

Maria Cybulska,  
\*Jerzy Maik

# Archaeological Textiles – A Need for New Methods of Analysis and Reconstruction

Technical University of Łódź  
Institute of Textile Architecture  
ul. Żeromskiego 11, 690-543 Łódź, Poland  
E-mail: maria.cybulska@p.lodz.pl

\* Institute of Archaeology and Ethnology  
(formerly the Institute  
of the History of Material Culture)  
Polish Academy of Sciences Łódź Branch  
ul. Tylina 1, 90-364 Łódź, Poland,  
E-mail: archeo@bilbo.cbmm.lodz.pl

## Abstract

*Archaeological textiles bear important testimony to everyday life, farming, trade, migration of nations, religious rituals, art and technical culture. The main reason we know very little about them is that textiles are very impermanent, fragile, and can survive well only in very good conditions. Most of them become nearly completely destroyed due to ageing in an extremely hard archaeological environment. However, it is possible to determine and identify the properties that archaeological textiles had in the past. Research undertaken by us resulted in the development of methods of analysis and visualisation of archaeological textiles in the form they were originally made, which will be presented in our next paper. This paper is to present the main problems scientists have to face when dealing with archaeological textiles.*

**Key words:** *archeological textiles, textile deterioration, textile sewability, archeological textile forms, textile reconstruction.*

that textile remains are exceedingly rare in archaeological sites. When compared with artefacts of a more durable nature as ceramic or metal, the survival of textile objects in an extremely difficult archaeological environment is uncommon. Textiles are very impermanent, and because of their fragility they can survive in good shape only in very good conditions. Unfortunately, they are most often discovered in crypts or ground graves where they have stayed for sometimes thousands of years exposed to humidity, extreme temperatures, fungi and microbes. Unlike Egypt or the Near East, well preserved textiles in Europe are very rare. Growing awareness of the value of these materials for many different areas of science has resulted in increasing interest in archaeological textiles.

Although collections of archaeological textiles finds in Poland are quite numerous, there still exist old collections of finds only cursorily analysed. The reason is mainly a lack of standards determining precisely what should be analysed and how, as well as the lack of a “common language” combining archaeological, historical, artistic and technical aspects, which archaeological textiles should be described in.

Proper documentation of these objects requires cooperation between researchers representing different areas of science like archaeology, chemistry, textile technology, and history of art. Archaeological textiles are especially difficult to analyse due to deterioration, discolouration, and so on. However, it is possible to determine and identify the properties archaeological textiles had in the past. Research undertaken by a research group from the Technical University of

Łódź, the Institute of Textile Architecture and the Institute of Archaeology and Ethnology, Polish Academy of Science, Łódź resulted in the development of methods of analysis and visualisation of archaeological textiles in the form they were originally made, which will be presented in our next papers, which will include results. The aim of this paper is to present the main problems scientists have to face when dealing with archaeological textiles.

The term *textiles* is applied to all products which result from interlacing threads made from fibres, mainly to woven fabrics, but also to the other structures obtained by braiding, looping, knitting, lace making, netting, etc. It also includes twines, cords, ropes and materials such as felts, obtained by a process other than spinning.

The term *archaeological textiles* means individual textile objects or collections resulting from archaeological excavations. Documentation of the object includes all information concerning conservation, analysis of cultural and historical context, data concerning the archaeological site, as well as results of different qualitative and quantitative analysis.

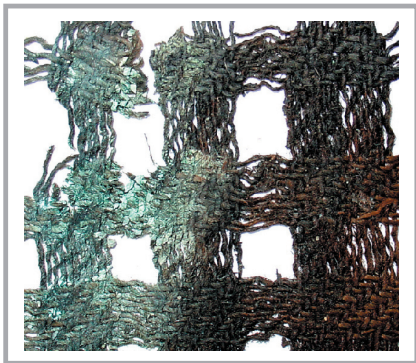
Archaeological textiles represent mainly spun, braided and woven structures, made from natural fibres of animal and vegetable origin: wool, hair, silk, cotton, flax, jute, hemp, nettle, grass, etc.

