

## Zusammenfassung

### Federn in mesolithischen Bestattungen

Es wird vermutet, dass Vögel in der Steinzeit nicht nur wegen ihres Fleisches, ihrer Eier und ihrer Knochen von Bedeutung waren, sondern auch aufgrund ihrer Federn und Daunen. Obwohl die tatsächlichen Überreste von Federn in der Tat selten erhalten sind, gibt es indirekte Hinweise auf sie. Knochen von Vogelflügeln, die in Gräbern gefunden wurden, deuten beispielsweise darauf hin, dass diese – vermutlich mit Federn bedeckt – den Toten beigelegt wurden. Außerdem wurden Federn zum Befiedern von Pfeilen benötigt. In ethnografischen Quellen wird von Kleidungsstücken aus Wasservogelhäuten in der nördlichen Hemisphäre berichtet. In jüngster Zeit hat der Nachweis von mikroskopisch kleinen Federfragmenten in Bestattungen, die Tausende von Jahren alt sind, neue Informationen über weiche organische Materialien geliefert, die absichtlich in Gräber gegeben wurden.

In diesem Beitrag werden die neuesten Ergebnisse der Faseranalyse vorgestellt, die bei der Analyse einer Reihe von mesolithischen Bestattungen, d. h. der Kinderbestattung von Majoonsuo, Nordkarelien (Finnland), und der Schamaninnen- und Kinderbestattung von Bad Dürrenberg, Saalekreis, eingesetzt wurden. Darüber hinaus werden einige vorläufige Ergebnisse aus den Friedhöfen Skateholm I und II, Skåne län (Schweden), vorgestellt. Die Analyse von Sedimentproben aus Bestattungskontexten zeigt, dass Federn von Wasser- und Raubvögeln am häufigsten für die Herstellung von Kleidungsstücken, Kopfbedeckungen und möglicherweise für die Ausstattung des Grabes verwendet wurden. Der Artikel unterstreicht die Bedeutung und Notwendigkeit systematischer Beprobungen für zukünftige Forschungen.

**Schlagwörter** Mikroarchäologie, Federn, Sedimentproben, Bestattungen, Mesolithikum

## Introduction

The plumage of birds consists of different types of feathers with varied functional properties related to flying, diving, and insulation. Even more, the soundless flight of an owl (Bachmann/Wagner 2011) and the drumming sound produced by the tail feathers of the Common snipe (*Gallinago gallinago*) are examples of species-typical functions of feathers. Accordingly, humans have exploited the different

## Summary

Birds are presumed to have been important in the Stone Age not only for their meat, eggs, and bones but also for their feathers and down. Although the actual remains of feathers are rare indeed, there is indirect evidence for feathers. For example, bird wing bones detected in graves imply that bird wings – presumably covered in feathers – were placed with the dead. Moreover, feathers will have been needed for fletching arrows. In ethnographic sources, garments made from waterfowl skins have been reported in the northern hemisphere. Recently, the detection of microscopic feather fragments in burials spanning thousands of years has provided new information on soft organic materials deliberately placed in graves.

This paper presents the latest results of fibre analysis implemented in the analyses of a series of Mesolithic burials, i.e. the Majoonsuo child burial, North Karelia (Finland), and the Bad Dürrenberg, Saalekreis district, shaman and child burial. In addition, some preliminary results from Skateholm I and II cemeteries, Skåne county (Sweden), will be presented. Analysis of sediment samples from burial contexts indicates that feathers of waterfowl and birds of prey have been used most frequently for making garments, headgear, and possibly furnishing the grave. The paper highlights the importance and need for systematic sampling in future research.

**Keywords** Micro-archaeology, feathers, sediment samples, burials, Mesolithic

species and feather types by selecting the best feathers for fletching arrows and filling pillows or preparing bird skins for garments. Additionally, feathers and bird body parts, such as wings, have been used as decorative elements (Serjeantson 2009, 207); their use in ritual costumes is well described in ethnographic sources throughout the world (Kononov et al. 2006; Lindsay Levine 1991; Pearlstein 2017a). For example, Finnish historian of religion U. Holmberg (1922, 6; 13–14; 20) documented the bird-type shaman



Fig. 1 Bird shaman dress after U. Holmberg.

Abb. 1 Kleid eines Vogelschamanen nach U. Holmberg.

costumes in Siberia and reported that the headgear was usually made of bird feathers, and – in some cases – even from a complete owl skin. Sometimes, bird wings were also attached to the shaman's shoulders. Feathers were also imitated: wings were indicated by sewing long strips of leather onto the under-arm seam of the sleeves. Throughout the outfit, small leaf-shaped pieces of iron were interpreted as feathers (Fig. 1).

