From Wool to Warp and Weft: Approaching Ancient Greek Textile Work through Experimental Archaeology

by

Tatianna Bechal

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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Abstract

Due to the perishable nature of the work performed by women throughout much of ancient history, little physical evidence survives to study directly. This research is an exploration of the process of wool-working employed by the Greek women of the fourth and fifth centuries B.C.E. Through both academic research and hands-on experimental archaeology, the steps of wool fibre processing were examined and re-created. The aim of this project was twofold. The first goal was to follow the life cycle of sheep wool from a raw fleece to a finished piece of cloth and learn about the practical aspects and history of textile work. The second goal was to reveal the social implications of this domestic work and the role it played in the social lives of the people who performed it.

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Thank you,

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Dedication

For my Mom, Bette, who has always cheered me on in all my endeavours and who has provided a source of constant support throughout my academic journey. You have always uplifted me and encouraged me to pursue the things I love. Thank you.

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Introduction

The experiences I have gained while working in the textile industry over the last two decades have largely inspired the questions which are examined in this thesis. Fabric and textile retail, fashion and costume design, and industrial factory sewing settings have all allowed me to work alongside many highly skilled and knowledgeable women from across the globe. It is the latter - industrial sewing settings - which have primarily inspired a deeper look into women's history with textile work. It was from these talented women seamstresses - many of whom immigrated from Asia, the Middle East, Europe, and South America - where I was exposed to a wide array of techniques from a variety of cultural backgrounds. During this time working in the industry I was struck by how the work remains largely female dominated to this day, even in a modern industrial setting. It was this experience which roused an interest to examine women's long history with textile work.

Evidence for ancient Greek textiles seems to be everywhere in our extant sources. References to spinning and weaving and some of the stages leading up to these activities appear on pottery, in poetry, historical prose, archaeology, and funerary inscriptions. As with so many crafts, weaving and all the processes leading up to that task were part of a larger shared cultural knowledge, and were practical skills passed down from generation to generation. While no single source provides a full account of the reality of the work, ancient sources can shed light on this subject. Images of spinning and weaving such as the one found on a Greek *lekythos* (Fig. 1), the appearance of textile work in Homer and Aristophanes' *Lysistrata*, and the physical remains of spindle whorls and loom-weights all provide partial evidence of this work in the ancient world. Despite these resources, there are many aspects of ancient textile work that were not depicted in ancient sources, and we are left with an incomplete understanding of how this work was carried out. How were the stages of textile work done? How much knowledge and experience was passed down through families but never made it into the ancient sources and into our history books? Who did the majority of this work and what did it entail for them?

In this project I examine the technology of weaving in Classical Greece. The primary goal of this research is to gain a richer understanding of the process of textile production and of those people who were primarily engaged in it in the fifth to fourth centuries B.C.E. A common pitfall of experimental archaeology is often the lack of academic context, and throughout the project effort was made to keep the hands on portion of the work within the "larger scheme of academic research with the experimentation being just one of the methods employed."[1] Employing a living history model, I trace out the process of wool-working using materials, tools, and methods used by Greek peoples of the ancient Mediterranean. The first half of this project serves as an academic overview of textile work in Classical Greece, and is written to appeal to academic audiences. The latter half is meant to be accessible to non-academic audiences, and therefore takes a somewhat less formal tone, documenting the process by way of experimental archaeology. Through re-creating the steps of wool fibre processing, the cycle of turning raw fleece taken from a sheep into a finished piece of cloth is described and illustrated in the following pages. Many of the steps in the process of textile work do not leave detailed evidence as to how they were performed in Classical Greece. In order to make sense of this process it is necessary to draw on a variety of sources on the

[1] Outram 2008, 5.

subject, including Greek, Roman, Viking, and modern textile artists. Specifically, this project seeks a deeper understanding of the ancient process of weaving. The format of this MA thesis opens up the process of textile production to both interested general audiences and academics by describing the stages of this ancient skill - an important and integral technology for millenia – using primary and secondary sources, images, and video.

Fig. 1: Terracotta *Lekythos* (oil flask). Attica ca. 550–530 B.C. Attributed to the Amasis Painter. Women are depicted in various stages of wool working. (left) Two women fold a woven cloth, while two women spin wool; (right) Two women stand before a loom. The Metropolitan Museum of the Arts, New York. Accession Number: 31.11.10.

As with other experimental archaeology such as the work done by Eva Andersson Strand, Elizabeth Barber, and others, the description of the hands-on portion of the work takes on a more informal tone in an attempt to capture the experience of people who performed this work.[2] The second aim of the project is to gain a deeper understanding of the cultural and social importance of weaving in Classical Greece, and the implications of that work for the skill, education, time, and social connections in the lives of women who performed it.

How Ancient Textiles are Studied

We use clothing as a means of identifying ourselves to others and to signal our place in society. Humans throughout history have used clothing to express who we are: our gender, age, social status, ethnicity, religious beliefs, and family affiliations.[3] What we chose to wear on our bodies reflects who we are as people. In studying how and with what our predecessors dressed themselves, we can better understand their identities, needs, and technologies.[4] Understanding the history of textiles is "vital to a greater understanding of the human experience."[5] While clothing is perhaps the most immediate example of how textiles are used, there are far more items in our daily lives than just the clothing we wear which fall under the umbrella of a textile. In the most basic of definitions, a textile can be defined as "a web of interlaced threads produced on a loom."[6] There are, however, many objects in our daily lives which do not fit this description and are still considered textiles. Cord, basketry, carpeting, matting, and woven cloth all fall under this umbrella term. Throughout history textiles have been used for clothing, shelter, swaddling babies and shrouding the dead, bandages, containers, hunting and fishing equipment, sails, and even weaponry.[7] All of these are

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[2] Andersson Strand and Nosch 2019; Barber 1991, 1994; Olafsson 2015.
[3] Andersson Strand 2010. 150; Plin. *Natural History*, 22.2-4, in which he describes how the Dacians, Samaritans, Gauls, and Britons decorate themselves with different plants which can signify social and religious importance.
[4] Good 2001, 216.
[5] Brøns 2017, 10.
[6] Good 2001, 211.
[7] Brøns 2017, 10.

important products that have helped humans adapt and flourish, and thus we encounter everyday metaphors derived from the production of textiles.[8]

Further, how a textile is made and which raw materials are used to make them can also tell us much about the people and societies responsible for their creation. Finished textiles are the result of a complex relationship between resources, technology, and the people who make up a society. Their creation requires extensive planning. The needs and desires of a community come together and interact in ways which ultimately influence the "exploitation of resources and development of technology."[9] Spinning fibres into thread which can then be woven into fabric are only two steps in a long chain of processes and relationships required to create a finished, usable textile.

