Stone Age Textiles – Materials, techniques, and the value of reconstructions

Eva IJsveld and Dorothee Olthof

Zusammenfassung

Textilien aus der Steinzeit – Materialien, Techniken und der Wert von Rekonstruktionen

Steinzeitliche Kleidung wird oft mit Leder und Pelz in Verbindung gebracht, während das Wort »Textil« Bilder von Wolle, Spinnen und Weben auf großen Webstühlen hervorruft. Archäologische Funde zeigen uns jedoch, dass Pflanzenfasern die frühesten Textilmaterialien waren, die von der Menschheit verwendet wurden. Bast, Nesseln, Gräser und andere Pflanzenfasern wurden gedreht, gezwirnt, gezwirbelt und gewickelt, um Schnüre und Seile, Umhänge, Körbe, Hüte, Matten und sogar Schuhe herzustellen. In diesem Artikel untersuchen wir die Materialien und Techniken dieses frühen Textilhandwerks, die archäologischen Funde und ihre möglichen Verwendungszwecke sowie den Wert der Rekonstruktion alter Techniken und Gegenstände für wissenschaftliche und pädagogische Zwecke.

Schlagwörter Pflanzenfasern, Steinzeittextilien, experimentelle Archäologie, Rekonstruktionen, Textilhandwerk

Summary

Stone Age clothing is often associated with leather and fur, whereas the word ›textile‹ conjures images of wool, spinning, and weaving on large looms. However, archaeological evidence shows us that plant fibres were the earliest textile materials used by (wo)mankind. Tree basts, nettles, grasses, and other plant fibres were twisted, plied, twined, and coiled to make cordage and ropes, capes, baskets, hats, mats, and even shoes. In this article, we explore the materials and techniques of these early fibre crafts, the archaeological finds and their possible uses, as well as the value of reconstructing ancient techniques and objects for scientific and educational purposes.

Keywords Plant fibres, Stone Age textiles, experimental archaeology, reconstructions, fibre crafts

Introduction

In the popular view, people of the Stone Age all wore crude clothing made of bearskins. Some researchers even adhere to the view that until the Neolithic people wore nothing but skin clothing (Gilligan et al. 2024). The archaeological record, however, shows us that plant fibre textiles have been around since the Palaeolithic. Evidence from this ancient era is quite rare due to the fragile nature of the material. The oldest find so far is a 46 000–41 000-year-old piece of string (Hardy et al. 2020). In addition, 25 000-year-old imprints in clay from Dolní Věstonice, Břeclav District (Czech Republic), show several textile techniques and engravings on some ›Venuses‹ also suggest the use of textile materials (Soffer et al. 2000; Soffer et al. 2001; Olthof 2020). Mesolithic and Neolithic wetland sites, dry caves and glaciers have yielded extraordinary finds of Stone Age textiles: cordage, baskets, bags, nets, mats, capes, hats, and shoes, expertly made from a whole range of plant fibres.

The fragile textiles are rare in the archaeological record, but they once made up a large part of Stone Age material culture (Hurcombe 2014). Let us take a closer look at some Central and Western European finds, the materials they were made of, the techniques used to turn the fibres into objects, and the value of reconstructing these finds for scientific and educational purposes.

Grasses, bast, and nettles

Plant fibres are the oldest known textile materials. Archaeological evidence for the large-scale use of wool does not appear before the Bronze Age (Grömer 2016). Our Stone Age ancestors used tree bast, grasses, nettles, and other plants to craft functional and beautiful textiles (Grömer 2016; Rast-Eicher 2016a; Rast-Eicher/Dietrich 2015). The most frequently used Stone Age plant fibres will be discussed below.

Tree bast

Bast is the fibrous layer between the wood and the bark of a tree (Fig. 1). In spring, when the sap is rising, the bark can be pulled off the tree quite easily. The bast layers and bark are stuck together with pectins and lignins and must be separated. The easiest way to do this is by retting: putting the bark in (running) water until the bast layers separate from the tough bark and from each other (Fig. 2). Depend-

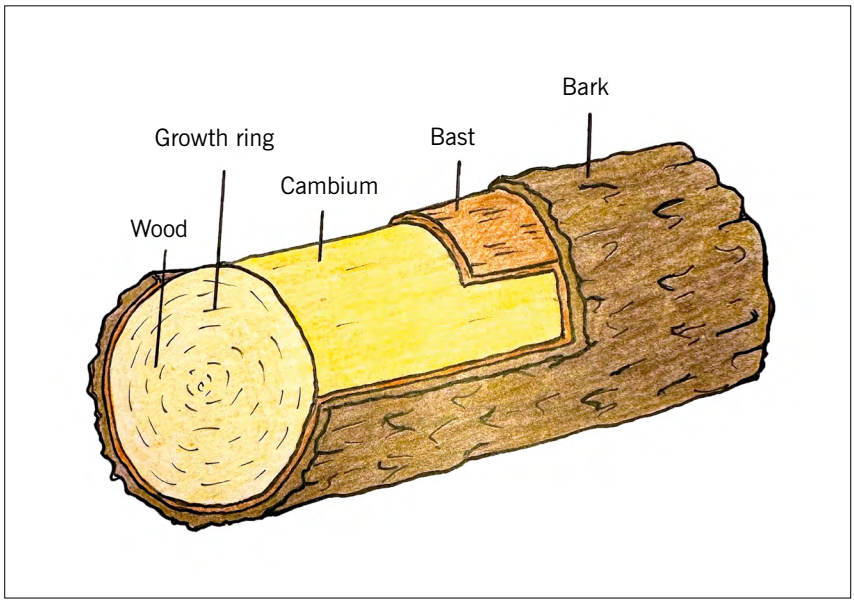

Fig. 1 *The bast layer of a tree is situated between the wood and the bark.*

Abb. 1 *Die Bastschicht eines Baumes befindet sich zwischen dem Holz und der Rinde.*

ing on the water temperature, this can take several weeks or months, with higher temperatures speeding up the process. After retting, the bast is rinsed and dried. It can then be stored until further use; it will keep for many years. Before use, it needs to be rehydrated to make it more pliable (Rast-Eicher/Dietrich 2015; Reichert 2020).

There are other ways of preparing the bast for crafts. The bast and bark layer of very fine twigs can be used without

Fig. 2 Retted lime bast separates into many thin layers. The youngest inner layers are the finest, the layers close to the bark are coarser.

Abb. 2 *Gerösteter Lindenbast teilt sich in viele dünne Schichten auf. Die jüngsten inneren Schichten sind die feinsten, die Schichten in der Nähe der Rinde sind gröber.*

much preparation except for drying and rehydration. For finer work, the thin bark can be scraped off with a sharp knife. To speed up the retting process, it is also possible to boil bast in water or water with wood ash. The alkaline solution breaks down the pectins and lignins faster. The Indigenous peoples of the Pacific Northwest Coast softened cedar bast by beating it with wooden or stone implements before turning it into clothing. They even oiled the fibres to make the clothing water-repellent (Stewart 1984). Perhaps Stone Age people did something similar.