Although it is generally assumed that feathers already were important during the Stone Age, the finds themselves are extremely rare in archaeological contexts, as feathers are soft organic materials that tend to degrade over time (e.g. Hurcombe 2014, 91–92). However, zooarchaeological analyses have occasionally documented cut marks related to the removal of feathers, indicating a systematic and geographically widespread tradition of extracting feathers by Neanderthals and other Palaeolithic human groups (e.g. Finlayson et al. 2012; Fiore et al. 2020; Peresani et al. 2011). In Northern Europe, the osteological evidence of feathers is composed of wing bones that indicate the placing of complete wings in Mesolithic and Neolithic burials. The most spectacular example is the whooper swan (*Cygnus cygnus*) wing fragment (the proximal part of the right *carpometacarpus*) recovered below the burial of a baby in Grave 8 at Vedbæk, Capital Region (Denmark; Albrethsen/Brinch Petersen 1976; Mannermaa 2013a; Nilsson Stutz 2003). In another instance, at Zvejnieki, Vidzeme region, in northern Latvia, almost forty carpometacarpal bones and three wing phalanges of Eurasian jay (*Garulus glandarius*) were found in an adult male grave (Grave 164). In this case, at least 17 jay individuals were butchered and used to decorate the burial, probably selected for their

impressive wing feathers of the bright blue colour spectrum (Mannermaa 2006; Mannermaa 2013b).

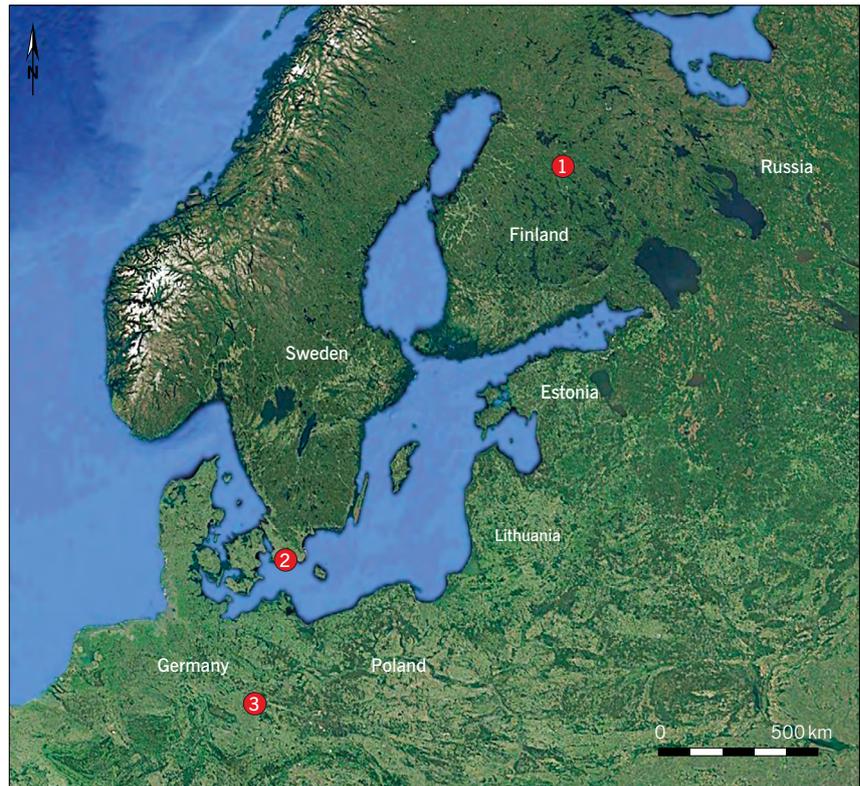
For the preservation of complete feathers, special circumstances such as extreme cold or aridity, submerged or peat bog contexts are required (e.g. Rast-Eicher 2016, 15–31). For example, feathers that had been used in fletching arrows have been detected in melting glaciers worldwide (Dove et al. 2005; Junkmanns et al. 2019; Rosvold 2016). In Punta de la Peña 4, Salta Province (Argentina), a site located in the arid Andean highland, several complete feathers have been studied in a context dated to 500–1000 BP (Velardez-Fresia/Urquiza 2024). Also, in the Kagamil Cave burial site in Alaska, feathers and mammalian hairs have been preserved in contexts with mummified corpses (Dove/Peurach 2002; Funk 2018).