Like so many of the products women have historically created, textiles are perishable goods which often do not survive the ages for us to find and study.[10] The meals we share as family, the clothing which keeps out the elements, the daily management of a household, the raising of children - these are all basic human needs required for our survival to one degree or another.[11] These are also all roles which have been largely - but not exclusively - filled by women, and which do not survive in the same way as other evidence of past societies.[12]

In the past it was long assumed that there was a clear distinction in Classical Greek households between the private inner world of women, and the public domain of men.[13] This

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[8] Good 2001, 209; interwoven, social fabric, intertwined, inextricably bound, etc.
[9] Andersson Strand 2010, 150.
[10] Andersson and Nosch 2002, 203; Barber 1994, 286.
[11] Good 2001, 209; Thompson 1982; Pomeroy 2011, 72; Smith and Tzachili 2012, 143; particularly in their analysis of the centralised wool industry in Cyprus and Crete, it seems very likely that much of the wool processed outside the home for commercial use and sale may have been done by men, and the fullers listed in the Linear B tablets are always men.
[12] Nevett 1999, 14, 155; Barber 1994, 286-299; Thompson 1982.
[13] Cohen 1989, 6.

idealised dichotomy of inner and outside, public and private, manifests itself clearly through the gendered division of labour and is reflected in the written sources. This division of labour is clearly expressed in Xenophon's *Oikonomikos*, as Ischomachus explains to his new wife their respective roles as husband and wife:

Cover is needed for the nursing of the infants; cover is needed for the making of the corn into bread, and likewise for the manufacture of clothes from the wool. [22] And since both the indoor and the outdoor tasks demand labour and attention, God from the first adapted the woman's nature, I think, to the indoor and man's to the outdoor tasks and cares. [23] For he made the man's body and mind more capable of enduring cold and heat, and journeys and campaigns; and therefore imposed on him the outdoor tasks. To the woman, since he has made her body less capable of such endurance, I take it that God has assigned the indoor tasks. [24] (Xen. Oec. 7. 21-24. Translation by E.C. Marchant William Heinemann, Ltd., London. 1979)

Based solely on the written sources such as the one above, it would seem there existed a clear division of the sexes in the Classical Greek *oikos*. However, the physical and archaeological remains of Greek households often contradict this assumption and have led many to challenge the notion of strict division of gendered spaces within the home. The presence of loom weights and spindle whorls found in a variety of household spaces such as common courtyards may indicate the flexibility of domestic space and challenges the belief that the Greek *oikos* was strictly divided between the sexes.[14]

[14] Nevett 1999, 4-10, 154; 2010, 49, 118; Ault and Nevett 2005 111, 162; Bundrick 2008, 310-313.

Pottery, sculpture, architecture, and literature have left behind evidence for us to learn about our predecessors, yet so much of the lived experiences of women in the past has been missed, forgotten, or overlooked.[15] Besides the products themselves, much is missing in the physical and written record about how the knowledge of this work was transmitted, the time required, and the investment of resources which is not reflected in the physical or literary record. How much cultural and technological knowledge has passed through generations of women, kept alive by use and shared cultural narrative, but not always recorded for posterity? Women's work - domestic work - has always had far reaching social and economic significance.

By going through the process of fibre preparation and textile manufacture we can understand more fully the skill, time, and resources required to create the textiles of the past.[16] In their 2002 recreation of Viking weaving technologies, Eva Andersson Strand and Marie-Louise Nosch look at archaeological and textual evidence of textile work. While Viking societies of Bronze Age Europe and the Classical Greek world were very different, the tools and methods used in textile work have not changed drastically throughout much of pre-industrial Europe. Before the spinning wheel made its way from China to Mediaeval Europe, and the later industrial revolution, the basic fundamentals and tools used to create textiles throughout history have not changed much, and the methods used share enough similarities to warrant the use of comparative data from Viking textile production to understand Greek works from the Bronze and Late Iron Ages.[17]

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[15] Andersson Strand and Nosch 2002.
[16] Barber 1994, 41.
[17] Andersson Strand and Nosch 2002, 197; Barber 1991, 78; Chamberlain and Crockett 1974, 39-40.

Much of the work done at the Centre for Textile Research in Copenhagen has been that of experimental archaeology. By using replicas of Late Bronze Age spindle whorls, textile technicians Anne Batzer and Linda Oloffson sampled spun wool and flax.[18] Through re-creation they were able to determine that "…the fibre, the size of the spindle, the weight of the whorl, and the spinner together determine the spun yarn."[19]

The Role of Experimental Archaeology

There are several limitations in studying ancient fibre remains. Insufficient preservation and fibre degradation are significant problems when analysing ancient fibres.[20] Often fibres and textiles are found in a state of carbonization, which can make identifying the type of fibre difficult if not impossible. Regular conventional light microscopy, which is often used for textile analysis, is not much use when fibres are found in this state, and more specialised tools are needed to identify them. Scanning electron microscopy, phase contrast and interference microscopy, and chemical or biochemical methods can be immensely helpful here, but they are tools which are not always readily accessible to many researchers.[21] Physical fibre remains are scant, interpretation can be difficult, and due to the perishable nature of textiles, analysis tends to "belong to a rather specialised field."[22] Many times the initial investigation of an ancient textile is focused on identifying the fibres and describing the technical descriptions of the object, but more detailed "qualitative, and contextual interpretations… come in a second phase." Overall, textile analysis can vary widely in quality and approach, and research is often

[18] Andersson Strand and Nosch 2019, 16-18.
[19] Andersson Strand and Nosch. 2019, 17.
[20] Barber 1991, 28.
[21] Good 2001, 217-218..
[22] Andersson Strand 2010, 150; Good 2001, 218.

focused on the “how and what” of textiles. To gain a deeper and more rounded understanding of the role and importance of these items in ancient societies, we should also be considering the “when, from where, and why.”[23]

