

Neolithic clothing discoveries of the Alpine Region. Waterlogged finds from submerged and glacial sites

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Zusammenfassung

**Neolithische Kleidungsfunde aus dem Alpenraum.
Feuchtbodenfunde aus Seeufersiedlungen und glazialen
Fundstellen**

Textilien aus archäologischen Befunden wurden erstmals Mitte des 19. Jhs. in Europa in alpinen Seeufersiedlungen entdeckt. Ihre bemerkenswerte Erhaltung machte sie zu sensationellen Funden. Es handelt sich bei den meisten Textilien um kleine Fragmente, aber auch größere Kleidungsstücke wie Umhänge wurden entdeckt. Die Eisfunde in der hochalpinen Zone der Alpen bieten sogar noch bessere Erhaltungsvoraussetzungen als die bereits hervorragenden Bedingungen in Seeufersiedlungen. Zu den bemerkenswerten europäischen Funden gehören die Eismumie vom Tisenjoch in Italien und die Funde vom Schnidejoch in der Schweiz, wo Schuhe, Kleidung und Kopfbedeckungen gefunden wurden. In den Seeufersiedlungen haben nur Stoffe aus pflanzlichen Materialien überlebt, während Leder im Eis Tausende von Jahren erhalten geblieben ist. Das Material aus Feuchtbodenfundstellen liefert direkte physische Belege für Stoffe und Kleidung aus prähistorischer Zeit. Diese außergewöhnliche Erhaltung ermöglicht die Anwendung moderner Analysemethoden, die Aufschluss über die Herkunft und Art der verwendeten pflanzlichen Rohstoffe wie Baumbast, Leinen und andere Fasern geben. Darüber hinaus können paläogenetische und chemische Analysen von Leder die Genome der genutzten Tiere und die verwendeten Gerbtechniken aufdecken. Diese Übersicht gibt einen Überblick über die neolithischen Textilfunde aus den Seeufersiedlungen der Alpenregion (5000–2500 v. Chr.), die seit 2011 zum UNESCO-Weltkulturerbe gehören, sowie über die Bekleidungsfunde aus zwei alpinen Eisfundstellen aus der Zeit zwischen dem 4. und 3. Jt. v. Chr.

Schlagwörter Neolithikum, Feuchtbodenfundstellen, Schweiz, Alpen, alpine Pfahlbauten

Archaeological sites in the Alpine region containing organic artefacts

In general, woven fabrics and leather finds are an extremely rare category in the archaeological context. Prehistoric clothes are made either from plant fibres or from keratin fibres of animal origin. Leather is the tanned dermis of ani-

Summary

Textiles from archaeological contexts were first discovered in Europe during the mid-19th century, specifically in Alpine lakeside settlements. Their remarkable preservation rendered them sensational finds. While most fabrics are small fragments, larger items of clothing, such as capes, have also been uncovered. Ice sites in the high Alpine zone of the Alps offer even better preservation than the already excellent conditions in lakeshore settlements. Notable European finds include the ice mummy from the Tisenjoch in Italy and discoveries at Schnidejoch in Switzerland, where shoes, clothes, and headdresses have been found. In the lakeside settlements, only fabrics made of plant materials have survived, whereas leather, composed of animal proteins and tannins, has survived in the ice for thousands of years. Material from waterlogged sites provides physical, direct evidence of fabrics and clothing from ancient times. This exceptional preservation allows modern analytical methods to be applied, yielding information about the origin and type of plant raw materials used, such as tree bast, linen, and other fibres. Additionally, paleogenetic and chemical analyses of leather can reveal the genomes of the animals used and the tanning techniques employed. This review provides an overview of the Neolithic textile finds from the lakeside settlements of the Alpine region (5000–2500 BC), recognised as UNESCO World Heritage sites since 2011, and the clothing finds from two Alpine ice sites dating from the turn of the 4th to 3rd millennium BC.

Keywords Neolithic, waterlogged sites, Switzerland, Alps, alpine lake dwellings

mals. All these materials are of organic origin. However, like all organic materials, fabrics and leathers decompose rapidly in the archaeological context and only survive under exceptional conditions. Archaeological finds of textiles and leather are preserved either in completely dry or in fully water-saturated environments. Preservation in ice is a special form of water-saturated conservation. Examples of par-

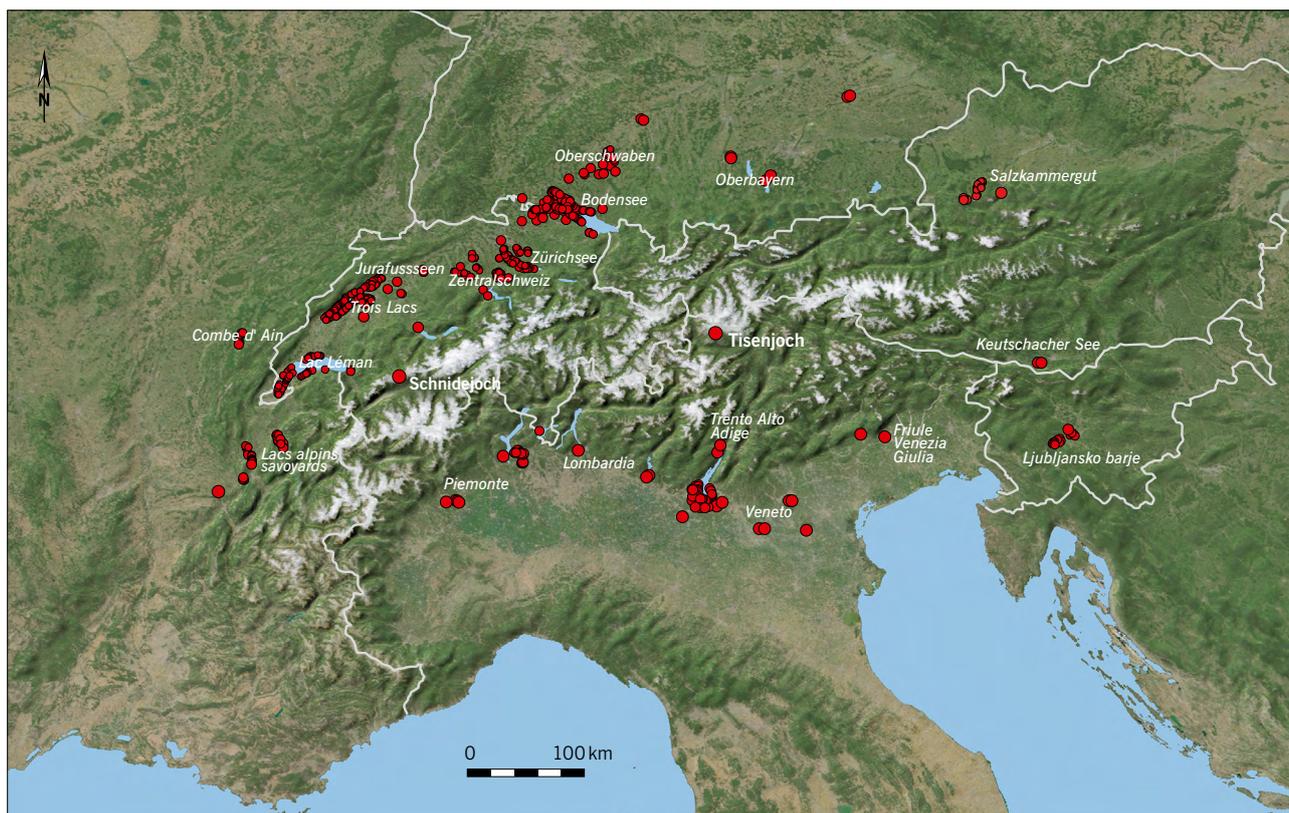


Fig. 1 Archaeological sites containing organic finds of the Alpine region. Prehistoric lake shore settlements in the Alpine foothills (5000–800 BC) and the high-Alpine ice-patch sites of Tisenjoch (Ötztal Alps, Italy) and Schnidejoch (Bernese Alps, Switzerland).