Occasionally, microscopic feather fragments, i.e. barbules, have also been preserved – for example, on the surfaces of lithic artefacts that have been used for processing bird skins or feathers (Hardy et al. 2001; Hardy et al. 2018; Kirkinen et al. 2023). Plumulaceous barbules, although usually only ca. 0.2–5.0 mm long, are useful finds as they not only testify to the use of feathers but can also entail diagnostic features for identification of species or genera (see Dove/Koch 2011). The finding of barbules in residue analysis (e.g. Hardy/Moncel 2011; Robertson 2002) shows that they may also survive in sediments different from grave fills.

In this paper, I will present a selection of the latest results on microscopic bird feather fragments in Mesolithic burials (Fig. 2). For this purpose, I have selected the Majoonsuo child burial, North Karelia (Finland; Kirkinen et al. 2022), and the Bad Dürrenbergshaman and child burial, Saalekreis District (Orschiedt et al. 2023). In addition, the pre-

**Fig. 2** The locations of the sites discussed here. 1 Majoonsuo, North Karelia (Finland), red ochre grave; 2 Skateholm I and II, Skåne County (Sweden), burial sites; 3 Bad Dürrenberg, Saalekreis District, shaman burial.

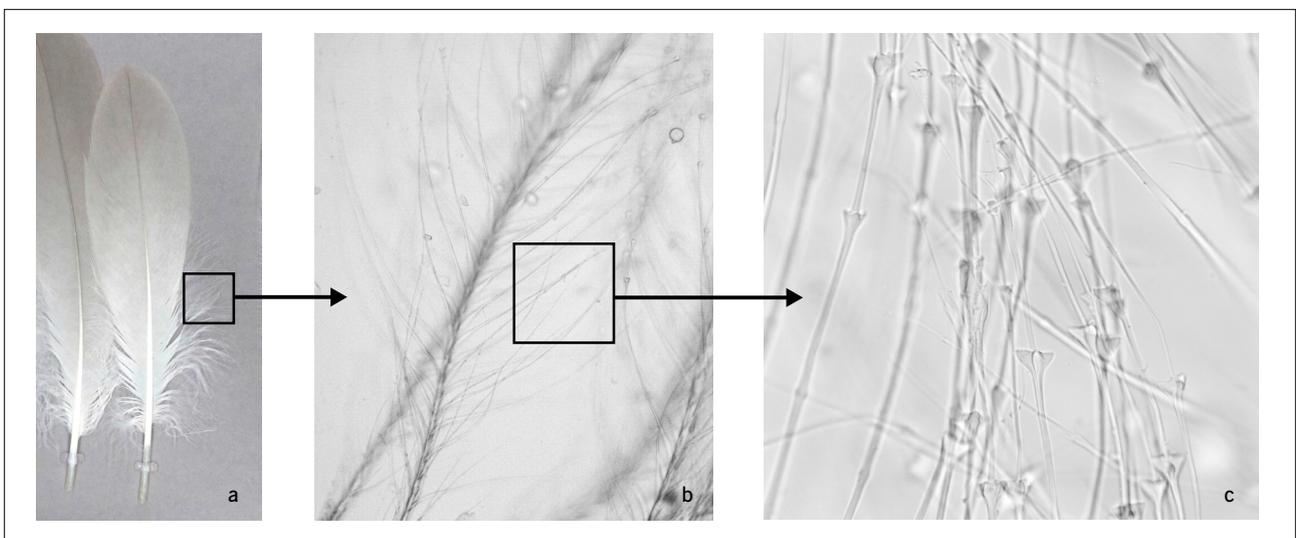
**Abb. 2** Die Lage der hier behandelten Fundstellen. 1 Majoonsuo, Nordkarelien (Finnland), rotes Ockergrab; 2 Gräberfelder Skateholm I und II, Skåne län (Schweden); 3, Bad Dürrenberg, Saalekreis, Bestattung einer Schamanin.



liminary results of Skateholm I and II cemeteries, Skåne County (Sweden; Larsson 2016), will be noted. The barbules have been detected in sediment samples that have been collected both in recent excavations and even in a research project, whose sediment samples had long been in a storage. First, the preservation of feather fragments in archaeological sediment samples is discussed, after which the three selected Mesolithic burial sites are presented as good examples for potential fibre analysis. Finally, source-critical issues related to the sourcing of microscopic barbules will be discussed.