The most frequently used tree basts in the European Stone Age were lime (*Tilia* sp.), oak (*Quercus* sp.), and willow (*Salix* sp.). However, there are also finds of elm (*Ulmus* sp.) and poplar (*Populus* sp.) (Böhm et al. 2023; Olthof 2020), as well as unspecified coniferous bast (Hardy et al. 2020). Interestingly, during experiments, oak bast proved too brittle for cordage or plaiting, whereas it is regularly found in archaeological contexts (Reichert 2020). Clearly, the Stone Age fibre artists knew more than we do now, and more experiments are needed to evaluate different ways of preparing the fibres. Ethnographic studies could provide new ideas and techniques for this.

Nettles and flax

Stinging nettles *(Urtica dioica)* and flax *(Linum usitatissimum)* are also bast fibres, only much finer than tree basts. Whereas flax was introduced to Europe by the first farmers at the beginning of the Neolithic, nettles are native plants that have been around for much longer (Grömer 2016). Like tree basts, the fibres of nettles and flax are found in the stems, under a (very thin) ›bark‹ and around the woody stem.

Flax is traditionally sown in April, around the 100th day of the year, and harvested about 100 days later, in July. Nettles are harvested in summer and early autumn when the stems have grown to full height.

In historical times, the stems of the plants were retted, broken, and heckled (combed) to extract and separate the fibres before spinning. In Neolithic textiles, the fibre bundles are usually not separated, and parts of the epidermis are sometimes still present. This points to another extraction method, with no or incomplete retting, possibly scraping the fibres without heckling (Gleba/Harris 2019; Rast-Eicher/Dietrich 2015).

Grasses, rushes and sedges

The long, flexible stems of certain grasses *(Poaceae)*, rushes *(Juncaceae)*, and sedges *(Cyperaceae)* are very well suited for fibre crafts. ›Ötzi‹ from the Tisenjoch, South Tyrol (Italy), wore a cape made of grass (*Brachypodium pinnatum*; Egg/Spindler 2009), the Cueva de los Murciélagos, Province of Córdoba (Spain), yielded beautiful baskets and sandals made of esparto grass (*Stipa tenacissima*; Martínez-Sevilla et al. 2023), and many coiled baskets from the lake dwellings in the Alpine area have a core of grasses, rushes or sedges (Böhm et al. 2023).

These plants are harvested in July and August, dried, and stored until further use. Before plaiting, they must be rehydrated to make them flexible again. Esparto grass can be processed further by crushing the leaves to make them more pliable. Traditional esparto artisans also retted the grass in stagnant water for 20–40 days to make it more flexible. The Neolithic fibre artists of the Cueva de los Murciélagos used both crushed and uncrushed grass for their work, depending on the type of object they made, while their Mesolithic colleagues only used uncrushed grass. The archaeological finds showed no evidence of retting (Martínez-Sevilla et al. 2023).

Each plant fibre has its own season for harvesting and its own preparation method. Common to all fibres is the need to harvest, dry, and rehydrate them before use to restore their flexibility. Harvesting fibre plants would have been an important seasonal activity during the Stone Age year, for hunter-gatherers and farmers alike.

Twisting, twining, coiling

The word ›textile‹ derives from the Latin word ›texere‹, which means to weave on a loom. In our modern understanding, most people would agree that objects made in other techniques, like knitting, felting or crochet, can also be called textiles. When studying Stone Age fibre arts, we definitely must broaden the definition of the word to include techniques other than weaving, since weaving on large looms is a relatively late development, probably originating in the Neolithic (Grömer 2016).

Stone Age finds show us a range of different textile techniques. The most prevalent ones will be discussed below. Here, ›textile‹ will mean any more or less flexible object or fabric that consists of connected fibres. All the different techniques which were used to make textiles have their own names. For clarity in communication with other (textile) archaeologists and craftspeople, it is important to use the appropriate names for the techniques. Calling everything ›woven‹ leads to confusion and misunderstanding (Banck-Burgess 2023).

Twisting and plying

The string or thread is the basis of (nearly) all textile techniques and is also very useful on its own for binding, attaching, and hanging things. So perhaps it is not surprising that cordage dominates the Stone Age textile record (Böhm et al. 2023).

Cordage is made by twisting and plying fibres. Loose fibres are twisted in one direction (right or left, Z or S) to make a longer strand. Two or more strands are then plied together in the other direction (left or right, S or Z) to make durable cordage that does not untwist easily (Fig. 3a). This process can be done by hand and does not require any specialised tools.

So far, the oldest evidence of cordage is a 46 000–41 000-year-old find of very fine string from Abri du Maras, Dep. Ardèche (France). A Neanderthal had plied three

