INTRODUCTION

Johanna Banck-Burgess, Elena Marinova-Wolff, and Doris Mischka

The humid soil conditions encountered at the sites of prehistoric lakeside settlements at the foot of the Alps have yielded spectacular textile remains, which are forcing researchers to rethink the significance of textiles within prehistoric contexts. The everyday utensils of former agriculturally oriented settlements were, to a large extent, textile products derived from the natural environment, and the technical textiles used in everyday subsistence activities were indispensable for the tasks the settlers had to perform in the context of a sedentary lifestyle.

This may sound slightly provocative, but in essence, the question arises as to what extent sedentariness would even have been possible without textiles. The simple fact is that no other material category is as versatile as textile raw materials. Evidence shows that in the alpine region, this would mainly have been wood bast material. The procurement and processing of this material was a widely available skill, coupled with the essential understanding and knowledge regarding this material and general material processing within the Mesolithic hunter-gatherer cultures.

This particular question was a vital part of the joint project THEFBO ("Textile craftsmanship in the prehistoric wetland settlements on Lake Constance and Upper Swabia – requirements for textiles and their perception") funded by the Federal Ministry of Education and Research in Germany from 2019 to 2021. The conference volume THEFBO II contains papers presented at a conference organized by the THEFBO project. The research results of the collaborative project will be published in THEFBO Volume I. Since the editorial work on this extensive evaluation volume is much more time-consuming, the conference volume will appear first.

The conference was structured to align with the key topics of the THEFBO project, which concern the significance of prehistoric textiles for the early farming communities in Central Europe. Technical textiles are considered one of the first technologies to be used by human populations. Thus, the conference contributions presented evidence on textile raw materials (including their occurrence and detectability), on finds (their properties and possible uses), and on terminology in the context of early prehistoric archaeological sites. The final contributions examined a more recent phenomenon in the development of textile crafts: the cultivation of textile fibres and early evidence for weaving. Due to the fact that the focus of textile archaeology is mainly placed on woven textiles, and because finds consist of highly perishable materials, the vital importance of technical textiles for prehistoric societies is often underrated and overlooked.

The first paper in the volume, authored by the THEFBO team, outlines the major outcomes of the project and provides some insights into the scientific studies dedicated to the materials under consideration.

A contribution by Johanna Banck-Burgess (State Office for Cultural Heritage Preservation in the Regional Council of Stuttgart / LAD, Esslingen) focuses on terminological aspects in the context of technical textiles.

The Mesolithic-Neolithic peat-bog site of Friesack in the Berlin glacial valley is one of the best-known and exemplary sites for its outstanding finds of archaeological textiles. Bernhard Gramsch (Potsdam) gives an overview of the tree bast cords, ropes, and nets from the Middle Preboreal to the Early Boreal (9100–7800 cal. BC) which were preserved in the waterlogged sediments of this site. The raw materials used for these textile products were bark and bast from willow, poplar, lime, and elm.

Maria Herrero-Otal, Susagna Romero-Brugués, and Raquel Piqué Huerta (Autonomous University of Barcelona) critically examine the identification methodologies for the determination of vegetable textile fibres in the context of the findings in the waterlogged sites of La Draga in Banyoles (Girona, 5300–5000 cal. BC) and Coves del Fem in Ulldemolins (Tarragona, 4941–4545 cal. BC). Methodological limitations will often result in the exclusion of those materials from subsequent scientific analysis. The authors present a range of different techniques that can be used to determine the raw material used to produce vegetal fibre objects such as baskets, mats, and ropes.

Thirteen wells from the Early Neolithic Linear Pottery culture (LBK, 53rd to 51st century BC) have been documented in Saxony

(Germany). The finds, evaluated by Harald Stäuble (State Office for Archaeology, Saxony, Dresden) illustrate the wide range of bast utilization in the LBK. In addition to hundreds of fragments belonging to cords and ropes, sewn containers are among the most significant finds from these wells. Two types of bast containers can be distinguished at present, and these are examined in this contribution.

Organic objects from ice patches in the Bernese Alps (Switzerland) are discussed by Regula Gubler (Department of Education and Culture of the Canton Bern, Office for Culture, Archaeological Service). Sewn splint-wood boxes or fragments of braided bast can be found among the finds from the Schnidejoch and the Lötschenpass.

From the Neolithic period at the latest, the lime tree predominates as a supplier of bast and bark for textile artefacts. Oliver Nelle and Elena Marinova-Wolff (LAD, Hemmenhofen) present an overview of features of the main native linden species with regard to tree biology and woodland ecology, and consider the palynological and plant macrofossil evidence concerning the role of the genus Tilia in the prehistoric vegetation and landscapes of Europe, as well as its utilization as raw material.

The significance of organic containers (in particular sewn bark containers) in prehistoric everyday life had a direct influence on ceramics. In a pilot study based on the composition of the pottery inventories of the Lake Constance area in the 4th millennium BC, Irenäus Matuschik (LAD, Hemmenhofen) explores the question whether organic containers and ceramic vessels were supplementary or competitive phenomena.

Karina Grömer (Natural History Museum, Vienna) discusses the link between the crafts of cordage and pottery during the Central European Bronze Age.

Małgorzata Siennicka's (University of Kassel) paper deals with flax and wool in the Early Bronze Age Aegean. The use of wool fibre changed textile production to a considerable degree, not only in the Aegean, but in other areas of prehistoric Europe and the Eastern Mediterranean as well. Novel types of textiles, including garments with properties that were different from those made of plant-based fibres, could now be woven on looms. They could thus be produced on a larger scale, both for private purposes and for exchange or redistribution by political and economic centres.

