Cloth as human experience: looping, furs, and twining in the Mesolithic of north-west Europe

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Zusammenfassung

Kleidung als menschliche Erfahrung: Schlingen, Felle und Zwirne im Mesolithikum Nordwesteuropas

Dieser Artikel bietet einen neuen Einblick in kleidungsähnliche Materialien spätmesolithischer Jäger-Sammler-Fischer-Gesellschaften in Nordwesteuropa, indem er archäologische Belege und abgeleitete sensorische Beschreibungen von Personen kombiniert. Kleidungsähnliche Materialien sind flexible, dünne Bahnen, die gewickelt, gefaltet und geformt werden können und das Potenzial haben, Menschen und Dinge zu bedecken. Diese Definition umfasst Stoffe aus verflochtenen Fasern und Tierhäuten. Zu den archäologischen Belegen für mesolithische kleidungsartige Materialien gehören sowohl organische Schlingen- und Zwirngewebe aus Pflanzenfasern als auch archäozoologische Überreste, die auf die Verwendung von Leder und Fellen hinweisen. Die Belege konzentrieren sich auf die späte Ertebølle-Kultur in Südskandinavien (ca. 5400–3950 v. Chr.) in ihrem weiteren geografischen und chronologischen Umfeld.

Der zweite Aspekt dieser Arbeit erforscht diese ungewohnten Materialien mit Hilfe einer innovativen Methode. Gruppen von Teilnehmern wurden gebeten, sich physisch mit einem nachgebildeten mesolithischen Kleidungsinventar auseinanderzusetzen und einen Fragebogen auszufüllen, in dem sie gebeten wurden, jedes einzelne Stück anhand seiner Haptik, seines Aussehens, Geruchs und der erzeugten Geräusche zu beschreiben. Philosophisch gesehen basiert dieser Ansatz auf der kulturellen Bedeutung von Empfindung und Wahrnehmung. Die sensorische Beschreibung der Materialtypen durch das Handhabungsexperiment stellt die standardmäßige technische Analyse des Rohmaterials und die Identifizierung der Stoffstruktur in Frage. Sie ermöglicht ein neuartiges Verständnis dieser Materialien, wie sie von Menschen verwendet werden.

Schlagwörter Mesolithikum, stoffartige Materialien, Pflanzenfasern, Tierhäute, sensorisch

Summary

This paper provides a novel insight into cloth-type materials of late Mesolithic hunter-gatherer-fisher societies of North-west Europe by combining archaeological evidence and person-derived sensory descriptions. Cloth-type materials are flexible, thin sheets that can be wrapped, folded, and shaped with the potential to be used to cover people and things. This definition includes fabrics made from interlaced yarns and animal skins. The archaeological evidence preserved for Mesolithic cloth-type materials includes organic looped and twined fabrics made with plant fibre, as well as archaeozoological remains indicating the use of leather and fur. Evidence focuses on the Late Ertebølle culture of southern Scandinavia c. 5400–3950 BC in its wider geographical and chronological setting.

The second aspect of this paper explores these unfamiliar materials through an innovative methodology. Groups of participants were asked to physically engage with a replica Mesolithic cloth assemblage and respond to a questionnaire asking them to describe each one according to its texture, appearance, smell, and sound. Philosophically, this approach is based on the cultural significance of sensation and perception. The sensory description of the cloth types through the handling experiment reframes the standard technical analysis of raw material and identification of fabric structure. It provides a novel understanding of these materials as used by people.

Keywords Mesolithic, cloth-type materials, plant fibres, animal skins, sensory

Introduction

Here, ›cloth‹ refers to the range of flexible, thin sheets of material that can be wrapped, folded, and shaped, with the potential to be used to cover people and things (Harris 2008, 225–227). This focus on cloth-type materials, rather than the technology, brings together cloth made of fibre worked into yarns or strands in a variety of fabric structures with those made of animal skins including leathers (where fur, scales or plumage is removed), and those with fur or other skin appendages such as scales or feathers. In this paper, Stone Age cloth-type materials were identified through archaeological evidence of the Late Mesolithic Ertebølle culture of southern Scandinavia some 7500–6000 years ago, in its wider chronological and geographical setting.