While certainly not enough alone without an academic foundation, experimental archaeology is uniquely equipped to reveal valuable information about the skills and resources that went into creating textiles. In her discussion on why re-creation is important and relevant to the study of these ancient items, Elizabeth Barber describes her first attempt at recreating a piece of twill weave at home and what she learned from the experience.[24] During her experimentation, it took her as long to set up the loom itself as it did to weave a finished piece, if not longer. She learned that the setup process could very well require several people depending on the size of the loom and the pattern of weave. By performing the work herself she was able to see how certain types of weaves could only be done with several sets of hands, and gained insight into the importance of community and the social aspect of domestic labour.[25] Experiential knowledge of weaving techniques is useful in examining ancient remains. A clear example of the relevance of first-hand knowledge of ancient textile technologies presents itself along with the remains of several 'bog bodies' found in Denmark (Fig.2).[26] Some of the garments accompanying these remains have survived nearly intact.[27] Several of the textiles found along with them consist of patterns of weave which may have required up to three people to produce, indicating a clear necessity for co-operative work.[28]

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[23] Andersson Strand 2010, 150.
[24] Barber 1994, 22.
[25] Barber 1994, 22, 86.
[26] Barber 1994, 86-87.
[27] Mannering et al 2009, 261.
[28] Barber 1994, 86-87; Good, 2001, 210.

Even spinning and weaving tools such as the loom itself were complicated and intricate devices, developed over many centuries.[29] By approaching ancient technologies from a re-creation standpoint, we are often able to illuminate how women worked together in very real and tangible ways which do not always appear in archaeological or textual data. In places such as the Aegean and Levant where actual fibre evidence is rare, we are left to rely on the tools used to tell us about the process of textile work and the skill required. It is through hands-on experimentation using tools such as the ones recovered from these areas that textile technicians Anne Batzer and Linda Oloffson were "able to explain the parameters that define and influence textile production."[30]

As well as revealing much valuable information about ancient technologies and how they were used and developed, experimental archaeology can teach us about the lives of the people who performed this work.[31] Elizabeth Barber likens the social aspect of women's textile work to American pioneer women, who often gathered together for community sewing and quilting bees, and her chapter entitled "Courtyard Sisterhood" addresses the social implications of textile work and the social role it must have played in women's lives.[32] Indeed, during my own experimentation of spinning and weaving I often found myself wondering about all the many hundreds of hours spent working together on a project with the women of a household and community. I recalled the old Scottish tradition of wool waulking, which was a group task

[29] Barber 1994, 41.
[30] Andersson Strand and Nosch 2019, 17.
[31] Andersson Strand and Nosch 2002.
[32] Barber 1994, 86.

of washing woven pieces of wool while singing traditional waulking songs and undoubtedly, was used as a time to socialise and build community.[33]

Fig 2 : Huldremose Woman's clothes, Early Iron Age. A wool skirt and scarf woven in an alternating pattern of dark and light wool fibres, and two skin capes. The National Museum of Denmark.

While my hands did the work of turning wool from raw fleece into thread, I spent my time listening to podcasts, audio books, music, and television - not to mention the many phone calls and impromptu visits from neighbours curious about what I was doing in my backyard. Throughout the entire process I wondered at the stories, experiences, and knowledge shared

[33] "Women of The Outer Hebrides - Waulking Song | AI Enhanced 1941 Film". Youtube. Uploaded by glamourdaze. 22 Mar 2021. https://www.youtube.com/watch?v=QeSrkZfpAjc

between these women who spent so many hours of their lives working together. It is *because* there is so little physical evidence of textiles left - and even less first hand information from the people who performed that work - that re-creation is important.[34] In the case of textile work, re-creation can teach us valuable information about the lives of women which we cannot find in any book. So much of the evidence has been lost to time, and "to understand these ancient [iron and bronze age] textiles one must make them."[35]

[34] Barber 1994, 24.
[35] Chamberlain and Crockett 1974, 29.

1. The History of Textile Work

Textiles in Prehistory

Textiles represent "one of the earliest human craft technologies"[36] Evidence for our earliest creation of textiles is scattered and indirect, but it seems humans developed textile crafts sometime in the upper palaeolithic, and the evidence indicates our use of twisted threads as early as 20,000-30,000 years ago.[37]

While very little actual fibre evidence has survived this span of time, we are often able to deduce the existence of threads by their effect on other, sturdier objects from this time in the form of imprinted patterns of weaving on clay objects and fibre traces inside artefacts such as beads.[38] Such evidence has been recorded at the Upper Palaeolithic Gravettian sites of Dolni Vestonice I and II and Pavlov I in Moravia, where textile impressions appear on both fired and unfired clay, indicating the "existence of highly diverse and sophisticated textile technologies that included the production of cordage and nets, the plaiting of baskets, and the twining and loom-weaving of cloth."[39] Such a high level of mastery over textile fibres suggests that people were creating textiles for quite a long time before this period and "the variety of these inventories and the fineness of many of the final products clearly indicate that these are in no sense 'primary essays in the craft."[40]

By 26,000 B.C.E. items begin appearing such as needles, beads with increasingly

[36] Andersson Strand 2010. 150.
[37] Barber 1994, 42-43; 52-53; Kvavadze, 2009.
[38] Barber 1994, 43; Good 2001, 210, 213. One small fragment of spun cord has been recovered which dates back to 15000 B.C.E.
[39] Soffer et al 2000, 512.
[40] Soffer et al 2000, 512-513.