Abb. 1 Archäologische Fundstellen mit organischen Funden in der Alpenregion. Prähistorische Seeufersiedlungen im Alpenvorland (5000–800 v. Chr.) und die hochalpinen Fundstätten Tisenjoch (Ötztaler Alpen, Italien) und Schnidejoch (Berner Alpen, Schweiz).

ticularly dry climates that allow the preservation of prehistoric textiles can be found at archaeological sites in deserts or high-altitude regions, mostly in the context of burials or sacrificial sites. Notable examples include Pharaonic tomb complexes in Egypt (Vogelsang-Eastwood 1993), prehistoric cemeteries in the Turfan Depression and the Tarim Basin of the Uygur Autonomous Region of Xinjiang (China; Beck et al. 2014; Kramell et al. 2014), as well as pre-Columbian cemeteries of the Tarapacá region in the Atacama Desert of Chile (Sepúlveda et al. 2021) and human sacrifices on high-altitude mountain peaks of the Andes (Reinhard 2005). A rare form of dry conservation involves the presence of salt. In prehistoric Eurasia, such conditions are notably met in salt mines (Grömer et al. 2013; Barber 2024). For a complete picture, the preservation of textile and leather remains through corrosion of metal objects in the direct vicinity should also be mentioned (Grömer 2016).

In the European Alpine region, organic material is preserved in two types of archaeological sites (Fig. 1). Waterlogged sediments in lakes and wetlands of the Alpine foothills (including former, now silted-over lakes) provide ideal conditions for the preservation of plant-based organic material such as wood, bark, fibres, seeds, and fruits. Animal protein-based organic materials, such as leather, hides, hair, fingernails and horn, do not preserve in these conditions. In contrast, all these materials have a high preservation potential in Alpine glacial sites.

Prehistoric lakeshore settlements, or ›pile dwellings‹, from the Neolithic and Bronze Age periods (5000–800 BC) have been known in the Alpine region for over 170 years and have been the subject of intensive research ever since (Fig. 2). Approximately 1000 settlement areas, most of them with multiple settlement phases, have been identified. However, their spatial distribution is uneven: around 880 are located north of the Alps, while about 120 are on the southern side. The highest concentration is found between Lake Geneva and Lake Constance, with Switzerland's Three-Lake Region (Lake Biel, Lake Murten, and Lake Neuchâtel) alone containing over 200 sites. The oldest settlements on the southern side of the Alps date back to 5000 BC, with Bronze Age sites particularly common in this region. In contrast, Neolithic settlements (4300–2500 BC) dominate north of the Alps. The study of these sites began in the mid-19th century, with F. Keller's publication ›Die keltischen Pfahlbauten in den Schweizerseen‹ (Keller 1854) marking the formal start of European lake settlement archaeology. Since 2011, the ›Prehistoric Pile Dwellings around the Alps‹ have been recognised as a transnational UNESCO World Heritage site (Hafner 2012b; Hafner 2013). The discovery of Alpine pile dwellings was a pivotal moment in European settlement archaeology. When excavated, these exceptionally well-preserved sites yield a comprehensive range of artefacts, along with structural remains such as buildings, palisades, and pathways.

Fig. 2a–b Archaeological sites containing organic finds of the Alpine region. Around 1000 Neolithic and Bronze Age lake shore settlements form an extensive group of waterlogged sites, which are characterised by the exceptionally good preservation of wood and plant fibres, including fibres for clothing. a Excavation Zug-Riedmatt; b underwater excavation Lake Biel, Canton of Bern (Switzerland).

Abb. 2a–b Archäologische Feuchtbodenfundstellen mit Erhaltung von organischem Fundmaterial in der Alpenregion. Rund 1000 neolithische und bronzezeitliche Seeufersiedlungen bilden eine umfangreiche Gruppe, die sich durch die außergewöhnlich gute Erhaltung von Holz- und Pflanzenfasern, einschließlich Fasern für Kleidung, auszeichnen. a Ausgrabung Zug-Riedmatt; b Unterwassergrabung Bielersee, Kanton Bern (Schweiz).



Fig. 3 Archaeological sites containing organic finds of the Alpine region. Numerous examples of leather clothing have been found at two well-known high-Alpine ice-patch sites. Pictured: find situation at Lenk, Schnidejoch, Bernese Alps (Switzerland), 2750 m above sea level (picture taken in 2005).

Abb. 3 Archäologische Fundstellen mit organischen Funden in der Alpenregion. Auf zwei bekannten hochalpinen Fundplätzen aus dem Eis wurden zahlreiche Beispiele für Lederbekleidung gefunden. Im Bild: Fundlage an der Lenk, Schnidejoch, Berner Alpen (Schweiz), 2750 m über dem Meeresspiegel (Aufnahme von 2005).

Notably, dendrochronology allows for remarkably precise dating, often down to the exact year.

In contrast, glacial sites in the Alpine region represent a relatively recent source of archaeological discovery (Fig. 3). The first prehistoric finds from a high-altitude ice patch were made in 1991 on the Italian side of the Ötztal Alps. The discovery of human remains, clothing, and personal equipment from the 'Iceman' of Tisenjoch, South Tyrol (Italy), more than 30 years ago marked the beginning of global glacial archaeology (Dixon et al. 2014). The individual, who died violently around 5300 years ago at an altitude of over 3300 m above sea level, is considered one of the most significant finds of prehistory. Due to global warming, Alpine glaciers and small ice fields are increasingly revealing more artefacts. Since 2003, and up until recently, around 900 objects from the period between 4800 BC and 1200 AD

have been uncovered from a melting ice patch at Schnidejoch, a high-altitude mountain pass in the Bernese Alps of Switzerland, some 2750 m above sea level (Hafner 2012a; Hafner 2015). Both high Alpine sites share the fact that they have yielded exceptional clothing and equipment made from organic materials, items that had never been discovered before and were excellently preserved over millennia in the ice. For the preservation of fragile organic materials and human remains, it is crucial that they are embedded in flat, small ice patches with stagnant ice. Individuals or objects that fall into crevasses of large glaciers are destroyed by the downward movement of the ice and the powerful forces at play there. The oldest finds from 'flowing' glaciers are typically no more than a few decades or centuries old, while archaeological organic objects from stagnant ice can be preserved in perfect condition for thousands of years.