The Late Ertebølle was a stone tool and ceramic using hunter-gatherer-fisher economy. Studies argue these societies had social complexity, shamanism, prestige hunting, and a level of sedentism (summaries in Hellerøe 2023, 2–4; Blankholm 2008). The Ertebølle was chosen as the focus of this research due to exceptionally preserved plant fibre fabrics and zooarchaeological evidence of animals butchered

for their skins, which provide compelling evidence for identifying a late hunter-gatherer cloth assemblage. Following the archaeological evidence, these cloth types were made or sourced to bring together the physical cloth assemblage. Given their unfamiliarity, an innovative sensory handling experiment was developed to collect data on people's experience of late hunter-gatherer cloth types following repeatable methods (Harris 2014; Hamilton/Whitehouse 2006; Hamilton et al. 2020). The combined archaeological evidence and sensory information provide new insights into the cloth assemblage and culture of the Late Ertebølle.

Sensory worlds

What are the senses? What are the worlds of sense? The senses are bodily ways of perceiving and knowing – at once universal and culturally distinct. In neuroscience, the sensations are separated into vision (sight), audition (hearing), chemosenses (taste/smell), vestibular sensations or proprioception (motion/balance) and somatosensation (touch); the latter is now considered distinct from thermoception (temperature) and nociception (pain) (Fritzsch 2021). Sensations are studied from a spectrum of perspectives: from human universals studied empirically to a human-centred approach focused on sensation and the diversity of perception (Goldstein 2014, 5 Fig. 1,1; Oberman et al. 2010). Classen's social-anthropological study of cross-cultural perspectives on sensation argues for the cultural specificity of sense (Classen 1993, 1–5). Her philosophy of sensation is based on the significance of perception as cultural and learned: senses order culture and express cultual values. The significance of sensation to living beings is immense. Without the nervous system's detection, regulation and response, no thought or action occurs. This is the world of perception that is an ongoing, learned, and interconnected response to the world around us (Merleau-Ponty 2004). These responses provide divergent approaches to cloth; does the body experience comfort, practicality and attractiveness in cloth as a human universal, or are these situated experiences that change over time between groups and individuals?

As archaeologists, sensory information is useful since it allows us to find human connections between cloth and the larger sensory world these materials engender. It provides an avenue into human experience alongside ethnography and recent history (for example, Owen 2005). By producing a sensory description of the cloth through the handling experiment, it is possible to describe the Mesolithic cloth assemblage as a human experience from today's perspective. This moves away from the technical analysis of raw material and fabric structure into the relationship of humans, cloth assemblages and their surrounding world.

Handling experiment

The ›Mesolithic Cloth Handling Experiment‹ had two parts (see Harris 2014, 39–40). In Part 1, participants chose from different types of cloth and were asked to respond to questions based on their sensory experience of that cloth. These covered the senses of vision (sight), audition (hearing), somatosensation (touch), and chemosensation (smell/taste). For example, is the cloth flat or uneven? Is it shiny or matt? Transparent or dense? Permeable or impermeable? Does it have a weak or strong odour? Participants were asked to state their favourite and least favourite cloth and say why. In Part 2, the participants were asked to work in groups of three or more and order the cloth samples according to a single sensory criterion, such as from the most flexible to the least flexible, the stretchiest to the stiffest, or the noisiest to the least noisy.

Part 1 of the experiment provided the results of people's sensory experience of individual cloth types. Part 2 dealt with the same issues by assemblage. The 57 participants were students and other volunteers living in London, UK. Approximately 7–16 responses were obtained for each cloth type and five groups of comparative responses. Including the introduction and filling out both questionnaires, the handling experiment took two to three hours for each participant. Twenty-first century people cannot comprehend the perceptions of Mesolithic people. However, what is achieved is a ›sensible‹ description of Mesolithic cloth, where sensible means both engaging the senses and being practical. The discussion revisits the question of how these sensory descriptions provide insights into the cloth of late hunter-gatherer societies in north-west Europe.

Results

The following sections present the archaeological evidence for Late Ertebølle cloth types and the sensory results of the handling experiment.

Looping

Looping, also called knotless netting or buttonhole stitch, is a fabric structure where a continuous thread is used to create interconnecting loops, which can be joined and twisted in several ways (Seiler-Baldinger 1994, 10–12).

Archaeological evidence

Looping is preserved in waterlogged contexts at Tybrind Vig, a submerged Ertebølle settlement on the western coast of the island Fyn (Denmark), dated to around 6000 years ago (Bender Jørgensen 2013, 393–395). At Tybrind Vig, there are several types of looping. These include simple looping and looping made with a foundation where an additional yarn runs through the loops. Another type is twisted looping with a foundation (Bender Jørgensen 2013, 393; Seiler-Baldinger 1994, 11). The Tybrind Vig looping was made from tree bast of willow *(Salix)*, possibly also poplar *(Populus)*, and grasses *(Poaceae)* (Bender Jørgensen 2013, Appendix A [U. Körber-Grohne], 401–403).

