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# The Bryndum burial ground in Denmark: news on Viking Age women's clothing

## Abstract

In the village of Bryndum on the west coast of Denmark four kilometres north of the modern town of Esbjerg, a Viking Age cemetery dated to first part of the ninth century CE was excavated in 2016. A block lift from grave G12 turned out to contain two oval brooches covered with organic remains and textiles. The subsequent lab-controlled excavation revealed that there were six different textiles preserved in the grave. It is possible that the buried woman was covered by a greyish wool duvet filled with threshed straw which originally may have been filled with down and feathers. The clothing most likely consisted of a blue or purplish wool overwear lined with a whiteish linen fabric. She was probably clad in a blue wool dress with straps made of a tablet-woven wool band, held together with a pair of oval bronze brooches. This is the first time that the tablet weaving technique has been recorded for this specific use. Underneath the dress, remains of a pleated linen inner garment were found. The grave thus contains both well-known and new details relating to Danish Viking Age female clothing. The findings were uncovered during a careful excavation and registration process and are the results of a fruitful collaboration between conservators, archaeologists, and other scientists.

**Keywords:** Viking Age, female grave, textiles, tablet weave, duvet

## Introduction

The village of Bryndum is located four kilometres north of the modern town of Esbjerg on the west coast of Jutland in Denmark. The village was first mentioned in the 13th century as "Brynnum" and "Brunnum", the prefix of which probably refers to a well or spring, while the -um ending (hem) refers to a settlement (Hald 1950, 53). Bryndum Church is among the most distinguished and largest ashlar stone churches in Jutland. It is dendrochronologically dated to the 1240s and was built between two larger burial mounds probably from the Bronze Age. Today, the Danish Wadden Sea extends approximately to Esbjerg, but in the Viking Age it continued further up the west coast of Jutland and provided good sailing connections along the coast and inland via river connections. In the Middle Ages, the parishes throughout the west Jutland coastal zone were able to provide a high tax yield equal to that of the more fertile lands around the fjords of eastern Jutland

(Søvsø 2020, 82). In *Ribe Oldermor's* church list from the mid-14th century, the Bryndum church is listed as giving the highest tax to Ribe Diocese, indicating a large resource base and a high degree of wealth in the area.

In 2016, in connection with the construction of a new parish house immediately south of Bryndum church yard, Museum Vest found a burial site consisting of 14 inhumation graves from the Viking Age (fig. 1). Most of the graves were shallow and had already been disturbed by various animal activities. The sandy subsoil in western Jutland tends to provide poor preservation of organic material and metals. Only a few small and very decomposed pieces of skeletal remains were preserved in the Bryndum graves. Traces of decomposed wood indicated that most of the graves once contained coffins or hollowed-out oak trunks of various shapes. Judging by the size of the graves, at least four were burials for children, all the way down to infancy, and one of the children was

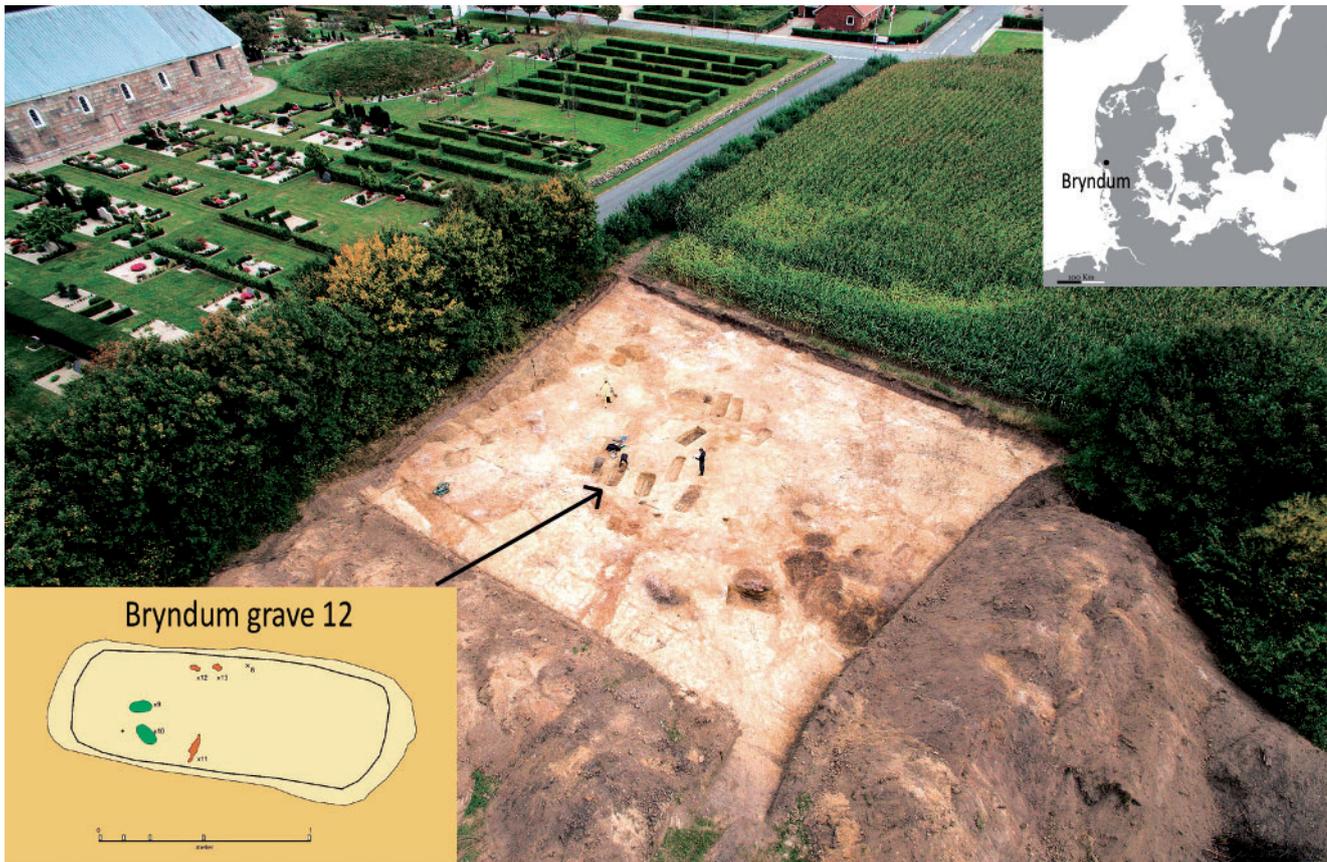
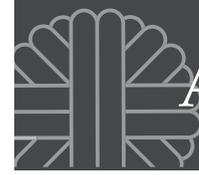


Fig. 1: Overview of the rescue excavation of the Viking Age cemetery next to the church graveyard in the village of Bryndum in Jutland, Denmark, with an outline of Grave 12 (inset left) and where it was found (Images: John Randeris; graphics: Charlotte Rimstad)

evidently buried in a wooden box. All the graves were approximately east-west-oriented, and in four cases it was possible to detect the outline of the body by the colour of the subsoil. In each case the deceased was lying in a supine position with the head in the west. The graves were generally sparsely equipped. In five graves knives had been placed at the hips. One grave, G12, differed from the others in that it contained both jewellery and well-preserved textiles. These are the main focus of this article.

Before the discovery of the Bryndum cemetery, 22 Viking Age graves from more than ten sites were known in the Esbjerg area, several with graves in combination from the Early and Late Iron Age. Three of the sites included both cremation and inhumation burials dating to the end of the eighth or ninth century CE (Stoumann 2009, 253–263). Thus, the burial customs in Bryndum correspond with the general local and overall pattern in western Jutland in the ninth century CE. This includes the pronounced east-west grave orientation and the position of the head to the west (Egebjerg et al. 2009).

### The Bryndum woman's grave

Grave G12 appeared to be an oblong cut measuring 173 x 63 cm. Due to its depth of only 35 cm, it was disturbed by bioturbation, but diffuse traces of the coffin were observed along the sides and bottom of the grave. The wooden coffin measured 150 x 55 cm and had rounded sides. It was probably a log coffin. During the excavation, straw was found in the west end of the grave, which at first glance looked like material from a mouse nest. However, it turned out that there were preserved textiles immediately under the straw and a green coloration from two underlying copper alloy objects, which turned out to be a pair of oval brooches. A block-lift was therefore made across the width of the grave, which included the grave goods and the preserved textiles.

Altogether the block-lift turned out to contain one amber bead (ID 200376833) and a turquoise-green glass bead (ID 200376832) placed near the oval brooch, known as find "x10" (ID 200376828) thalay on the right side of the woman's chest. Above the glass bead was a faceted amber ring (ID 200376831) with an inner



diameter of 20 mm. As the amber ring lay over the edge of the brooch it is interpreted as a pendant that was used together with the two beads. The oval brooch, known as find as “x9” (ID200376829) placed on the left side was significantly less well-preserved and deteriorated to a degree that makes the ornamentation almost indistinguishable. However, it can be surmised that they were likely identical. On the right side of the woman, a knife (x11, ID 200330744) was found, and on the left side, several undeterminable iron fragments (ID 200376875, ID 200376876, ID 200376877) (fig. 2).

Although metal detection in recent decades has shown that dress accessories such as oval brooches were more common in this area in the Iron, Viking, and Middle Ages than assumed on basis of the burial finds, the clearest social marker at Bryndum remains the artefacts found in grave G12. On this basis it is likely that the woman in grave G12 at Bryndum belonged to the better-off part of the population. She had the wealth and social class able to acquire jewellery in the markets of nearby Ribe or Hedeby, and she had access to high-quality textiles.