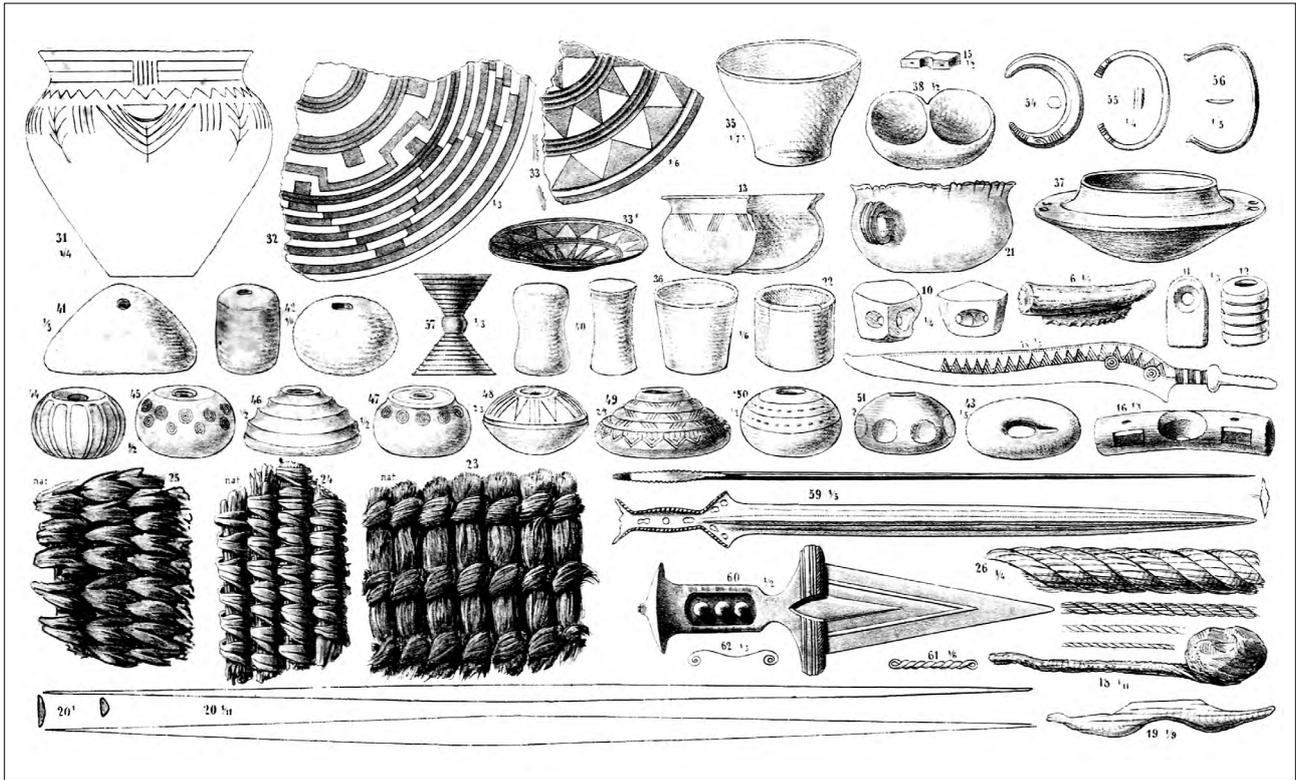


Fig. 4 First (1858) illustration of plaited mats from the lakeshore settlement of Wangen on Lake Constance, Constance District (Germany).

Abb. 4 Frühe (1858) Abbildung von geflochtenen Matten aus der Seeufersiedlung von Wangen am Bodensee, Lkr. Konstanz (Deutschland).

Woven and plaited fabrics from waterlogged sites in lakes and bogs

The first reports of the discovery of woven fabrics from prehistoric lake dwellings were published by F. Keller in the second and fourth pile dwelling reports of 1858 and 1861, respectively (Fig. 4–5; Keller 1861). Shortly thereafter, these findings were disseminated to a wider audience through publications aimed at education and teacher training (Fig. 6; Staub 1864). In the late 19th century, plaited and woven items, including those from private excavations by the Swiss farmer J. Messikommer, such as from Wetzikon-Robenhausen, Canton of Zurich (Altörfer 2010), were sold as scientific souvenirs and curiosities to European tourists. These items found their way, often through indirect routes, into numerous museums around the world (Fig. 7). Textiles from prehistoric, waterlogged pile-dwelling sites were previously unknown in Europe and worldwide. Due to their rarity, they became highly sought-after and prized additions to both private and museum collections, ultimately becoming ‘the measure of all things’ (Banck-Burgess 2019). In the era of Evolutionism, they were seen as evidence of humanity’s early craftsmanship. The fragility of the woven fabrics discovered posed significant challenges, especially when they needed to be studied or displayed in museums. As a result, early finds were stored between glass plates, often sealed with various adhesives, making them nearly impossible to open today. The first comprehensive study of the woven and braided fabrics and mats from Neolithic and Bronze Age lake settlements in Switzerland was

published in the 1930s (Vogt 1937). In recent years, compilations on plant fibres and fabrics from lakeside settlements, synthesising the material, were published, emphasising the significance of these finds for prehistoric research (Médard 2010; Rast-Eicher 2015; Karg 2025).

The presence of hackle teeth and combs, spinning whorls, balls of yarn and loom weights in Neolithic find complexes provides clear evidence of fibre processing, thread production, and loom use (Fig. 8–11). This stage of textile production is therefore well-documented. The two concentrations of a total of over 40 loom weights in two buildings of the Neolithic settlement at Sutz-Lattrigen, Rütte, Lake Biel, Canton of Bern (Switzerland), dating to around 2700 BC, allow the reconstruction of nearly 2-metre-wide looms (Suter 2017). This suggests that these looms were used to weave fabrics over 1.0 to 1.5 m in width. On the other hand, while hundreds of woven fabric fragments have been discovered, complete garments are entirely absent (Fig. 12). The fineness and tight weave of the fabrics suggest that they were most likely intended for use in clothing, rendering alternative applications such as carpets or curtains unlikely. The existing finds do not allow for a conclusive reconstruction of the clothing worn by Neolithic populations of the Alpine region. As a result, we lack even a partial understanding of the crucial production steps that followed fabric making or the final appearance of their garments. Moreover, leather clothing from lakeshore settlements has not survived at all. One of the few larger objects found, made of tree bast and linen, is a cloak from Lüscherz on Lake Biel, Canton of Bern (Switzerland), dating to around 3600 BC (Fig. 13; Rast Eicher in Hafner/Suter 2005).

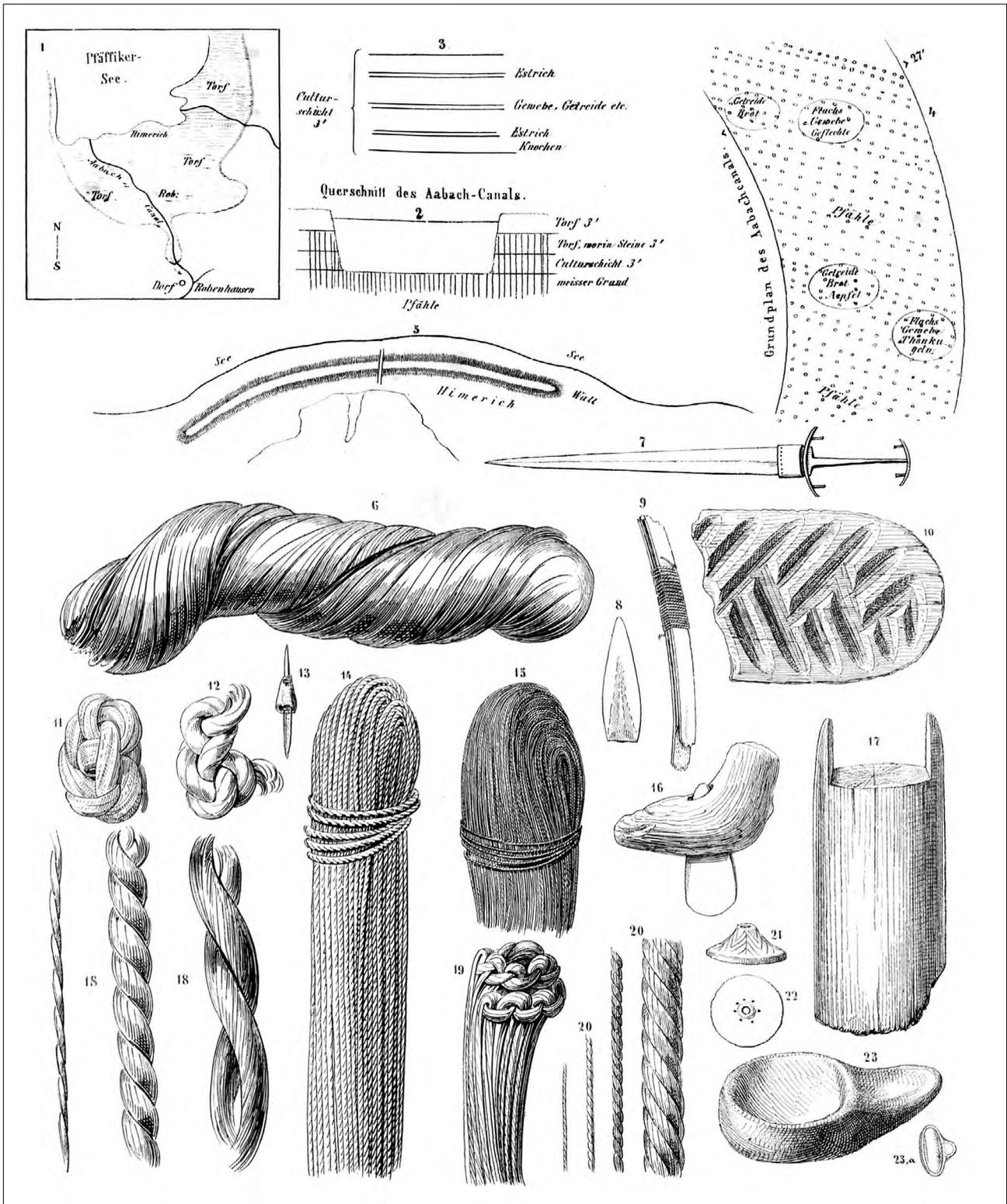


Fig. 5 »Fäden, Schnüre, Seile« (threads, cords, ropes) from the lake shore settlement of Wetzikon-Robenhausen, Canton of Zurich (Switzerland).