Looping is also known from other Mesolithic sites. For example, multiple twisted loops at Friesack, Northern Germany, c. 6000 BC, are identified from disconnected loops of plant fibre yarn (Kernchen/Gramsch 1989, 23–25). At Frie-

Fig. 1 Tree bast was a source of fibre in the Mesolithic. Lime *(Tilia)* bast has a distinctive sharp, sappy, grassy odour that fades with time. Each species of tree bast has a unique colour and odour, which varies according to how it was processed.

Abb. 1 *Baumbast war im Mesolithikum eine Quelle für Fasern. Der Lindenbast* (Tilia) *hat einen charakteristischen scharfen, saftigen, grasigen Geruch, der mit der Zeit verblasst. Jede Art von Baumbast hat eine einzigartige Farbe und einen einzigartigen Geruch, der je nach Verarbeitung variiert.*

sack, it is twisted looping. Similar looping was found at Hardinxveld Polderweg in the Netherlands, c. 5500–4500 BC, where their production is associated with bone needles from swan *(ulnae)* (Van Gijn 2012, 277 Fig. 3; Louwe Kooijmans et al. 2001, 401–405). Looping continues into at least the early Neolithic period, with what is probably lime *(Tilia)* tree bast looping discovered at Bolkilde, island of Als (Denmark), c. 3400 BC (Bender Jørgensen 2013, 394; Mannering et al. 2012, 95 Fig. 3.2).

Sensory experience

Three variations of looping were made for the handling experiment using lime tree bast fibre (Fig. 1): simple looping with two-ply yarns (Fig. 2a), single yarns looping with foundation (Fig. 2b) and twisted looping with foundation (Fig. 2c).

When made from lime tree bast, the colour of the looping is reddish yellow to yellow (Munsell 7.5YR 7/6; 10 YR 7/6). Willow tree bast looping has a red to dark reddish-brown colour (Munsell 2.5YR 2.5/4, 5/6). The hue and shade of the looping depend on the natural colours of the different tree species and how it is processed. All three looping variations were described as visibly even to very uneven, with thin to neutral thickness. In terms of sheen, when made with twisted yarn, the looping is matt to neutral. The three looping variations are visibly transparent, and the open loops are physically permeable to air, water, and other substances.

The sound associated with looping made with tree bast fibre is described by the participants as soft, low, crackling, »like rubbing dry grass together«, »leaves rustling«, and »walking through dried grass«. There is a crackly, crispy, crunchy element to rubbing a hand over the surface of this cloth, which is especially noticeable due to the uneven surface.

Tree bast has a strong odour that fades with time. Lime tree bast was described as smelling like wood, dried plant stems, or straw and as smelling sharp, like grass, plants and tree sap. There was a hint of smoke, a fragrance gained by proximity to cooking fires. For one participant, lime tree bast smelt »like summer«. Different species of tree bast fibres have distinctive smells but similar sounds.

To the touch, tree bast looping feels cool or neutral and is rough to very rough. When handled, looping material is flexible to very flexible. The simple looping is very stretchy. Compared with the other cloth-type materials in the assemblage, elasticity is simple looping's most distinctive feature,

Fig. 2a–c a Simple looping is the most elastic, permeable cloth in the Mesolithic cloth assemblage. It is rough to the touch, matt, of medium thickness and has a crackling, crunching sound. b Looped cloth with foundation is known from late hunter-gatherer sites in north-west Europe. It is flexible, moderately stretchy, while also stiff. It is permeable and transparent, with texture, smell and sound like simple looping. c Looping with twist and foundation has similar sensory qualities to looping with foundation, except it is more transparent due to the larger spaces created by the additional twist.