In "Why not wool", Agata Ulanowska (University of Warsaw) presents the evidence for raw materials and technical uses of textile products in the context of imprints on the undersides of clay seals from Bronze Age Greece.

The paper presented by Marco Baioni (Museum of the Sabbia Valley, Italy), Margarita Gleba (University of Padua), Claudia Mangani (Archaeological Museum Desenzano del Garda), and Roberto Micheli (Department of Archaeology, Fine Arts and Landscape of Friuli Venezia Giulia, Trieste) discusses finds belonging to the context of textile production from the excavations at Lucone di Polpenazze del Garda (Brescia) in Italy.

In their contribution "Threads for science (material tests of tree bast and linen)", Hildegard Igel and Johanna Banck-Burgess describe the material properties of linen and tree bast. The analysis of experimental sample material has yielded new information about the production of spliced and spun yarn made from flax and tree bast.

The realization of the conference and the conference volume presented here was only possible due to the generous support we received. Our particular thanks go to the German Federal Ministry of Education and Research and the State Office for Cultural Heritage Preservation in Baden-Württemberg for funding the project and the conference, and in particular Kerstin Lutteropp and her colleagues, who always answered our questions helpfully and with a great deal of patience.

The THEFBO conference was originally planned as a regular in-person meeting, but the Corona pandemic eventually presented us with the challenge of looking for alternatives. With the substantial and indispensable support of Dörte Hellmuth and the Leipziger Messe, we transformed the meeting into an online-only event. The digital format proved to be a success, as it actually allowed a significantly larger number of participants from all over the world to attend the conference. We counted almost 240 participants from Europe and far beyond, including Australia, Canada, China, Egypt, India, and Russia. Given the pressure of lockdown conditions, this mode of exchange proved a great relief and enrichment for all. Thanks to an online platform organized by Doris Mischka of the Friedrich-Alexander-University Erlangen-Nürnberg, it even became possible to continue the discussion in a virtual forum after the end of the actual presentations.

Faced with an online format which was new to all of us, the implementation actually worked out great thanks to the excellent collaboration of the THEFBO team and additional helpers. For this, we would like to especially thank Henrik Junius, Sebastian Million, Mila Andonova-Katsarski, Anja Probst-Böhm, Sebastian Böhm, Oliver Nelle, Renate Ebersbach, and Karina Grömer.

For compiling the manuscripts and coordinating the peer reviews (all contributions were peer reviewed), we would particularly like to thank Ulrike Lorenz-Link. Without her professional help, timely publication of this conference volume would not have been possible. Translations and English language proofreading were provided by Shane Ćavlović and Martin Baumeister. Special thanks also go to Thomas Link, who supervised the editorial work, and to the publishing house Dr. Ludwig Reichert Verlag for the layout and production of the book.

Our greatest debt of gratitude is owed to all the speakers who contributed to the success of this conference, and to the many participants who contributed to the fruitful discussion.

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THE THEFBO PROJECT

Initial insights into the analysis and results of neolithic textiles and the natural sciences

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Abstract

From september 2018 to august 2021, the Federal Ministry of Education and Research (BMBF) has been funding the project THEFBO „Textile craftsmanship in the prehistoric wetland settlements on Lake Constance and Upper Swabia – requirements for textiles and their perception". This interdisciplinary project is performed by five co-partners from the universities of Erlangen-Nürnberg and Würzburg, the Archaeological State Museum of Baden-Württemberg, the Curt-Engelhorn-Center for Archaeometry and the State Office for Cultural Heritage Preservation in Esslingen as coordinator.