Abb. 5 »Fäden, Schnüre, Seile« aus der Seeufersiedlung von Wetzikon-Robenhausen, Kanton Zürich (Schweiz).

Leather clothing from alpine ice-patch sites

The sensational 1991 discovery of an ice mummy at Tisenjoch – a high-altitude pass at 3210 m above sea level in the Ötztal Alps, straddling the Austria-Italy border – captivated

global attention. Today, the Tyrolean Iceman stands as the most extensively studied prehistoric human body (Nerlich et al. 2021; Zink/Maixner 2019; Keller et al. 2012). However, his remarkably well-preserved remains, belonging to a man who was around 45 years old when he met a violent end

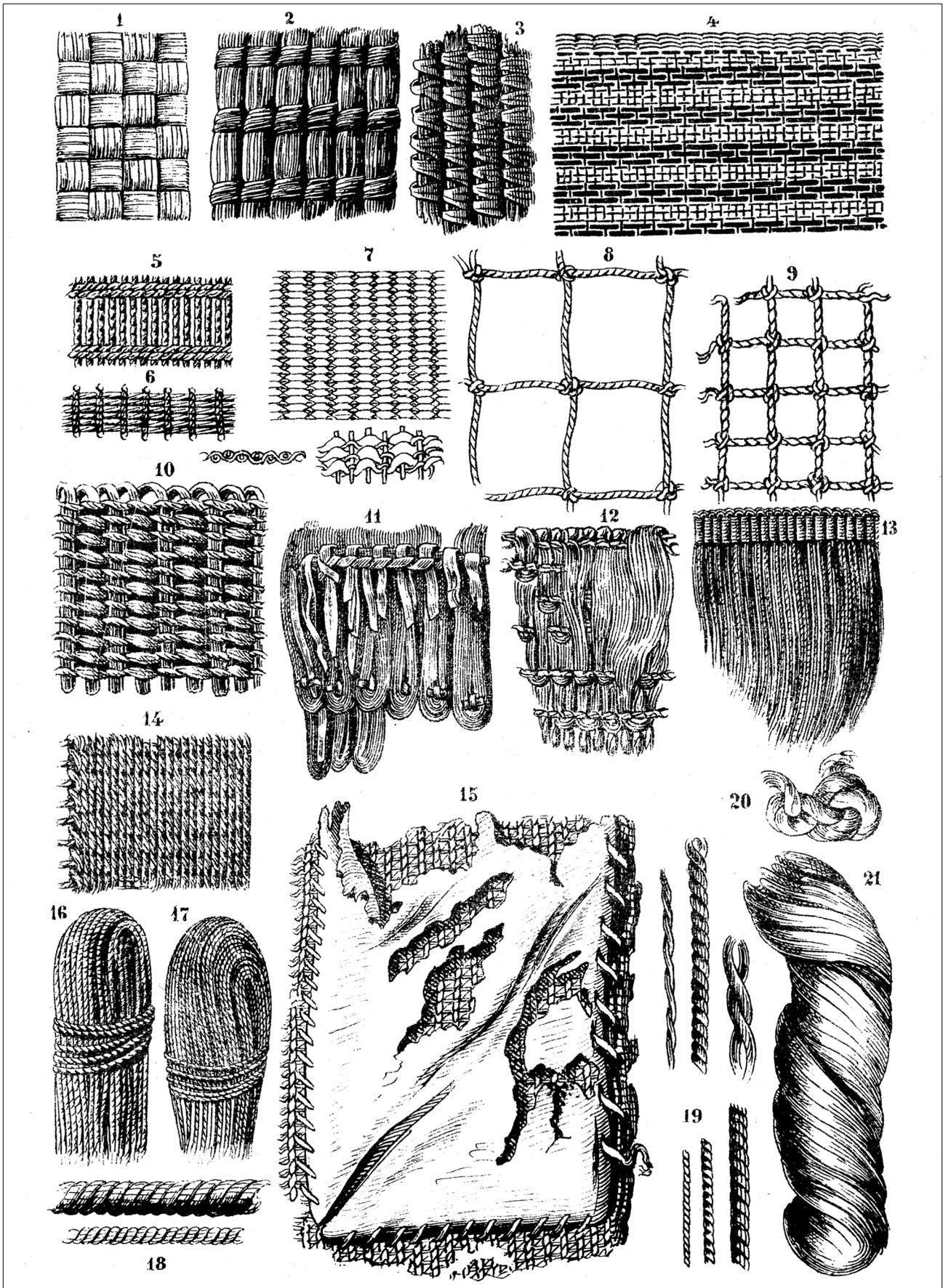


Fig. 6 »Gespinnste, Geflechte, Gewebe« (spun yarns, braids, fabrics). Comprehensive educational guide to Swiss pile dwellings for schoolteachers with a collection of woven fabrics and plaits.

Abb. 6 »Gespinnste, Geflechte, Gewebe«. Umfassendes Lehrbuch der Schweizer Pfahlbauten für Schullehrer mit einer Sammlung von gewebten Stoffen und Geflechtem.



Fig. 7 Various fragments of cords, fabrics, and plaits, most probably from excavations by the farmer and archaeologist J. Messikommer (1828–1917) at the site of Wetzikon-Robenhausen, Canton of Zurich (Switzerland). They are now in the State Historical Museum, Moscow, and were probably purchased by Russian travellers before 1918.

Abb. 7 Verschiedene Fragmente von Schnüren, Geweben und Zöpfen, die wahrscheinlich von Ausgrabungen des Landwirts und Archäologen J. Messikommer (1828–1917) an der Fundstelle Wetzikon-Robenhausen, Kanton Zürich (Schweiz), stammen. Sie befinden sich heute im Staatlichen Historischen Museum, Moskau, und wurden wahrscheinlich von russischen Reisenden vor 1918 erworben.

5300 years ago, are only part of the significance of this find. Equally valuable are the numerous clothing items and the equipment recovered alongside him, providing an unprecedented glimpse into the life and appearance of a Neolithic Alpine mountaineer (Egg/Spindler 2009; Wierer et al. 2018).

Since the European heatwave of 2003 and continuing until recently, the retreating ice field at the Schnidejoch site in the Bernese Alps of Switzerland has revealed numerous prehistoric artefacts (Fig. 14)¹. Like Tisenjoch, Schnidejoch is a high-altitude pass, situated at 2756 m above sea level. The oldest objects date back some 6800 years, while the most recent finds originate from the 12th to 14th centuries AD. In contrast to the Tisenjoch Alpine crossing, where a single historical event – the violent death of a man – is documented by material remains, the discoveries at the Schnidejoch pass reflect a 6000-year history of travel and mobility, likely linked to alpine pastoralism, spanning from the Neolithic period to the Middle Ages. The cooler climatic conditions at the onset of the Little Ice Age in the 14th century caused the surrounding glaciers to advance, effectively

blocking the Schnidejoch crossing, which had been in use since the climatic optimum of the Middle Holocene (Grosjean et al. 2007).