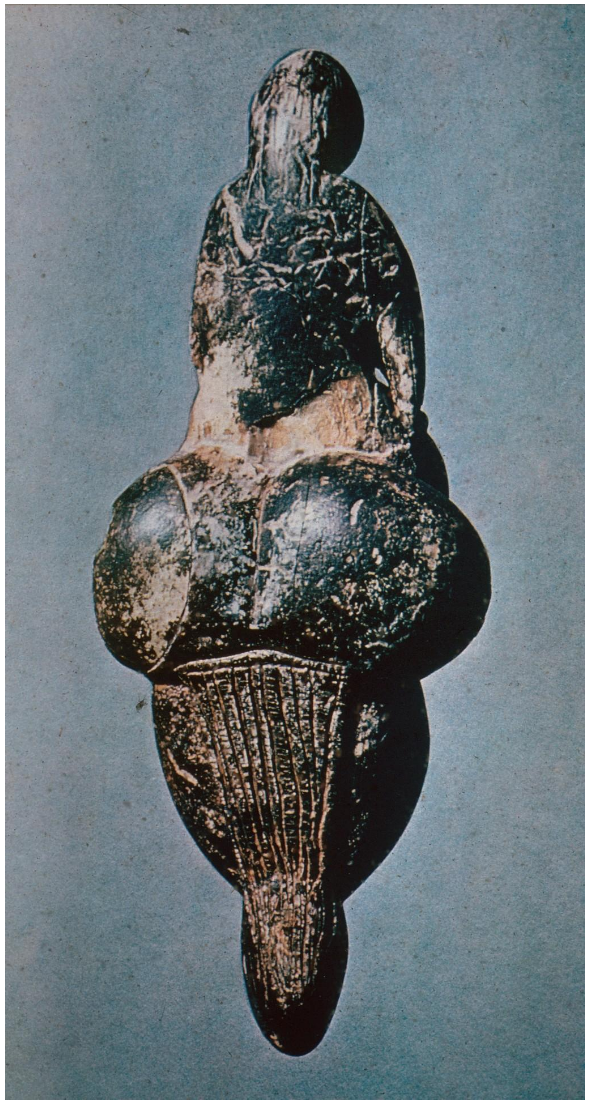

Fig. 3: Venus of Lespugue (Back View), Mammoth Tusk. Found at the Saint Perier Excavations. p. 1. Peabody Museum of Natural History.

smaller holes, and funerary remains of palaeolithic humans with orderly rows of beads draped across their bones, indicating that they may have been sewn onto a garment worn by the person at the time of burial.[41] Around this time is when we have an increase in the production of "Venus Figurines" (Fig. 3). Some of these figures are carved wearing string skirts with long strands hanging down from a band, with the strands carefully carved to indicate the delicate

[41] Barber 1994. 43.

twists of spun thread. The presence of these strands so carefully carved to represent twisted cord is a significant detail as it indicates the early development of spun fibres as opposed to other materials like gut or sinew.[42] Barber elaborates further that when studying the Venus of Lespugue closely, the strands of her skirt can be seen to have fraying and untwisted fibres hanging from the ends, further supporting the existence of twisted threads at such an early period in prehistory.[43]

Fig. 4: Egtved Girl's Costume, late second millennium B.C.E. Showing a traditional string skirt made of wool. The National Museum of Denmark.

[42] Barber 1994, 44.
[43] Barber 1994, 43-45, 295.

Although a much later find, the Nordic "Egtved Girl'' (Fig. 4), dating to 1370 B.C.E. was buried wearing a very distinctive string skirt not unlike that depicted on the Venus Figurines. This style of skirt has a long history and is thought to be an inherently feminine garment, symbolically and ritually linked to fertility and child-bearing age.[44] While others were painting caves or knapping flints "some genius hit upon the principle of twisting handfuls of little weak fibres together into long, strong thread."[45]

The process of spinning thread, simply put, is the action of taking several single, usually short, and often weak pliable fibres and twisting them into a length of much stronger thread. Some raw vegetable materials like reeds and grass are strong on their own, but they lack flexibility. Other more flexible fibres like wool, silk, and bast are not strong by themselves, but when overlapped and twisted together they can be made into strong and pliable thread.[46] The discovery of how to create string by twisting fibres into a single strong thread opened the door for our species' survival, and has even been likened to how the harnessing of steam spurred the industrial revolution of the 17th century.[47] String was so useful and revolutionary to all aspects of life that it gave humans an edge which allowed us to dominate the natural world.[48] "Manipulating reeds, bark, basts, and seed down into cords, braids, baskets, nets, mats, and cloth bolstered our capacity to adapt exponentially,"[49] and it is now

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[44] Barber 1994, 50-69. Barber covers in great detail the long and widespread history of this type of skirt throughout Europe, where it is still present in many cultures as a traditional garment worn by women.
[45] Barber 1994, 43.
[46] Barber 1991, 9..
[47] Barber 1994, 45.
[48] Barber 1994, 70; Good 2001. 209.
[49] Good 2001, 209.

widely recognized that this so-called 'String Revolution' changed how humans interacted with the world in enduring ways.[50]

Textile Work, Textile Workers: Evidence from the Mediterranean

Textile work has been ideologically associated with women throughout history. Women of all ages and social strata in antiquity "contributed through their handiwork to the self-sufficiency of their own households."[51] In the ancient Greek and Roman world, women's textile work was inextricably linked with female virtue and idealised womanhood, and many written sources point to the role which textile work played in idealised femininity.

Weaving was seen as a sacred and vital role for women in Homeric epic. Helen, Penelope, and Andromache are just a few female figures who illustrate the strong connection between myth, religion, and the craft of wool working to show how textile work was an essential activity associated with the feminine. The hard working and honourable woman is described as one who "weighs and spins wool in order to support her family."[52] Weaving in Homeric epic even serves as a symbol of domestic stability, and it can be argued that "any change in this order reverses the image of the loom from a symbol of domestic stability to a symbol of disrupted domestic harmony, as we see in Hector's fear that Andromache will serve as a slave at the loom of another man."[53] Ancient imagery often reflects the ideology that women's place was indoors working wool, whereas men's domain was outside; it is alignment

[50] Barber 1994, 45; Good 2001, 209.
[51] Pantelia. 1993, 493; Pomeroy 2011, 30.
[52] Hom. *Illiad*, 12. 432-435.
[53] Pantelia 1993, 493; Hom. *Il.* 6.456. Also *Il.* 22. 441-42: When Andromache learns of Hector's death she drops her shuttle, Pantelia suggests this is symbolic of the balance between "martial and domestic spheres" (Pantelia 1993, 495).

of women with inside and men with outside that accounts for the conventions of colour for the two. Women are rendered as pale or white because they are inside, whereas men are depicted in dark or black colour. On the attic red figure cup portraying Penelope and Telemachus, Penelope appears seated before her loom veiled and fully covered, indicating her domain inside the *oikos* (Fig. 71). Telemachus is shown standing before her, partially nude, and holding spears in his hand, linking him to the outside world. All Homeric women of myth wove regardless of social status,[54] and their work "symbolises the normal order of life, in which women take care of their households while men defend the city."[55]