#### *Dating the grave*

The beads, and especially the oval brooches of the Bernald type JP 23/24, constitute the primary basis for

dating not only grave G12, but the entire cemetery. Bernald brooches are known all over Scandinavia, but occur most often in Norway, Denmark, and Schleswig in northern Germany (Petersen 1928, 19–22; Jansson 1985, 24–25, 31). Bernald brooches are known to have been produced in the nearby emporium of Ribe located just 30 km south of Bryndum, at least since the last two decades of the eighth century and continuing until after the middle of the ninth century CE. At that time, double-shelled oval brooches were introduced (Feveile and Jensen 2006, 155). Until now, no casting-moulds from the production of this specific Bryndum/Bernald type have been found. Characteristic of decorations from the first half of the 9th century, the Bernald and Oseberg/Broa styles are marked by the introduction of the gripping beast with heads shown *en face*. The brooches from Bryndum are voluminous and loosely composed examples, where the profiled body of the gripping beast is placed in a triangle. The dating of this style corresponds roughly to the production period of other Bernald brooches in Ribe, mainly attributed to the first half of the ninth century CE (Jensen and Wilson 1965, 23–57).

As the ring-shaped amber piece and the beads do not contribute to a more precise dating of the grave, it was decided to make two radiocarbon dates of the straw

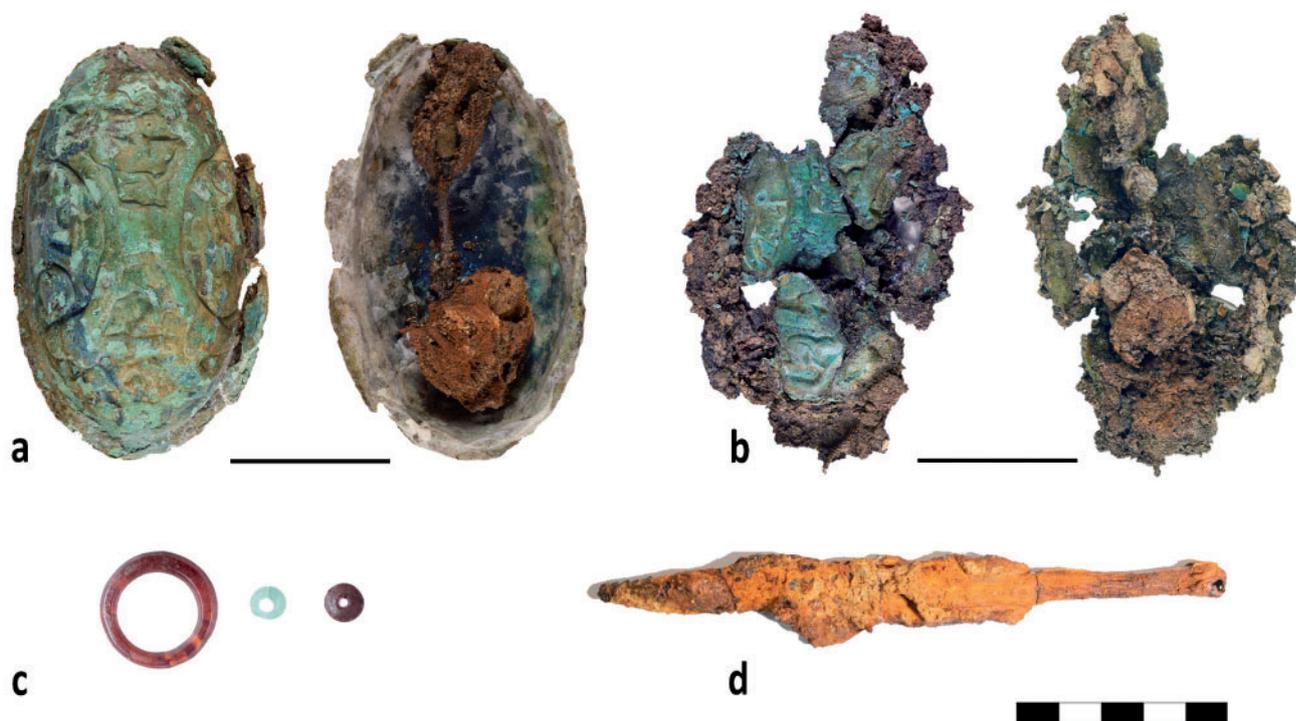


Fig. 2: The front and back of a) the right oval brooch x10; b) the left oval brooch x9; and the other artefacts in Bryndum Grave 12; c) the amber ring, the glass and amber beads; and d) the iron knife x11 (Images: Museum Vest)

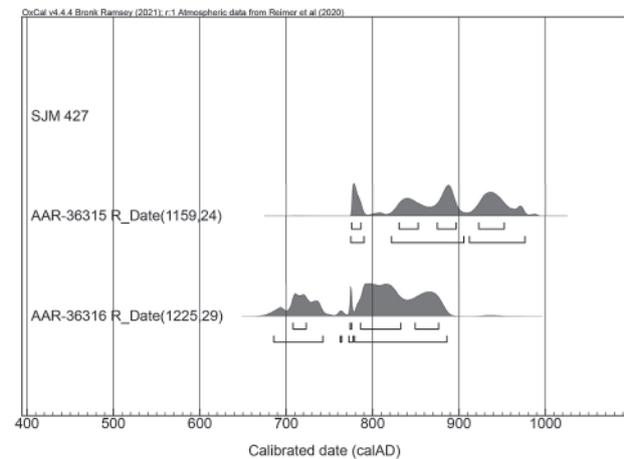
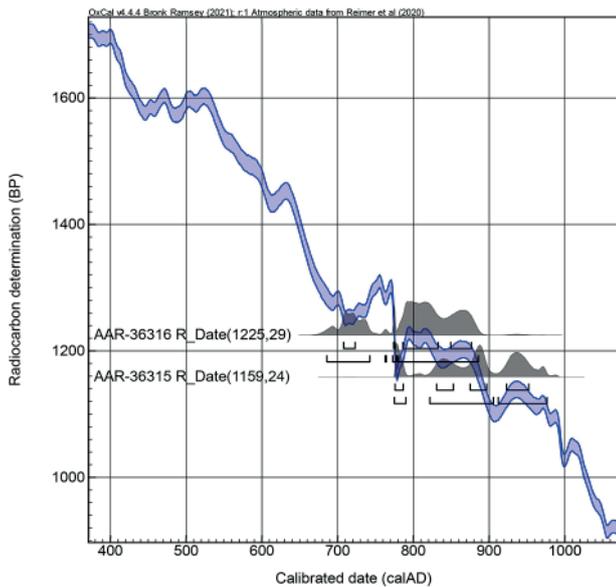


Fig. 3: The radiocarbon dating results of the straw found in Bryndum Grave 12 (Image: Aarhus AMS Centre)

found in the block-lift. The analysis was carried out by Aarhus AMS Centre in Denmark. Results showed that within two standard deviations the samples were dated to the period 775–977 CE (AAR 36315: 14C age  $1159 \pm 24$ ) and 686–886 CE (AAR 36316: 14C age  $1225 \pm 29$ ) (fig. 3). Combined with the dating of the Berdal brooches it is most likely that the Bryndum woman was buried sometime during the ninth century CE.

#### *Excavation of the block-lift from G12*

The block-lift comprising the oval brooches and the surrounding soil was transferred to the Department of Archaeological Conservation at the Conservation Centre in Vejle. The block-lift was waterlogged upon receipt, and the textiles and other organic remains close to the oval brooches were still well-preserved. The oval brooches were found with the surfaces turned upwards, indicating that the woman was buried lying on her back, and as the body decomposed the oval brooches gradually sank to the bottom of the grave. The distance between the two oval brooches was approximately 7 cm. It is assumed that the poorly-preserved left brooch (x9) originally was positioned more or less as it was found, while the right brooch (x10) had shifted slightly from its original position. Both oval brooches were oriented with the inside pins pointing towards the shoulders.

The top layer above the oval brooches consisted of threshed straw arranged in a random pattern. Samples of the straw were sent for analysis at Moesgaard Museum, but the plant species could not be identified. Underneath the straw, several textile layers were visible. At this stage of analysis, it was

decided to conduct a partial separation of the textiles from the oval brooches. This means that the textiles inside the brooches were kept in place, while the textiles from the upper side were separated as one solid layer from each brooch. This made it possible to study the style and decoration of the brooches while the textile layers could be studied from both sides, i.e. the ones that lay above and upon the brooch as well as in cross section. The separation was carried out while the textiles were still waterlogged and had some degree of flexibility. Subsequently, the textiles were freeze-dried without the application of vacuum. This was to prevent the collapse of the fibres. Following this process, the textiles became exceedingly fragile and prone to crumble. From a conservation perspective, it would have been optimal to impregnate the textiles. However, this entails significant drawbacks, as the impregnation agents inevitably create a reflective surface that complicates photo documentation and observation under a stereo microscope. Furthermore, scientific analyses of the fibres (e.g., dye, fibre type, radiocarbon dating, strontium analyses, and future analyses that we cannot yet envisage) would be rendered impossible or considerably more complex.

After visual analysis and photographic documentation of the textiles, they were described, measured, and categorised into various textile types. Some fragments were impregnated with the acrylic copolymer, Paraloid B72, to ensure the future preservation of their appearance. But the majority of the different textile fragments were left untreated. Also, the textile fragments preserved inside the oval brooches were left in situ to maintain their functional context.