Around 600 years after the Tisenjoch incident, another individual may have perished at Schnidejoch around 2800 BC (Hafner 2015). This consideration is supported by the discovery of a complete set of archery equipment, including a yew bow, bowstring, bow case, and numerous arrows, all of which have been radiocarbon-dated to the same period. Additionally, items of clothing such as a grass cape, leather leggings, and leather shoes were found (Fig. 15–17). It is unlikely that such valuable equipment would have been abandoned in the high mountains without necessity or that someone would have willingly removed their clothing in such a harsh environment. However, despite extensive searches, no human remains have been found. Unlike the Tisenjoch site, which lies away from the immediate pass, the discoveries at Schnidejoch were made directly within the narrow passage defined by the surrounding rock faces. This suggests that a body may have been quickly recovered

¹ Gubler et al. 2024; Hafner 2015; Hafner/Schwörer 2018; Hafner 2012a.



Fig. 8 Spindle whorls from various Neolithic lakeshore settlements on Lake Biel, Canton of Bern (Switzerland), made from clay/ceramic (top), stone (middle), and antler (bottom).

Abb. 8 Spinnwirtel aus verschiedenen neolithischen Seeufersiedlungen am Bielersee, Kanton Bern (Schweiz), aus Ton/Keramik (oben), Stein (Mitte) und Geweih (unten).

Fig. 9 Hackle comb made from bovine rib bones, with remnants of a cord indicating its original bast wrapping from Nidau-BKW, Lake Biel, Canton of Bern (Switzerland; c. 3400 BC).

Abb. 9 Hechelkamm aus Rinderrippenknochen, mit Resten einer Schnur, die auf eine ursprüngliche Bastumwicklung hinweist, aus Nidau-BKW, Bielersee, Kanton Bern (Schweiz; ca. 3400 v. Chr.).

after a fatal event while the equipment was left behind, possibly deemed taboo or unusable. At the time, a collective megalithic burial site existed with the two dolmens M XII and M VI of Sion, Petit Chasseur in Valais, located south of Schnidejoch (Favre/Mottet 2011; Gallay/Chaix 1984). It is conceivable that an individual who died at Schnidejoch was laid to rest there. If one accepts the hypothesis that fatal events occurred at both Tisenjoch and Schnidejoch, then these sites together provide two distinct ensembles of clothing and equipment from the Alpine region, dating to the period 3400–2800 BC. This era coincides with the numerous lakeshore settlements in Switzerland associated with the ›Horgen‹ and ›Lüscherz‹ ceramic styles, which immediately precede the emergence of the so-called ›Corded Ware‹ ceramic style around 2750/2700 BC. A comparison of the finds from both Alpine sites reveals a remarkably well-preserved collection of clothing, primarily made of leather, which has survived exceptionally in the ice (Fig. 18). Common garments found at both locations include fragments or complete grass cloaks, leather leggings, and leather shoes. The Tisenjoch ensemble is more extensive, also featuring a fur coat, a loincloth, and a bear fur cap, offering an unparalleled glimpse into the attire of Alpine inhabitants during the Late Neolithic. The preservation of leather found in ice

is so exceptional that paleogenetic and biochemical methods could be applied successfully. It was possible to determine that the leggings from Schnidejoch were made from the skin of a domestic goat (*Capra hircus*), belonging to the caprine haplogroup, which is rare in Europe today (Schlumbaum et al. 2010). Paleogenetic analyses of the leather from the Iceman found at Tisenjoch revealed that his coat and loincloth were made from sheepskin, while a shoelace was crafted from cattle leather. His leggings, however, like the one from Schnidejoch, were made from goatskin (O'Sullivan et al. 2016). Recently, leather finds from Tisenjoch were analysed using protein analysis. Two samples from his coat and one from his leggings were identified as originating from sheep, while the upper leather of his moccasins was made from cattle (Hollemeier et al. 2008). There is a contradiction in the identification of the leather used for the leggings from Tisenjoch; however, the biochemical analysis does not completely rule out goat as a possibility.

Neolithic clothing of the Alpine space: what we know

The hunter-gatherer societies of late Pleistocene Central Europe inhabited a treeless tundra landscape where no

Fig. 10 Examples of loom weights from the Neolithic site of Sutz-Lattrigen, Rütte, Lake Biel, Canton of Bern (Switzerland; 2700 BC). The discovery of two clusters, each containing 22 loom weights, suggests the use of looms approximately 2 m wide, enabling the production of broad fabric strips.

Abb. 10 Beispiele für Webgewichte aus der neolithischen Fundstätte von Sutz-Lattrigen, Rütte, Bielersee, Kanton Bern (Schweiz; 2700 v. Chr.). Der Fund von zwei Clustern mit jeweils 22 Webgewichten deutet auf die Verwendung von Webstühlen mit einer Breite von etwa 2 m hin, die die Herstellung breiter Stoffstreifen ermöglichten.

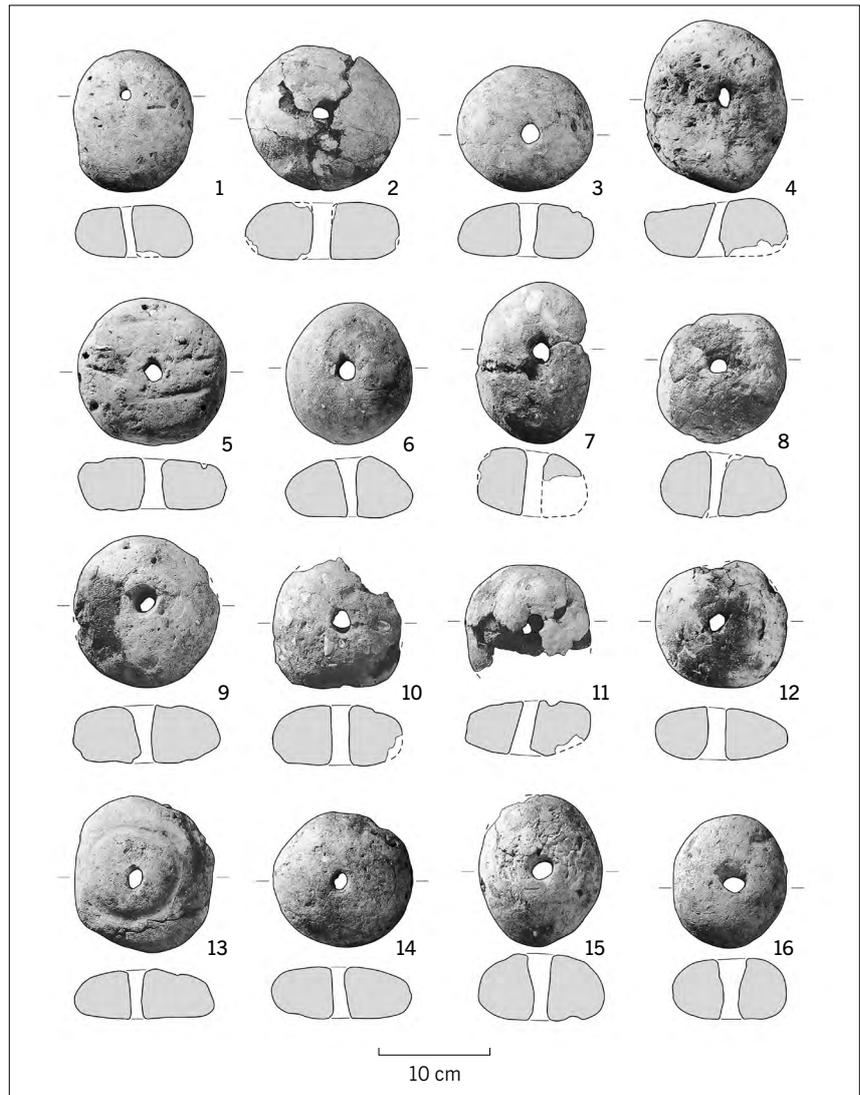


Fig. 11 Ball of yarn from the Neolithic site of Sutz-Lattrigen, Hauptstation (c. 3200 BC).