### The preservation of feathers

The feather fragments that have been recovered in archaeological sediment samples represent the smallest elements that compose a feather; they are called barbules (Fig. 3). These barbules can measure less than one millimetre in length, while the longest ones from large birds may even be 4–5 mm long. In practice, archaeological barbule finds are often fragmented, and the smallest ones detected by sieving are only 0.2–0.3 mm long. Barbules are categorised as *pennaceous* and *plumulaceous* barbules; only the latter provide



**Fig. 3a–c** Whooper swan (*Cygnus cygnus*). a feather; b barb; c barbules with their diagnostic triangular-shaped nodes.

**Abb. 3a–c** Singschwan (*Cygnus cygnus*). a Feder; b Federast; c Håkchen mit ihren diagnostischen dreieckigen Knoten.



**Fig. 4** Majoonsuo rescue excavations in 2018 by the Finnish Heritage Agency. The red formation in the middle of the photo is the uppermost level of the red ochre grave.

**Abb. 4** Die Rettungsgrabungen in Majoonsuo im Jahr 2018, durchgeführt von der Finnischen Denkmalschutzbehörde. Der rote Befund in der Mitte des Fotos ist die oberste Ebene des roten Ockergrabes.

diagnostic features for species identification (see Hudon 2005; Dove/Koch 2011).

The preservation of barbules compared to other feather parts is related to their structure. Bird feathers are composed of proteins, lipids and biopigments, the proteins of which consist of keratins (Pearlstein 2017b, 6). Compared to mammalian hairs, bird feathers have a greater amount of  $\beta$ -keratin that is more consistent with soil microbiome than  $\alpha$ -keratin, which is the main component of hairs (Lange et al. 2016; Schweitzer et al. 2018). Moreover, the evolutionary diversification of feathers has resulted in various keratinous components of feathers from different parts of birds and in different parts of feathers (Barone et al. 2005; Fraser/Parry 2008; Ng et al. 2014). For example, pennaceous barbules are known to be composed of specific  $\beta$ -keratin (Kowata et al. 2014; Ng et al. 2014), and barbules in general have also shown their resistance to microbial degradation in experimental residue analysis (Monnier/May 2019, 6818).

For the preservation of microscopic fibres in archaeological contexts, the sediment texture and pH have turned out to be among the most important factors (Kirkinen et al. 2022). In general, keratins are favoured by acidic sediments (e.g. Janaway 2001; Rowe 2020, 158; Wilson 2008). However, there is evidence that hairs and barbules can also be preserved in alkaline environments if the sediment is fine-grained, i.e. clay or silt. It seems that even small anomalies of fine-grained soil can form protective, air-free envelopes around the fibres. In Stone Age graves, red ochre also seems to have been a positive element enhancing the preservation of fibres, not only due to its clay particles but also because of its ferrous content (Kirkinen et al. 2022).

### The archaeology of barbules

Barbules or their fragments are the most numerous parts of feathers recovered from archaeological sediment samples. Due to their microscopic character, barbules, as well as animal hair and plant fibre fragments, must be separated from the sediment by water sieving. The protocol for this procedure has been described in T. Kirkinen et al. (2022). Thus far, evidence of bird feather fragments has been detected in several Mesolithic (Kirkinen et al. 2022; Mannermaa/Kirki-

nen 2020; Mannermaa et al. 2019) contexts, mainly in Northern Europe and Germany. In the following, examples of the research results will be presented.