Additionally, sample material was extracted for future analysis.

Altogether, the textiles found in close proximity to, and on top of, the bronze brooches are all well-preserved and in an organic state. However, they are extremely fragile. On the other hand, most of the textiles found inside and underneath the oval brooches are hard and brittle. In some cases they are completely mineralised by the iron corrosion coming from the pins placed inside the brooches. Only small parts of these textiles are suitable for analysis. It is evident that the copper

salts from the degradation of the bronzes contributed to the preservation of the organic materials, but only those that were in close contact with the brooches.

**Methods used**

For this study, a wide range of methods were applied. These were implemented primarily on textiles still in their organic state. Fibre diameter measurements were made based on digital photographs captured by transmitted light microscopy using a Primo Star iLED microscope from Zeiss with a 10x objective, equipped

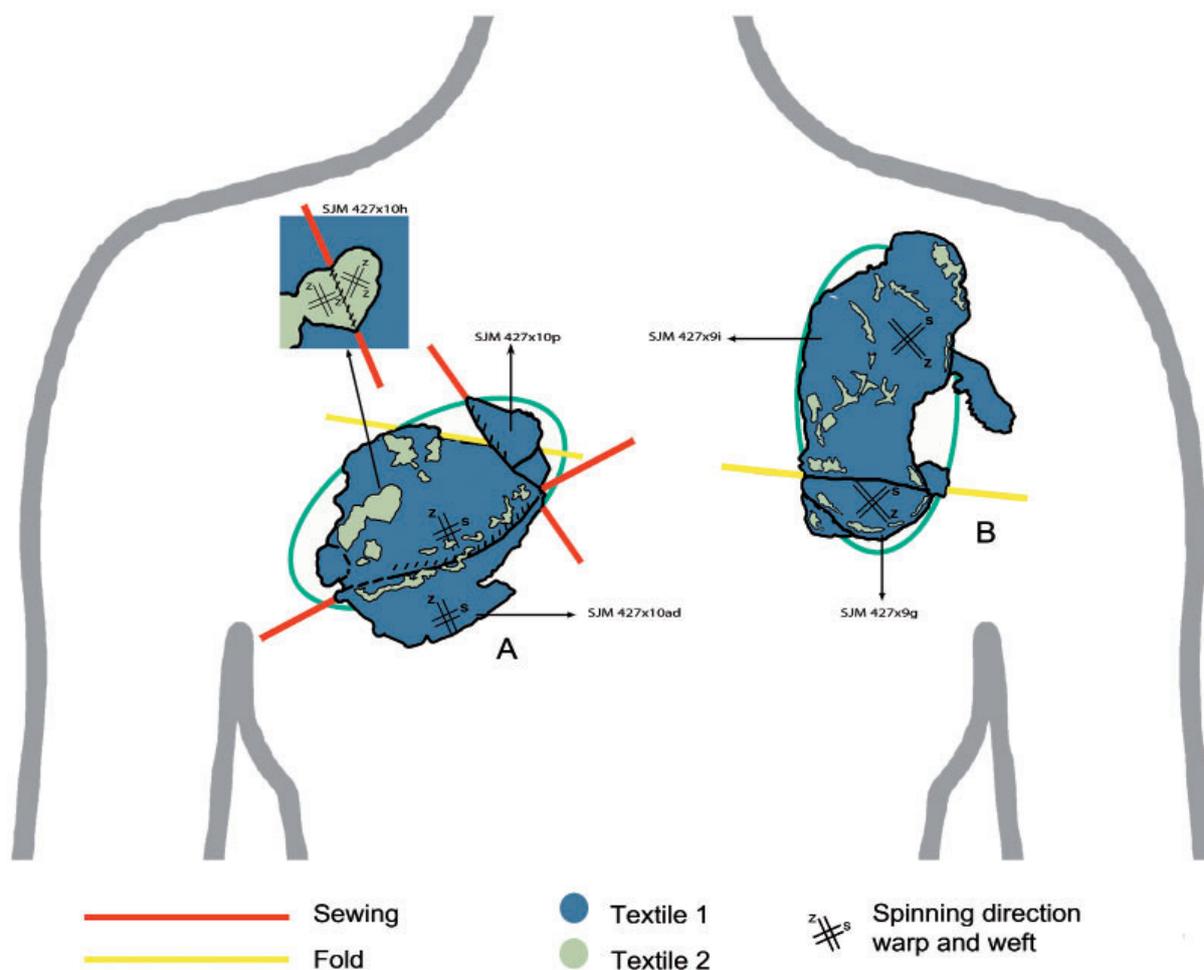
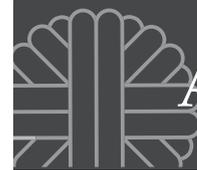


Fig. 4: Visualisation of the layers of Textile 1 (blue twill) and Textile 2 (possibly flax) on top of the brooches. Note that the textiles are drawn on top of a mirrored photo of the inside of the flakes of the textile layers (figs. 6a and 6c) even if they are seen from the outside on this presentation. This makes it possible to see the folds and sewing seen from inside and to compare these between the brooches and relate to the expected orientation of the body. The brooches are placed as they were found in the grave and indicate the possible situation at the burial. Note the direction of the s- and z-twist of the warp and weft of Textile 1 is exactly the same on the fragments of both brooches despite sewing and folds. The fold (yellow line) indicates that the displacement of the proper right brooch happened before the burial or shortly after it, when the brooch slid under the upper garment. Note also the double layered fragment x10p with the stitches facing downward, which may be folded over the neck opening. The lining x10h has different spinning directions on each side of the stitches, indicating it was cut to shape (Image: Lise Ræder Knudsen)



with an AxioCam ERc5s camera and with a minimum of 100 fibre diameters per sample. Statistical data processing was made in Excel. The percentage results were sorted into groups of Fine (less than 25 microns), Medium (25 to 40 microns), and Coarse fibres (more than 40 microns) and cumulative frequency diagrams as well as histograms were created to evaluate and compare the results (Skals 2024; Skals et al. 2024a; 2024b). The results were further classified according to Rast-Eicher's categorisation format (Rast-Eicher 2008; Rast-Eicher and Bender Jørgensen 2013).

Identification of the organic colorants was performed by High Performance Liquid Chromatography and photo diode array detection system (HPLC-DAD) with Arc HPLC equipment (Waters, USA). The analyses were interpreted using the Empower software system from Waters. A detailed description of the analytical protocol has been published by Vanden Berghe et al. (2009). The colourants were recovered from the fibres using extraction with hydrochloric acid and ethylacetate purification.

Fourier transform infrared (FTIR) spectroscopy is a technique that can analyse materials by measuring how they absorb infrared light, resulting in a spectrum that serves as a distinctive molecular fingerprint. FTIR analysis was used to identify the plant fibre textiles, although not to specific species level. Attenuated total reflection – Fourier Transform Infrared Spectroscopy (ATR-FTIR) spectra were recorded on a Nicolet iS5 FTIR spectrometer from ThermoFisher Scientific, fitted with a single bounce ATR (Attenuated Total Reflectance) sampling accessory including a diamond crystal. Spectra of the samples were recorded over the range of 4000–500  $\text{cm}^{-1}$  with a resolution of 4  $\text{cm}^{-1}$  and 16 accumulations. The spectra were compared with reference spectra in the software OMNIC and OMNIC SPECTRA.

During the preliminary preparation of the textiles on the upper side of the oval brooches, it was challenging to decipher the various layered sequences, as multiple layers were preserved. The textile layers lay with alternating thread directions, and folds and seams were present at different locations. It was therefore not possible to separate all the different layers without causing significant destruction of the material and compromising the integrity of the context. On this basis, a method was developed during the excavation of the block lift, that helped obtaining as much information as possible about the location and relationship between different textiles throughout all levels. This made it possible to document where textile layers, thread directions, seams and folds were located in relation to the oval brooches and the buried woman.

All of this information was documented through digital layering in Adobe Photoshop, where images of individual textiles were overlaid onto photographs of the specimen. Images of both the underside and upper side were adjusted, mirrored, or oriented upright, depending on their position, thus enabling a virtual “through-layer” view that was then documented with line drawings for the textiles on the top and inside each of the brooches. This resulted in a total of four drawings. This approach allowed precise visualisation of the placement of seams and folds in relation to the body of the buried individual (fig. 4).

### Textile types and layer sequences

#### *Textile 0, straw and down*

As mentioned, the top layer above the oval brooches consisted of randomly positioned broken straws that were bent at several points along the stem. This indicates that the straws were not deposited as a parallel cohesive bundle but were most likely straws from threshed grain. Although today the layer is very thin, it may originally have been much thicker. There may also have been additional textile layers above the straw that have not been preserved (fig. 5).

Directly under the straw, remains of a 2/2 twill textile were found (Textile 0, see also fig. 12). It was made of a light grey-brown wool. The yarns used in the weave have combined twist directions: z-spun threads with a twist angle of approximately  $56^\circ$  in one direction, and s-spun threads in the other direction with a twist angle around  $45^\circ$ . All threads in the weave are quite thick. They measure 1.4 to 1.5 mm in diameter, and the weave has a thread density of approximately 6–7 threads per cm (fig. 6 and table 1). The dye analysis revealed that both thread systems contained extracts from clubmoss (*Lycopodium*), which is typically associated with mordanting of the yarn prior to dyeing. Furthermore, both thread systems contained traces of an indigotin-containing plant dye (in this context probably woad), which most likely are the result of leaked dyes from the other blue-dyed textiles found in the grave (table 2). The presence of clubmoss suggests that Textile 0 originally could have been dyed, but that the dye component has completely disintegrated.