Abb. 2a–c *a Ein einfaches Schlingengewebe ist das elastischste, durchlässigste Gewebe der mesolithischen Kleidung. Es fühlt sich rau an, ist matt, von mittlerer Dicke und verursacht ein knisterndes, knirschendes Geräusch. b Schlingengewebe mit Unterlage ist von Fundplätzen später Jäger- und Sammlergruppen in Nordwesteuropa bekannt. Es ist flexibel, mäßig dehnbar, aber auch steif. Es ist durchlässig und transparent, mit einer Textur, einem Geruch und einem Klang wie bei einfachen Schlingen. c Schlingen mit Drehung und Grundierung haben ähnliche sensorische Qualitäten wie Schlingen mit Grundierung, nur dass sie aufgrund der größeren Zwischenräume, die durch die zusätzliche Drehung entstehen, transparenter sind.*

contrasting strongly with the solid, stiff furs and leathers. The looping variations with foundation, while still flexible, are neither overtly stretchy nor stiff. The foundation acts as a stabiliser and prevents the loops from stretching freely. The looping with foundation was rated consistently stiffer and less elastic than the simple looping. The porous and per-

Fig. 3 Twining technique is known from Mesolithic fish traps. The same technique can be used to make cloth. This open twining made with lime tree bast is flat, medium transparent and matt. It has a rustling and slightly crunching, crackling sound.

Abb. 3 *Die Zwirntechnik ist von mesolithischen Fischreusen bekannt. Die gleiche Technik kann auch zur Herstellung von Stoffen verwendet werden. Dieser offene Zwirn aus Lindenbast ist flach, mittelmäßig transparent und matt. Er erzeugt ein raschelndes und leicht knirschendes, knisterndes Geräusch.*

meable quality of all looping variations is another defining feature of this cloth type. The looping with twist and foundation is similar to looping with foundation, except it is a little more transparent and porous due to the larger spaces created by the twist.

The material made by simple looping was appreciated because it was satisfyingly loose and stretchy. Among the participants, there was a general disbelief that this loose, rough, scratchy material would be worn directly on the skin as clothing. Instead, people imagined it for food containers or bags. What such a bag might drain or contain depends on the loop size. Participants were fascinated by the looping in tree bast because it had no immediate modern comparisons. Compared with the other cloth types in the handling experiment, the looped cloth was consistently among the coolest, roughest, noisiest and stretchiest fabrics. Adding the foundation significantly reduces the flexibility of looping and makes the fabric stiffer.

Twining

Twining is a fabric structure made by connecting a series of parallel aligned strands (called passives) using a pair of twisting elements (called actives) (Seiler-Baldinger 1994, 31). Twining creates fabrics of varying density and flexibility depending on the choice of materials and technique.

Archaeological evidence

Early twined fabric structures in north-west Europe come from fishing traps. These include twined fish traps made with plant materials from the Ertebølle contexts of Nidløse, Zealand (Denmark), several sites in the Netherlands including Bergschenhoek, c. 4200 BC, and Hardinxveld-Giessendam De Bruin, c. 5100 BC (Zaliznyak 1998, 50; IJsveld 2014). At these sites, rigid fish traps will likely be preserved due to their waterlogged contexts. It is plausible that Mesolithic people also made twined cloth using flexible materials. The early Neolithic site of Tulstrup Mose, North Zealand (Denmark), has twining made of lime tree bast (Bender Jørgensen 2013, 395).

Twined cloth appears to be one of the oldest cloth technologies. Twining impressed in clay has been reported at the Palaeolithic site of Pavlov I, Czech Republic (Adovasio et al. 1996, 529–531), dated more than 30 000 years ago (Svoboda et al. 2016, 102). It is likely that the fine twined structure at Pavlov I made with twisted, plied threads would have produced a semi-flexible cloth.

Sensory experience

The twining used for the handling experiment was an open twined structure using lime tree bast strands in the passive elements and lime tree bast cord for the paired active

elements (Fig. 3). As it is made from lime tree bast, the colour and smell were described similarly to the looping. The visual aspects of the open twining produced mixed results. For some participants, it was seen as flat; for others, neutral or uneven and somewhat dense, while also slightly transparent due to the small gaps between the strands. Overall, twining was rated as matt. The sound made when a hand was rubbed over the cloth or when the cloth was rubbed on itself was described as »rustling and slightly crunching«, »crackling«, »scratchy«, »like a brush sweeping«, »dry«, »rustling« and »a creaky rustle«. The texture was described as somewhere between soft and rough. To the touch, it was cool to neutral. The twining is fairly thin, porous, flexible, and a little stretchy while also stiff.

Compared with the other cloth types in the assemblage, the twining is rated as average or medium for visual evenness, sheen, odour, roughness, thickness, porosity, and permeability. The open twining has distinctive sounds and flexibility. It was rated by several groups as the noisiest and most inflexible cloth and one of the coolest fabrics to the touch.