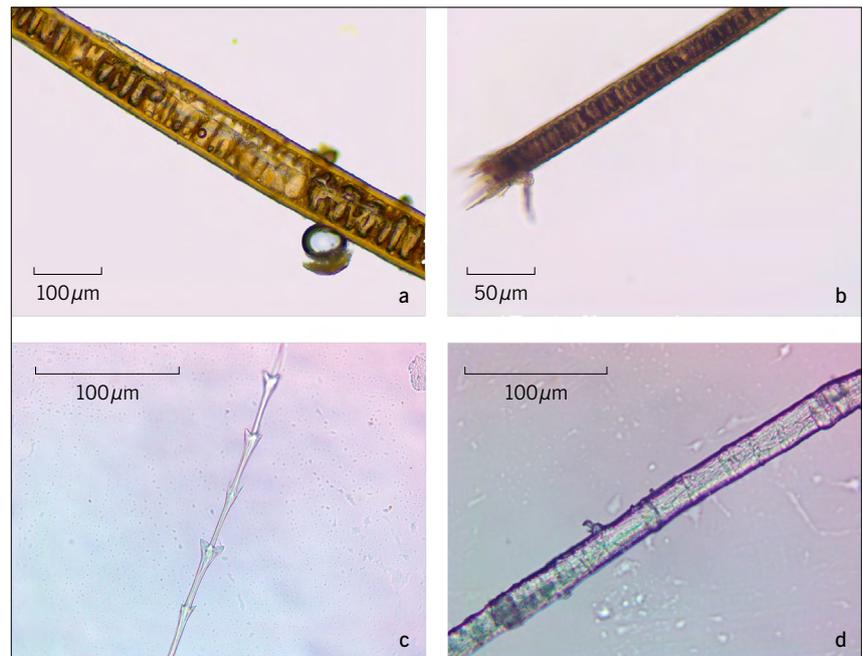
### Majoonsuo

The first Mesolithic site that was studied for microscopic fibres was the grave of a 3–10-year-old child in Majoonsuo (Kirkinen et al. 2022). The grave was excavated in 2018 by the Finnish Heritage Agency as a rescue excavation (Fig. 4). The research team collected almost all the sediment from the grave fill – coloured heavily by red ochre – and from its surroundings, to be used in testing and developing the sieving method in the search for microscopic fibres.

From a total of 60 sediment bags, 23 were selected for further analysis. In each case, 150–300 g of sediment was studied for fibres. The analysis produced a single Canid hair, bast fibres, and over 20 bird feather fragments, i.e. barbules (Fig. 5). The feather fragments were especially detected at the lowest level of the grave. Most of the barbules lacked diagnostic features that could be used for species identification; some, however, could be identified as waterfowl (*Anseriformes*), probably ducks, and one as falcon (*Falconidae*). The falcon feather fragment was tentatively interpreted as a costume decoration or the remains of feathers used for fletching arrows placed in the grave with the child. The waterbird feathers were hypothesised to originate from a garment made of bird skins or from a layer of downy feathers that separated the deceased from contact with the surrounding sediment. In both cases, ethnographic parallels evidence similar uses of bird skins and feathers in the northern hemisphere. In Greenland and among Canadian Inuits, for example, bird skins are known to have been used especially for children's anoraks and garments due to their softness and warmth. Moreover, waterfowl skins were preferred due to their insulation properties and durability, and for children, e.g. skins of juvenile common eider (*Somateria mollissima*) were selected due to their extra softness (Buijs 2004, 16; 46; Nakashima 2002). There is also additional evidence of the relationship between children and birds; for example, C. Funk (2018) has reported that bird feathers were strongly associated with child mummies in the Kagamil Cave burial site in the eastern Aleutians, Alaska.

Fig. 5a–d Examples of fibres recovered in the Majoonsuo child burial. a canid hair; b carnivore hair; c waterfowl barbule; d bast fibre.

Abb. 5a–d Beispiele von Fasern, die in der Kinderbestattung von Majoonsuo geborgen wurden. a Haare von Hunden; b Haare von Fleischfressern; c Hähchen von Wasservögeln; d Bastfasern.



In that cave, bird wings and a hawk skin were placed next to children, and some mummies were wrapped in shirts prepared from waterfowl skins. In addition, feathers were scattered throughout the Kagamil Cave (Dall 1877; Dove/Peurach 2002; Hrdlička 1945). These examples are presented here only to show that the many explanations are possible, and more investigation is needed to understand the roles of bird feathers in death rituals.

### Skateholm

The Mesolithic burial sites of Skateholm I and II are composed of a total of 87 graves, situated by a shallow lagoon on the south coast of Scania (Fig. 6; Larsson 2016). The cemeteries and the nearby settlement site were excavated by L. Larsson, 1980–1984; since then, this archaeological complex has been under active multidisciplinary research (e.g. Eriksson/Lidén 2002; Larsson 1988; Macâne 2022). During excavation, Larsson took 1–12 sediment samples in each grave for pollen analysis (Larsson 2016, 179). After the analysis, the remaining samples, 139 in number, were stored on the premises of the University of Lund. For this research, a collection of 58 samples from 27 graves in Skateholm I and 21 samples from eight graves in Skateholm II was analysed for fibres and feathers 2022–2024 (Kirkinen et al. forthcoming).

The preliminary results indicate the importance of waterfowl and hawks or eagles (*Accipitridae*) in these sites. The birds of prey barbules were recovered especially from the samples taken in the head and neck area. Therefore, it is reasonable to assume that hawk/eagle and owl feathers or

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Fig. 6 Skateholm I and II landscape today. In the front, the remains of a lagoon are still visible.