## ■ The beginnings of textiles

The history of textile products and technologies is very long. It has been proved that fibrous materials were already known in

## ■ Introduction

When we think about archaeological discoveries we have in mind mainly picturesque ruins, beautiful jewellery and ceramics from Egypt, Byzantium or ancient Greece. Except for the Turin Shroud, known for religious reason rather than as a textile product, we know very little about textiles, though they bear important testimony to everyday life, farming, trade, migration of nations, art and technical culture of different areas of Europe during the centuries of the formation of European culture and identity. The main reason for such a situation is



**Figure 1.** A fragment of fabric made from wool and linen from the 2<sup>nd</sup> century, Leśno, Poland.

the Upper Palaeolithic. The first evidence of a textile product is the carved bone figure of Venus wearing cloth in the form of a fringe of twisted strings of fibre, dating from about 20000 B.C. [1]

The first proof of weaving is dated to around 7000 B.C. It comes from impressions of textiles stamped on two little clay balls found in Iraq. Fragments of simple linen burial cloths prove that weaving with flax existed circa 6000 B.C. in Çatal Hüyük, site of a Neolithic city in the Konya region of Anatolia. In Jarmo in northeast Iraq there is evidence of woven cloth circa 7000 B.C., while in Nahal Hemar in the Judean desert there is proof of woven cloth circa 6500 B.C.[2] Other evidence from Mesolithic and Upper Palaeolithic are impressions recovered in sites in Eastern Europe. Sometimes microscopic amounts of fibre remains were found in the material containing the impressions [3].

The first material used for textile products was probably vegetable. Carbonised remains of textiles recovered in Turkey, dating from around 6000 B.C., were made from flax fibres. Similar textile objects were found in the alkaline lake mud of Robenhausen and Irgenhausen, two Neolithic lakeside settlements in Switzerland, dating from around 3000 B.C., where fragments of high quality linen cloth were uncovered. They were woven stripes, checks, triangles with fringes, beadwork and fancy edges. One of the woven pieces has triangles within a complicated pattern of interlaced checks [4]. Neolithic flax textile objects were also found in Egypt. For instance, at the site in Faiyum a fragment of linen fabric dating from around 5000 B.C. was found in a small pot [5]. The oldest known garment is a 5000 year old linen shirt with

finely pleated shoulders and sleeves, and creases inside the elbows.

Use of protein fibres was the beginning of the use of dyes, because animal fibres can be dyed much easier than flax. It is known that from around 3000 B.C. dyeing techniques were well established in China. However, scientists still cannot determine when exactly the dyeing of textiles began.

In the Bronze Age textile production was well developed. Evidence for the manufacturing of textiles comes from Denmark from famous Bronze Age burial mounds and bog finds. In each grave significant textile remains were found. They include coats, skirts, tunics, hats, caps, hairnets and many others. Early Celtic textiles come from the marshes of Northern Europe. Peat preserves organic materials very well, including textiles. Graves dating from around 1300 B.C. uncovered in the Netherlands contained rich woollen garments, among others woollen underwear decorated with embroidery, woollen skirt, scarf, and leg wrappings. The most valuable of them were dyed blue [3].

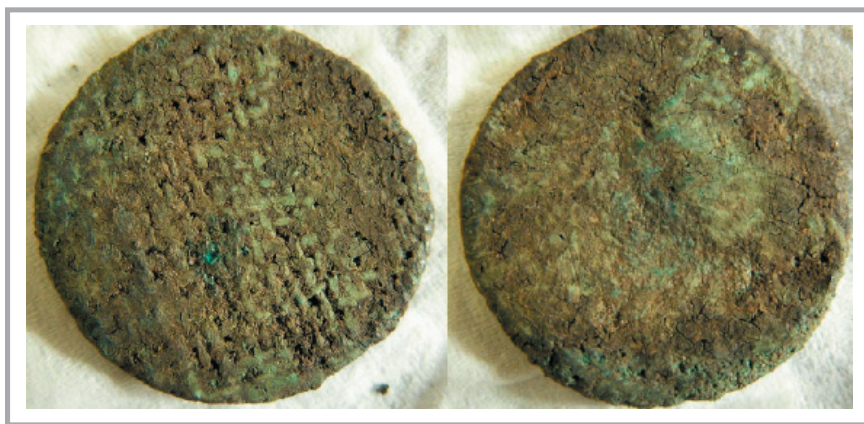
Textiles have long been an integral part of human adaptability. In the beginning all textiles were produced manually then gradually elements fastened into passive threads onto a frame were developed, forming the first loom. We can find early representations of this process on Neolithic ceramics from Egypt, western Asia and Europe. Direct evidence for looms is rare, but the production of textiles is well testified, mainly by loom weights and spindle whorls found at many excavated sites. [6]