Abb. 11 Garnknäuel aus der neolithischen Fundstätte von Sutz-Lattrigen, Hauptstation (ca. 3200 v. Chr.).

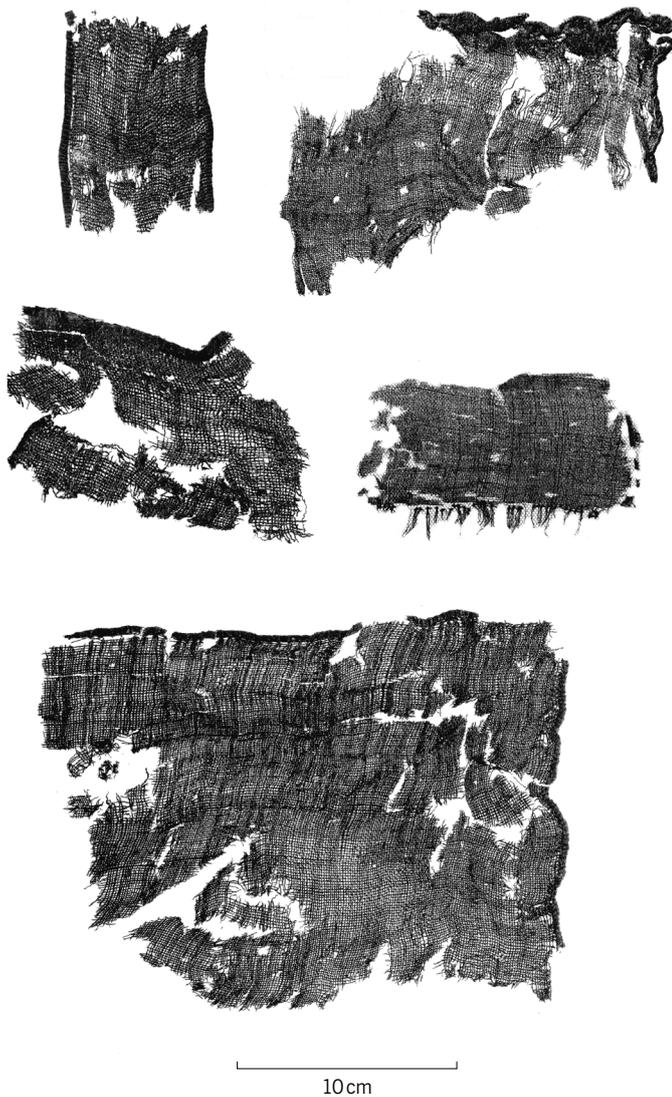


Fig. 12 Fragments of woven fabrics from the site of Wetzikon-Robenhausen, Canton of Zurich (Switzerland), excavations by J. Messikommer (1828–1917).

Abb. 12 Fragmente von gewebten Stoffen aus der Fundstätte von Wetzikon-Robenhausen, Kanton Zürich (Schweiz), Ausgrabungen von J. Messikommer (1828–1917).

tolia (Rast-Eicher et al. 2021). Additionally, the first European farmers cultivated flax (*Linum* sp.), providing another important fibre source for textile manufacturing (Harris 2014). Another key resource for textile production is wool from domesticated sheep. Since the earliest sheep in Central Europe likely had a coat more similar to that of goats, which was not suitable for producing thread or fabric, wool from sheep probably only became significant later in the Central European Neolithic (Becker et al. 2016; Grömer 2010). In any case, regardless of the type of organic material, the preservation of woven fabrics in archaeological contexts is highly challenging, particularly at terrestrial sites without waterlogged conditions. The absence of suitable preservation environments makes it nearly impossible to find direct evidence of textiles (Hafner 2023). Indirect evidence, such as spindle whorls made of stone or ceramics and loom weights crafted from air-dried clay, is commonly found in Central and Western Europe from the 4th millennium BC onward, though isolated discoveries date as far back as the 6th millennium BC. These artefacts confirm that Neolithic farming communities were widely engaged in textile produc-

plant-based materials were available for clothing production. The earliest-known eyed needles, typically used for making leather garments, appear in Europe some 26 000 years ago, whereas they had already emerged in north-east Asia 40 000 years ago (Gilligan et al. 2024). With the mid-Holocene arrival of agriculturally oriented populations to the regions north of the Alps, woven textiles most likely complemented the previously dominant leather clothing but did not replace it completely. In the forested landscapes of Central Europe, various tree species were available for fibre extraction. Lime trees (*Tilia* spp.) were a primary source of bast fibre in prehistoric and, more specifically, Neolithic Europe due to the material's superior quality. Bast materials obviously played a crucial role in early textile production as shown by examples from Neolithic Ana-

Fig. 13 Textile fragment, probably part of a cape, measuring 73 cm in length and made of tree bast and line. Lüscherz, Dorfstation, Lake Biel, Canton of Bern (Switzerland), »Kettenstoff mit Zwirnbindung«. The Tyrolean Iceman wore a similar cloak made from sedge (*Carex* sp.).

Abb. 13 Textilfragment, wahrscheinlich Teil eines Umhangs, 73 cm lang, hergestellt aus Baumbast und Leinen. Lüscherz, Dorfstation, Bielersee, Kanton Bern (Schweiz), Kettenstoff mit Zwirnbindung. Der Tiroler Eismann trug einen ähnlichen Umhang aus Segge (*Carex* sp.).



Tab. 1 Clothing Items from Neolithic Alpine lakeshore settlements and ice-patch sites that offer insights into Neolithic clothing in the broadest sense. Garments made of woven fabric have only survived in fragmentary form, making it impossible to determine their original appearance or construction. These textiles were likely worn in combination with leather, possibly serving as undergarments.

Tab. 1 Kleidungsstücke aus neolithischen alpinen Seeufersiedlungen und Eisfeldfundstellen, die Einblicke in die neolithische Bekleidung im weitesten Sinne bieten. Kleidungsstücke aus gewebtem Stoff sind nur fragmentarisch erhalten, sodass ihr ursprüngliches Aussehen und ihre Konstruktion nicht bestimmt werden können. Diese Textilien wurden wahrscheinlich in Kombination mit Leder getragen und dienten möglicherweise als Unterbekleidung.

tion. Clay loom weights are only preserved if they undergo secondary firing, for example, in the event of a house fire. Likewise, spindle whorls made from organic materials have very low preservation chances, suggesting a potential bias in the archaeological record (Tab. 1).

Waterlogged settlement sites in lakes and bogs offer the most valuable insights into early textile production. Since

	Leather	Fur	Grass braid	Woven fabric
Shoes	•		•	
Leggins	•			
Loincloth	•			
Belt	•			
Coat	•		•	
Headgear		•	•	
Clothing, unspecified				•

the mid-19th century, numerous woven fabrics made from flax (*Linum* sp.) and tree bast have been discovered. Some sites, such as Wetzikon and Robenhausen in the Canton of Zurich (Switzerland) became renowned for their exceptional number of textile finds (Messikommer 1913). These settlements provide comprehensive evidence of the entire production process, from spinning thread with spindle



Fig. 14 Leggings made of goatskin from Lenk, Schnidejoch, Canton of Bern (Switzerland; 2800 BC; see Fig. 15–16), discovered in 2004 after emerging from the melting ice. Pictured find situation (picture taken in 2005).

Abb. 14 Leggings aus Ziegenleder aus Lenk, Schnidejoch, Kanton Bern (Schweiz; 2800 v. Chr.; vgl. Abb. 15–16), entdeckt 2004 im schmelzenden Eis. Im Bild Fundlage (Aufnahme von 2005).

Fig. 15 Leggings made of goatskin from Lenk, Schnidejoch (2800 BC; see Fig. 14 and 16). The inner leg length of the garment measures 85 cm. A nearly identical piece of clothing was also found on the Tyrolean Iceman at Tisenjoch.

Abb. 15 Leggings aus Ziegenleder aus Lenk, Schnidejoch (2800 v. Chr.; vgl. Abb. 14 und 16). Die innere Beinlänge des Kleidungsstücks misst 85 cm. Ein fast identisches Stück wurde auch bei dem Tiroler Mann aus dem Eis am Tisenjoch gefunden.