Textile work in Homer serves to give women a voice and presence; it acts as a domestic backdrop against which women are framed. When women speak in Homer they are often accompanied by scenes of weaving or the tools associated with women's work, and this can be understood as a sort of staging device.[56] Helen's first appearance in the *Iliad* occurs as she weaves a purple tapestry which depicts scenes of the battle raging around her.[57] Later in the *Odyssey* she sits among her weaving implements in her home in Sparta and weaves a story with her words for Telemachus.[58] Even divine women appear in this context, as the goddess Aphrodite appears to Helen disguised as a wool-comber.[59]

As well as serving to give voice to the women of Homer and allowing them a form of *kleos*, it can even be argued that textile work can function as a way of establishing and maintaining networks of *xenia* - guest friendship - between women and perhaps even

[54] Lyons 2003, 100. The Odyssey shows the economic role of women. Slave, free, mortal, and immortal women all participate in textile crafts.
[55] Pantelia 1993, 493.
[56] Karanika 2014.
[57] Hom. *Il*, 3. 125-28.
[58] Hom. *Od*, 4. 259-61.
[59] Hom. *Il*, 3. 386-89.

patriarchal family units.[60] Weaving allows women in Homer to play a direct role in the hospitality of entertaining guests. It acts as a platform for visibility and participation in the narrative, and allows them to perpetuate and pass on their own *kleos*. In book 3 of the *Odyssey,* Helen uses the textiles she created to transfer her own *kleos* from one house to another:

> "Dear child, I too give you a gift to remember Helen by, made by her own hands, for your bride to wear when the longed-for wedding day arrives. Let your dear mother keep it by her in the palace until then. As for yourself I wish you a joyful return to your own home and country."
>
> (*Odyssey*, 15. 125-28. Translated by A.S. Kline 2004)

As a role intrinsically associated with the feminine, domestic textile work can also be used to illustrate feminine deceit as well as virtue. In the *Odyssey*, Penelope weaves a web of deceit, as she nightly unravels the great shroud she weaves for her husband Laertes in an attempt to thwart unwanted suitors.[61] For Penelope, weaving both functions to keep her safe from the outside world and also acts as a backdrop throughout the narrative to give her a limited power to stave off her suitors from a distinctively feminine and domestic platform using the only tools at her disposal.[62]

As well as Homeric epic, Classical Greek literature, mythology, and imagery also associate the spinning and weaving of wool with the feminine. Xenophon conveys the ideal female domestic role in his *Oeconomicus* where the wife of Ischomachus is described as being

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[60] Mueller 2010; Blondell 2013.
[61] Hom. *Odyssey*. 24. 125-146; Mueller 2010, 2.
[62] Blondell, 1995, 55.

responsible for making textiles and supervising the slaves who carry out the weaving. The husband's role was to provide shelter for his wife so that she could undertake the "rearing of infant children... making food out of the harvest [and]... the making of clothing from wool."[63] For the women of the ancient Mediterranean world, spinning and weaving was not just a daily chore, it served to establish and uphold the ideal vision of womanhood.[64]

Women's relationship to textile work appears in many different areas of ancient life. As well as appearing together in literary and mythological sources, women participated in the civic and religious lives of their communities in very real and tangible ways through the craft of weaving, and "the performance of certain religious rites was reserved to the women of the city."[65] During the annual Panathenaic procession, two women were chosen to both create and present a woven garment called a *peplos* as an offering to Athena, patron goddess of the city of Athens.[66] These women were chosen from the upper class, and their role in this important religious ceremony - and specifically the strong connection to woven goods - indicates the importance of textile work, and the ideology associated with it.[67] The symbolic role of the *peplos* throughout myth is recurring, and as a garment traditionally created and worn by women, it also serves as a "symbol of female domesticity and devotion to the marital household."[68] From Mycenaean times through to the Hellenistic period, domestic textile work was largely the "province of women, be they domestic slaves or royalty."[69]

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[63] Xen. *Oeconomicus*. 7.10-21.
[64] Wohl 1993, 19; Ovid, *Fasti*. 3. 815-824.
[65] Arthur 1973, 13.
[66] Gould 1980, 51; Stamatopoulou 2012, 72; Arthur 1973, 13; Pomeroy 2011, 75-76.
[67] Gould 1980, 51.
[68] Dova 2020, 71
[69] Arthur 1973, 14.

Even in Roman epigraphic records women were memorialised by praising their skills at wool working. A 1st century Roman funerary inscription reads:

> *"Here lies Amymone, wife of Marcus best and most beautiful, worker in wool, pious, chaste, thrifty, faithful, a stayer-at-home."*
>
> *(Funerary inscription, Rome. 1st century B.C.E.. ILS 8402. L = WLGR p. 17)*

Another Roman inscription lists a woman's skill with wool working among her life's accomplishments:

> *"Friend, I have not much to say; stop and read it. This tomb, which is not fair, is for a fair woman. Her parents gave her the name Claudia. She loved her husband in her heart. She bore two sons, one of whom she left on earth, the other beneath it. She was pleasant to talk with, and she walked with grace. She kept the house and worked in wool. That is all. You may go."*
>
> *(Funerary inscription, Rome, second cent. B.C.E.. ILLRP 973 = ILS 8403 = = CIL VI.15346 = WLGR p. 16)*

The close relationship between women and textiles is one which stretches far back into our history and across many different societies, and is suggested by the very female nature of the string skirt worn by the Egtved Girl. This particular style of skirt has a long history throughout much of Neolithic central and eastern Europe,[70] and it is perhaps unsurprising then

[70] Barber 1994, 56.

that it represents "the first type of clothing for which we have good evidence [and] is symbolic rather than purely utilitarian and suggests the relative importance of women and their work."[71]

[71] Barber 1994, 69. For a very detailed discussion on the long history and significance of the string skirt throughout much of Neolithic Europe to today see Barber 1994, 56-70.