## Deterioration of archaeological textiles

The deterioration of textiles can take several forms, such as biodegradation of fibres resulting in brittleness or even decay, discoloration, staining, etc. All textiles can be deteriorated by light, insects and micro-organisms, which singularly or together cause considerable loss of their tensile and elastic properties.

Compared with artefacts of a more durable nature, the survival of textile objects in most archaeological conditions is uncommon. Textile materials become degraded during prolonged burial and are already fragile and weakened when excavated. Deterioration of the material depends on many factors, the most important being the nature of the fibre and the environment the material was kept in. Textiles are very impermanent, and because of their fragility they can survive in good shape only in very good conditions. Unfortunately, they are most often discovered in crypts or ground graves, the environment preferable for micro-organisms. Humidity, heat, lack of ventilation and contact with another decaying material can result in a microbiological attack in a few days. Archaeological textiles have lain for sometimes thousands years exposed to humidity, extreme temperatures, fungi, mould and microbes, damp heat, stagnant air and contact with vegetable matter.

While woollen fabrics can often be found in fairly good shape, linen finds are very rare. It is because animal fibres are made mainly of protein and therefore are more resistant to decay than vegetable fibres, which are composed of cellulose. Figure 1 presents a twill woven



**Figure 2.** A sample of linen cloth from 17<sup>th</sup> century found in burial site near Rawa Mazowiecka, Poland.





**Figure 3.** A fragment of chasuble, Tum near Łowicz, Poland.

fabric made from wool and linen from the 2<sup>th</sup> century from Lešno. One can see well preserved woollen threads and small residues of linen, almost completely biodeteriorated [7].

Flax and cotton are much more susceptible to attack by bacteria under humid conditions and seldom survive in archaeological environments. Susceptibility or resistance of textiles to biodeterioration depends on the content of cellulose, lignin and other organic constituents. For instance, cotton is less susceptible to micro-organisms than flax. Although animal fibres, such as silk and wool, are not as susceptible to deterioration as vegetable, they can be attacked by micro-organisms if they are stored under warm and humid conditions. Silk is fairly resistant to biodeterioration. Microbiological damage appears mainly as discoloration, stains, brittleness and low tensile strength [8].

Another factor facilitating the deterioration of textiles in archaeological conditions is the structure. Low twist thread

and loosely woven fabrics can hold more dirt and micro-organisms between fibres. Tightly woven fabrics are more resistant to penetration by bacteria and insects.

Despite their original colour, most archaeological textile finds are in different shades of brown. The main reason for the discoloration of archaeological textiles is the immersion of the objects. In addition to the physical damage, it could lead to the dissolution of the dyes.

Textiles are very susceptible to ageing even when exposed to normal atmospheric conditions. Exposure to ultraviolet light causes a type of deterioration known as tendering and photochemical degradation of susceptible dyes [9].

### ■ Survivability

Despite the fragility of textiles, well preserved archaeological textiles can be found in places characterised by, at first sight, unfriendly conditions: deserts, acidic peat bogs, alkaline lake mud, per-

mafrost, etc. These are, however, places with inhibited microbial degradation. In some cases it is not the climate that prohibits degradation; microbial growth can also be inhibited by the presence of metal fibres, often used for embroidery, particularly when copper or other heavy metals are present. In Figure 2 one can see a sample of linen cloth from 17<sup>th</sup> century found in a burial site near Rawa Mazowiecka, Poland. The fabric survived attached to some metal object – coin or button. On one side the fabric structure can be clearly seen, on the other individual linen fibres can be seen using a microscope [10].