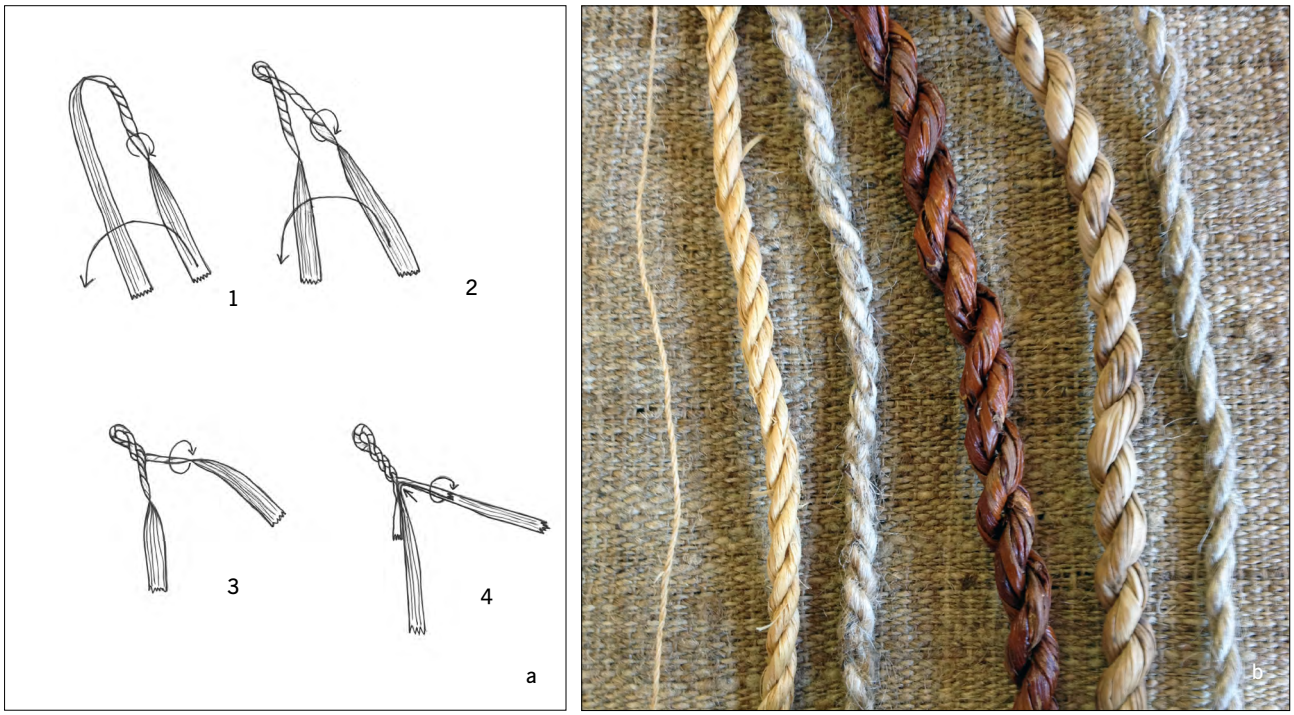

Fig. 3a–b Cordage. a Plying cordage with two strands. b Recreations of Stone Age cordage. From left to right Abri du Maras, Dep. Ardèche (France; 0.5 mm Ø), Lascaux, Dep. Dordogne (France; 6–8 mm Ø; both in lime bast), nettle string from Hardinxveld-Giessendam, South Holland Province (Netherlands), and cordage in willow, rush and flax.

Abb. 3a–b *Schnüre. a Verzwirnen von Schnüren mit zwei Strängen. b Nachbildungen von steinzeitlichen Schnüren. Von links nach rechts Abri du Maras, Dep. Ardèche (Frankreich; 0,5 mm Ø), Lascaux, Dep. Dordogne (Frankreich, 6–8 mm Ø; beide aus Lindenbast), Nesselschnur aus Hardinxveld-Giessendam, Provinz Zuid-Holland (Niederlande), und Schnüre aus Weide, Binsen und Flachs.*

twisted pieces of coniferous tree bast into a string with a thickness of just 0.5 mm (Hardy et al. 2020). Another Palaeolithic piece of rope has been found in Lascaux, Dep. Dordogne (France; Glory 1959). More than 20 000 years old (Valladas et al. 2013), it is younger than the Neanderthal string and easier to see: it was a three-ply cord, 6–8 mm thick and 30 cm long. The exact material could not be determined, but it was a plant fibre, probably tree bast (Barber 1991, 40). From the Mesolithic onwards, there are many finds of strings, ropes, and threads all over Europe, made of plant fibres like nettle, willow, lime, and other tree basts (Fig. 3b; Böhm et al. 2023; Louwe Kooijmans et al. 2001; Rast-Eicher/Dietrich 2015).

Knotting and netting

A sufficient length of string can be turned into a net by knotting. One of Europe's oldest fishing nets has been found in Antrea (today Kamennogorsk, Leningrad Oblast [Russia]). It was made of willow bast string and is dated around 10 400 cal BP (Miettinen et al. 2008). Later Mesolithic and Neolithic European wetland sites have yielded many net fragments, all made of plant fibres and constructed with one of the following knots: the sheet bend, the reef knot, and the overhand knot or ›Pfahlbauknoten‹ (Fig. 4)[1]. Mesh sizes vary, as does the thickness of the string, probably in relation to the function of the net. Nets could be used for fishing, but also for gathering, transport, hunting birds, and storage (Böhm et al. 2023; Louwe Kooijmans et al. 2001; Rast-Eicher/Dietrich 2015). Netting needles and mesh sticks are useful tools for making nets with consistent loop sizes.

Twining

In a twined fabric, a passive system of fibre bundles (the warp) is entwined by an active element consisting of two (or more) fibre bundles. The active fibre bundles are plied, just as in cordage making, except that in every turn there is a passive fibre bundle between the active elements (Fig. 5a). In this way, a fabric is created. Depending on the thickness of the fibre bundles and the closeness of the twining, the fabric can be thin and soft or thick and stiff (Fig. 5b). No tools are needed, just hands, though for large projects it can be practical to suspend the warp from a frame.

The technique can be utilised to make mats, baskets, bags, and hats, but some fragments are so fine – made with fibre bundles of just a few millimetres in diameter – that use as clothing can be envisioned. Ethnographic and archaeological evidence shows us that throughout history and across the globe, from New Zealand to Japan and from the Stone Age to

1 Named after many finds from the lake dwellings in the Alpine area.

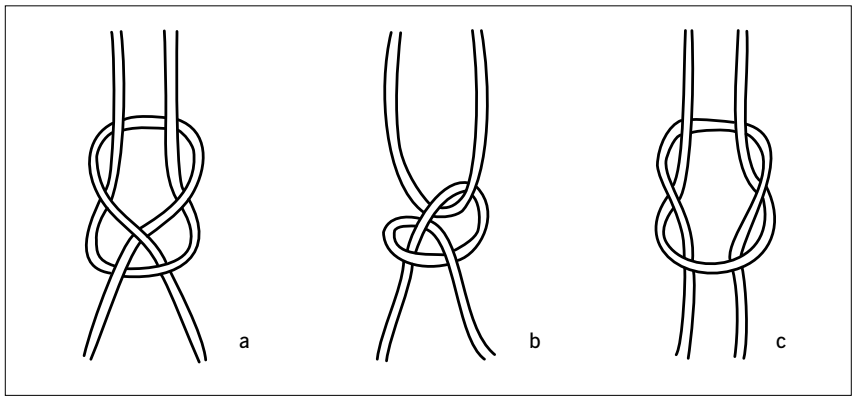

Fig. 4a–c Knots used for Stone Age nets: the sheet bend (a), the overhand knot (b), and the reef knot (c).