Leather and fur

Leather is made from animal skins and is here used to define those skins where the fur, hair, scales or plumage is removed, in contrast to those skins where the coat (fur, hair, scales, feather) is left intact.

Archaeological evidence

In the absence of preserved Mesolithic furs and leathers, their presence is investigated through zooarchaeological evidence. The full range of animals butchered at a site – whether mammals, fish or birds – had a skin; all can be processed into cloth. A range of animals was butchered at Late Ertebølle sites in Denmark, including those with striking furs. For example, the Ringkloster seasonal hunting camp, eastern Jutland (Denmark), the Tybrind Vig habitation site, and the Agernæs specialist fur procurement site, North Funen (Denmark), have archaeozoological evidence: that includes red deer *(Cervus elaphus)*, auroch *(Bos primigenus)*, roe deer *(Capreolus capreolus)*, brown bear *(Ursus arctos)*, pine marten *(Martes martes)*, polecat *(Mustela putorius)*, wolf *(Canis lupus)*, fox *(Vulpes vulpes)*, domestic dog *(Canis familiaris)*, lynx *(Lynx lynx)*, wild cat *(Felis silvestris)*, otter *(Lutra lutra)*, badger *(Meles meles)* and beaver *(Castor fiber)* (Rowley-Conwy 1994, 88 Fig. 1; Trolle-Lassen 1986; Richter 2005). The high proportion of foetal or newborn roe and red deer skeletal remains at Ringkloster suggests they could have been exploited for the specific physical properties of their young skins or distinctive speckled hides (Rowley-Conwy 1994, 94–95). Given the importance of cloth-type materials in human material culture assemblages, an underlying assumption is that the skins of all butchered animals were used in one way or another.

Cut marks on the extremities of animal carcasses are associated with skinning, partly to preserve the full extent of the skin, and hint at an interest in the hide or fur (Charles 1997, 259). Historically, certain species were appreciated for their attractive furs or plumage and seem to have been targeted in the Mesolithic. The Ringkloster pine marten skeletons have cut marks on the skull and mandible associated with skinning, indicating the removal of the pine marten's distinctive dark brown fur with a white bib. They were found in large quantities with fully articulated skeletons, suggesting that, although skinned, they were not exploited for meat (Andersen 1994, 49; Rowley-Conwy 1994, 95–96). Similar pine martin bone assemblages are found at Agernæs, where the pine martens have burnt teeth; this may suggest they were trapped by thrusting burning sticks into their dens (or burrows they occupied) to draw them out, thus maintaining an intact coat (Richter 2005, Fig. 3).