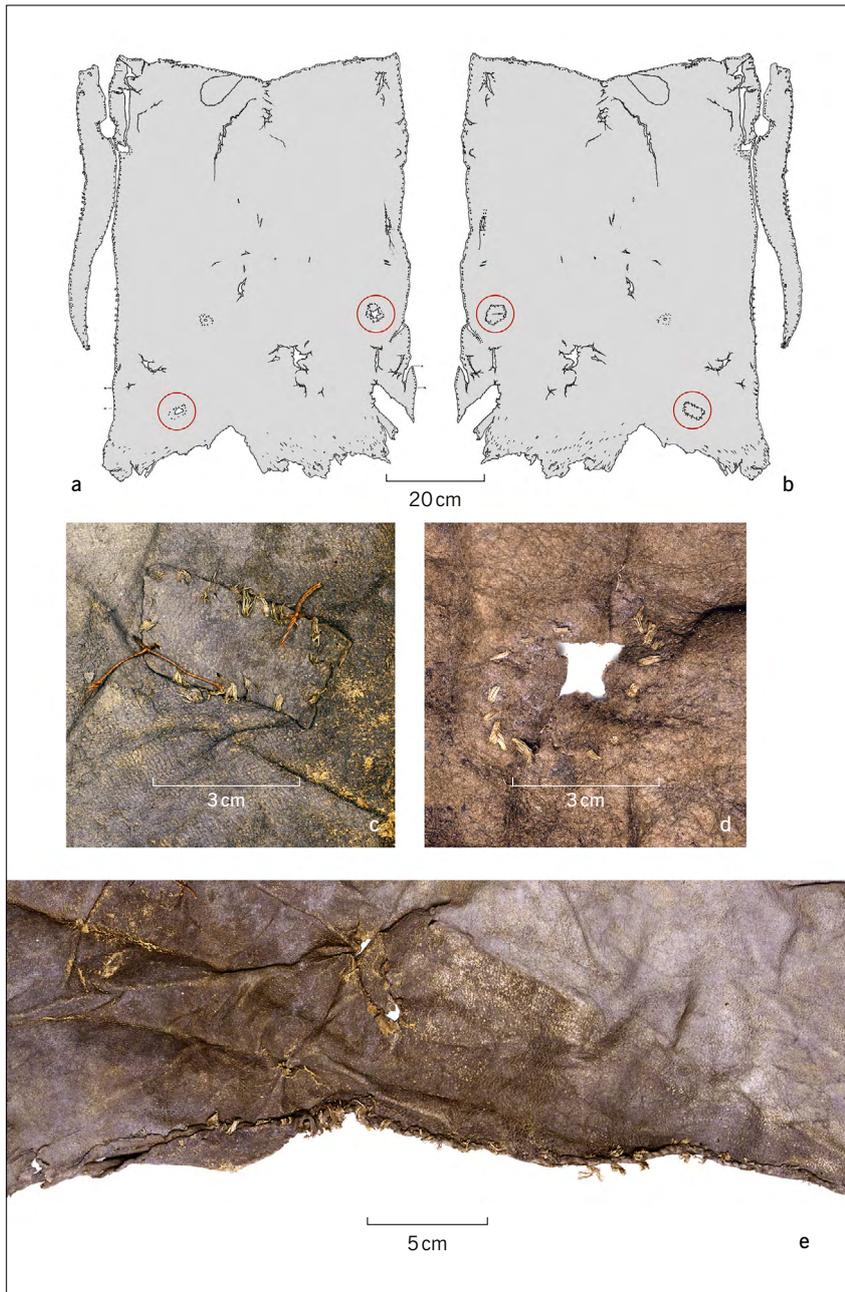


Fig. 16a–e Leggings made of goatskin from Lenk, Schnidejoch (2800 BC; see Fig. 14–15), featuring two clearly visible, relatively coarse patch repairs (marked with red circles).

Abb. 16a–e Leggings aus Ziegenleder aus Lenk, Schnidejoch (2800 v. Chr.; vgl. Abb. 14–15), mit zwei deutlich sichtbaren, relativ groben Flickstellen (markiert mit roten Kreisen).

whorls to weaving on looms equipped with loom weights. In contrast, leather artefacts are rarely preserved in lake and bog sediments due to unfavourable conditions. However, in glacial environments, leather survives exceptionally well, offering a rare and invaluable glimpse into prehistoric craftsmanship.

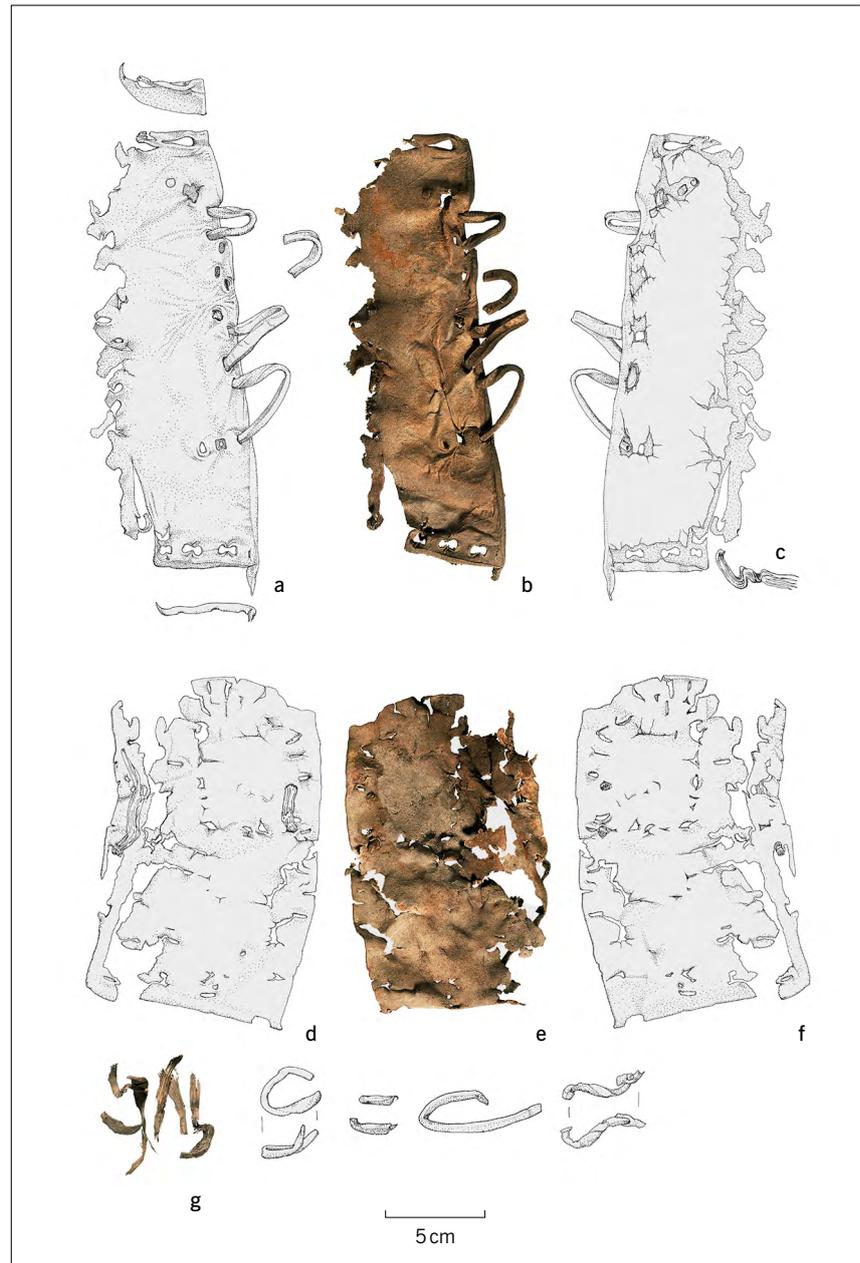
From an economic perspective, both textiles and leather – especially those featuring intricate patterns and colours – held significant added value. The entire process of fabric production, from fibre extraction and spinning to weaving, could be carried out almost anywhere. The labour-intensive nature of textile manufacturing enabled the accumulation of valuable goods, making it a significant aspect of early economies. Leather production required not only knowledge of tanning techniques but also considerable manual labour. Many tasks, such as softening hides by chewing them, were highly labour-intensive (Groenman-van

Waateringe et al. 1999). Despite these challenges, leatherworking was not limited to regions with fertile soils and favourable agricultural conditions. It remained a viable industry even in more demanding environments, such as the higher elevations of the Alpine region, where hunting likely played a key role in sourcing raw materials. Both woven textiles and leather were undoubtedly highly valued commodities, making them ideal for trade and highlighting their significance in early economies. Examples of garment repair are rare. The woven textile fragments from the lakeshore settlements show no evidence of mending techniques such as darning. In contrast, the two patched areas, featuring sewn-on leather pieces, on the leather leggings from the high-altitude ice site of Schnidejoch clearly indicate that clothing was repaired and considered valuable (cf. Fig. 16).