Fabric that is in contact with metal in a burial environment can often be preserved by accident. Metal starts to corrode very quickly in damp conditions and corrosion products start to form on the metal surface around the textile fibres. Through the years, the fragile textiles will degrade and disappear, but the corrosion products survive holding the shape of fabric. This is called a pseudomorph [11].

In ground graves small fragments of fabrics often survive attached to brooches, buttons, pots and other metal artefacts found at burial sites. Well preserved textiles can also be found in metal coffins. An example is the chasuble found in a crypt during conservation work in Tum near Łowicz, Poland. In Figure 3 one can see a fragment of embroidery made from silk and silver and gold warped thread.

Linen and other cellulose fibres preserve better in alkaline conditions, while animal protein fibres such as wool, preserve better in slightly acidic environments.



**Figure 4.** An iron chunk from a Merovingian burial site from 5<sup>th</sup> - 6<sup>th</sup> century, in St. Quentin, France.



**Figure 5.** Roman Period textiles, Nowy Łowicz, Poland. Examples of textiles from Roman period, Nowy Łowicz, Poland.

Examples are woollen clothes of early Celts found in acidic peat bogs of Northern Europe, and linen garment from alkaline mud in Switzerland [4]. Some fabrics survived due to carbonisation resulting from, for instance, burial rituals.

### Forms of archaeological textiles

There are several forms in which archaeological textiles can be uncovered. They range from actual objects to degraded fragments of textiles and clothes, chemically degraded pseudomorphs, fibre residues in soil, to imprints in clay and plaster. Information about textiles can also be obtained from patterns found in ancient art and texts [12].

#### Intact and deteriorated textile structures

Textile finds representing complete articles of clothing can be found in archaeological excavations only occasionally. Much more common are fragmented textiles or other perishable objects that have retained their structure. Archaeological textiles are usually only very small frag-

ments, at least partially deteriorated due to fibre decay, deformation, burning, milling, and discoloration.

#### Pseudomorphs

A pseudomorph is a physical trace of a former fibre, thread, or other textile structure. Pseudomorphs can be found on ceramic and metal objects, and even on stone. They occur primarily when textiles are in contact with metal objects and do not contain fibres. The mechanism of their formation has been presented in the previous chapter. The figure presents an iron chunk from a Merovingian burial site from 5<sup>th</sup> - 6<sup>th</sup> century, in St. Quentin, France. One can see, in Figure 4, a well preserved imprint representing plain woven fabric. Pseudomorph is the property of Silesian Museum in Bytom.

#### Impressions

Another form of indirect textile trace is the imprint. Textile impressions are commonly found in clay, mud, plaster and ceramics. The last one is because textiles were used in pottery. The traces left by cloth on the surface of a clay object were then baked right onto the object.

### Archaeological Textiles from the area of Poland

The earliest textile finds from the area of Poland come from the Neolithic Period. One of them is an impression on pottery found at Bilice Złote, in former Polish Ukraine. The second one is a large mat twill woven, found in Huta Łączyńska near Gdańsk [3]. However, most of the early textile finds come from the Roman Period.

Because of the millennium of the State of Poland and the millennium of Christianity in Poland, numerous excavations were conducted in the 1950s. They resulted in the uncovering of interesting collections of medieval archaeological textiles (9<sup>th</sup> - 14<sup>th</sup> century) from Gdańsk (around 1000 items), Opole (500 items), Wolin (200 items), Wrocław (300 items). They were well preserved in damp archaeological layers together with other organic remains.

During later excavations in the 1960s and the 1980s the earlier excavations were studied in detail. At some of them, mainly at burial sites from the Roman



Figure 6. A fragment of cloth from Roman Period, Odry, Poland.



Figure 7. Medieval woollen fabrics from Kolobrzeg (on left), and Elbląg, Poland.