Abb. 4a–c *Knoten, die für steinzeitliche Netze verwendet wurden: der Bogenknoten (a), der Überhandknoten (b) und der Weberknoten (c).*

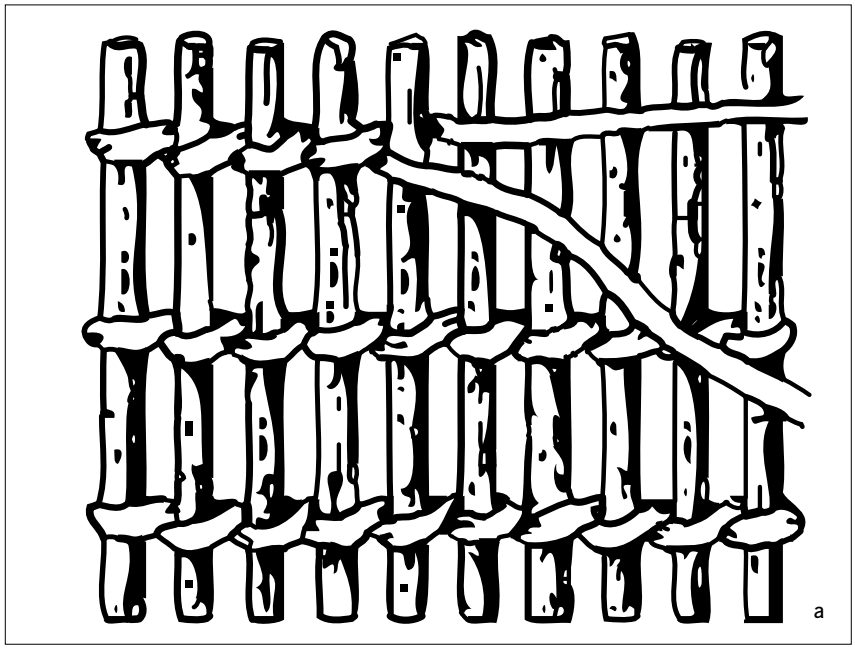

Fig. 5a–b Twining a fabric. a Twining a fabric with two active fibre bundles around the passive warp fibres. b Variations in twining, all based on techniques seen in archaeological finds from pile dwellings in the Alpine area (fibre bundles approx. 1.5–2.0 mm Ø).

Abb. 5 a–b *Bei der Zwirnbindung werden zwei aktive Faserbündel um die passiven Kettfasern gezwirnt. b Zwirnbindungsvariationen, die alle auf Techniken basieren, die an archäologischen Funden aus Pfahlbauten im Alpenraum festgestellt wurden (Faserbündel ca. 1,5–2,0 mm Ø).*

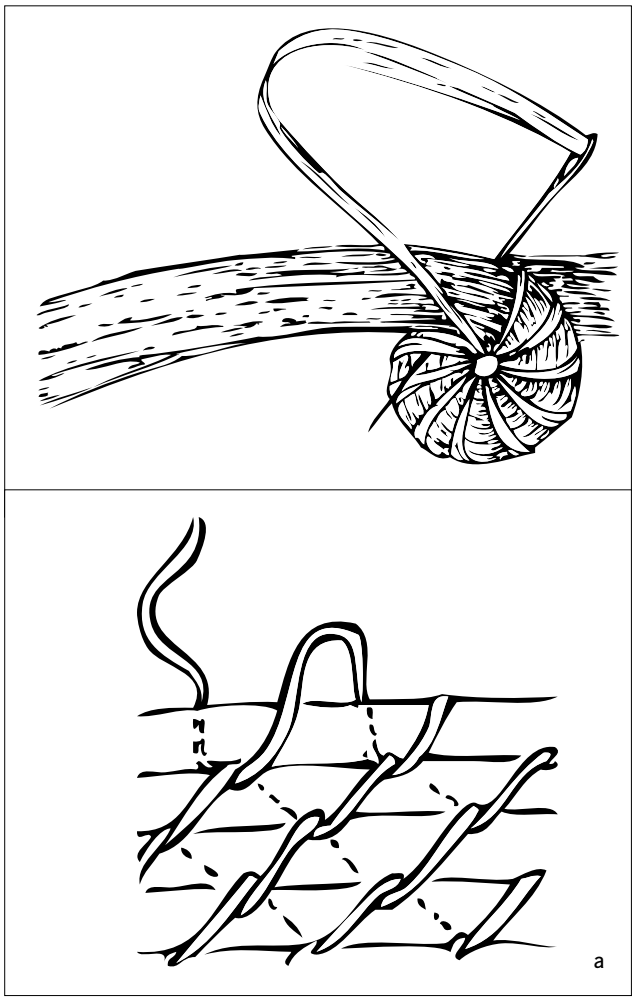

Fig. 6a–b a The coiling technique. b A coiled basket made of rushes and lime bast (coiled bundles c. 5 mm Ø).

Abb. 6a–b *a Spiralwulstflechten. b Ein gewickelter Korb in Spiralwulsttechnik aus Binsen und Lindenbast (gewickelte Bündel von ca. 5 mm Ø).*

the present time, twined plant fibre clothing was made and worn by many people (Böhm et al. 2023; Olthof 2020; Rast-Eicher/Dietrich 2015).

Coiling

Coiling is a technique where a passive fibre bundle is rolled into a spiral and sewn with an active fibre bundle (Fig. 6). Coiling always starts at the centre and spirals outwards. A needle or an awl is a useful tool for this technique. There are numerous finds of coiled fragments from Stone Age wetland sites, often made of monocotyledonous stems as the passive bundles and bark strips as the binders. They are usually interpreted as baskets, used for storage, gathering, or cooking. The finer fragments could perhaps have come from hats (Böhm et al. 2023; Rast-Eicher/Dietrich 2015). Sometimes, the fibres have not survived, but their imprint in the soil has. At Almere-Hogevaart, Flevoland Province (Netherlands), imprints of four coiled mats of at least 1 m diameter have been found in a clay-rich pit. They are dated to the Early Neolithic period, around 4300 cal BC, and were probably used as floor coverings during pottery making (Hogestijn/Peeters 2001).

Looping

There are many terms for this technique: looping, knotless netting, and needle binding. It is the craft of making textiles from loops with (relatively) short pieces of yarn. There are endless variations possible in how the loops are stitched through each other. The oldest find so far comes from the Nahal Hemar cave in Israel and can be dated to 8000 cal BC. It is a small fragment in simple looping (Fig. 7a). Mesolithic sites in Northern Europe, like Friesack, Havelland District (Germany), and Tybrind Vig, Funen (Denmark), have also yielded examples of looping techniques (Fig. 7b), as have the Neolithic lake dwellings (Rast-Eicher/Dietrich 2015). Looping is suitable for making nets, bags, baskets, hats, and hairnets. Some variations can be done entirely by hand; for others a blunt needle is a useful tool (Claßen-Büttner 2012).

Weaving

A woven fabric consists of a passive element, the warp, and an active element, the weft, that are interlaced at right angles. The simplest form is called plain weave or tabby: over one thread, under one thread (Fig. 8). When this is done with stiff materials, like bark strips or rushes, the result will be a mat or a basket, and the technique is usually called plaiting. Actual weaving is done with long, thin, flexible threads and produces a soft, flexible fabric (Fig. 8b). To keep the warp threads under tension they are stretched on a frame or a loom. To avoid having to plait the weft over one and under one thread manually, at some time in Prehistory, the heddle rod was invented to separate the even and uneven threads of the warp and create a weaving shed. Now, it was possible to place the weft between the two layers of the warp all in one go: the loom was invented, one of the first machines invented by (wo)man. It made weaving faster and more efficient. This invention probably originated in the Near East and spread through Europe with the first farmers in the Neolithic period (Grömer 2016).