The fibre analysis further showed that the z-spun yarn has a predominance of fine fibres, and for the remaining part an equal presence of medium-range and coarse fibres (fig. 7 and table 3). In contrast, the s-spun yarn has a majority of fine and medium fibres with a number of coarse fibres that match the z-spun yarn. The z-spun yarn also contained several kemp fibres, which are short, smooth, and robust hairs with a large medulla (Skals et al. 2024a, 5). Kemp fibres

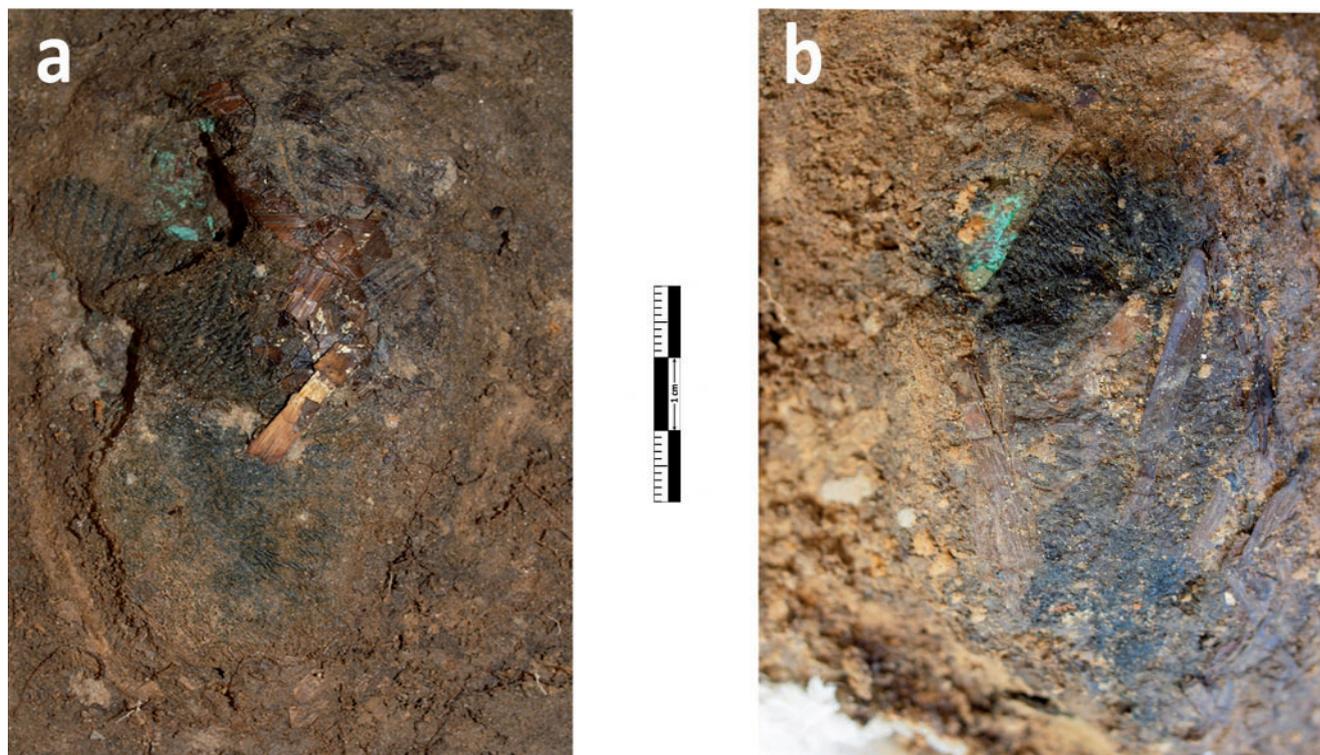
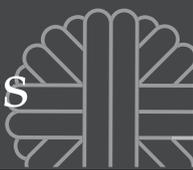


Fig. 5: The upper layers on the two oval brooches revealing straw and the well-preserved Textile 1. Later, when the straw was removed, small and less well-preserved fragments of Textile 0 became visible: a) the right oval brooch x10; and b) the left oval brooch x9 (Images: Conservation Centre Vejle)

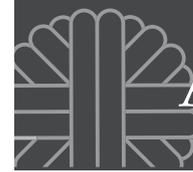
are only observed in the most primitive sheep breeds and tend to disappear in the wool composition of the more evolved breeds (Ryder 1983). This combination of fibres is somewhat unusual and indicates that the wool used for the two different yarns may come from the same source but was sorted and eventually spun in different ways. An unexpected side effect of the fibre analysis was that the remains of down were detected among the wool fibres in Textile 0 despite the fact that no traces of feathers or downs were observed on any of the other textile surfaces. It is thus likely that Textile 0 was in close contact with down/feathers during its use or when the yarns for the weave were spun.

#### **Textile 1**

Under the wool twill, but still on top of the oval brooches, a fine 2/2 wool twill textile (Textile 1) was found. This weave is more unbalanced, with a thread density of 15–21 threads per cm in the warp and 7–12 threads per cm in the weft. But it still utilises combined twist directions like in Textile 0 (table 1). The warp system is made in a z-spun yarn with a twist angle of 40°, whereas the s-spun yarn in the weft has a twist angle of 26°. The fibre analyses of the warp and weft samples taken from the left oval brooch (x9)

show a difference in the wool composition of the two yarns. As such, the warp is characterised by a large content of coarse fibres. The weft has a majority of fine fibres, while the content of medium-range fibres is the same in both yarns. Altogether this fibre combination shows how wool could be sorted in slightly different ways that supported the desire to produce a thin strong warp thread and a softer and more fluffy weft yarn (fig. 7 and table 3). This supports the existing hypothesis that, during the Viking Age, wool was sorted and spun into yarn selected specifically for the intended function of the textile for which it would be used (Skals et al. 2024a).

Textile 1 appeared dark blue to black while it was still waterlogged. Dye analysis confirmed that the warp was dyed with woad (*Isatis tinctoria*). In the weft, woad and an unknown red colour component were detected in the sample taken from the right oval brooch (x10). Only woad and no red colour component was found in the warp and weft samples extracted from the left brooch (x9) (table 2). This feature could imply several things. Either this specific part of Textile 1 has a wide colour band made in a more purplish weft yarn, or the red dye component has leaked from one of the other textiles into the weft yarn. Nevertheless, as none of



the other textiles in the grave contain traces of red dye components, this option is the least likely. Based on the overall appearance of this weave, it is likely that all the fragments found on the two brooches come from the same weave – possibly a striped one.

Further, it was noted during excavation that Textile 1 had clear diagonal stripes created by the twill structure in a blue and possibly more purplish colour on one side of the fabric. The reverse side of the twill stripes was less distinct. This optical phenomenon is created by the 2/2 twill structure that on one side has Z-directed diagonal stripes and on one side S-diagonal stripes that line up with the different twist directions in warp and weft. This was further accentuated by the difference in the twist angles (warp with a significantly tighter twist than weft) and the higher thread counts for warp than weft (Hammerlund and Vestergaard Pedersen 2005, 215–216; Oelsner 1915, 20–21).

Another important characteristic of the Textile 1 fragments is the observation of a significant napping. This was particularly obvious on the side that has a less distinct twill structure (the side of the textile with

S-twill structure which in most cases are the outside) although the cleaning of the textiles down to visible thread structure during conservation may have removed the napping in some areas. Viewed in the light microscope, the fibres from the napping seem to have a mixture of both strong blue and uncoloured fibres that match the occurrence of dyes in warp and weft.

It is further characteristic that Textile 1 is preserved in several layers on top of the brooches, sometimes in four to six layers on top one another. One of the now loose pieces coming from the lower edge of the right brooch even contains a hem that joins two layers of Textile 1 (x10p, fig. 8). The hem is preserved at a length of 2 cm and measures 4 mm in width. It is most likely two pieces of Textile 1 on top of each other both with the Z-twill direction on the visible side, but the thread direction is slightly twisted so that one side (fig. 8 left) is cut at an angle of about 75° to the warp threads, whereas the other side (fig. 8 right) is cut at an angle of about 90° to the warp. These two pieces are held in place with a decorative line of staggered running