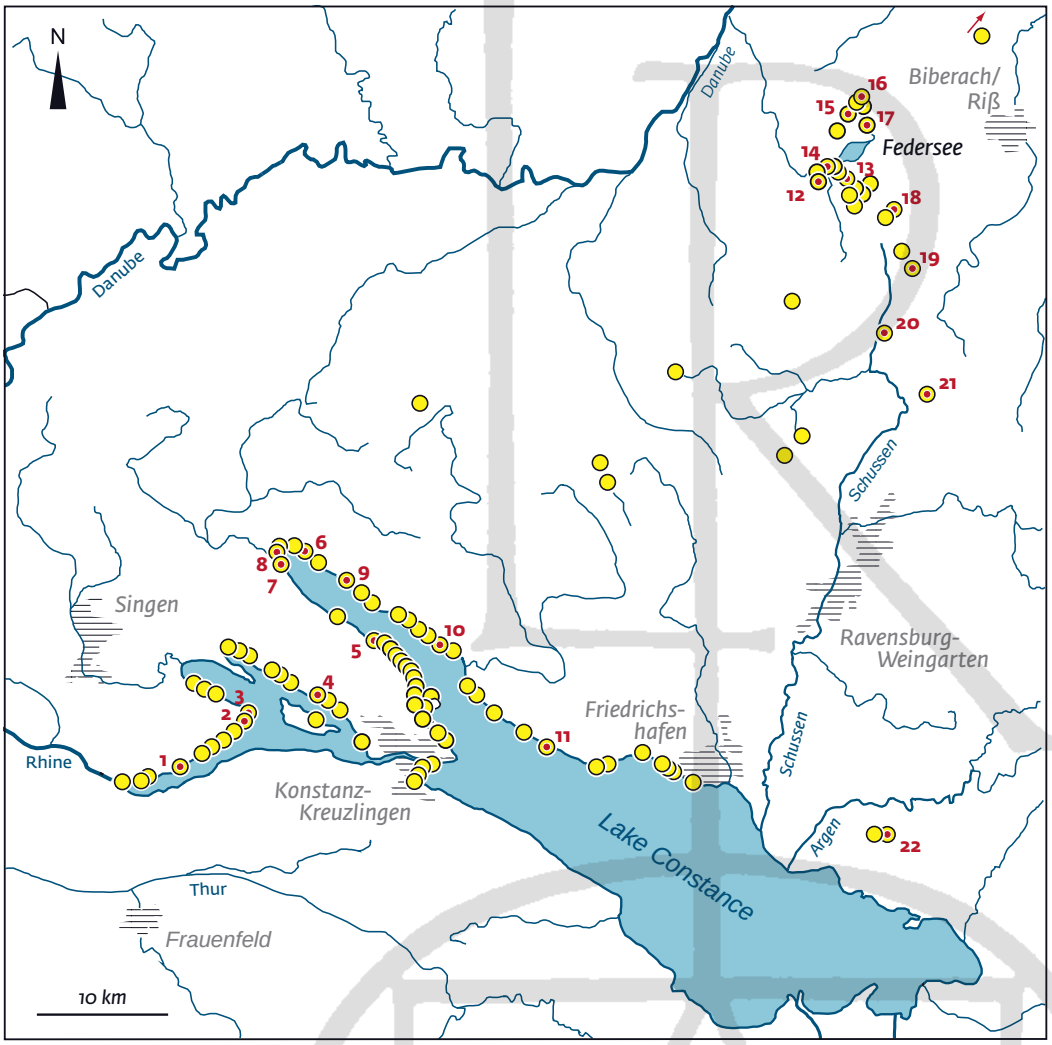
Textiles made of plant fibres from the Neolithic pile-dwellings within the research area build the basis of the studies. The project objective is to find out more about the role of textiles like coiled baskets, bark containers, cords/ropes or nets in Neolithic everyday life. Therefore the manufacturing techniques, the textiles' functionality and use-contexts as well as the used raw materials are analysed in the project. First, the archaeological finds and their contexts are described. The previous analysis has revealed a wide variance within manufacturing techniques. Then we focus on the conservation of textiles from prehistoric wetland sites and its impact on the determination of the raw materials. Further, first results and also possibilities and limits of the determination of the processed raw materials are shown, especially of lime bast and bark. Last but not least, it turned out that quite more different species of monocotyledons were used for the production of certain objects as expected.

Keywords: THEFBO project, prehistory, wetland settlement, textile functionality, raw material, lime bast, lime bark, Southern Germany

INTRODUCTION: THE THEFBO PROJECT AND THE SIGNIFICANCE OF PREHISTORIC TEXTILES

The THEFBO project aims to research prehistoric textiles and their significance in the context of pastoral Neolithic communities along the lake shores and wetlands of the northern Alpine region of south-western Germany (Fig. 1). Beginning in October 2018, the Federal Ministry of Education and Research (BMBF) financed this collaborative project, which went under the full title 'Textile craftsmanship in the prehistoric wetland settlements on Lake Constance and Upper Swabia – requirements for textiles and their perception'. The interdisciplinary project has been undertaken by five co-partners, namely the Friedrich-Alexander-University of Erlangen-Nürnberg (FAU), the Julius Maximilian University Würzburg (JMU), the Archaeological State Museum of Baden-Württemberg (ALM), the Curt Engelhorn Centre for Archaeometry (CEZA), and the State Office for Cultural Heritage Preservation in the Stuttgart Regional Council (the coordinator of this project).

Despite their immense research potential, these textiles have only in the last twenty years attracted attention from the international scientific community (see Körber-Grohne/Feldtkeller 1998; Winiger et al. 2010; Grömer et al. 2013; Rast-Eicher/Dietrich 2015; Pique et al. 2016; Siennicka et al. 2018; Schier/Pollock 2020; Herrero-Otal et al. 2021; Romero-Brugués et al. 2021). Apart from the rich tradition of textile research with regard to the circumalpine wetland sites of south-western Germany, only a few sites with preserved textile finds have been investigated so far: Seekirch-Achwiesen (Feldtkeller 2004), Degersee (Banck-Burgess 2015), Wallhausen-Ziegelhütte (Lübke 2009), Ludwigshafen-Seehalde (Feldtkeller, in prep.), Sipplingen-Osthafen D (Kolb 2003), Bodman-Weiler I (Schmid/Köninger 1995), Allensbach-Strandbad (Fischer 2006). All too often, only selected objects have been analysed and published (Wangen-Hinterhorn, Hornstaad-Hörnle IA, Allensbach-Strandbad, Sipplingen-Osthafen – Körber-Grohne/Feldtkeller 1998; Hornstaad-Hörnle I – Schlich-



1 Distribution map of sites with and without preserved textiles.

therle 1990). Thus, a comprehensive overview of the textiles discovered at wetland settlement sites in Baden-Württemberg is lacking. The THEFBO Project aims to close this gap by systematically recording the textile finds from the wetland settlements of Baden-Württemberg and presenting their full inventories. This also provides, for the first time, a spatial and diachronic comparison of the Neolithic wetland sites in the north-western Alpine region.

The present study has focused on a find complex consisting of approximately 2 200 textiles such as coiled baskets, bark containers, cords and ropes, twinings, and nets from 22 sites situated around Lake Constance, in Upper Swabia, and in the Swabian Allgäu region (Fig. 2).