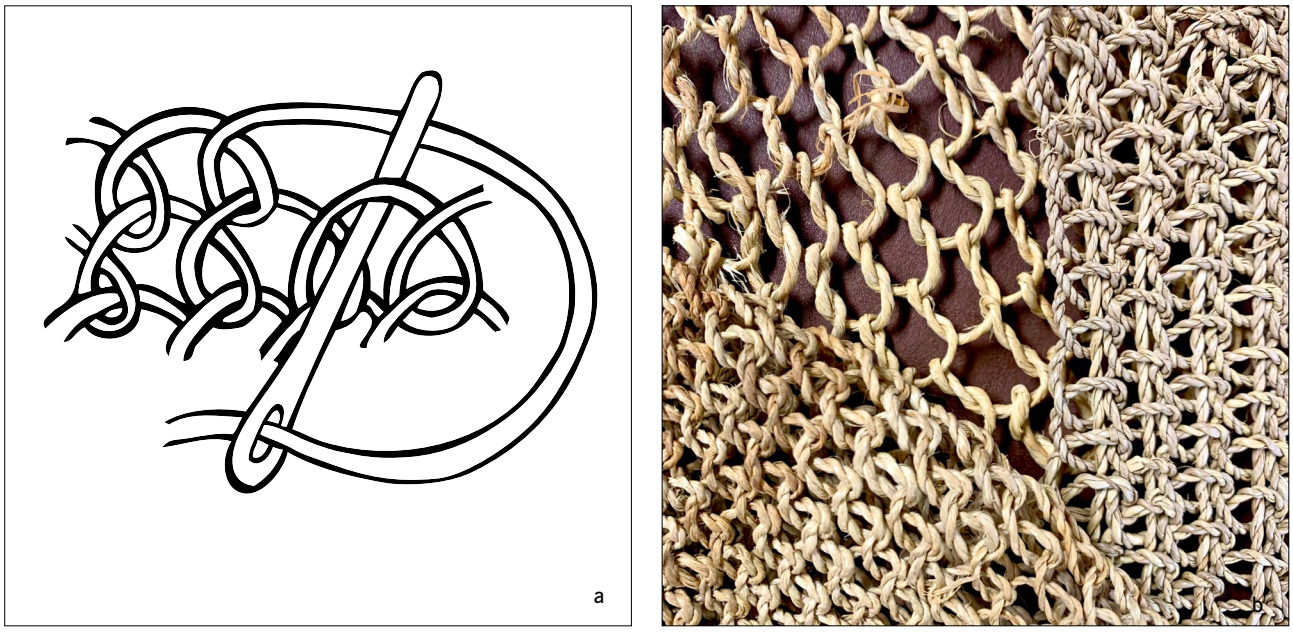

Fig. 7a–b Looping techniques. a Simple looping is done by sewing loops into each other. b Reconstructions of looping techniques from the Mesolithic sites at Friesack, Havelland District (Germany), and Tybrind Vig, Funen (Denmark). Cordage approx. 1.5–2.0 mm Ø.

Abb. 7a–b *Schlingentechnik. a Einfache Schlingen werden durch das Ineinandernähen von Schlingen hergestellt. b Rekonstruktionen von Schlingentechniken aus den mesolithischen Fundstellen von Friesack, Lkr. Havelland, und Tybrind Vig, Fünen (Dänemark). Schnüre ca. 1,5–2,0 mm Ø.*

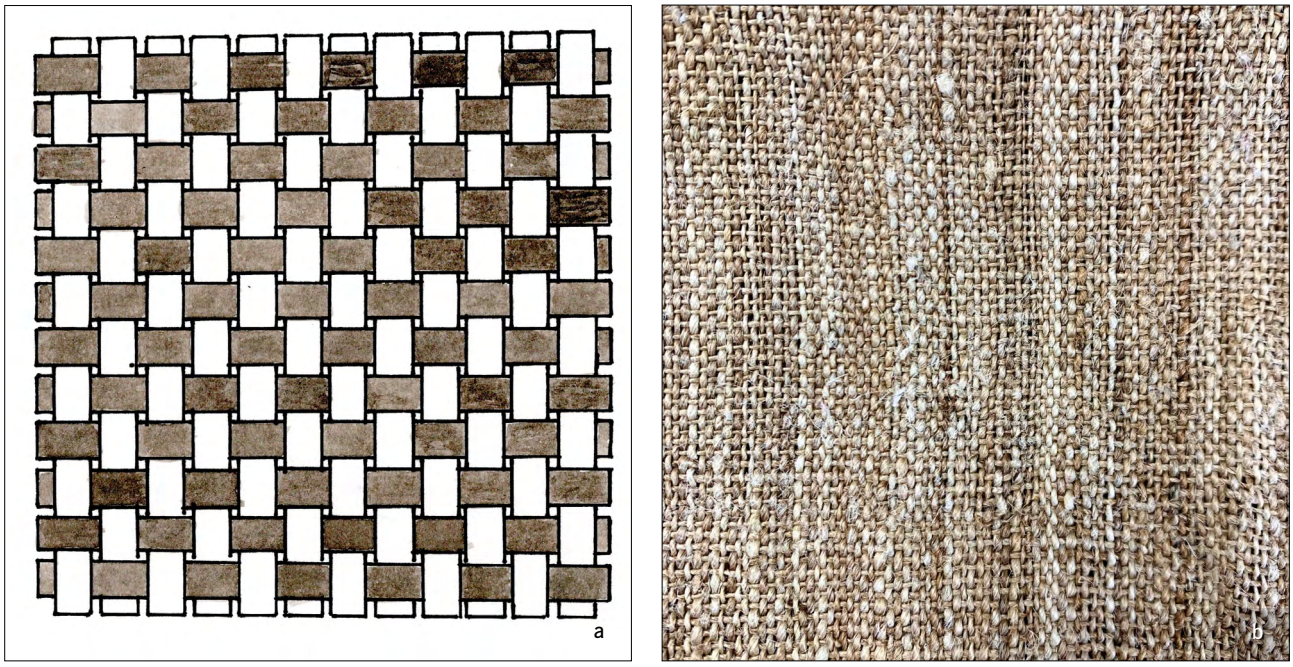

Fig. 8a–b Plain weave. a The structure of plain weave or tabby: over one thread and under one thread. b Plain weave modern nettle fabric from Nepal (10 threads per cm).