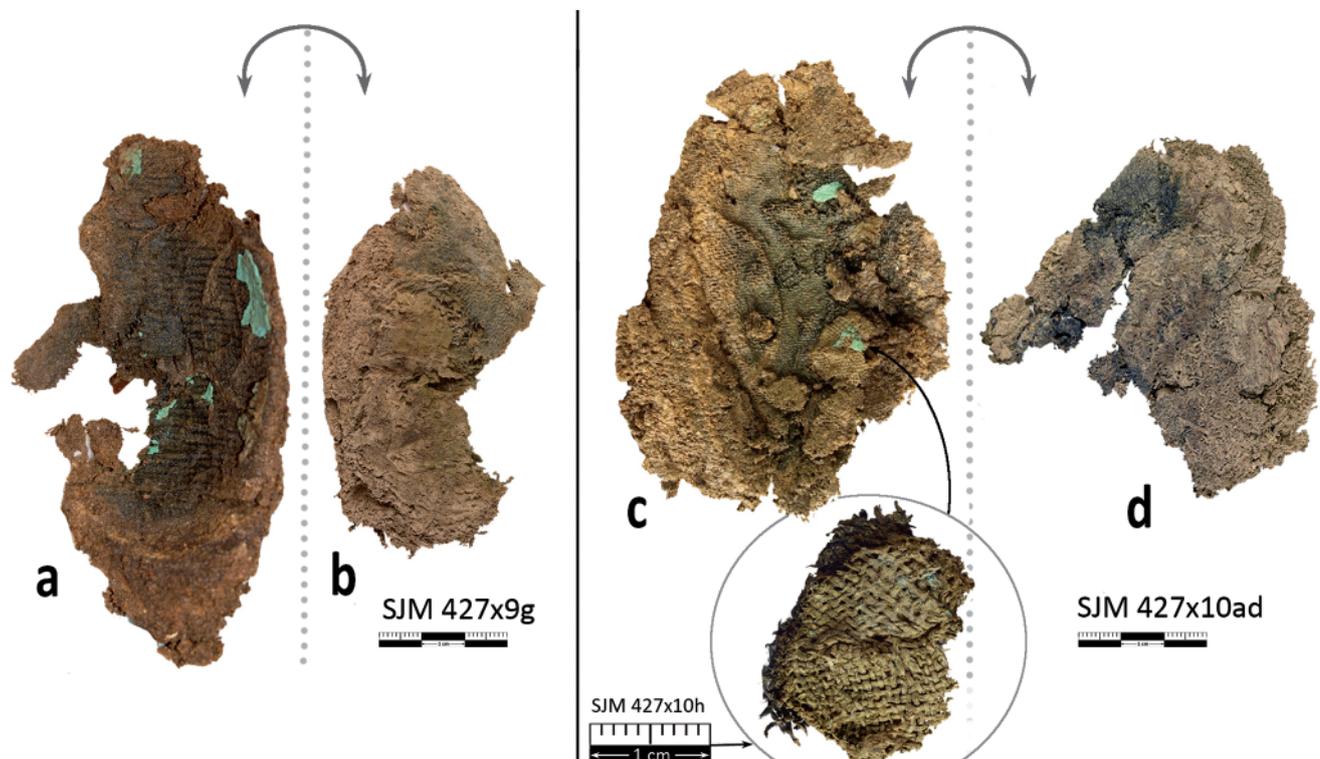
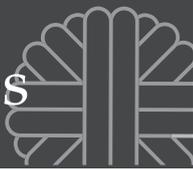


Fig. 6: The waterlogged inner side of: a) the right oval brooch x10 and c) the left oval brooch x9; the freeze-dried upper side of b); the right oval brooch x10; and d) the left oval brooch x9. After freeze-drying, loose fragments were removed, which made the fragments (a and b, c and d) look different. The tiny well-preserved fragment of presumably flax x10h in the middle (magnification below c) has a seam across it and the lower piece has the thread direction running parallel to the stitches, whereas the fragment above c has the thread direction running diagonally to the stitches indicating that this textile could be tailored (Images: Conservation Centre Vejle, graphics: Charlotte Rimstad and Lise Ræder Knudsen)



Textile	Weave/ feature	Twist direction	Twist degree	Thread density per cm	Thread diameter mm	Fiber type	Colour/ dye	Comment
Layers on top of the oval brooches SJM 427x9 (left) and 427x10 (right)								
Textile 0	2/2 twill balanced	z/s	56°/45°	7/6	1.4/1.5	Wool	Light grey	
Textile 1	2/2 twill unbalanced	z/s	40°/26°	15-21/ 7-12	0.4/0.7	Wool	Blue	
Textile 1 hem Sewing thread A	Staggered running stich 8 mm	$S < \frac{z}{z}$	Very light twist		1.5<0.9/0.9	Wool	Blue	Seen on Fragment x10p
Textile 1 seam Sewing thread B	Hem stich 5 mm	$S < \frac{z}{z}$	Very light twist		0.95<0.5/0.6	Wool	Light grey	Seen on Fragment x10ad
Textile 2	Tabby balanced	z/z	13°/12°	14-15/13-20	ca. 0.5/ ca. 0.5 (uneven)	Plant	White	
Textile 2 seam Sewing thread C	Hem stich 3 mm	$S < \frac{z}{z}$	Very light twist		0.27<0.14/0.11	Plant	White	Seen on Fragment x10h
Layers inside and on the lower edges of the oval brooches SJM 427x9 (left) and 427x10 (right)								
Textile 3	Tabby unbalanced	z/z	34°/29°	31/10-15	0.4/0.3	Wool	Blackish	
Textile 3 hem Sewing thread D	Staggered running stich 8 mm	$S < \frac{z}{z}$	Very light twist		1.2<0.8/0.7	Wool	Blue	Seen on Fragment x10q
Straps sewn to Textile 3	Tablet weave 1.4 cm wide Sewn edge to edge to form a tube with a width of 0.6 cm	Warp: $S < \frac{z}{z}$ Weft: s		12 tablets Edge: 2 tablets with 4 threads SZ orientated Pattern: 10 tablets with 2 threads Z orientated	Warp: 0.75 mm Weft: 0.85 mm	Wool	Reddish by rust from the iron needle	Seen on Fragment x10s
Textile 4	Tabby balanced	z/z	34°/33°	14/14	0.5/0.5	Plant	Reddish by rust from the iron needle	

Table 1: The technical data from the Bryndum G12 textiles

stitches placed parallel to the outer hem line. The stitch length is approximately 8 mm while the distance between the staggered rows is around 3 mm (table 1). The decorative stitching is made with a S-plyed yarn, S2z, circa 2 mm in diameter. The fragment was found with the hem decoration facing inwards, and as the two layers of fabric have different thread directions it is clear that this clothing item was at least partly tailored. Considering the decorative stitching and the orientation of fragment x10p (see fig. 4), it could be part of a cut-to-shape and folded neckline. When the

lump of Textile 1 found on top of the right brooch was turned around so that the side touching the bronze surface was exposed, a seam running from the top to the bottom of the brooch could be observed (x10ad, fig. 4 and fig. 6c). The seam is sewn with regular hem stitches with a spacing of about 5 mm using an S-plyed sewing thread approximately 1.0 mm in diameter. In this case, the two textiles joining in the seam have different thread directions, supporting the impression that Textile 1 belonged to a kind of tailored clothing item. The left oval brooch was also covered by Textile

Textile	Weave	Sampled yarn	KIK/IRPA code	Biological source
X9 Textile 0	2/2 wool twill	z-spun thread	14995/69	Clubmoss (trace of Indigo/woad)
X9 Textile 0	2/2 wool twill	s-spun thread	14995/70	Clubmoss (trace of Indigo/woad)
X9 Textile 1	2/2 wool twill	warp	14995/64	Indigo or woad
X9 Textile 1	2/2 wool twill	weft	14995/65	Indigo or woad
X10 Textile 1	2/2 wool twill	warp	14995/66	Indigo or woad
X10 Textile 1	2/2 wool twill	weft	14995/67	Indigo or woad + unknown red
X10 Textile 3	wool tabby	warp & weft	14995/68	Indigo or woad

Table 2: The result of the dye analyses of the textiles from Bryndum G12

1, and together with a larger, now loose, fragment (x9g) it is clear that Textile 1 was mostly positioned with the Z-twill structure stripe direction placed at a right angle to the length axis of the brooches.

### Textile 2

Textile 2 is represented by small fragments of a balanced tabby found on the inside of Textile 1 touching the surface of the brooches. This weave is made in a lightly z-twisted yarn with a twist of approximately 12° in both thread directions. Although the average thread diameter lies around 0.5 mm, they vary considerably. As such, the evenness of the threads also varies (table 1). In this case, the FTIR analysis confirmed the suspicion based on the visual appearance that the weave is made of plant fibres. A specific determination between nettle, hemp, or flax could not be made.

A small but well-preserved fragment of Textile 2 (x10h) features a seam sewn together with hem stitches in an S-plyed sewing thread, made of slightly thinner z-twisted threads than used in the weave. It is important to note that on one side of the seam, the thread direction of the weave is oriented diagonally to the seam, while on the other side, the thread direction runs parallel to the seam line. This shows that at least some parts of this textile were sewn together from pieces with diagonal cuts (fig. 4 and fig. 6c).

When the complex layers of textiles were removed from the surface of the brooches in the initial wet state, lumps of a vegetal mass and fibres were observed directly on top of the bronzes, which must come from Textile 2. Characteristically, these showed multiple stages of degradation, ranging from well-preserved and largely unaffected by deterioration to a slimy uniform grey-brown mass that would not have been recognised as coming from a textile without the context provided by the more well-preserved parts (see for instance fig. 2a and fig. 6c). Upon drying, this mass formed clay-like deposits around the fibres of the other textiles and on the surface of the bronzes, leaving a clear imprint of

the textile that deteriorated after exposure to air. This clay-like deposit was found between different layers of Textile 1, indicating that Textile 1 (wool) was originally separated by layers of Textile 2 (likely flax).