This contribution provides the first insights into some of the selected aspects concerning site description, research history, preservation conditions, detailed information regarding the finds, and results of the interdisciplinary research project. A final and extended publication is in preparation (THEFBO I in prep.).

RESEARCH QUESTIONS AND METHODS

A central research question concerns the manufacturing of textiles, i.e., whether certain manufacturing techniques were preferably used to process certain raw materials or to produce certain objects. For this approach, the finds were recorded techno-morphologically according to standardised criteria within a database. The textiles were then analysed and categorised according to different manufacturing techniques. In addition, the state of preservation of the individual objects and the technical data of the textiles were recorded, e.g. the thread thickness, the number of strands, and the type of knot used. The variability of objects of the same category within and between sites and local find contexts, as well as the diachronic regional and trans-regional comparisons, constitute the focal point of this project.

In order to determine the functions of textiles within Neolithic settlements, the textile finds were mapped to reconstruct the context of their last functional use. For example, residues in organic containers were analysed to un-

derstand what these containers may have been used for.

Given that organic materials are degraded more thoroughly by microorganisms under humid conditions or even decomposed completely by drying out, the finds were stabilised as quickly as possible. However, as concerns arose as to whether or not the botanical identification of the materials would still be possible, the workflow needed to be re-evaluated accordingly.

To answer the question concerning the correlation between certain manufacturing techniques and the raw materials that were used, the finds were identified botanically. For this approach, the project applied two different types of analyses.

The botanical investigations comprise the monocotyledons and the tree bast/bark. For both methods, a reference collection of modern as well as archaeological samples was established. In the case of wood, determination of the tree species has long been practised in archaeology, but the criteria for a systematic determination of tree bast had yet to be established. Additionally, an identification key was proposed within the project for the monocotyledonous plants.

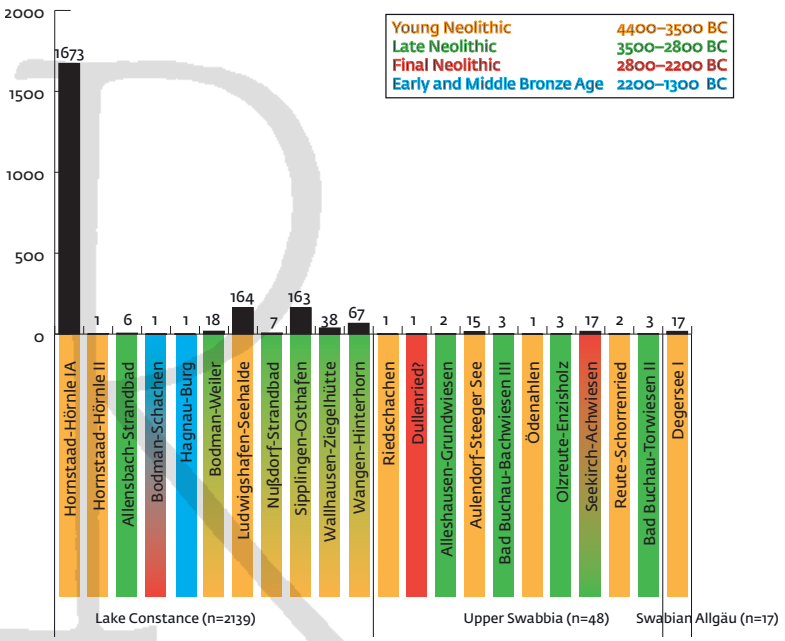
To investigate the use of the different plant materials and the correlation with regard to the specific methods used to process, prepare, and manufacture them, the entire data has been linked.

Furthermore, the function, the functionality, as well as the properties of certain objects, goods, and raw materials were subjected to examination. The material properties of tree bast and flax of recent samples were simulated and tested at the German Institutes for Textile and Fibre Research (DITF). Altogether, the project results have allowed for a better understanding of the processes of raw material selection, preparation, and manufacturing.

The assumption that prehistoric societies possessed a sophisticated knowledge of different raw materials and their unique properties along with the artisanal expertise required to process them is seen as an essential prerequisite for understanding the significance of textiles in these communities.

THE CHRONOLOGICAL SETTING OF THE THEFBO PROJECT

The textile finds under study originate from 22 sites in Baden-Württemberg, Germany (Fig. 1). Of these, eleven belong to the wetland settlements around Lake Constance (Hornstaad-Hörnle IA and II, Allensbach-Strandbad, Hagnau-Burg, Bodman-Weiler I, Ludwigshafen-Seehalde, Bodman-Schachen, Nußdorf-Strandbad, Sipplingen-Osthafen, Wallhausen-Ziegelhütte, and Wangen-Hinterhorn), ten are located in Upper Swabia (Riedschachen, Dullenried, Alleshausen-Grundwiesen, Aulendorf-Steeger See, Bad Buchau-Bachwiesen III, Ödenahlen, Olzreute-Enzisholz, Seekirch-Achwiesen, Reute-Schorrenried, and Bad Buchau-Torwiesen II), and one settlement lies in the Swabian Allgäu region (Degersee).