Abb. 8a–b *Leinwandbindung. a Die Struktur von Leinwandbindung oder Tabby: über einem Faden und unter einem Faden. b Modernes Nesselgewebe in Leinwandbindung aus Nepal (10 Fäden pro cm).*

All Neolithic woven textiles are made in plain weave. The fibres of choice are often flax, but surprisingly, woven lime bast textiles also existed. At Zurich-Mythenquai (Switzerland), a woven lime bast fabric has been found that looks exactly like a piece of linen fabric to the naked eye. It is dated to the Late Neolithic Corded Ware culture (Banck-Burgess 2020).

Once weaving on looms was invented, the other textile techniques did not disappear. Twining with bast fibres remained the most utilised fabric-making technique during the Neolithic, even after the introduction of the loom. Finds at Must Farm, Cambridgeshire (United Kingdom), and the lake dwelling sites in the Alpine region show evidence that all the techniques were still in use during the Bronze Age

Fig. 9 Neolithic lime bast shoe from Maur-Schifflände, Canton of Zurich (Switzerland).

Abb. 9 *Neolithischer Lindenbast-Schuh aus Maur-Schifflände, Kanton Zürich (Schweiz).*

(Böhm et al. 2023; Harris/Gleba 2024; Rast-Eicher/Dietrich 2015). Some crafts, like ropemaking, coiling and netting, have survived until the present time.

Recreating Stone Age clothing

Stone Age textiles usually do not look like much during and after excavation. They are fragmented and torn; to the untrained eye, they are just brown blobs of fibrous material. It is difficult to envisage their original colour and appearance, the shape of the original object, how they felt (soft, hard, smooth, hairy, stiff) and what it would be like to wear or use them. From a technical point of view, the study of the preparation of the plant fibres, the textile technique used, the working sequence, the possible tools involved, and the amount of material required helps us better understand this craft.

Therefore, the recreation of Stone Age textiles and clothing is an invaluable tool for studying and understanding the finds and presenting them to the public. The following two case studies will highlight this.

The shoes from Maur-Schifflände

During underwater excavations in the Greifensee at Maur-Schifflände, Canton of Zurich (Switzerland), in 2017–2018, fragments of more than 40 lime bast shoes came to light, dated to around 3000 BC. All sizes were represented, from small children's shoes to large adult sizes, and some were nearly completely preserved (Fig. 9)[2]. The Cantonal archaeology Zurich asked the authors to replicate two shoes for an exhibition about this unique find.

Reconstructing the shoes required studying the finds very closely and questioning every detail we saw: the number of bast strips, construction of the heel, plaiting technique of the sole and the upper, number of shoelaces, and so on. We found that all the shoes were of the same model: plaited of nine lime bast strips in rep (over one, under one, very close together), starting at the heel and continuing to the toes. There, the strips were plaited over the top of the foot as a twined tongue. The soles of the shoes were reinforced with a sole profile of twisted lime bast strips attached to the soles in a figure eight pattern. The shoes were tied to the foot with shoelaces of plied lime bast (Fig. 10). Some construction details remained unclear, so we compared the Greifensee shoes to other Neolithic lime bast shoe finds from lake dwellings. Unfortunately, that did not answer our questions, although it showed us that the other shoes were most probably made in the same way as those from Greifensee: plaited in rep, with a twined tongue and a sole profile. The traces of the tongue and sole profile were not as clear as in the Greifensee shoes and, therefore, had not been recognised before. However, once we had seen these elements, we could not

2 Pers. comm. A. Huber, Kantonsarchäologie Zürich.

Fig. 10 Reconstruction of an adult-sized lime bast shoe from Maur-Schifflände, Canton of Zurich (Schwitzerland). The heel, sole and sides are plaited in rep, the tongue is twined, and the underside of the sole is reinforced with a sole profile; no scale.

Abb. 10 *Rekonstruktion eines Lindenbast-Schuhs in Erwachsenengröße aus Maur-Schifflände, Kanton Zürich (Schweiz). Die Ferse, die Sohle und die Seiten sind geflochten, die Zunge ist gezwirnt, und die Unterseite der Sohle ist mit einem Sohlenprofil verstärkt; o. M.*

unsee them and could distinguish them in the shoes from Allensbach, Bern, and probably Sipplingen (Feldtkeller/Schlichtherle 1987; Moll-Dau 2015; Wiesner/Stelzner 2011).

Eventually, we made a small children's shoe and an adult shoe in lime bast for the exhibition and for educational purposes. In addition, we made three pairs of raffia shoes in different sizes for handling by the public. Our only tools were our hands, a hollow awl and a sharp piece of flint to cut off excess lime bast. It took 11 hours to make the adult shoe. It should be noted that this is not representative of the time investment of prehistoric people, as they were probably much quicker and more routinized. As much as possible, we based our reconstructions on archaeological evidence. Where the evidence was missing or unclear, we made educated guesses based on our observations and what we thought would be plausible solutions.

The reconstruction of the shoes required an extremely detailed analysis of the finds. It gave us new insights into the construction of Neolithic lime bast shoes, the working sequence, the tools needed, and even new ideas about former shoe finds. The reconstructions are not proof; however, they are a possibility. One can make several different reconstructions based on these same finds, depending on which decisions are made about the unclear details.

Fig. 11 The reconstructed lime bast cloak of Zurich-Parkhaus Opéra, made by E. IJsveld; no scale.

Abb. 11 *Der rekonstruierte Mantel aus Lindenbast von Zürich-Parkhaus Opéra, hergestellt von E. IJsveld; o. M.*

The public also learned a great deal about the shoes during the exhibition and hands-on activities: the original appearance of the shoes (golden-yellow, not brown!), the feeling of the lime bast, and the fit of the shoes when wearing them. Nevertheless, some questions remain, the biggest one being: How long did these shoes last? We do not really know yet. After wearing them for a week in a Stone Age setting, the sole profile in the toe area started to disintegrate. However, this did not mean the shoes should be discarded, because the profile could be replaced. Perhaps making the profile from coarser bast fibres would extend its life span. There is always room for more experiments!

The lime bast cape from Zurich-Parkhaus Opéra

During excavations at Zurich-Parkhaus Opéra (Switzerland) in 2010–2011, the remains of a Neolithic pile dwelling settlement were found. Among the many interesting finds was a fragment of a cape, dated to around 4000–3500 cal BC. It was made of finely twined lime bast fibres, with the rows of twining about 1 cm apart. The complete neckline and parts of the side edges were preserved, including a fringe of bast fibres along these edges (Rast-Eicher 2016b). The good preservation of the garment and the clear photographs and drawings in the publication made it possible for E. IJsveld to make a plausible reconstruction.