Abb. 6 Die heutige Landschaft von Skateholm I und II. Im Vordergrund sind noch die Überreste einer Bucht zu erkennen.

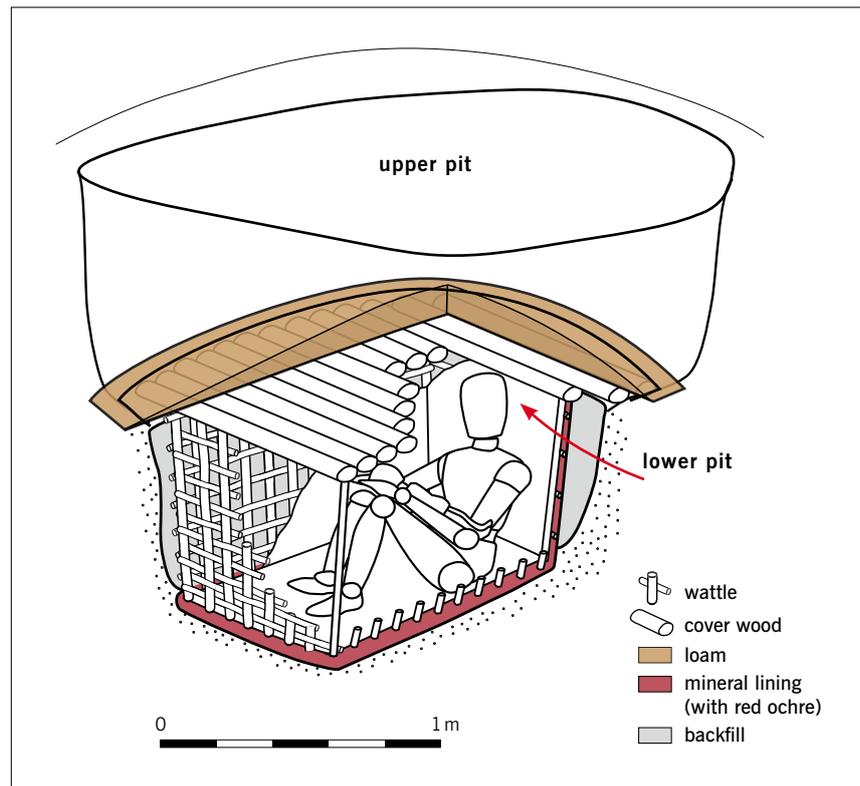


Fig. 7 Bad Dürrenberg. Roe deer antlers, perforated and unperforated teeth of bovids and red deer, and split, worked and partly perforated wild boar canine halves. No scale.

Abb. 7 Bad Dürrenberg. Rehgeweihe, gelochte und ungelochte Zähne von Boviden und Rothirschen sowie gesplattene, bearbeitete und teilweise gelochte Eckzahnhälften von Wildschweinen. O.M.

Fig. 8 Bad Dürrenberg, reconstruction of the grave pit. The sampling spot is marked with a red arrow.

Abb. 8 Bad Dürrenberg, Rekonstruktion der Grabgrube. Die Probenahmestelle ist mit einem roten Pfeil markiert.



complete skins were used as headgear or head decorations – perhaps also attached to the shoulders. In ethnographic comparisons, headgear made of birds of prey feathers has been explicitly connected with North Eurasian shamanic dress (e.g. Burged 2023, 85; Hasanov 2016; Holmberg 1922). In particular, waterfowl feathers were detected in contact with the torso and limbs, which might indicate a similar use as in the Majoonsuo child burial (see previous chapter), i.e. for garments, loose wrappings or coverings made of water-bird skins.

Compared to the feather remains, bird bones have been recovered only rarely in Skateholm I and II burials (see Macãne 2022, 251–252). In Grave 35, a possible *Accipiter* (hawk) *phalanx* and in Grave 47, *vertebra* of *Gavia stellata* (red-throated diver) have been detected. Bird bones have also been recovered from graves 46 and IX, but in these cases their belonging to the original grave inventory is questionable. However, in Grave IX a bone attributed to *Anatidae*, found in the filling of the grave, matched the waterfowl barbules detected between the femurs and in contact with the human scapula. The lack of bird bones in graves with barbules indicates that the feathers do not originate from complete birds or bird parts, such as wings.

