often consist of sheep's wool and show the processing of wool with a wide variety of fibre preparation, spinning and weaving techniques. The variety of techniques also implies a range of qualities that sheep's wool must bring – a phenomenon that continues to expand in the Iron Age.<sup>30</sup>



Fig. 4. On the left – one of the five iron rings 86.608 with a piece of hide. This was used for the SEM examinations. On the right – all five rings.

Photo: Alice Schumacher.

4. att. Pa kreisi – viens no pieciem gredzeniem, paraugs 86.608, kuram saglabājusies kažokāda un kurš izmantots SEM analizēm. Pa labi – visi pieci gredzeni.

Foto: Alise Šumahere.

Thus, it can be seen that in the preparation of the wool, several steps of sorting, washing and combing led to the different qualities.<sup>31</sup>

### The horse hide from Magdalenska Gora, Tumulus II

A special find was made in the richly furnished grave 57 from Magdalenska Gora, Preloge, Tumulus II, which, in

addition to many grave goods, also had a horse positioned above the buried person. Remains of a hide were discovered on some iron rings (inv. no. 86.608, (Fig. 4).

Through images taken with a scanning electron microscope (Fig. 5) and fibre analysis, the hairs on the ring could be clearly identified as horse hair due to their characteristic scale structure.<sup>32</sup> The horse hair was compared with a recent primitive horse breed. Samples of the Przewalski's horse (*Equus ferus przewalski*) were taken

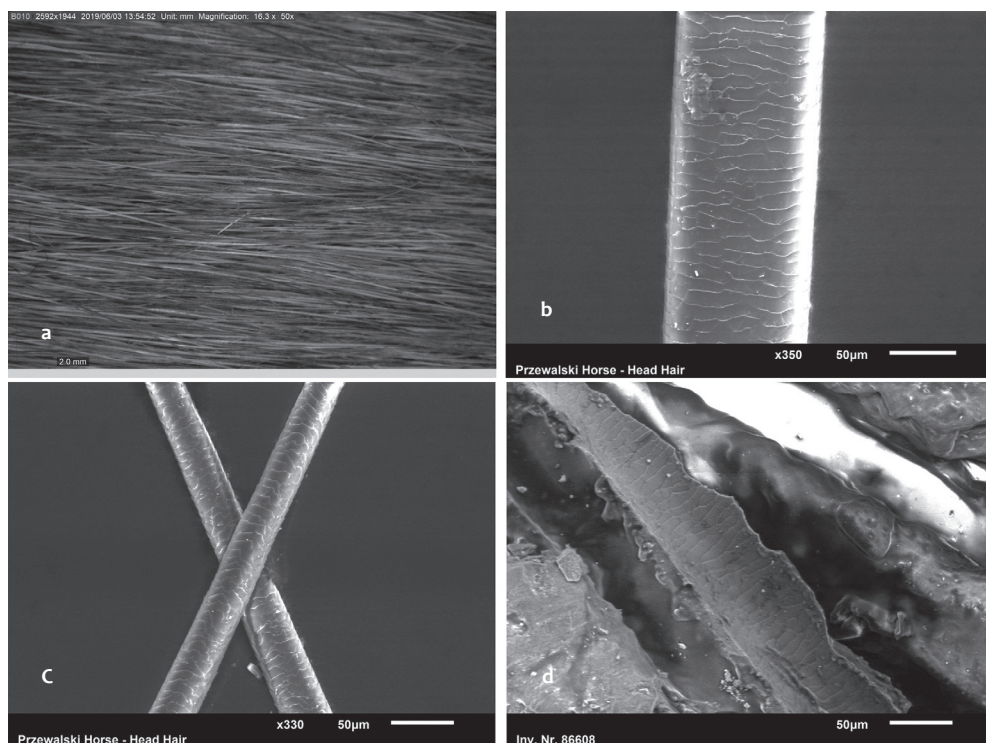


Fig. 5. a – microscope image of the coat structure on the head of the Przewalski's horse; b – SEM image of a hair from the head of the same horse; c – SEM image of two hair samples from the head of the Przewalski's horse; d – SEM image of a negative impression.

Photo: 5. b, c: Angelika Rudelics, 5.a, d: Ronja Lau.

5. att. a – mikroskopattēls ar Prževaļska zirga galvas daļas kažoka struktūru; b – SEM mikroskopattēls ar Prževaļska zirga galvas daļas matu; c – SEM mikroskopattēls ar diviem Prževaļska zirga matiem no galvas daļas; d – SEM mikroskopattēls ar mata negatīva iespaidumu.