2. History of Fibres

Textile fibres generally fall into four main categories. Vegetable, animal, mineral, and synthetic. Vegetable fibres include cotton, flax, and hemp. Animal protein fibres include materials such as wool, hair, and silk. Mineral fibres such as asbestos, and gold have also been used throughout history in the making and embellishment of textiles. Finally synthetic fibres - a relatively new invention - are ones such as polyester, rayon, acrylic, spandex, and others.[72]

Bast fibres are collected from the inner layer of several plant species. These fibres come from the filaments inside the stalk which surround the central shaft of plants such as flax, hemp, and jute.[73] It is likely that bast was the first fibre to be spun by our ancestors, and the earliest evidence for the domestication of flax for making linen seems to have come from Northwestern and Eastern Iraq dating at around 5500-5000 B.C.E.. Evidence for this appears in the form of seeds which seem to have been selectively bred and improved over time for agricultural usage.[74] Although these seeds suggest the early domestication of flax by humans, it is unknown whether these plants were grown for their fibrous stems or for their "oil-bearing seeds."[75] In any case, we do know that flax was used for making linen long before 5000 B.C.E., though whether it was domesticated or gathered from the wild is undetermined.

Wool has a long history of use in the Mediterranean, however it is difficult to determine when humans began spinning these animal fibres into threads. The earliest solid evidence to date for the use of wool comes to us from the Early Bronze Age Levant (3000-2900 B.C.E.), and wool did not become a common find in the eastern Mediterranean

[72] Chamberlain and Crockett 1974, 10-15.
[73] Chamberlain and Crockett 1974, 10, 37-38; Barber 1991, 13-20.
[74] Barber 1991, 12, 25.
[75] Barber 1991, 12.

until the Late Bronze Age. While certainly not evidence for the use of wool, faunal remains of sheep begin appearing on the southern peninsula of Greece as early as 6000 B.C.E. (Franchthi cave), indicating a potential shift into animal husbandry.[76] Slaughter patterns from Late Neolithic Knossos show clear evidence of animal husbandry for meat. By the Bronze Age, physical remains as well as flock composition records from the Linear B tablets indicate those patterns may have shifted to favour wool.[77] As well, tools, dyes, traces of lanolin, and even Bronze Age texts have all been used to try and find earlier evidence of wool's use in making textiles, but little evidence has yet been found. With so little physical evidence, wool is "rather invisible and difficult to grasp, even with the above-mentioned array of archaeological methods."[78]

While the evidence for the early use of wool is scant, earlier remains of plant fibres have survived to be studied. Some of the earliest actual fabric remains which currently have been found come from Nahal Hemar in the Levant (seventh millennium B.C.E.), and Çatal Hüyük in southern Anatolia (sixth millennium B.C.E.). Both of these remains contain primarily bast fibres, and it is assumed they are most likely flax.[79]

With domestication of animals and changing horticultural and agricultural practises, the gendered division of labour in Neolithic families shifted. Women's work increasingly began to coincide with its compatibility with safe child care. Stationary living changed humans as a species, and for women this meant they no longer needed to carry their children everywhere as

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[76] Andersson and Nosch 2019, 27-29.
[77] Nosch 2014, 1-2; Killen 1964. Halstead 1999. Linear B tablet records from Late Bronze Age Knossos list the ages and sexes of sheep, which could be used to suggest their intended use. It is suggested that sheep which were slaughtered young were likely raised for their meat, whereas the remains of older sheep tend to indicate they were kept alive longer to make use of their wool.
[78] Andersson and Nosch 2019, 29.
[79] Barber 1994, 25.

their communities migrated about hunting and foraging for food, thus freeing up their hands for more specialised work. The gradual chain of events that led to a sedentary lifestyle began a domino effect that Elizabeth Barber likens to "the greatest pyramid scheme of all time… [starting] small and getting bigger, leaving the last people to pay for all."[80] As humans shifted from nomadic living to more permanent settlements, they began acquiring, collecting, and storing the tools, materials, and resources required for survival. As a result this new way of living required more hands to manage the work, leading to significant population increase, which in turn only furthered the need for more and more resources.

Humanity's relationship with their environment changed drastically with the ability to store food for long periods of time. This stockpiling of grains may have led to the gradual development of planting seeds to grow crops - an advancement which made it possible to control the quantity and location of food supplies. This shift in living necessitated that hunting for food suddenly required for any kills to be transported back home to the community, as opposed to bringing the community to the location of the kill. Necessity may have led to the domestication of animals and eventually to genetic selection for more docile traits in livestock.[81] With a permanent residence and control over food sources, families began to produce more children. With more reliable resources humans were able to feed more mouths, and it was no longer imperative to space out offspring to accommodate a nomadic lifestyle.[82] Further, close quarters living with animals allowed for the evolution and spread of disease, which further

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[80] Barber 1994, 71-72, 75-76.
[81] Barber 1994, 75.
[82] Barber 1994, 76. Modern hunter gatherers such as the !Kung in southwestern Africa provide an excellent example of hunter-gatherer societies who carefully space out their children three or four years apart.

necessitated the bearing of more children to increase the likelihood of more members of the community surviving through infancy into adulthood.

Before the invention of the plough and yoke to aid in agriculture people presumably used horticultural practises to grow food and crops were tilled by hand. It was in these early horticultural societies where women began to be in charge of their homes, food supply, children, and textile crafts.[83] While some may consider fibre crafts such as spinning and weaving to be dull and repetitive tasks, they are activities which facilitate frequent distractions and multitasking. Significantly, spinning and weaving are jobs which generally do not pose a danger to small children, and it may be reasonable to assume that women took up the task of textile work in part due to this reason.[84]

[83] Barber 1994, 76.
[84] Barber 1994, 29-30; 54.