### Bad Dürrenberg

The famous shaman and infant burial in Bad Dürrenberg was recovered in 1934 from the construction-work trench of a water pipeline and, therefore, had to be excavated on a very tight schedule. Supposedly, the woman and child were buried in a seated position with a versatile grave inventory consisting of bone and stone tools, animal tooth pendants, and a complete roe deer (*Capreolus capreolus*) antler front-

let (Fig. 7). In addition, over one hundred pieces of mammal and bird bone fragments were included, among them crane (*Grus* sp.) humerus and tibiotarsus (Grünberg 2016; Grünberg et al. 2016).

Starting from 2019, the site was re-excavated by the State Office for Heritage Management and Archaeology Saxony-Anhalt, State Museum of Prehistory, providing important new information about the burial (Orschiedt et al. 2023). The remains of the grave were transported as a sediment block and excavated in the laboratory premises of the State Office. As part of the excavation, seven sediment samples were taken for fibre analysis from behind the head of the interred. The samples form a vertical series collected from the remaining original Mesolithic context, which has been interpreted as a backfill between the wooden wattle-like construction that supported the wall of the grave pit and the burial container, probably built of wattle, too (see Orschiedt et al. 2023, Fig. 7). This material was located outside the organic container, inside which the shaman and infant were laid to rest, covered with red ochre (Fig. 8). One of the samples was a block of undisturbed sediment located next to the shaman's head; the other samples were sieved before the analysis. In addition, two samples from an adjacent, younger – but also Mesolithic – deposition of two antler masks located ca. 1 metre west of the shaman burial were analysed. In addition, a reference sample was taken outside the grave pit.

As a result, a total of 15 bird feather fragments were detected in six soil samples. The barbules were 0.4–1.3 mm in length. One of them, located approximately at the skull level of the female, was identified as waterfowl (*Anseriformes*) based on the extended (triangular) shape of the nodes (see Dove/Koch 2011). The number, shape and size