### Textile 3

When the bronzes were turned around, two layers of quite differently preserved textiles were discovered. On the inside of the right brooch and arching around the rim (x10), a well-preserved and still organic wool tabby was discovered (Textile 3). The weave is quite unbalanced with 31 threads per cm, a thread thickness of 0.4 mm, and a twist angle of 29° in one direction, and 10–15 threads per cm, a thread thickness of 0.3 mm, and a twist angle of 34° in the other direction (table 1). Although all yarns have the same twist direction (z/z) it is clear that in this case the production of the yarns, starting with the sorting of the wool, was specifically done in order to underline the unbalanced appearance of the weave. In this case warp and weft have an equal number of fine fibres while the content of medium and coarse fibres differs slightly. The warp has more coarse fibres and the weft more medium-range fibres. The difference in the sorting of the fibres for warp and weft yarns is thus not as marked as in the case of Textile

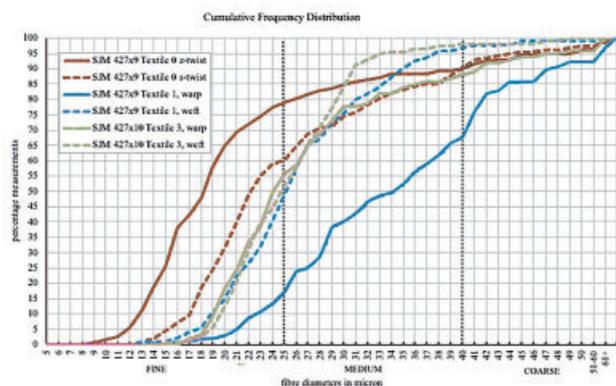


Fig. 7: The cumulative fibre diameter distributions of Textiles 0, 1 and 3 (Graphics: Irene Skals)



1. There can be little doubt that the wool used for Textile 3 came from the same fleece (table 3). Further, it was noted that during excavation Textile 3 appeared entirely black. The dye analysis revealed that both yarn systems were dyed with an indigotin-containing

plant dye, most likely woad (table 2). Given that the fibres appeared almost black, it is assumed that the textile was originally a deep dark blue. It is important to note that at the rim of the right brooch a small piece of a hem was found (x10q, fig. 9). This features the

Bryndum SJM 427 x9 Textile 0		Light with few pigmented fibres. The z-spun yarn has a majority of fine fibres and equal contents of medium and coarse fibres. The s-spun yarn has a majority of fine and medium fibres, and a content of coarse similar to the z-spun. This is an unusual fibre combination				
Calculations of fibre measurements in microns						
Sample	% Fine	% Medium	% Coarse	Range	Category	No. of fibres
z-spun	79	11	11	9-34, 38, 40-43, 45, 47, 50, 61, 65-66, 70, 82, 104, 124	D	199
s-spun	64	26	10	12-36, 38-44, 46, 48-49, 53, 55, 64-65	CD	157
Bryndum SJM 427 x9 Textile 1		Light, unpigmented fibres with traces of blue stains. The weft has a majority of fine fibres and very few coarse fibres while the warp has a majority of medium fibres and a larger content of coarse than of fine. Almost similar contents of medium fibres are recorded in warp and weft				
Calculations of fibre measurements in microns						
Sample	% Fine	% Medium	% Coarse	Range	Category	No. of fibres
Warp	24	44	32	15, 17, 19-43, 46-48, 54-57, 59, 61-62, 66	D	105
Weft	58	39	3	12, 15-37, 39-40, 44, 70	B	95
Bryndum SJM 427 x9 Textile 3		Light, few pigmented fibres with traces of blue stains. Similar contents of fine fibres are recorded in both yarns. The contents of medium and coarse fibres differ slightly in the yarns				
Calculations of fibre measurements in microns						
Sample	% Fine	% Medium	% Coarse	Range	Category	No. of fibres
Warp	58	30	12	16-32, 34-36, 38-43, 46, 48, 51, 53	CD	100
Weft	58	40	2	14, 17-33, 35, 37, 39, 46, 48	AB	114

Table 3: The results of the analysis of textile fibres from Bryndum G12. The categories listed in the table refer to Rast-Eicher's categorisation (Rast-Eicher 2008)

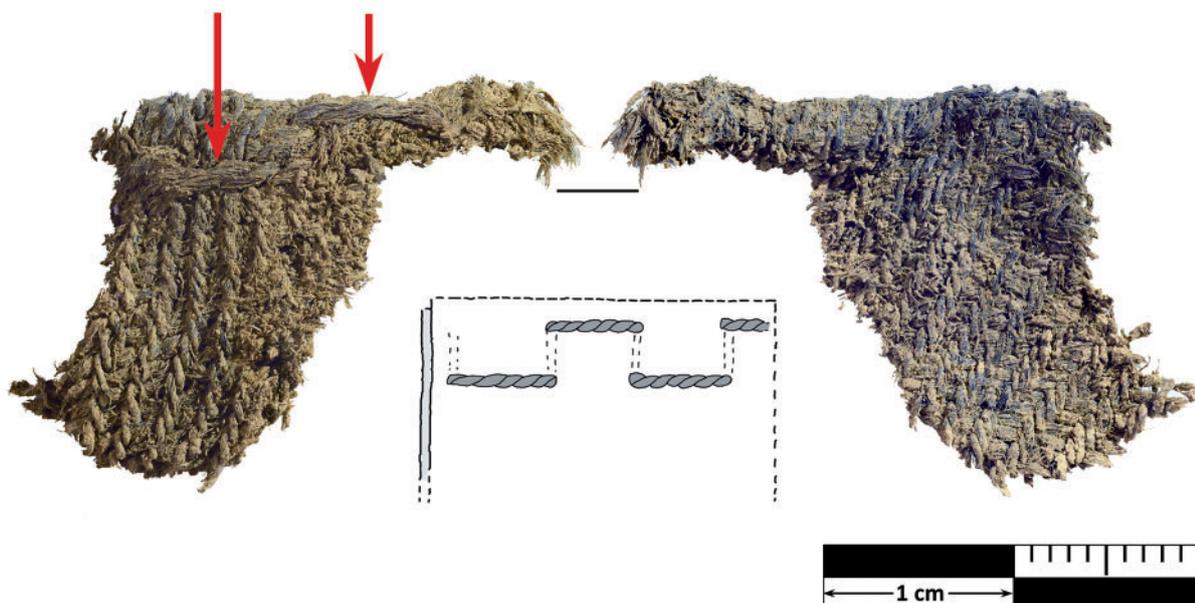


Fig. 8: Fragment x10p seen from both sides. This fragment consists of two layers of Textile 1 both having the Z-twill direction pointing outward, but note that the right image has the warp threads running perpendicular to the upper edge and the left image showing the opposite side has the warp threads running some 70° to the same edge indicating that the edge was not cut on the straight grain. Furthermore, a double sewing thread is seen on the left image forming a hem as seen on the drawing (Image: Lise Ræder Knudsen)

same characteristics and construction – with staggered running stitches – as described for Textile 1.

Further important features recorded inside the right brooch are the textile lumps located approximately at the upper end of the pin. These are heavily mineralised by the iron salts coming from the brooch pin (x10s, figs. 10 a, b and c). Together, they form a strap that was still visibly sewn to the parts of Textile 3 that touch the pin base at the lower edge of the brooch. Fragments of altogether four straps are preserved in situ around the pin catches and pin bases, showing that textile straps were placed around the pins coming from positions above and below the oval brooch. The strap preserved around the pin base of the right brooch is the most well-preserved specimen, and from this it is clear that it consists of a roughly 1.4-cm-wide tablet-woven band. This band was sewn together lengthwise using a S-2z-ply sewing thread, creating a round and sturdy strap (fig. 10). The band is woven using a simple pattern-weaving technique with at least 12 visible tablets, including the two tablets that form one of the band edges. These are threaded with four threads: one in each tablet hole. Unfortunately, due to the stitching, the other edge cannot be seen, but it most likely had an identical construction. The pattern section in the band consists of ten tablets threaded with two threads in the diagonal holes, which gives

the surface of the band a more open structure (table 1). By regularly turning the tablets, a diagonal pattern emerged in the middle-part that reveals the weft to a higher degree than in the edges. This gives the band a twill-like appearance. It is further possible to see a reversal of the tablets' turning direction in one of the loose strap fragments (x10s), where the pattern-section tablets are turned in the opposite direction, while the edge tablets continue turning in the same direction (fig. 10). The independent rotation of the pattern tablets thus indicates a desire for disrupting or making variations in the surface pattern, rather than preventing the constant tablet-rotation in one direction unravelling the twists of the warps located on the far side of the tablets (Collingwood 1982, 106–107). The warp in the band is made of the same s-twisted threads approximately 0.75 mm in diameter, while the weft is z-spun with an approximate diameter of 0.85 mm. Altogether there are approximately 20 threads per cm in the warp and nine threads per cm in the weft.

Apart from the stitches joining the band edges, another type of stitch is placed horizontally to the edge of the strap. This Z-ply yarn most likely originates from the joining of the tablet-woven strap to Textile 3 (table 1). The loose strap piece located at the midpoint of the pin inside the right brooch is in this way connected to the lower edge of a clothing item touching the



SJM 427x10q

Fig. 9: Large piece (x10q) of Textile 3 found on the lower back of the right oval brooch. In the right area, a hem is preserved which has the same construction as in x10p seen in fig. 8 (Image: Lise Ræder Knudsen)

lower part of the brooch. The bent-together strap is approximately 3 cm long measured from the brooch edge to the strap fold. As the straps are heavily mineralised by iron corrosion from the pin of the brooches, it was not possible to take any samples for fibre and dye analysis. On the inside of the left brooch (x9), only a small mineralised part of Textile 3 is preserved at the lower edge. However, remains of the are still preserved in situ around the pin catches and pin bases, which must have been attached to a textile coming from above and below the brooches.