3. Developments in Textile Research

Over the past half century there has been a great deal of growth in the field of ancient textile research. At one time considered "little more than chance finds and curiosities,"[85] textiles and other perishables have now generated the attention of many researchers - in part due to the improved techniques available to scholars, and in part due to a heightened awareness of the value of these finds and what they can tell us about the people who populated these societies. The study of ancient textiles is highly technical as it analyzes the physical evidence found in archaeological digs. A detailed textile analysis requires the assessment of the dimension, condition, colour, fibres, preparation, twist direction, thread count, type of weave, edges, decoration, faults, and wear.[86]

In the past, textile research within the field of archaeology has largely been heterogenous, and "textile analyses naturally tend to vary in quality and approach", which has led to a great deal of overlap in academic fields and research techniques.[87] In recent years there has been an effort to increase collaboration and dialogue between adjacent fields of research, which has led to a broader understanding of ancient textiles and technologies.[88] There are many notable scholars working in the field of ancient textile research today, and their varying approaches demonstrate the value of a holistic approach to the study of ancient perishable. Elizabeth Barber's "pioneering scholarship" on ancient textiles has been a foundational resource in textile research.[89] Dr. Eva Andersson Strand and her colleagues at the Centre of Textile Research at the University of Copenhagen are performing important hands-on

[85] Good. 2001, 201, 210.
[86] Gleba 2014, 5; 2001, 211.
[87] Andersson Strand et al. 2010. 150.
[88] Andersson Strand et al. 2010, 150; Good 2001, 210.
[89] Andersson Strand and Nosch 2019, 15; Barber 1991; 1994.

re-creation of prehistoric and Bronze Age Viking textile technology.[90] "Recent efforts in art history, textile history, and archaeology, as well as in textile science and chemistry, have helped to create momentum in bringing cohesion, meaning, and accessibility to this once arcane subject."[91]

Today there are many tools at the disposal of scholars in the study of ancient textiles. These tools include fibre and dye analysis, strontium isotope tracing, molecular analysis, radiocarbon analysis, visual grouping, archaeobotany and archaeozoology, tool studies, and ethnographic studies.[92] As well, DNA, lipids, and proteins can sometimes be collected from animal fibres, and the data collected from these samples may often be used to determine the fleece type of prehistoric sheep for comparison with modern breeds.[93]

The tools themselves used for creating textiles tend to be the most numerous and direct evidence available to researchers, and they can reveal valuable information about how textiles were produced.[94] Spindle whorls and loom-weights are the most common surviving textile related finds, as they were often made of non-perishable materials like clay, stone, or metal.[95] These objects are so numerous in the archaeological record that there are "spindle whorls in nearly every Aegean excavation, varying in materials and size."[96]

Environmental factors also play a significant role in the survivability of textiles. Environments in which a textile is likely to survive include extreme aridity, sub zero

[90] Andersson Strand and Nosch 2002; 2019.
[91] Good 2001, 219.
[92] Andersson Strand 2010.
[93] Good 2001, 218; Gleba 2014, 5.
[94] Smith and Tzachili 2012, 143.
[95] Nosch 2011, 38; Smith and Tzachili 2012, 143.
[96] Andersson Strand and Nosch 2002, 200.

temperatures, acidic microenvironments (near metal objects), and nitrogen rich bogs.[97] The ideal soil pH for preserving a fibre differs based on the type of fibre in question. Very few textiles themselves survive in the Aegean, and we must rely on spinning and weaving tools to understand the process of preparation where physical fibre remains are absent. It is because so little direct evidence for ancient textiles survives that re-creation is an important tool for research. The application of experimental archaeology "in combination with knowledge from traditional textile craft and textile techniques… [to] explain the parameters that define and influence textile production"[98] is invaluable to our understanding of these ancient technologies.

Experimental Archaeology

As stated above, the domestic work performed by women - particularly the women of ancient Greece - has historically consisted largely of perishable items. The very nature of the types of products made by their hands, and the absence of their voices in the historical records has resulted in the erasure of certain types of work, and by extension of the lived experiences of certain groups. We have little direct information about the lives of Classical Greek women and how economically significant their work was in society. Often the information available is difficult to separate from the ideology of a society.[99] Due to many factors - lack of first hand accounts, biassed secondary accounts, a lack of physical evidence, reliance on pre-drawn conclusions about women - it is not surprising that so little is known about these women.[100]

[97] Mannering et al 2009; Good 2001, 211.
[98] Andersson Strand and Nosch, 2019, 17.
[99] Cohen 1989, 9.
[100] Barber 1994, 286; Cohen 1989, 4; Brøns 2016, 10-11.

Fig. 5: White-ground Pyxis ca. 460B.C.-450B.C.. Scene of women engaged in various domestic tasks, including textile work. Copyright Trustees of the British Museum. Asset number 1502100.

While visual representations of women in Greek society can be useful in understanding women's role, it is crucial to remember the relationship which exists between art and society in perpetuating a cultural ideology.[101] While scenes of women spinning and weaving are numerous in classical archaeology, they must be scrutinised and carefully decoded in order to understand.[102]

In the past many have assumed the imagery of women engaged in textile work to be indicative of their oppression in society. Many now believe these same scenes in fact employ a

[101] Cohen 1989, 3-4.
[102] Bundrick 2008. 284.

"dual metaphor of weaving and marriage to express the harmonia of *oikos* and *polis*."[103] Using imagery alone to understand the reality of women's lives is problematic, just as literature of the past often obscures, colours, and excludes the lived experiences of certain groups, art must also be interpreted carefully and understood as a product of the society from which it originated.[104]

While archaeological remains, literature, and art can help uncover important information about the lives and work of women, it is important to bear in mind that "neither texts nor images nor archaeological artefacts nor textiles alone can provide a full picture of this technology, or the complete understanding of the practicalities and symbolic value of clothing."[105] Re-creation has the unique ability to shed light on an aspect of daily life which written texts simply do not provide. What was the time commitment required for this kind of production? What skills were needed to create these goods, and how was the knowledge of those skills transmitted from generation to generation? How did the type of work performed by ancient people affect and shape their social lives and strengthen the connections to the other members of their communities? These are all questions which hands-on re-creation can bring us closer to answering, and which will be uncovered in this project by combining traditional scholarship with re-creation.

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[103] Bundrick 2008. 283. See also Figure 92 in which a husband stands before his wife, who is seated before a wool basket. Her clothing and activity indicates traditional indoor female life, while her husband stands before her partially nude holding a leg of meat, presumably brought in from outside the oikos.
[104] Bundrick 2008. 283-284.
[105] Andersson Strand and Nosch 2019, 15.

5. Materials and Supplies

Why wool?

While it was not the earliest fibre used for making textiles, sheep wool has been one of the most widely used for much of our history and it has several properties which make it an ideal candidate for spinning into thread.[106] Wool is the easiest fibre to spin.[107] Unlike bast fibres such as flax and hemp, the structure of each hair consists of a scaly outer layer (Fig. 6), and the filaments themselves have a natural crimp (number of bends per unit length) which allows the fibres to grab onto each other easily while being twisted and spun into string. It is this scaly surface which makes wool itchy against the skin. The scales and the crimp combined "produce air pockets between the fibres making wool an excellent insulating material against heat and cold."[108] At the centre of each filament is a honeycomb shaped central core containing air to help insulate, and the cells in the hair respond to moisture.