The first step was sorting the raw material. Long, straight lime bast strips were selected and torn into thinner strips of 0.5–0.8 cm. Reconstructing the cloak started at the neckline with a 4 mm-wide string. Strips of lime bast were folded over this string and twined closely together. When all the strips had been fastened along the neckline over a length of 30 cm, the second row of binding was added 1 cm lower. To make the cape wider over the shoulders, extra strips of lime bast were added into the twining of the next rows. This resulted in folds in the cape, which were also clearly visible in the original find. The wider the cape got, the longer it took to twine a row. The widest row took an 8-hour working day to finish; the complete cape took about a month (30 days of 8 hours). The reconstructed cape is 1 m long; the length of the original is not clearly known, as it was incompletely preserved (Fig. 11).

Fig. 12 Adding the fringe to the edges of the cloak of Zurich-Parkhaus Opéra; no scale.

Abb. 12 *Hinzufügte Fransen an den Rändern des Mantels von Zürich-Parkhaus Opéra; o. M.*

The final step was adding the fringe to the neckline and the side edges. This could have been done simultaneously with the twining or added after the twining was finished. The correct working sequence cannot be deduced from the find; E. IJsveld opted for the latter possibility. With a needle, fibre bundles were sewn into the twining along the neck and the starting cords of the edges to form a long fringe that covered the shoulders and the front of the cape (Fig. 12). Apart from the needle and a sharp flint to cut the fibre bundles, no tools were used for making this cloak.

The cape from Zurich-Parkhaus Opéra is not a unique find. Additional Neolithic plant fibre capes are known: as mentioned above ›Ötzi‹ had a grass cape (Egg/Spindler 2009), and other lake-dwelling settlements, such as Lüscherz-Innere Dorfstation, Canton of Bern (Switzerland), and Horgen-Scheller, Canton of Zurich (Switzerland), have also yielded fragments of capes, complete with fringes. In the ethnographic record, plant fibre capes worn against rain and cold are a common garment worldwide. Perhaps they were a regular piece of clothing in the Neolithic as well (Rast-Eicher 2016b).

However, is the cloak functional? The twining is fine, but there are still small gaps between the fibre bundles, so will it repel the rain? E. IJsveld tested the garment during heavy rain and was quite convinced. Her shoulders got slightly wet, but that could be remedied by adding more fringes to the neckline. After the rain, the cape dried quickly in the wind, which was an added bonus: a win for Stone Age technology!

Discussion

Plant fibre textiles must have constituted a large part of Stone Age material culture, more prevalent than, for instance, stone tools (Hurcombe 2014). Gathering and preparing the fibres for textile use must have played an important part in the seasonal activities of Stone Age (wo)man. Mats, nets, baskets, ropes and strings, hats, shoes, capes, and other pieces of clothing were made of plant fibres like tree basts, nettles, grasses, rushes, sedges, and flax in many different techniques: twisting and plying, netting and knotting, coiling, twining, looping, and weaving (Böhm et al. 2023; Olthof 2020; Rast-Eicher/Dietrich 2015). Unfortunately, fibres are fragile and are rarely preserved in the archaeological record. When they are, the once beautifully plaited objects have usually turned into ›brown blobs‹ that are difficult

to appreciate for non-textile archaeologists and the public. Therefore, they are often neglected.

Reconstructing these finds in their original materials can be a very informative and rewarding way of studying them and presenting them to the public. First of all, making a reconstruction requires an extremely detailed analysis of the archaeological object to find the correct material, technique, and *chaîne opératoire* used to make the artefact.

Next, this archaeological evidence must be translated into a craft by a skilled craftsperson familiar with the techniques and materials required. Craftspeople use different skills than archaeologists to analyse and understand objects: experience, practice, muscle memory, intuition, and an in-depth knowledge of the (im)possibilities of the raw material and the technique. These skills may not be highly scientific, but they are highly informative and were used by Stone Age craftspeople as well. They make a valuable contribution to studying past societies. All this in-depth studying and working with the finds and materials often creates new insights and new questions, thereby furthering the scientific process and archaeological interpretations.

Reconstructed Stone Age textiles bring the artefacts back to life: they reveal the original colour, texture, and appearance of the objects. They can be looked at, touched, and experienced as archaeological finds can never be, because the originals are too fragile to handle and are usually quite decayed. Archaeologists and the public alike can wear Stone Age shoes, test a bast cape in the rain, smell retted lime bast, or feel the softness of nettle fibres. Where our modern society (and hence archaeology) is mostly focused on visual material culture, reconstructions allow an interaction with all the senses, thus contributing to a sensory archaeology and a deeper understanding of the past (Hurcombe 2014).

Bibliography

Banck-Burgess 2020
J. Banck-Burgess, Underrated. Textile making in Neolithic lakeside settlements in the northern Alpine foreland. In: W. Schier/S. Pollock (eds.), The Competition of Fibres. Early textile production in western Asia, south-east and central Europe (10000–500 BC). Ancient Textiles 36 (Oxford 2020) 153–164.

Banck-Burgess 2023
J. Banck-Burgess, Textile Terminology and the Importance of a Generic Term for Textile Manufacturing Techniques in Prehistoric Times. In: J. Banck-Burgess/E. Marinova/D. Mischka (eds.), The Significance of Archaeological Textiles. Papers of the International Online Conference 24th–25th February 2021. THEFBO Volume II. Forsch. u. Ber. Arch. Baden-Württemberg 28 (Wiesbaden 2023) 37–46.

Barber 1991
E. J. W. Barber, Prehistoric Textiles. The development of cloth in the Neolithic and Bronze Ages with special reference to the Aegean (Princeton 1991).

Böhm et al. 2023
S. Böhm/A. Probts-Böhm/D. Mischka/S. Million/M. Andonova-Katsarski et al., The THEFBO project. Initial insights into the analysis and results of neolithic texties and the natural sciences. In: J. Banck-Burgess/E. Marinova/D. Mischka (eds.), The Significance of Archaeological Textiles. Papers of the International Online Conference 24th–25th February 2021. THEFBO Volume II. Forsch. u. Ber. Arch. Baden-Württemberg 28 (Wiesbaden 2023) 13–36.

Claßen-Büttner 2012
U. Claßen-Büttner, Nadelbinden. Was ist denn das? Geschichte und Technik einer fast vergessenen Handarbeit (Isenbrunn 2012).

Egg/Spindler 2009
M. Egg/K. Spindler, Kleidung und Ausrüstung der kupferzeitlichen Gletschermumie aus den Ötztaler Alpen. Monogr. RGZM 77 (Mainz 2009).

Feldtkeller/Schlichtherle 1987
A. Feldtkeller/H. Schlichtherle, Jungsteinzeitliche Kleidungsstücke aus Ufersiedlungen des Bodensees. Arch. Nachr. Baden-Württemberg 38/39, 1987, 74–84.

Gilligan et al. 2024
I. Gilligan/F. d'Errico/L. Doyon/W. Wang/Y. V. Kuzmin, Paleolithic eyed needles and the evolution of dress. Scien. Advances 10,26, 2024, doi:10.1126/sciadv.adp2887.