#### **Textile 4**

Preserved in the iron corrosion inside the brooches, remains of Textile 4 were discovered. These must have been placed closest to the body. The textile remains, very small and heavily mineralised, are primarily found on the pin bases. Visually determined, Textile 4 is most likely made of a plant fibre such as flax. However, it was not possible to extract any fibres for species determination, nor to take samples for dye analysis. The fabric is a fine balanced tabby with 14/14 threads per cm. The threads are z-twisted. The thread thickness averages around 0.5 mm and has a twist

angle of approximately 33° for both thread systems. This is a significantly tighter twist than used in Textile 2 (fig. 11, table 1). All thread counts and measurements were taken on fragment x10r, which was located on the inner side of the right brooch. Additionally, corroded lumps of the tabby textile on the pin fasteners of both brooches have multiple folds. The lumps measure approximately 9 mm in height and have 3–4 folds per cm across the width. The folds are found below the pin bases and were not perforated by the pin but lie parallel to it and perpendicular to the edge of Textile 4. This suggests that Textile 4 was gathered in multiple folds or even pleated. More fragments with folds were found at the top of the left brooch (x9), indicating that the folding of the cloth also continued above the position of the brooches.

#### **Interpretation**

Six different textiles (including the tablet-woven band) are preserved in the Bryndum grave. Four were made from wool and two from plant fibres, most likely flax. Altogether the textile analyses show that the textiles found in close proximity to and on top of the bronze brooches are generally well-preserved and in an



organic state, although extremely fragile. Most textiles found inside and underneath the brooches are hard and brittle, and in some cases completely mineralised by the iron corrosion coming from the pins inside the brooches. Only few of these textiles could be analysed, and fibre and dye analyses were only performed on the still-organic parts.

Regarding the position of the oval brooches in Grave 12, the excavation revealed that during the decomposition of the body, the right brooch was displaced approximately 30° relative to the left brooch. This probably occurred at the burial or shortly after, as indicated by the skewed position of Textile 3 (fig. 4 and fig. 10). In contrast, the left brooch most likely remained in the position it was in at the time of burial. In the contemporary Birka graves located on Björkö in Lake Mälaren in Sweden, similar information exists about the location of the preserved textile remains that are of great value for understanding the complex processes taking place during the decomposition of a body in a grave. Out of 163 graves with metal brooches, 140 contained preserved textile remains that show how textiles came into contact in various ways with oval

brooches, sometimes resulting in a fabric originally placed below the brooches being found on the upper side of the brooch (Hägg 1974, 4–8). Consequently, misinterpretations may arise if it is assumed, without further consideration, that textiles found on top of the bronzes were also positioned in that manner at the time of burial. Based on the careful and detailed excavation documentation, it can be concluded that because the Bryndum textiles appear in the same layer sequences on both brooches, the recorded textile stratigraphy most likely reflects the original sequence at the time of burial (fig. 12).

This also means that three textile types and their connected sewing threads can be seen as items/garments placed above the oval brooches, while the others were placed underneath the brooches. The textiles found above the brooches all have very different constructions and appearances but are interpreted as coming from two different items. The quite thick and relatively coarse 2/2 wool twill, Textile 0, found on top of the Grave G12 brooches, did not contain any traces of dyes. The fibre analysis revealed that the white or light grey wool fibres have a fibre

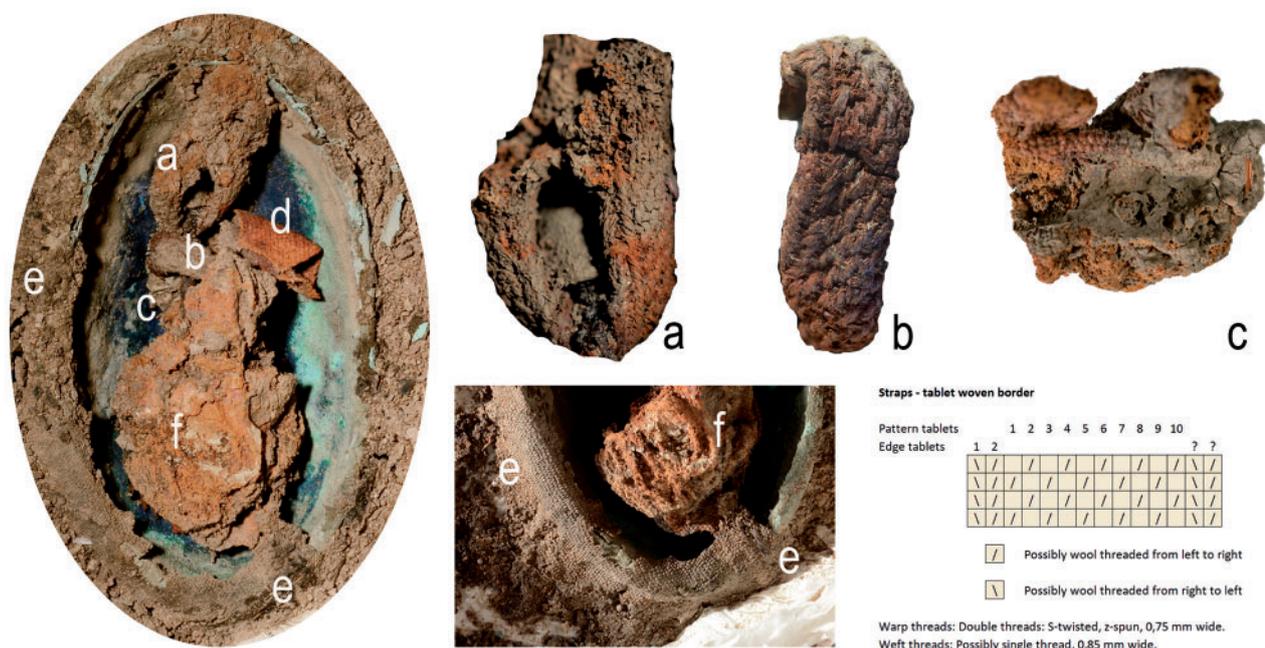


Fig. 10: The inside of the best preserved right oval brooch x10; a) the tablet-woven upper strap. The pin and pin catch can be seen on and below the strap; b) the lower strap. The tablet woven border was pattern woven using two threads in the opposite corners of each tablet by turning the tablets; c) a fragment showing the upper edge of the dress Textile 3, and at the top the remaining two ends of the strap b which were sewn to the folded upper edge of the dress; d) see fig. 11; e) the upper edge of the dress Textile 3 with the folded edge to the right. This textile was probably already twisted in relation to the brooch during the burial ritual. See also fig. 4; f) parallel to the pin on the oval brooch, many folds of textile 4 were seen – presumably remains of vertically folded pleats of the inner layer. Below right is a drawing showing the weaving instruction for the tablet-woven band (Images: Conservation Centre Vejle, graphics and instructions :Lise Ræder Knudsen)



quality that differs from the other textiles found in the Bryndum grave. The closest comparison is found in a twill weave from the female grave from Hvilehøj in northern Jutland, dated to the late tenth century (Mannering and Rimstad 2023, 8, 14; Skals et al. 2024a, 76–77). Just like Textile 0, the Hvilehøj textile has combined twist directions, but this textile was dyed with a blue dye source (Vanden Berghe et al. 2023). As far as it could be determined on the basis of the layer sequences recorded in the Hvilehøj grave, this textile, primarily found underneath fur, and the textile remains that are considered to have come from the deceased woman's clothing, was thus interpreted as a blanket or a cover for a mattress on which the body was placed. The positions of Textile 0 above the body, combined with the different and somewhat coarser fibre qualities, support the interpretation that Textile 0 represents the last remains of a blanket. Another possibility is that Textile 0 represents a duvet that was filled with threshed straw. Although no textile layers were found on top of the straw, traces of down trapped

inside the threads in the weave indicate that the cover at some point was in close contact with feathers and down. If Textile 0 was originally a straw-filled duvet, then the top layer of the duvet's fabric would probably not have been preserved, as only textile in close contact with the oval brooches is preserved. It is thus most likely that the duvet – in an earlier life stage – was originally stuffed with feathers and down as is known from several other contemporary Viking Age graves (Rimstad forthcoming). The fact that the downs are only located inside the small fibre samples from Textile 0, and not among any of the other textiles in the block-lift, indicates that the change of the stuffing material, from feathers/down to threshed straw, happened immediately before or during the preparation of the grave.

Textile 1, a 2/2 twill weave, was found in several layers on top of the oval brooches, right underneath Textile 0. In this case, the dye analysis showed that the wool textile, which also has a strong nap on the outer side of the fabric, was dyed in a deep blue colour. Additionally, the dye analysis revealed that in some areas the weft threads also contained traces of a red dye, which may have given the textile occasional or regular stripes in a more purplish/reddish tone. The technical details of Textile 1 combined with its many folds and the recorded hem and seams indicate that it was most likely used as a kind of clothing item. Although the many squeezed-together layers of Textile 1 are difficult to interpret, it is clear that this clothing item was rich in folds. As most of the textile joins do not follow the warp/weft thread directions, the different cuts suggest that the garment was at least partly tailored. Furthermore, Textile 1 was produced in such a manner that there was a significant and discernible difference between the appearance of the two fabric sides, with extensive napping predominantly – though not exclusively – on the side of the textile which has an S-directed twill structure, i.e. the side that appears to have faced outwards.