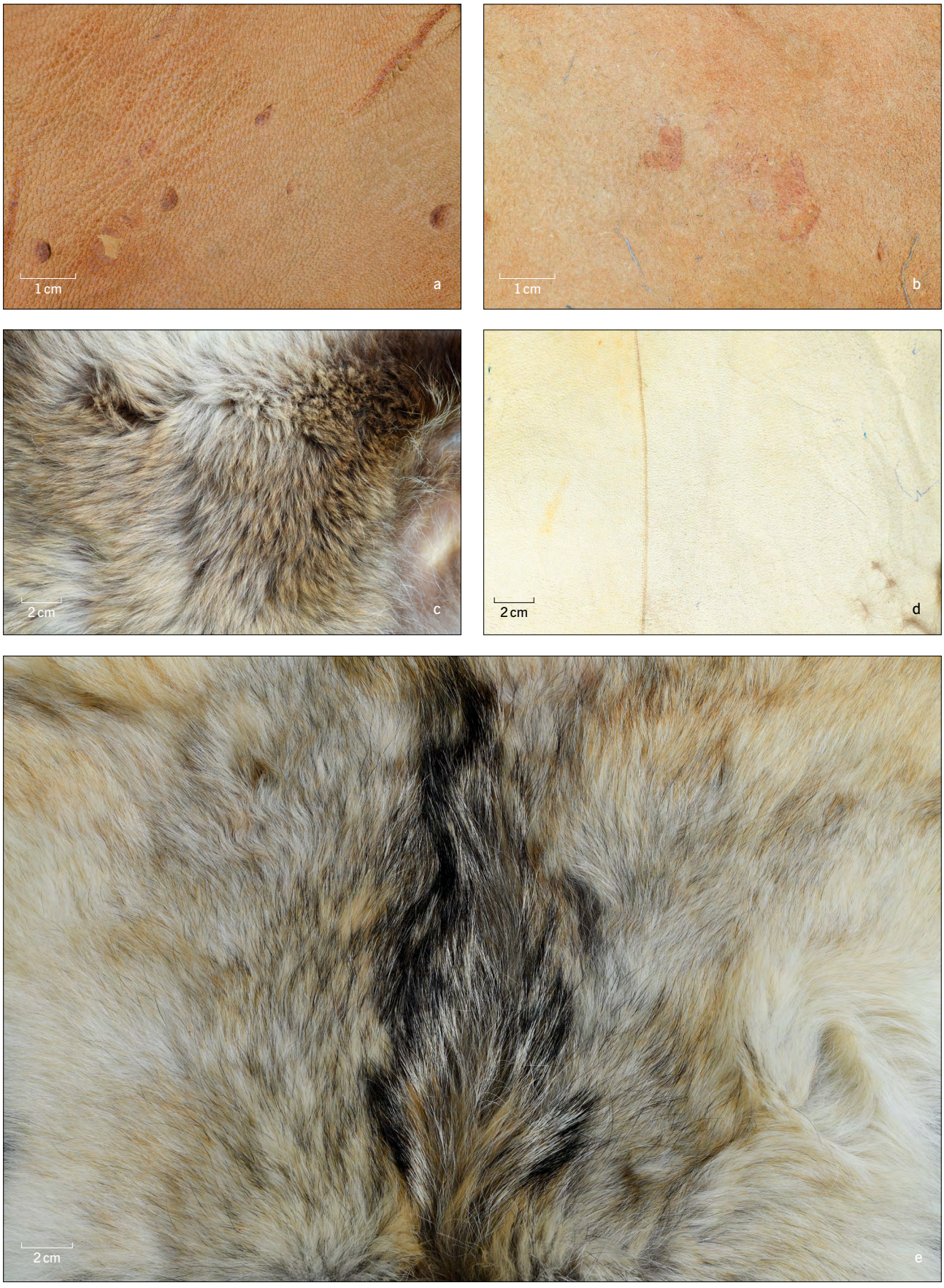
It is not only mammals that have attractive and useful skins. The Late Mesolithic Ertebølle site Aggersund in North Jutland (Denmark) is interpreted as a kill site for swans, a potential source of feather plumage and down (Blankholm 2008, 118). Bird skins with down and feathers are becoming better appreciated as cloth-type materials due to new methods for their detection (Kirkinen et al. 2022, 7). The survival of keratin fibres (animal hair, feathers) at a Mesolithic child's burial at Majoonsuo, Outokumpu (eastern Finland), 7521–7337 cal. BC (Ua-64385, 8354 ± 37 BP), indicates that the grave was furnished with waterfowl down *(Anseriformes)* (Kirkinen et al. 2022, 9; 13). Fish skins, especially those of salmon, eel, shark, catfish and burbot, are an underappreciated source of leather (Rahme/Hartman 2001, 42) and are still to be detected archaeologically.

Sensory experience

Fat-tanned deer leather has two distinct faces, the grain side (outward facing) and the flesh side (Fig. 4a–b). Deer leather is reddish to brownish yellow (Munsell 7.5YR 6/8; 10YR 7/8, 6/8). The grain side is visually flat, shiny and very dense. The flesh side has the same features, except it is visually matt. Both sides are soft to the touch and not especially cool or warm, although the grain side is somewhat cooler to the touch than the warmer flesh side. People likened the smell to tanning products, a shoemaker's shop, a »warm smell«, »like a leather jacket«. This was a familiar odour described

Fig. 4a–e (right page) a Furs and skins were an important source of cloth for hunter-gatherer societies. Deerskin leather, grain side, is thin and very flexible, with a flat, smooth surface. b Deerskin leather, flesh side, has a rough and slightly sandy texture when compared to the smooth, grain side. c Red fox, fur side *(Vulpes vulpes)*, is pale yellow to yellowish brown and light red. The fur is a mix of flat and uneven areas that are shiny and very dense. To the touch, fox fur is very soft. d Red fox, flesh side, has a flat, slightly rough surface, which contrasts to the fur side. e Silver fox fur *(Vulpes vulpes)* is variegated from white to pinkish white, very pale brown to black. The odour is described as smelling like a dog, like a fur coat or musky.