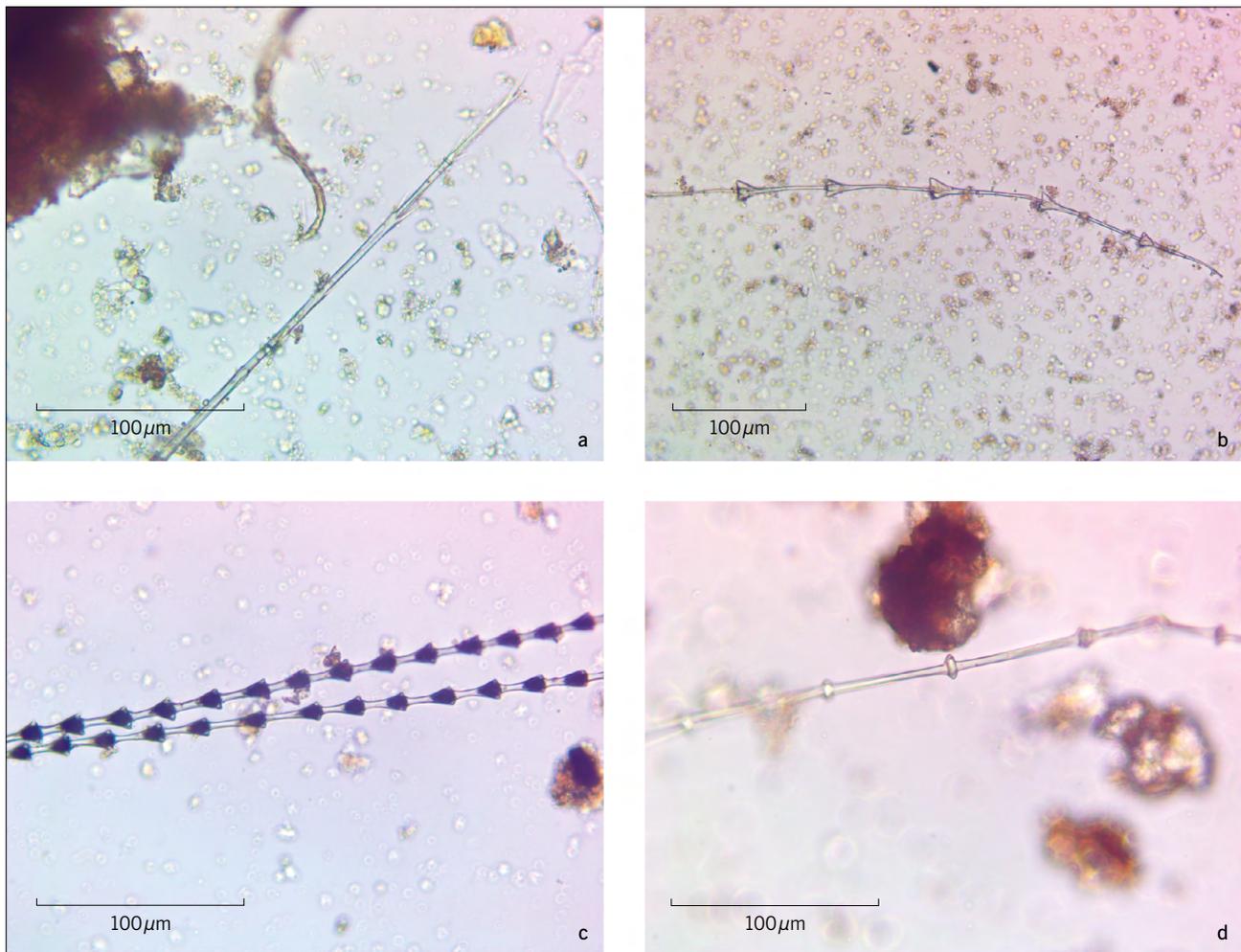


Fig. 9a–d Feather fragments detected in the Bad Dürrenberg soil samples. a Unidentified barbule with distal prongs; b waterfowl barbule; c *Passeriformes* (songbirds) barbules; d *Galliformes* sp. barbule.

Abb. 9a–d Federfragmente, die in den Bodenproben von Bad Dürrenberg gefunden wurden. a Nicht identifizierte Häkchen mit distalen Zinken; b Häkchen von Wasservögeln; c Häkchen von Singvögeln (*Passeriformes*); d Häkchen von *Galliformes* sp.

of the nodes, and the distance between the nodes (Fig. 9b) indicate that the find belongs to the family of *Anserinae* (geese) (Dove/Koch 2011).

The two samples from pit feature 15, in which the two above-mentioned antler masks were recovered, revealed four barbules in contact with antler mask 1, i.e. two fragments that were identified by their pigmented nodes as songbirds (*Passeriformes*); falcons (*Falconidae*) cannot be excluded. An additional barbule fragment with ring-shaped nodes was identified as *Galliformes*, in this case evidently grouse (*Tetraoninae*). The last of the four barbules provided no diagnostic features for closer identification. The sample taken in contact with antler mask 2 contained no bird-feather fragments but did include one bast fibre. Both the feather fragments found behind the shaman's head and those in contact with antler mask 1 indicate that feathers had been an important part of the headgear or other head decorations. This aligns with the evidence collected from the Skateholm I and II cemeteries.

Finally, although this paper has concentrated on feather finds, the remains of bast fibres and mammalian hairs were also detected. The material had mostly lost its morphologi-

cal features due to decomposition, so the hairs could not be identified in many cases. The most numerous group of hairs, 15 in total, was comprised of non-medullated guard hairs similar to *Bovidae*, i.e. aurochs (*Bos primigenius*) or bison (*Bison bonasus*).

## Discussion

The search for microscopic fibres from graves is an issue that has a very short research history. Although furs, textile remains, and feathers have been regularly reported from archaeological contexts (see e.g. Rast-Eicher 2016), separating tiny fibres from sediments has been considered challenging (Rowe 2020, 157). However, it is already clear that the microarchaeological research on fibres is essential if we are to retrieve new information from the distant past.

Based on the research conducted thus far, the wealth of systematic sampling with sufficient sample sizes (100–150 g) cannot be overestimated, as it opens an entirely new door in the reconstruction of burial contexts, costumes and garments. Additionally, the resolution of sampling and the

level of documentation directly affect the possibilities for interpreting the findings. Even at its best, the resulting information is fragmentary, and in order to contextualize the results, both case studies of single burials and analyses of large cemeteries are needed for comparisons. For example, it seems that feathers have been commonly used for headgear or to decorate the head area. Moreover, the use of ethnographic analogies, although not without problems of their own, can offer insights into alternative interpretations. In future, high-resolution sampling with exact documentation in laboratory environments, aided by the most up-to-date scientific imaging technologies, should be tested to gain new information on the use of soft organic materials in burials.

To conclude from the case studies to date, feathers have been an integral part of clothing and grave constructions from the Stone Age onwards. This paper has concentrated on Mesolithic burials; however, there are several examples from burials from later periods, and material has also been collected from settlement sites. Furthermore, downy feathers are familiar even in present-day burials when used to fill the pillow placed under the deceased's head.

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