Although only a few small fragments of Textile 2 are preserved, it is likely that the balanced linen tabby, found on the inside of Textile 1 and thus directly on top of the oval brooches, served as a kind of lining for the garment made of Textile 1. The linen textile was not tested for dyes, but the current light greenish colour indicates that it was undyed. Due to the range of natural colours that plant fibres may achieve during processing, the colour could have ranged from white to greenish or greyish. The colour contrast between Textile 1 and 2, the outer and inner textile layers of this clothing item, would have been striking and even further accentuated by the quite different textures and

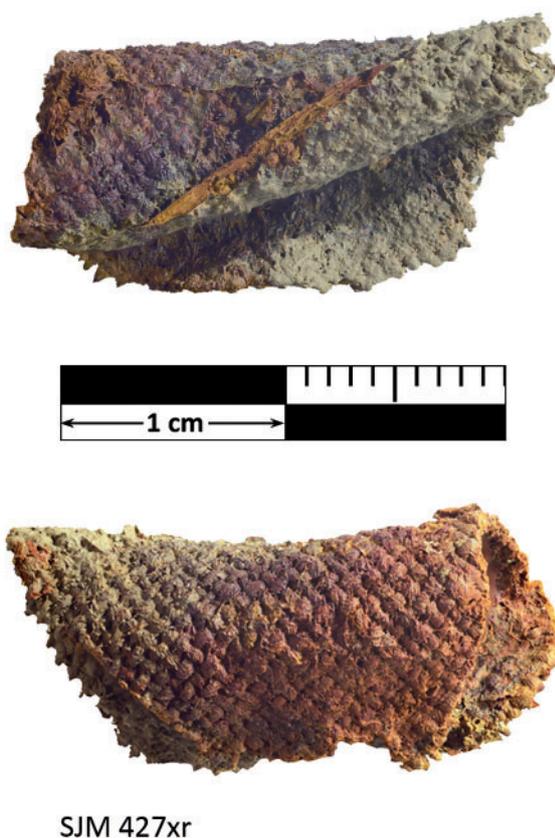
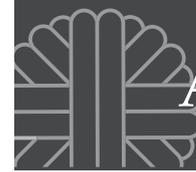


Fig. 11: Textile 4 presumably flax from the inner garment. The fragment is seen in fig. 10 d (Image: Lise Ræder Knudsen).



feel of the fabrics. Textile 2 contributes an important understanding of the look of a highly degraded plant-fibre textile in a wet condition, as the clay-like substance detected around the wool fibres of Textile 1 most likely came from Textile 2. Furthermore, it is important to note that between the several layers of Textile 1, clay-like substances were found, indicating that Textile 2 (possibly flax) may have lined the blue wool Textile 1. The seam that joins pieces of Textile 2 with different thread directions indicates that this textile was tailored and cut-to-shape (see fig. 6c).

It is possible to interpret Textiles 1 and 2 as the outer and inner layers used for a tailored garment in which the blue or blue-reddish outer tweed-like fabric would have given an aesthetically pleasing contrast to the lighter inner lining. As the garment was placed on top of the oval brooches that supported another type of garment, it could have been a kind of linen-lined wool jacket as seen in some contemporary depictions (Bau 1981; Mannering 2017, 156–164). However, it should be noted that the wool twill did not feature a seam in the same position as the seam of the lining, as one would expect if it was a jacket. There are also other possibilities, for instance, that the seam of the lining represents some kind of repair.

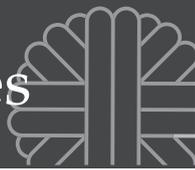
Textile 3, which was found underneath the oval brooches, is a fine unbalanced deep blue wool tabby. The presence of a folded edge located in the layer found immediately under the edge of the brooches, as well as the straps connected to the folded edge placed around the pin catches and bases, suggest that this was a kind of dress held in place by the brooches on the chest. All four straps (two inside each brooch) are quite small and delicate, about 0.6 cm wide and with a strap length of ca. 3 cm. Although it is not possible to know if the upper straps were originally much longer, the lower connection to Textile 3 indicates that they were in fact not visible beyond the rim of the oval brooches. In the Viking Age, textile straps seem to be linked to the use of the quite heavy oval brooches – a well-known feature in the above mentioned Birka graves. In these graves, most straps are interpreted as coming from a suspended dress, although just as in the case of Bryndum, they can be made of different types of fabric from the dress and also in different fibre materials (Geijer 1938, 154–155; Hägg 1974; Bau 1981; Gläsel et al. 2010). The diagonal-patterned tablet-woven band from Bryndum that was sewn together lengthwise and cut into four identical parts thus created narrow but strong straps that were integral for carrying the weight of the dress (fig. 10). Interestingly, according to the available evidence from preserved finds, tablet weaving was not a widely



Fig. 12: The sequence of textile layers observed on the oval brooches in Bryndum G12 (Image: Lise Ræder Knudsen)

used technique in the Late Germanic Iron and Viking Ages in Denmark (520/40–1050 CE) (Bender Jørgensen 1986; Ræder Knudsen 2015). While tablet-woven bands were found in approximately 10% of all graves containing preserved textiles dated to the Roman Iron Age (1–400 CE) and around 23% in the Early Germanic Iron Age (400–520/40 CE), there are very few finds from the Late Germanic Iron Age (520/40–800 CE). In the Viking Age (800–1050 CE), the number of tablet-woven bands increases slightly to about 3%, especially due to the occurrence of specialised metal-brocaded silk bands (Ræder Knudsen 2015, 35; Mannering and Rimstad 2023; Mannering and Rimstad forthcoming). Altogether, this is the first time that dress straps made of a tablet-woven wool band have been recorded and are associated with Viking Age female clothing in this specific way.

Finally, Textile 4, a fine balanced linen weave, was found closest to the body. It was preserved within the iron-rust originating from the pins of the oval brooches. In this position, several textile lumps were found parallel to the pins but not pierced by them. The pleating or gathering of the textile into small, fine tucks, approximately 9 mm in width with 3–4 tucks per cm, is a feature well-known in the Viking Age. Especially in the Birka graves, remains of pleated inner dresses were recorded in around 20 of the 140 female graves that contained oval brooches with preserved textiles (Hägg 1974, 4, 26). Of these graves however, the majority are dated to the 900s, and only few such examples to the 800s (Hägg 1974, 36). As the tucks of Textile 4 are also found on the upper edge of the left oval brooch, it is obvious that this garment continued over the shoulders and thus represents an item worn underneath Textile 3. If, hypothetically, the textile had tucks in a front piece measuring 30 cm in the width and with four tucks per cm, each 9 mm deep, it would have required a fabric more than 216 cm wide, which is an impressive quantity of fabric. Garments made of plant fibres are known both in male and female clothing in the Iron Age, but the pleating technique is – in a Danish Viking Age context – unusual and has



until now not been recorded in female graves. This adds a new feature to the design of the clothing in Grave G12, and hints at a technical construction and visual appearance that opens for connections to areas beyond the local.

### Conclusion

If it were not for the oval brooches preserved in the Bryndum woman's grave, it would have been difficult to date the cemetery more precisely than simply ranging from the ninth to eleventh century. This would make it contemporary with the earliest Christian burials in Denmark found in the cemetery at Ribe cathedral (Søvsø 2020, 185–200). Thanks to the chronology of the jewellery and the 14C-dating we now know that the Bryndum woman lived in the ninth century.

Even if it is difficult to be specific about the exact use of the textiles preserved in Grave G12, it is clear that the grave contains textiles and clothing items that match the general textile production trends of the period (Bender Jørgensen 1986, 317–324), but that also contain unusual details that offer new information. Six different textiles are preserved, four textiles made from wool and two from plant fibres. Three of these textile types and the connected sewing threads are found on top of oval brooches and three textiles are found underneath the brooches. Textile 0 is based on the thick and warm weave interpreted as a furnishing textile made of white or light grey wool such as a blanket or duvet cover perhaps filled with threshed straw at the funeral, but earlier filled with down. Textiles 1 and 2 are interpreted as being part of the same item, possibly a garment, that to some extent was cut to shape and sewn together. The outer layer consists of a blue or blue/reddish/purplish striped tweed-like wool textile with a strong nap on one side. Finally, the fine repp-like and blue-dyed wool tabby that was held together by the straps placed inside the oval brooches is a well-known feature of Viking Age female clothing. The fact that the straps are made in the tablet weaving technique is however unusual. We may imagine that the quite voluminous linen gown gave a beautiful colour contrast to the blue wool dress.

Although the small preserved textile fragments miraculously preserved in the Bryndum grave cannot be used to reconstruct a complete outfit, the Bryndum woman was undoubtedly buried in well-crafted textiles that fit into the known Viking Age cloth culture. Further the maker of the textiles and the outfit were creative in their design in ways not often preserved. The Bryndum woman was undoubtedly

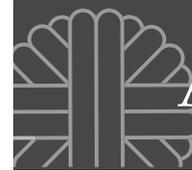
buried in an outfit that had deep roots in an earlier Iron Age clothing tradition (Mannering 2017; 2024), and she was sent to the afterlife in style.

### Acknowledgements

Thanks to the Agency for Culture and Palaces for funding the excavation and conservation of the block lift, Gerd Nebrich, Conservation Centre Vejle, for the careful excavation, documentation and conservation of the find, and conservator Clara Bratt Lauridsen (2025), also Conservation Centre Vejle, who made the FTIR analysis. Dye analyses were funded by the TeCoVa project (Danish Independent Research Fund Grant 10.46540/3097-00022B; Mannering 2024). We also thank Charlotte Rimstad for her help creating some of the photo collages. More photos of the Bryndum finds are available on <http://sol.musvest.dk/> by searching for SJM 427 or the given ID number.

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