Foto 5.b, c: Angelika Rudeliķsa, 5.a, d: Ronja Lau.

from the holdings of the Zoological Collection of the Natural History Museum Vienna.<sup>33</sup> Five different hair samples were taken from the coat (head, mane, neck, flank and tail). Under the microscope, the different hair structures of the various parts of the body were revealed, with the sample from the head matching the archaeological sample from the tail. The sample from the head corresponded best with the archaeological find.

The Przewalski's horse originates from Mongolia. When it became extinct in its natural habitat, it could be reintroduced into the wild through breeding.<sup>34</sup> Due to its stature and the texture of its coat, it corresponds very well to the image of an Iron Age horse and is therefore suitable as a comparison sample. Another possibility for sampling would be the tarpan (*Equus ferus*), which, however, is not part of the zoological collection of the Natural History Museum Vienna. It is related to the Przewalski's horse and is considered the ancestor of some domesticated horses.<sup>35</sup>

No statement can be made today about the condition of the horse skeleton found in Tumulus II, Grave 57, and which species exactly it belonged to. The zoological material from the excavations is available in the Museum of Natural History in Vienna. However, no record of this tomb and the skeleton had been retained or it must have been lost. Therefore, the horse bones do not have an inventory number and could not be located. Other horse bones from the graves in Magdalenska Gora were only titled as domestic horse (*Equus caballus*).<sup>36</sup>

### Horses in the graves of the Eastern Hallstatt Region

The horse burials in the Eastern Hallstatt area and in the Dolensko group have been and still are part of various

researches.<sup>37</sup> In 1968, Sandor Bökönyi began to elaborate the archaeozoological material from Magdalenska Gora with a discussion of horse breeds, species, groups and their characteristics in the eastern Hallstatt area. Above all, this concerned the finds of the Mecklenburg collection from the Peabody Museum.

S. Bökönyi's actual approach was to distinguish the Scythian from the Celtic horses on the basis of their skull size. When looking at the material from Magdalenska Gora, it is thought that these horses are very similar to the Scythian type. The following data were recorded for comparison: body size, proportions, characteristics of the skull, tooth enamel pattern and the size of certain long bones.<sup>38</sup>

Taking into account all previous theories on the development and domestication of the horse, Bökönyi first distinguished between oriental and western (local) species. Some of the prehistoric horses from Central and Eastern Europe were already assigned to the Oriental type. This is slender with a height at the withers of 112 to 141 cm. The western type was smaller. Larger specimens pointed to the eastern type or later also to Roman type.<sup>39</sup>

According to regional and morphological characteristics, an eastern group may include horses from Scythian complexes, from Hallstatt Hungary, Magdalenska Gora, Šentvid and Brezje, Thracian horses from Bulgaria and Romania of the 6<sup>th</sup> century BC, as well as Scythian and Greek horses from the Ukraine and southern Russia. The western group – the horse skeletons from Manching and from various Hallstatt sites in Germany and Austria.

The image that exists of the western "Helvetic-Gallic" horse is much worse than that of the eastern horse because of the few finds.<sup>40</sup>

The examined bones from both Magdalenska Gora and Brezje show that the finds



there clearly exhibit parallels to the Scythian horses. They were most likely used for more specific purposes because of their characteristics. They were able to carry heavy loads, to move quickly as mounts and cover long distances. This made them not only livestock but also close companions of the people. The type of horse described only appears in graves during this period; it has not yet been found in a settlement context.

The specific characteristics suggest that 83 such horses very likely reflected the social status of their owners.<sup>41</sup>

Throughout the eastern Hallstatt area, horse burials together with or next to their owners are not uncommon.<sup>42</sup> Apart from the horse burial from Magdalenska Gora Tumulus II, Grave 57, there is a total of three other graves in the Hallstatt Dolenjsko group which contain a horse and are situated above a human grave. Two of them are also in Magdalenska Gora and one in Novo Mesto on the Kapiteljska njiva.<sup>43</sup>

The range of objects found in the horse graves with horse harnesses and bronze cauldrons is not particularly wide, but these objects can be richly decorated, as in the case of the horse harnesses of the Szentes-Vekerzug type horse harnesses.<sup>44</sup> Furthermore, people, as well as horses were equipped with the grave goods. Only the harness was more often placed in the grave of the buried person(s).<sup>45</sup>

## Discussion

The exact location of the five iron rings with the number 86.608 in the grave cannot be determined precisely from the available records. In particular, it is unclear whether they belong to the area of the human skeleton, or perhaps to the horse burial above. A mixture of finds has often been observed in such old excavations and

should be considered. The attached remains of horsehair rather lead to the assumption that the rings are parts of a horse harness, namely, the parts that were applied to the head, as suggested by the strong correspondence with the hair samples from the Przewalski's horse described above. It can be assumed that the rings slipped out of their original position in the course of decay and collapse of the small burial chamber.