Abb. 4a–e (rechte Seite) *a Felle und Häute waren für Jäger- und Sammlergesellschaften eine wichtige Quelle für Kleidung. Hirschleder, Narbenseite, ist dünn und sehr flexibel, mit einer flachen, glatten Oberfläche. b Hirschleder, Fleischseite, hat im Vergleich zur glatten Narbenseite eine raue und leicht sandige Textur. c Rotfuchs, Fellseite* (Vulpes vulpes), *ist blassgelb bis gelblich-braun und hellrot. Das Fell hat eine Mischung aus flachen und unebenen Bereichen, die glänzend und sehr dicht sind. Bei Berührung ist das Fell des Fuchses sehr weich. d Rotfuchs. Die Fleischseite hat eine flache, leicht raue Oberfläche, die im Kontrast zur Fellseite steht. e Das Fell des Silberfuchses* (Vulpes vulpes) *ist weiß bis rosa-weiß, sehr blassbraun bis schwarz gefärbt. Der Geruch wird als hundeähnlich, pelzartig oder moschusartig beschrieben.*



as »just normal leather smell«, »it is a friendly sort of cloth«. The sound made by the material was described as slight scuffing, smooth without an abrupt cut-off, brushing, muffled, whispered, almost soundless, very soft, slightly different on each side, »the outside a little sandy«, »sounds like walking on a carpet«, »like wind blowing«. In terms of

touch, the leather is impermeable, very flexible, somewhat stretchy and neither especially thick nor thin. When compared with the rest of the cloth assemblage, the deerskin is notably thin and very flexible, with the flattest, smoothest surface.

Three furs were examined as part of the handling experiment: red fox, and silver fox *(Vulpes)*, bear *(Ursus)* (Fig. 4c–e). The silver fox is a less common colouration. Like leather, the furs have two distinct faces: the fur side and the flesh side.

The silver fox fur is variegated from white to pinkish white, very pale brown, and light greenish grey to black (Munsell 10YR 8/3, 2.5YR 8/1, 5YR 8/1-2, 7.5, Gley 1 8/10Y, YR 2.5/1). The red fox fur is very pale to pale brown, yellowish brown, pale yellow, and light red (Munsell 10YR 8/2, 10YR 5/4. 2.5 YR 6/6, 2.5Y 8/3, 5Y 8/2). The bear fur is dark brown, however the colouration of the bear fur in the experiment was discounted as it has changed due to the way it was tanned. The fur side of both foxes is perceived as both flat and uneven, shiny and very dense.

The fox has a strong odour. It is described as smelling like a dog, like a fur coat, musky, like warm fur or hair, reminiscent of animal fat or dry wool. The smell of the bear fur was described in a similar way. Regarding fox, a student who was also a farmer answering the questionnaire said he immediately »smelt the predator«.

To the touch, the fox and bear furs are very soft; participants initially rated them as »neutral to warm«, but this changed to »warm« when the dark furs heated up in the sun. When handled, fur seems impermeable, is very flexible, stiff to neutral, and thick to very thick. The flesh side varied between flat, matt and rough.

Compared to the cloth assemblage, the furs and the grain side of the leather are the shiniest, smoothest and most impermeable. The furs are the thickest cloth types and have the least sound. They are moderately flexible and stiff. Their odour is noticeable, especially the furs. Mostly, people were unfamiliar with the smell of the different animals and likened them to more familiar domesticated species, especially pets. The colour of each coat is varied and was appreciated for its decorative nature. The stretchiness of the soft deer leather was seen positively. The bear fur was noted for its potential rarity and striking dark colour. The fox fur was especially appreciated as a soft, fine fur, described as »like stroking a dog«. People thought it would be ideal as a hood edging or other decorative feature because »it's cute«. However, the smell of the fox was polarising – to some, it »smelt bad«, while to others, it »smelt nice«. The furs also elicited negative reactions because of what is perceived as an unnecessary death – a perception based in twenty-first-century ethical considerations of animal welfare. This is a reminder of the non-material considerations people make about cloth and the issue of cultural taboos.