We know very little about the appearance of prehistoric clothing, as complete garments are rarely preserved.

Fig. 17a–g Fragments of Neolithic leather shoes, Lenk, Schnidejoch (2800 BC).

Abb. 17a–g Fragmente von neolithischen Lederschuhen aus Lenk, Schnidejoch (2800 v. Chr.).



The only significant textile remains come from a few ice-patch sites, where exceptional preservation conditions have allowed for detailed studies. Trousers, in the modern sense, were most probably not known, but a combination of separate leggings and a loincloth seems to have been common. Evidence from the Tyrolean Iceman confirms this type of clothing. Further, his outerwear included a coat-like garment resembling a cape, made from striped pieces of goat and sheep hide stitched together. This long, sleeveless cloak draped over his shoulders was likely wrapped around the body for warmth, and a leather belt helped secure it in place.

We can assume that the clothing of the first farmers in Central Europe was carefully adapted to both weather conditions and environmental factors. During the Mid-Holocene Climatic Optimum, temperatures in the region were warmer than today. In mild weather, many people may have worn nothing more than a loincloth. In colder condi-

tions, they likely dressed in multiple layers of textiles and leather, often incorporating fur for added insulation, as well as leggings and wide cloaks draped around the body for additional warmth.

However, no woven fabric has been found at the high-alpine Neolithic sites of Tisenjoch (Ötzi's discovery site) and Schnidejoch, suggesting that leather may have been the preferred material for clothing in these extreme environments. In contrast, prehistoric lakeshore settlements in the Alpine foothills have yielded numerous fragments of woven textiles, indicating that fabric clothing was also widely used. Looms may have been up to nearly 2 m wide, enabling the production of broad textile panels. Although not yet archaeologically proven, it is likely that patterns and colours also played a significant role in Neolithic clothing. Because garments made of organic material rarely survive the ages, they are completely underestimated in the archaeological, material-based context.

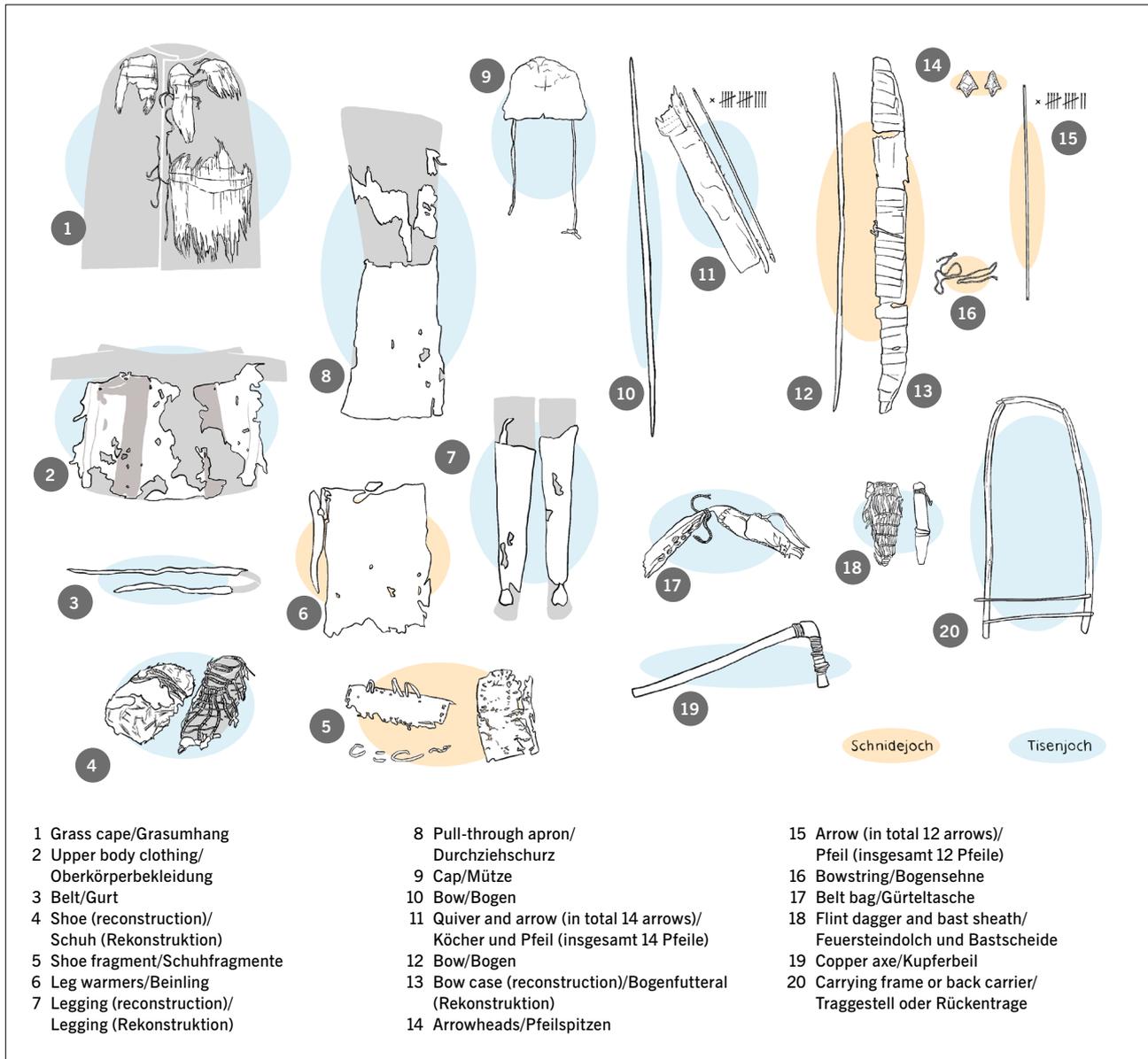


Fig. 18 Finds of leather clothing and equipment from high-altitude Alpine contexts. The ice mummy from Tisenjoch, Ötztal Alps (Italy), and an individual who likely perished at Schnidejoch, Bernese Alps (Switzerland). The Tisenjoch finds are highlighted in blue, while those from Schnidejoch appear in yellow. Together, they offer a realistic depiction of individuals from 5000 years ago, whose equipment was well adapted to the harsh conditions of the high-alpine mountains.

Abb. 18 Funde von Lederbekleidung und -ausrüstung aus hochalpinen Kontexten. Die Eismumie vom Tisenjoch, Ötztaler Alpen (Italien), und ein Individuum, das wahrscheinlich am Schnidejoch, Berner Alpen (Schweiz), ums Leben kam. Die Funde vom Tisenjoch sind blau hervorgehoben, während die vom Schnidejoch gelb dargestellt sind. Zusammen bieten sie ein realistisches Bild von Individuen vor 5000 Jahren, deren Ausrüstung gut an die rauen Bedingungen der hochalpinen Berge angepasst war.

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