These considerations are speculative, but plausible. The laying down of an additional horse hide in the grave is possible in principle, but comparisons with Scythian traditions do not provide any confirmation of this.

In Pazyryk, Russia, 1950s, V. O. Vitt succeeded in excavating the only mummified Scythian horses. Scythian horses that belong to a time horizon comparable to the finds from Magdalenska Gora time horizon. Due to favourable climatic and geological conditions, the horses have been preserved with their hide and equipment. They had different shades of yellow as coat colour and had short-cut manes, as can also be seen on numerous situlae.<sup>46</sup> The larger specimens were equipped with harness and masks, thus illustrating their value.<sup>47</sup> Skinning of the horses in Scythian areas, as well as in Magdalenska Gora and the addition of hide can be excluded on the basis of this finding.

## Conclusions

Woven fabrics of all kinds have always been part of prehistoric, historic and present societies. This sounds trivial but it is necessary to point it out, as textile archaeology is not always taught or in the minds of archaeologists.

The museum collections contain numerous objects from old excavations such

as these textiles. With the advancement of research, technology and methodology, there are increasing opportunities to study these textiles. There are expanding options for exploring the little-lit corners of textile archaeology and collecting the data. Only this data yields an insight into the production of textiles and the clothing of people in prehistory and early history.

Even from supposedly poorly preserved old finds excavated more than 100 years ago and already conserved and restored, such as those from the Slovenian cemeteries presented here, a great deal of data can be collected and restored. In part, these

support the common theories and interpretations on cultures, especially of the Early Iron Age.

Archaeologically evaluated textiles contribute to a more accurate picture of numerous prehistoric societies, because clothing has been and still remains a concise component of people's lifeworld, their identity and affiliation. One of the goals of this work is to strengthen the perception and acknowledgment for textile archaeology and archaeological finds from old excavations. It is not only modern excavated material that can be meaningful; the finds from the late 19<sup>th</sup> century are worth re-examining.

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- <sup>41</sup> *Ibidem*, p. 41.
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## KOPSAVILKUMS

Vairākos agrā dzelzs laikmeta / Halštates perioda (800.–400. g. p. m. ē.) apbedījumos Slovēnijas teritorijā sastopami mineralizētu tekstiliju atradumi. Tā kā tie ir saglabājušies uz metāla priekšmetiem, tos iespējams kontekstualizēt un analizēt, izmantojot dažādas metodes. Šajā rakstā aplūkots, kuras metodes ir būtiskas un ko iespējams uzzināt, analizējot sikus tekstiliju fragmentus. Izmantotās pētījumu metodes – eksperimentālā arheoloģija, tekstiliju priekšmetu analīze u. c. veida analīzes – interpretētas plašā, nacionāla mēroga skatījumā. Pētījums tapis kopīgā projektā ar Karīnu Grēmeri (*Karina Grömer*) un Vīnes Nacionālo vēstures muzeju, tas ir daļa no autorei maģistra darba.

Magdalenskas Goras, Brezjes un Podzemeljas arheoloģiskie pieminekļi reprezentē tā sauktās Dolenjsko grupas apmetnes un kapulaukus, kas atrodas Slovēnijas dienvidaustrumos. Šo ģeogrāfisko reģionu ir izdevīgi apdzīvot dzelzs atradņu, upju un ieleju dēļ. Tādas apmetnes kā Magdalenska Gora, Stična vai Vače attīstījās par turīgiem centriem, sasniedzot savas kultūras kulmināciju 725.–600. g. p. m. ē. jeb HA C1 līdz HA C2. Tieši dzelzs un sāls ieguve padarīja Halštati par bagātu reģionu.

Lielākā daļa šo Halštates perioda pieminekļu ir arheoloģiski pētīti 19. gadsimta beigās – 20. gadsimta sākumā. Privātie izrakumu veicēji vai muižnieki no Vācijas un Austrijas galvenokārt strādāja lielajos uzkalniņos, kur cerēja iegūt daudz rotaslietu un līdzīgus atradumus. Šajos uzkalniņos atradās vairāki apbedījumi, kas bija vienlīdzīgi sadalīti kremētajos (urnas) un inhumācijas apbedījumos, kuri datējami ar La Tēnas (*La Tène*) periodu. Diemžēl skābā augsne ir iznīcinājusi lielāko daļu skeletu materiālu u. c. organiskus priekšmetus. Raksturīgs turīgo personu apbedījumu kapa inventārs ir ieroči, rotaslietas, zirgu iejūgs un dzeramie trauki, galvenokārt *situlae* formā.