Sensory cloth worlds of late hunter-gatherer

What does this say about late hunter-gatherer cloth assemblages? Archaeological evidence points to a varied world of cloth. Plants processed to make fibres and yarns were made into looping and twined fabrics that could be adjusted in numerous ways. A supply of animal skins was gained by hunting mammals, birds and possibly fish. There was an interest in specific fur-bearing mammals, notably pine martens, with people killing and skinning them at specialist hunting sites. We are only just starting to understand the role of bird skins with plumage as cloth, which adds a swathe of materials to the late hunter-gatherer cloth assemblage. The killing of neonate deer may suggest the desire for especially fine, soft skins (L. Janik, pers. comm). Investigating the archaeological evidence for Late Ertebølle cloth in its wider geographical and chronological setting shows that there was an extensive repertoire of cloth-type materials.

The sensory results of the handling experiment provide novel insights into the physical and sensory qualities of the materials in relation to the human body. Because of their proximity to the body, we may assume cultural attitudes to practicality and comfort played an important role.

There is a noticeable contrast between the nearly silent animal leathers and furs and the crackly, crunchy plant fibre fabrics. This calls attention to the tasks of Late Ertebølle life: for trackers and hunters, moving silently in the world would be a benefit. Mammal furs and bird feathers are not simply source of food, as clothing their skins and pelage provide colour, pattern, texture and decorative potential. The lustrous sheen, the recognisable coat of each species, and even the lingering animal odours draw attention to the potential of what may be called the prestige of certain furs, especially when worn as clothing. Warmth, thickness and the impermeability of furs have long been assumed to be part of their appeal in northern latitudes and are aspects of how furs differ from plant fabrics. We add to this that dark-coloured furs like pine marten, bear, and beaver become warmer to the touch in the sun. The sensory results draw attention to the ways furs contain the smell of the animal and how smell, most of all the senses, is attached to memories of previous sensory encounters. Did the smell of a bearskin cloak elicit adrenalin and fear, as well as awe? Was the fox or pine marten scent prized or ignored? The underside of the leather and furs feels a little grainy, while the grain side of the leather is pleasantly smooth. At the Tybrind Vig habitation site, people decorated wooden oars (Andersen 2013); it is not difficult to imagine people carefully stitching garments to capture attractive designs.

The plant fibre fabrics rustle, crackle and smell according to their origins. Twining for fish traps is rigid basketry rather than cloth yet utilises the permeable and solid qualities of open twining. As flexible cloth, twining's medium flatness, flexibility, porosity and density suggest a versatile cloth. The spaces in twined fabrics are both permeable and a way to trap air; when layered with other fabrics this may act as insulation. In contrast, twining lacks the attractive gloss, smoothness, and texture of fur yet provides a simply constructed solid, stable, flexible fabric. Looping from plant fibres is a distinctive type of cloth. The looped open structure seems more suitable for containers than clothing. The elastic, open looping fabric would be ideal for carrying fish, seaweed, tubers, or other items where it would be beneficial to allow water, sand, or soil to drain away when they were carried or stored. It is harder to imagine this looped fabric as clothing. Yet, archaeologists will do well to remember that

we only see part of the cloth assemblage. The looped structure made of fine gut, sinew, or strips of hide could have been used creatively to elasticate garments.

The sensory experiences are a reminder of the interconnection between cloth and clothing and the Late Mesolithic culture, environment and task scape. As people wore clothes, so they appeared and smelled like the plants and animals they interacted with in other ways. For example, how did the feeling of winter fur clothing, or the distinctive smell and sounds of twined clothing, find connection with the plants people collected and processed, the animals they tracked, or the beings encountered in shamanistic rituals?

The cloth types are identified here through archaeological evidence, but also those less easily identified in the archaeological record were integral to the physical and sensory world of the Late Ertebølle hunter-gatherer-fishers. Their identification provides a basis for understanding the cloth and clothing people used and wore. The sensory experiences provide glimpses into the world of cloth and the people of these societies. They honour the cycle of daily interactions with plants and animals. People wore clothes that were planned and prepared, that rustled and smelt, and that could be stretchy, warm, smooth, red, white, yellow, brown, shiny, or matt. From the experimental results, we understand that the sensory experience of cloth among late hunter-gatherer-fishers of Late Mesolithic Scandinavia characterise a distinctive sensory cloth world, different from that to which we are accustomed. The lingering scent of animals, the prickle of plant fibres on the skin, or the non-breathability of fur clothing can be challenging to modern sensibilities. Cloth experiences of the past are based on culturally attuned sensations of comfort and practicality that may not be intuitive to us today (Harris 2019, 224). In the absence of preserved intact garments, the human experience of replicated Mesolithic cloth is one way to add depth and enquiry to the knowledge of clothing people made and wore in late hunter-gatherer societies.

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