2 Quantities of textiles per site and dating of the sites.

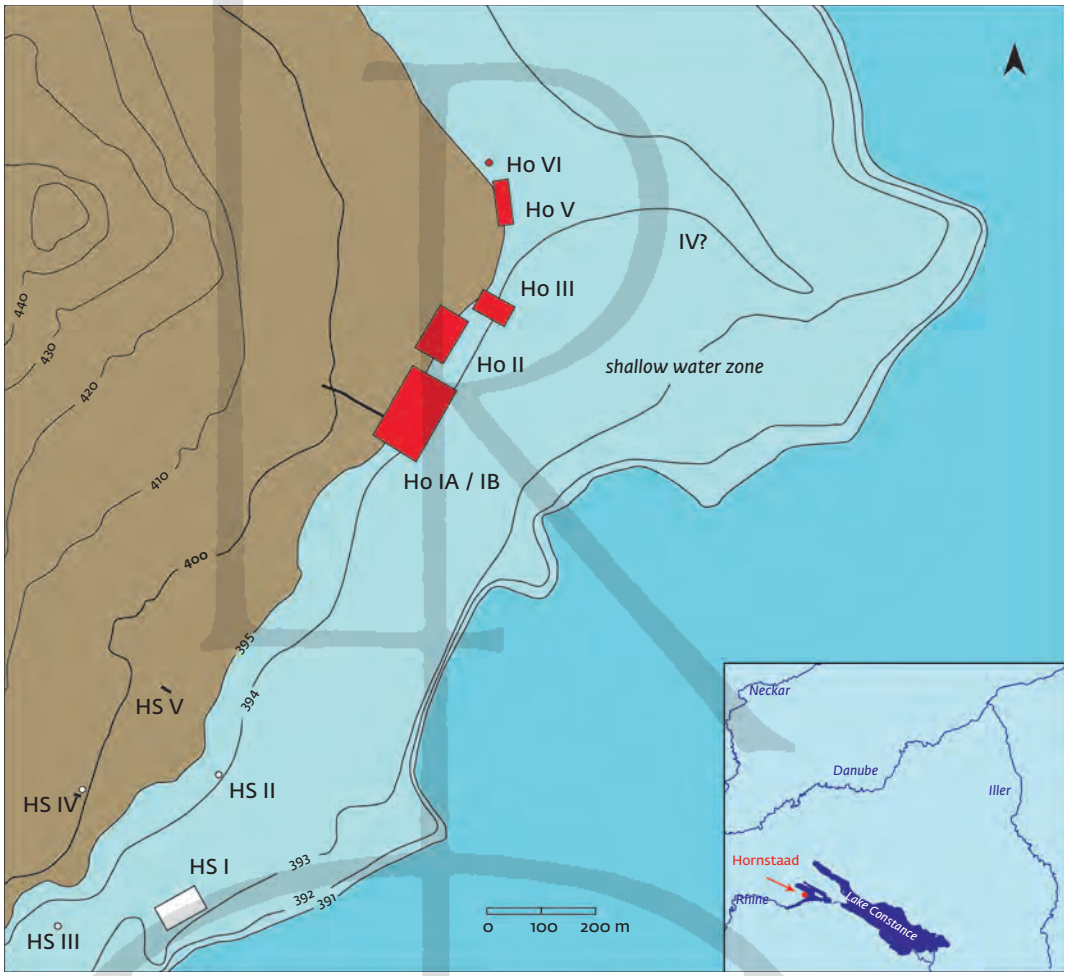
A total of 2 193 textile finds were registered by the study. While the number of investigated sites is distributed almost evenly between the region around Lake Constance, Upper Swabia, and the Swabian Allgäu, the number of textile remains differs enormously between the regions and sites: some sites have produced only a single find, while more than 1 650 finds were recorded at Hornstaad-Hörnle IA alone (Fig. 2).

The majority of sites date to the Younger Neolithic (roughly 4400–3500 BCE), while some date to the Late (3500–2800 BCE) and Final Neolithic (2800–2200 BCE) as well as to the Early and Middle Bronze Age (2200–1000 BCE).

THE KEY SITE OF THE THEFBO PROJECT: HORNSTAAD-HÖRNLE IA

The majority of textile finds analysed in the project were discovered at this settlement. Of the total of 2 193 objects which were examined by the THEFBO research project, 1 673 objects came from the site of Hornstaad-Hörnle IA (Fig. 2).

The settlement of Hornstaad-Hörnle I was systematically excavated and researched between 1973 and 1980, and was part of the German Research Foundation (DFG) priority programme ‘Archaeological Settlement Re-



3 Location of Hornstaad-Hörnle IA.

search in the Alpine Foothills' from 1983 to 1993 (Dieckmann et al. 2006). The settlement is one of the best-researched wetland sites in south-western Germany. In addition to the actual archaeological analyses, dendrochronological, sedimentological, pedological, palynological, and botanical analyses were also undertaken (Hoffstadt 2005; Dieckmann et al. 2006; Heumüller 2009; Matuschik 2011; Liese-Kleiber 1985; Rösch 1993; Maier 2001; Vogt 2001 and 2006; Ahrens 2001; Billamboz 2006; Billamboz et al. 2006; Bleicher 2006; Ostendorp 2006; Schmidt 2006; Veit 2006; Nickel 2006). These analyses provide additional important insights into the Hornstaad-Hörnle IA settlement, its inhabitants, and the surrounding area. The detailed level of information also allows for a reliable and meaningful spatial distribution of the textile finds.

The settlement was constructed and inhabited from 3917 BCE onwards in the shallow waters of the periodically flooded beach plateau at the tip of the Höri peninsula (Fig. 3–4). During the first construction phase (phase A), a total of about sixty houses were built over the course of several years (phase An). A major fire, which can be dated to late summer/autumn 3909 BCE, destroyed large parts of the settlement (Dieckmann et al. 2006, 250; Matuschik 2011, 17; Maier 2001, 26 f.). Dendrochronological data prove an immediate reconstruction and a continuation of the settlement until 3902 BCE (Billamboz et al. 2006, 416 f.). A total of four construction phases could be identified for the period after the catastrophic fire (phases B–E).