Masveida 19. gadsimta beigu izrakumi nav pietiekami dokumentēti. Tā kā Slovēnija un šīs senvietas atradās Austrijas monarhijas sastāvā, lielākā daļa atrasto senlietu tika pārvestas uz Vīni un tagad ir daļa no Dabas vēstures muzeja kolekcijām.

Visos trīs pieminekļos – Magdalenskā Gorā, Brezjē un Podzemeljā – atrastie materiāli aprakstīti laika posmā no 20. gadsimta 60. gadiem līdz 21. gadsimta sākumam. Šajās publikācijās atrodamas nozīmīgas interpretācijas, kas veido pamatu tekstilmateriālu atradumu

grupas izpētei. Piemēram, Lise Bendere Jergensena (*Lise Bender Jørgensen*) 80. gados analizējusi daļu no tekstiliju atradumiem un rezultātus publicējusi 2005. gadā. Tomēr šajā pētījumā nav apzināti visi šo materiālu grupai pieskaitāmie priekšmeti, un, autore veiktais izpētes laikā muzeja krātuvē tika identificētas vēl vairākas tekstilijas.

Pēdējās desmitgadēs arheoloģisko tekstiliju izpētē ir izveidojusies vienota standartizēta sistēma, tiek lietotas dažādas starpdisciplināras metodes, kas raksturīgas dabaszinātnēm. Tekstiliju izpētē izmanto tādas metodes kā šķiedru analīze ar skenējošo elektronu mikroskopu (SEM), mikrostratigrāfija, vilnas smalkuma mērījumi, trīsdimensionālā izpēte un rekonstrukcijas. Šķiedru analīzē ir būtiski izvēlēties paraugus no mūsdienu dzīvniekiem, jo tādejādi iespējams noteikt atšķirības un attīstības tendences.

Lai varētu interpretēt tehnisko šķiedru īpašības un iegūtos datus, izmantotas pamatpieejas un definīcijas, kas izstrādātas projektā *Creativity and Craft Production in Middle and Late Bronze Age Europe* (CinBA). Terminoloģiju angļu un vācu valodā radījušas L. Bendere Jergensena, K. Grēmere un Helga Rēzele-Mautendorferē (*Helga Rösel-Mautendorfer*).

Papildus tekstilijām tika analizēti un reģistrēti visi apbedījumos esošie darbarīki, kas saistīti ar to izgatavošanu. Šo senlietu datubāzei par pamatu izmantota Kopenhāgenas tekstiliju pētniecības centra (CTR) shēma, kuru izstrādāja Ēva Andersone Stranda (*Eva Andersson Strand*), Lone Gebauere Tomsena (*Lone Gebauer Thomsen*), Džoena Katlere (*Joanne Cutler*) u. c. Savukārt eksperimentālās arheoloģijas izmantošana palīdz izziņāt tekstiliju ražošanas procesus un to valkāšanas tendences. Mikrostratigrāfija pētījumā izmantota, lai attēlotu tekstiliju un priekšmetu savstarpējo saistību. Par mikrostratigrāfijas standartu izvēlētas Bavārijas Pieminekļu aizsardzības centra (*Landesamt für Denkmalpflege in Bayern*) un Vīnes Dabas vēstures muzeja izstrādātās vadlīnijas.

Dažādi audumi vienmēr bijusi daļa no aizvēstures, vēstures un mūsdienu sabiedrībām. Lai gan tas skan triviāli, ir nepieciešams to akcentēt, jo tekstiliju arheoloģija, kaut arī sniedz nozīmīgu informāciju, joprojām tiek uzskatīta par sekundāru.

No seniem atradumiem, kas atsegti pirms vairāk nekā 100 gadiem, ir konservēti un restaurēti, kā, piemēram, no šeit pētītajiem kapulaukiem, ir iespējams iegūt daudz jaunu datu, pat ja atradumi ir vāji saglabājušies. Šie dati daļēji apstiprina vispārpieņemtās teorijas un interpretācijas par arheoloģiskajām kultūrām, īpaši agrajā dzelzs laikmetā.

Viens no šī darba mērķiem ir veicināt izpratni par tekstiliju arheoloģiju un seno irakumu arheoloģisko materiālu. Šis pētījums pierāda, ka svarīgi ir ne vien mūsdienās izraktie atradumi, bet arī tie, kas atsegti 19. gadsimtā, tos ir vērts pētīt atkārtoti.

Arheoloģiski pētītas tekstilijas palīdz veidot precīzāku priekšstatu par senajām sabiedrībām, jo apģērbs bija un ir būtisks cilvēku dzīvesziņas, identitātes un piederības rādītājs.