**Table 1.** Collections of archaeological textiles in Poland:

Collection	Archaeological site	Period
Institute of Archaeology and Ethnology, PAN, Wrocław	Opole, Wrocław	Middle Ages
Department of Archaeology, University of Wrocław	Wrocław	Middle Ages
National Museum, Szczecinie	Gronowo, Grzybnica	Roman Period (I-III century.)
Institute of Archaeology and Ethnology, PAN, Szczecin	Szczecin	Middle Ages, modern
Institute of Archaeology and Ethnology, PAN, Wolin	Wolin	Middle Ages
Regional Museum, Koszalin	Nowy Łowicz	Roman period (I-III century)
Archaeological Museum, Gdańsk	Kamienica Szlachecka, Węsiory, Ulkowy	Roman period (I-III century)
Archaeological Museum, Gdańsk	Gdańsk	Middle Ages, modern
Museum of Elbląg	Elbląg	Middle Ages, modern
Museum of Chojnice	Leśno, Odry	Roman period (I-III century)
Institute of Archaeology, University of Łódź	Babi Dół-Borcz, Odry	Roman period (I-III century)
National Archaeological Museum, Warsaw	Numerous archaeological sites Mazowsze, Podlasie and Mazury	Roman period (I-III century) Middle Ages
Institute of Archaeology, Warsaw University Warszawskiego, Institute of Archaeology and Ethnology PAN, Warsaw	Weklice	Roman period (I-III century) Middle Ages
Institute of Archaeology UMCS, Lublin, Zamość Museum	Masłomęcz, Gródek Nadbużny	Roman Period (I-III century) Middle Ages

period, interesting textiles were found, which had survived because of contact with different metal objects. The largest collections come from burial sites of the Wielbark culture from 2<sup>th</sup> - 4<sup>th</sup> century from the Pomeranian towns Odry, near Chojnice (56 items), Nowy Łowicz (62 items), Gronowo, (67 items), Kamienica Szlachecka (55 items), Kowalewko (20 items), Leśno (21 items), Ulkowy (82 items). Figures 5 and 6 show exemplary textiles from Nowy Łowicz and Odry. They represent finely woven woollen fabrics with ornamental selvages and fringes.

Fabrics from that period are made mainly form fine and very uniform wool. They were woven using 2/2 twill weave and its derivatives – angled and diamond weaves. Sometimes they were chequered using different colours and raw material – wool and flax, like the fabric shown in Figure 1. They all represent high quality products and indicate skilled weavers [13].

During the last twenty years big archaeological excavations have been conducted due to a programme of revitalisation and reconstruction of monumental towns. During this work archaeological textiles have been recovered from 12<sup>th</sup> to 18<sup>th</sup> century: Elbląg (around 1 000 items.), Kołobrzeg (300), Wrocław (200), Gdańsk (1000). Exemplary medieval fabrics are shown in Figure 7. They are plain and twill woven, mainly woollen. However, as opposed to older fabrics

from the Roman period they are made from coarse wool, have worse quality and are often fullled [13].

## Conclusions

In spite of the importance of textiles to everyday life, farming, art, trade, the economy, the testimony they bring to the technological and economic development of regions, the migration of tribes and nations, there is still a lack and dissipation of information in this field. Archaeologists particularly interested in textiles are usually only concentrated on some regions of Europe, limited mostly to their own country. Likewise, most museums, except for the larger ones, exhibit archaeological finds from the area they are located, and as was mentioned before (with very few exceptions), textile finds are usually very rare.

Archaeological textiles represent a variety of structures, materials and technologies, sometimes complex and often distorted, which makes them especially difficult to analyse by archaeologists. In most cases documentation of textile collections is incomplete, made with the use of traditional, manual methods and thus not precise. It does not give us any impression of what the object originally looked like.

Because of the incompleteness and dissipation of data concerning archaeological

textiles, access to and sharing knowledge about them is very difficult, not only for archaeologists but also for other scientists interested in the subject.

Textile finds are greatly damaged when excavated. They are very impermanent and in danger of devastation everytime they are analysed. New standards of documentation with the use of modern non-destructive analytical methods are necessary, if we want to preserve them for the next generations.

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