Settlement IA (Hornstaad group) had a maximum size of approximately 7 500 m². Some 3 900 m² of a cultural layer, which was up to 35 cm thick in some parts (cultural layer package A), was preserved of this first settlement phase. Above this cultural layer – and separated by a layer of sea chalk – was layer B, a remnant of the Pfyn culture (Dieckmann et al. 2006, 249). About one third (1 262 m² – Billamboz et al. 2006, 415) of the cultural layer (and thus about 17 % of the total area of the Hornstaad settlement) was excavated. This material served (and still serves) as the basis for our analyses (Dieckmann et al. 2006, 249).

About two-thirds of the preserved Hornstaad-Hörnle textiles (64 %) originate from phase A. This phase was terminated by the aforementioned fire, which preserved the state of the settlement that had existed on the beach surface (Dieckmann et al. 2006, 250). This sit-

uation is, to a certain extent, a snapshot. However, it should not be forgotten that usable building materials and objects would certainly have been reused after the fire disaster (e.g. Hoffstadt 2005, 84). As a result of the fire, textiles made of flax – which otherwise would have decayed – are also extremely well preserved.

PRESERVATION AND CONSERVATION CONDITIONS

Due to the area's varying oxygen levels, the settlement did not burn evenly. As a consequence, the preserved textiles discovered in the conflagration layer were altered by the fire, but not burnt completely, explaining their charred state. As the fire irreversibly transformed the chemical composition of the plant fibre cellulose into charcoal, the physical properties of the fibres were also altered: their colours are now of various shades between black and brown, they are brittle, and they have shrunk in size. Their structure, however, has been very well preserved. The charred textiles are chemically very stable and were not further degraded by microorganisms while they were embedded in the debris (Margariti 2020, 388–389, 397; Rast-Eicher 2016, 21; Srinivasan/Jakes 1997, 521).

The neutral to slightly alkaline, lime-rich environment of the Alpine foreland, especially the area's lakes and wetlands, is highly conducive to the long-term preservation of uncharred plant materials. In addition to the weight of the soil exerting pressure on the objects, the fibres were slowly hydrolysed in the waterlogged environment. The alkaline conditions are responsible in particular for the hydrolysis of proteinic materials. In these extreme conditions, the rain or groundwater which remains stored in the soil leads to a reduction of the soil's oxygen content. Only a few, highly specialised types of microorganisms can survive in this environment, and these would normally be the most relevant in the breaking down of organic matter. Under these conditions, enzymatic decomposition takes place at a reduced rate, so that the organic material is accumulated in the humus layer (Madsen 1994, 103; Peacock 2003, 34–38; Rast-Eicher 2016, 21).

It is perhaps important to acknowledge at this point an opinion which postulates that the survival of the majority of the textiles to this day is due to charring (Fig. 5). Again, Hornstaad-Hörnle IA dominates the data set in this respect. In general, both charred and uncharred fragments were excavated from the settlements.

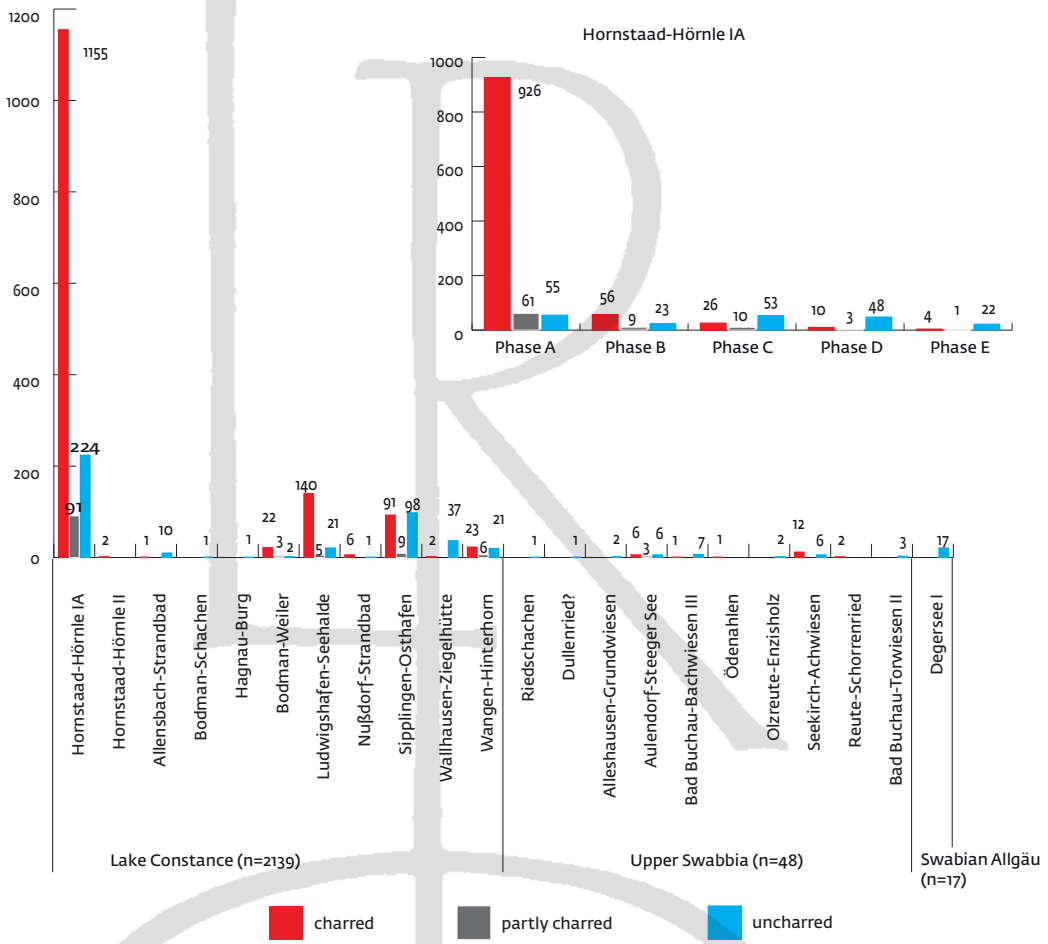
Only textiles made of plant fibres have survived. Tree bast and bark (e.g. of lime tree or willow), and various grasses or other plant fibres (e.g. flax) were used predominantly in textile production. Both charred and uncharred fragments of this material were excavated from the settlements. It seems that charred textiles are usually better preserved in the sediment than uncharred ones. Of course, this also depends on the degree of charring. Nevertheless, it can be stated that in most cases uncharred fragments show a higher degradation than charred ones. Fig. 5 shows that more charred textiles have been preserved in the settlements around Lake Constance (along with a significantly larger overall number of finds) than in the moorland settlements in Upper Swabia. In addition, the possibility of identifying the textile finds from Upper Swabia is severely limited due to the advanced level of degradation. Only in exceptional cases have the finds been preserved in an excellent quality.