Gleba/Harris 2019
M. Gleba/S. Harris, The first plant bast fibre technology: identifying splicing in archaeological textiles. Arch. and Anthr. Scien. 11, 2019, 2329–2346, doi:10.1007/s12520-018-0677-8.

Glory 1959
A. Glory, Débris de corde paléolithique à la grotte de Lascaux (Dordogne). Mém. Soc. Préhist. Française 5, 1959, 135–169.

Grömer 2016
K. Grömer, The Prehistoric Art of Textile Making. The development of craft traditions and clothing in Central Europe. Veröff. Prähist. Abt. 5 (Vienna 2016).

Hardy et al. 2020
B. L. Hardy/M. Moncel/C. Kerfant/M. Lebon/L. Bellot-Gurlet et al., Direct Evidence of Neanderthal Fibre Technology and its Cognitive and Behavioral Implications. Scien. Reports 10,4889, 2020, doi:10.1038/s41598-020-61839-w.

Harris/Gleba 2024
S. Harris/M. Gleba, Fibres and fabrics. In: R. Ballantyne/A. Cooper/D. Gibson/M. Knight/I. Robinson Zeki (eds.), Must Farm pile-dwelling settlement. Volume 2. Specialist Reports. McDonald Inst. Monogr. (Cambridge 2024), 449–534.

Hogestijn/Peeters 2001
J. W. H. Hogestijn/J. H. M. Peeters (red.), De mesolithische en vroeg-neolithische vindplaats Hoge Vaart-A27 (Flevoland). Deel 20. Op de grens van land en water: jagers-vissers-verzamelaars in een verdrinkend landschap. ROB Rapportage Arch. Mon. 79 (Amersfoort 2001).

Hurcombe 2014
L. M. Hurcombe, Perishable Material Culture in Prehistory. Investigating the missing majority (Abingdon 2014).

Louwe Kooijmans et al. 2001
L. P. Louwe Kooijmans/C. E. Vermeeren/A. M. I van Waveren, Artefacten van hout en vezels. In: L. P. Louwe Kooijmans (ed.), Archeologie in de Betuweroute. Hardinxveld Giessendam Polderweg. Een mesolithisch jachtkamp in het rivierengebied (5500–5000 v. Chr.). Rapportage Arch. Mon. 83 (Amersfoort 2001) 379–414.

Martínez-Sevilla et al. 2023
F. Martínez-Sevilla/M. Herrero-Otal/M. Martín-Seijo/J. Santana/J. A. Lozano Rodfíguez et al., The earliest basketry in southern Europe: Hunter-gatherer and farmer plant-based technology in Cueva de los Murciélagos (Albuñol). Scien. Advances 9,39, 2023, doi:10.1126/sciadv.adi3055.

Miettinen et al. 2008
A. Miettinen/K. Sarmaja-Korjonen/E. Sonninen/H. Jungner/T. Lempiäinen et al., The palaeoenvironment of the ›Antrea net find‹. Iskos 16, 2008, 71–87.

Moll-Dau 2015
F. Moll-Dau, Einblicke in die archäologische Textilkonservierung. Die konservatorische Begleitung eines neolithischen Bastschuhs von der Ausgrabung bis zur Präsentation. Arch. Bern 2015, 204–211.

Olthof 2020
D. Olthof, Van berenvel tot brandnetelrok. Kleding van textiel uit de steentijd. Kostuum 2020, 7–17.

Rast-Eicher 2016a
A. Rast-Eicher, Fibres. Microscopy of Archaeological Textiles and Furs (Budapest 2016).

Rast-Eicher 2016b
A. Rast-Eicher, Textilien. In: C. Harb/N. Bleicher (eds.), Zürich Parkhaus-Opéra. Eine neolithische Feuchtbodenfundstelle. Band 2: Funde. Monogr. Kantonsarch. Zürich 49 (Zürich 2016) 188–195.

Rast-Eicher/Dietrich 2015
A. Rast-Eicher/A. Dietrich, Neolithische und bronzezeitliche Gewebe und Geflechte. Die Funde aus den Seeufersiedlungen im Kanton Zürich. Monogr. Kantonsarch. Zürich 46 (Dübendorf 2015).

Reichert 2020
A. Reichert, Textile Materials in the Mesolithic and Neolithic and their processing. In: W. Schier/S. Pollock (eds.), The Competition of Fibres. Early textile production in western Asia, south-east and central Europe (10000–500 BC). Ancient Textiles 36 (Oxford 2020) 165–168

Soffer et al. 2000
O. Soffer/J. M. Adovasio/D. C. Hyland, The Well-Dressed »Venus«: Women's Wear ca. 27,000 B.P.. Arch., Ethn. and Anthr. Eurasia 1,1, 2000, 37–47.
Soffer et al. 2001
O. Soffer/J. M. Adovasio/D. C. Hyland/B. Klima/J. Svoboda, Perishable Industries of Dolní Vestonice I: New Insights into the Nature and Origin of the Gravettian. Arch., Ethn. and Anthr. Eurasia 2,6, 2001, 48–65.
Stewart 1984
H. Stewart, Cedar. Tree of Life to the Northwest Coast Indians (Vancouver 1984).
Valladas et al. 2013
H. Valladas/E. Kaltnecker/A. Quiles/N. Tisnérat-Laborde/D. Genty et al., Dating French and Spanish Prehistoric Decorated Caves in their Archaeological Contexts. Radiocarbon 55, 2013, 1422–1431, doi:10.1017/S0033822200048359.
Wiesner/Stelzner 2011
I. Wiesner/J. Stelzner/N. Ebinger-Rist, Virtual Analyses of Neolithic textiles. In: J. Banck-Burgess/C. Nübold (eds.), The North European Symposium for Archaeological Textiles XI (Stuttgart 2011) 109–117.

Source of figures

1–2 E. IJsveld
3 a R. A. Houkes, Leiden; b D. M. Olthof
4 R. A. Houkes, Leiden
5 a R. A. Houkes, Leiden; b D. M. Olthof
6 a R. A. Houkes, Leiden; b D. M. Olthof
7 a R. A. Houkes, Leiden; b D. M. Olthof
8 a E. IJsveld; b D. M. Olthof
9 M. Bachmann, Kantonsarchäologie Zürich
10 D. M. Olthof
11–12 E. IJsveld

Addresses

Eva IJsveld
Eva IJsveld Textiles, History & Art, Reconstruction & Education
Zoutmanstraat 22
2404 XV Alphen a/d Rijn
The Netherlands
evaijsveld@gmail.com

Dorothee Olthof M. A.
PRAE archaeology and education
Milanenhorst 80
2317 CH Leiden
The Netherlands
info@prae.biz