4 Reconstruction of the settlement Hornstaad-Hörnle I, phase A.

It is not only the charred or uncharred state which plays a role in the preservation of textiles, but also the deposition of the finds in either lake sediments or bogs. The analyses were carried out on objects which were fragmented and degraded to a widely varying degree.

Leather, rawhide, or sinew finds have unfortunately not survived in the wetland settlements of the Alpine foothills, but it can be assumed that these materials also played a significant role in the lives of the inhabitants. The glacier finds of the last few years provide an indication of the uses these materials could have had (see also Gubler et al., this volume)

After being extracted from the soil, the waterlogged organic finds are immediately exposed to a completely different environment. Within minutes of their removal, the finds shrivel, tear, and shed as they become irreversibly damaged. This is due to their high state of degradation from lying in the waterlogged soils, as documented e.g. for objects made from bark (Orsini et al. 2015, 9). Contemporary conservation ethics specifies that conservation measures should be carried out according to the principle



5 Distribution of charred and uncharred textiles per settlement.

of minimal intervention[1], and that conservators should aim to maintain the object 'as is' in the long term by preserving its structure and dimensions. Changes and material loss are also to be avoided (Muñoz Viñas 2005, 14–16). When applied in practice, this task actually becomes a compromise (Muñoz Viñas 2014, 5). Soon after recovery, most of the finds from Hornstaad-Hörnle were treated with an aqueous solution consisting of borax, boric acid, polyethylene glycol 400, and Luviskol K30 before they were freeze dried (Feldtkeller 1989, 131).

Due to limited resources at the time, only a part of the find complex could be analysed before conservation. This included both a technological description and the determination of the material (Körber-Grohne/Feldtkeller 1998). Further analysis of the finds already conserved within the framework of the THEFBO project aimed at developing an understanding of the human utilisation of the natural environment for textile production is still pending for most of the objects. This type of material analysis usually relies on diagnostic surface characteristics in comparison to known materials from a reference collection.

The analysis of the preserved find material included the following challenges: as shown in Fig. 6, the conservation solution covers the find's determining features. In these cases, the conservation solution must be removed prior to the analyses. Fully aware that new research questions and methods will arise in the future, the former conservator, Annemarie Feldtkeller, states that the conservation solutions can be removed with water at a late date and that the finds can remain in a protected state until their eventual examination (Feldtkeller 1989, 131). While the THEFBO project has confirmed the general effectiveness of this method, decayed material and sediment were nonetheless found to be stuck onto the very fragile fibres, and washing the find meant dissolving the cohesion of the fibre. In these cases, additional sample material was indispensable for a successful determination. Furthermore, the removal of the conservation solution was not the only necessary step, the cell structure also needed to be swollen by adding a sodium hydroxide (Hoffmann 1993, 258) or potassium hydroxide solution (Körber-Grohne 1977, 86).

1 https://icom.museum/en/resources/standards-guidelines/code-of-ethics/ [23.12.2020].

Considering the described experiences in conducting the material analyses, it becomes imperative to redefine the workflow between the stages of recovery, conservation, and analysis. This also means that samples of each find should be taken immediately after the find has been recovered (Körber-Grohne 1977, 86) prior to any conservation measures being taken. If there are no resources for analyses, then the samples should be stored safely until the materials can be determined. For this purpose, practical procedures, such as freezing, must also be evaluated. Moreover, taking samples from each and every find requires careful and detailed documentation.

PRELIMINARY RESULTS OF THE ARCHAEOLOGICAL RESEARCH

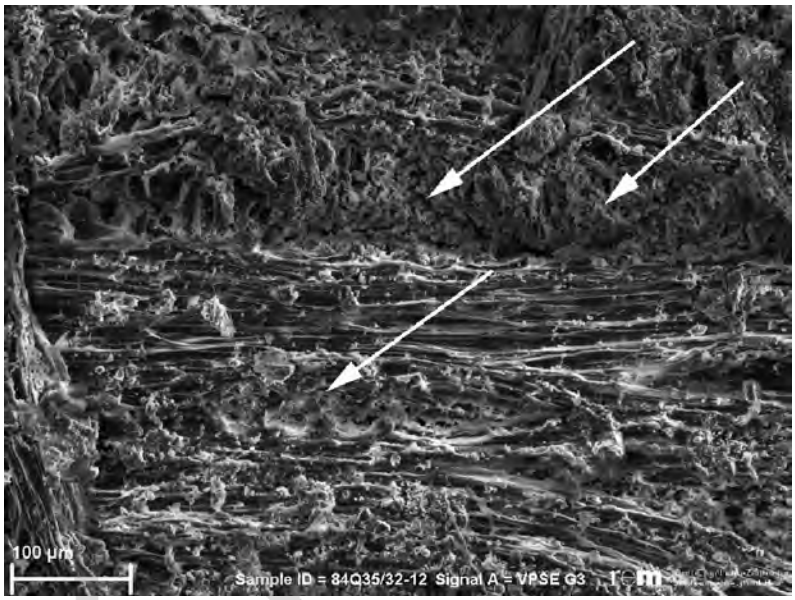
Manufacturing techniques

In total, twelve different categories of manufacturing methods could be determined (Fig. 7). Cordage and ropes, which include strips, strands, plied yarn, and braids are the most numerous (n= 695; ~32 %). The next two most frequent manufacturing methods are coiled baskets (n= 446; ~20 %) and twinings (n=369; ~17 %).

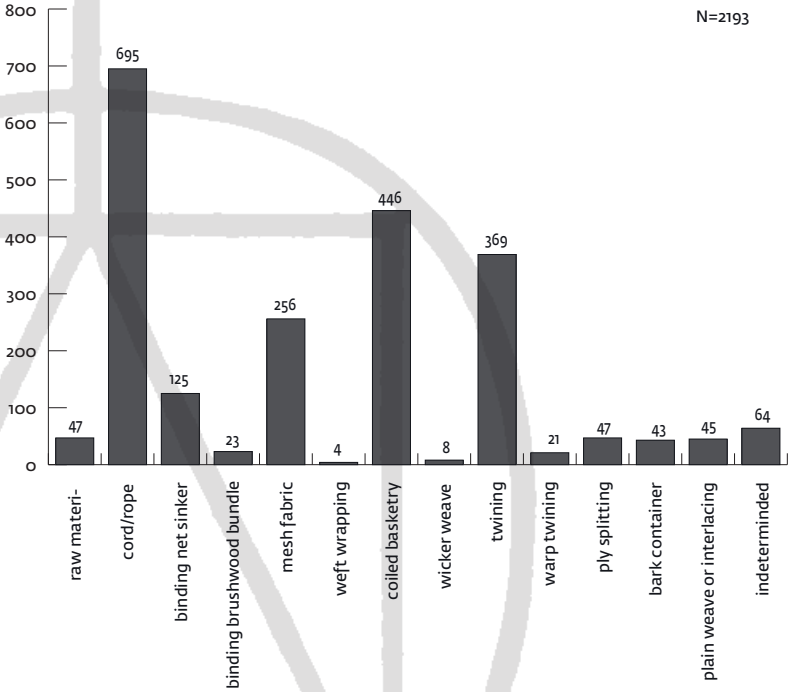
Furthermore, three different manufacturing methods can be defined according to Seiler-Baldinger (1991). Previous research had classified the textiles from the wetland settlements of Baden-Württemberg as twining, despite the fact that twining is actually a different method of manufacture. These methods include weft wrapping, which belongs to the simple braids and was mainly used in the manufacture of backpacks in Hornstaad-Hörnle IA. Moreover, warp twining and ply splitting are defined as separate groups. Warp twines were mainly used for ribbon-like objects, whereas ply splitting produces artefacts more similar in appearance to nets. Since these are more closely meshed and thus stiffer than most nets, they are usually referred to colloquially as sieves.

Nets

Net fragments have only been documented at four sites around Lake Constance (Hornstaad-Hörnle IA; Ludwigshafen-Seehalde; Sipplingen-Osthafen A, B, C; and Bodman-Weiler I) (Fig. 8). The small number of sites where net fragments have been observed has conservation-related reasons. Even though the material analyses have not yet been completed, it is clear that a large number of Neolithic nets were made of flax. Since flax is only preserved in a charred condition, it can only be expected to be found where it was exposed to some kind of fire which destroyed either an individual house or an entire settlement. As the nets occur most frequently and in some number in Hornstaad-Hörnle IA and Ludwigshafen-Seehalde, the following discussion focuses on these two settlements. In the case of the Hornstaad-Hörnle IA settlement, meshes represent the fourth-largest group in terms of manufacturing techniques with 159 finds (9 %). In Ludwigshafen-Seehalde, meshes even form the largest group with 58 finds (35 %).



6 Hornstaad-Hörnle IA. Lime bast conserved with PEG 400 and Luviskol K30 (BASF). Degraded residues and sediment adhere to the fibres together with the preservative and obscure characteristic determination features such as the bast rays (arrows); (Inv. No. 1973-0038-3532-0012).



7 Manufacturing technique in relation to the total number of objects. Raw material contains all plant tissues, from which textiles can be manufactured, such as bast bundles, flax stems and bundles, or rushes etcetera.