As well as being an excellent insulator against heat and cold, wool also has natural fire resistant qualities, is very elastic, and also has hydrophilic properties "absorbing up to a third of its weight before feeling wet to the touch." Because of this, it does not tend to build up static electricity in the way other fibres do, hence wool tends not "to attract dirt and dust from the air."[109]

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[106] Gleba 2014, 1-2; Chamberlain and Crockett. 1974, 12, 30.
[107] Chamberlain and Crockett 1974, 12.
[108] Gleba 2012, 3643; Gleba 2014, 1; Barber 1991, 20.
[109] Gleba 2012, 3643.

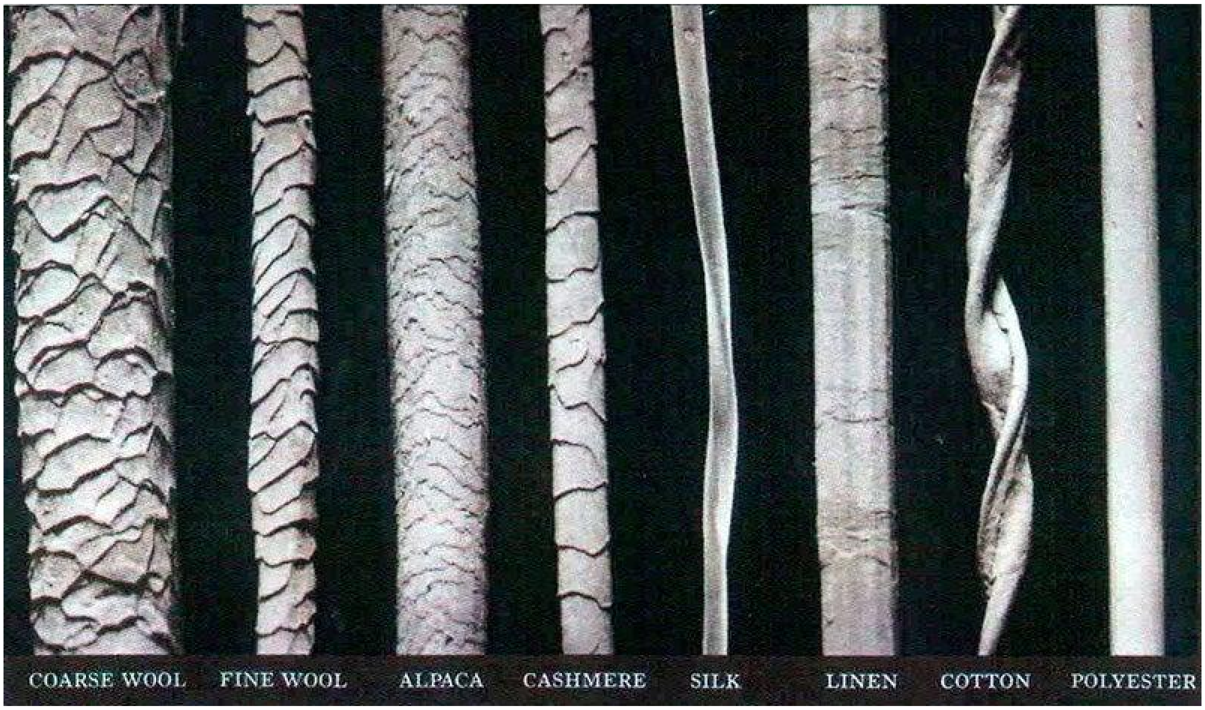

Fig. 6: Scanning electron microscopy of different fibres. Adapted from micrograph by Leo Barish, Albany International Corporation [112].

The scaled surface of the fibres also allows for a process called felting - one of the oldest methods of making fabric which happens when hair or fur is matted together.[110] Felting occurs when heat, moisture, and pressure are applied to wool or hair.[111] Sometimes referred to as a "kinetic phenomenon", this occurs when fibres are "laid at random and 'shocked' by moist heat and pressure [and] the scales on the filaments lock or crimp together."[112] While sudden changes in heat cause the scales to open up, cold temperatures will cause them to close. Therefore, abrupt changes between hot and cold cause the scales to open up and interlock with each other. When the fibres are hit with cold temperatures they close up tight again, this time tightly interlocking together. This reaction is what causes wool to shrink, and is also what

[110] Chamberlain 1974, 19; Barber 1991, 20; Emery 1966, 22.
[111] Gleba 2012, 3643; 2014, 1.
[112] Chamberlain and Crockett 1974, 19.

causes felting.[113] All wool can be felted, but sheep fleece having a higher crimp and scale content than other animal protein fibres tends to be better at creating felt.[114]

Lastly, wool is relatively easy to acquire and process compared to plant fibres such as bast. Wool does not require "prime agricultural land" to raise sheep, nor does it require advanced agricultural practises to grow, unlike most vegetable fibres. The raising of sheep for wool requires less people than farming crops, which makes it easy to divert energy and resources to other tasks.[115]

While the preparation of wool is no small task, it is considerably less laborious than the preparation of bast fibres such as flax for linen. Bast fibres are found inside the stalk of the plant surrounding the woody core of the stem. The core and outer skin of the plant must be stripped away from the rest of the plant in order to release the fibres. Before spinning can even begin the plant must be pulled up by the roots, dried out, and left to partially rot - a process called retting.[116] Once retting has been completed, the remaining stems are beaten and "drawn through a coarse metal comb to separate the coarse and fine fibres," leaving behind only the long smooth bast fibres.[117]

Even the spinning process for linen differs from that of wool. Wool fibres are much shorter than linen fibres, but their crimp and scales make it possible to easily spin into long threads with little effort. Draft spinning is a technique used to spin some fibres like wool by continuously drawing out the fibres from a bundle and simultaneously twisting them into

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113 Chamberlain and Crockett 1974, 35. This interlocking of scales can also be done by agitating the wool, which forces the scaled surface of the filaments to interlock.
114 Chamberlain and Crockett 1974, 22.
115 Gleba 2014, 1.
116 Barber 1991, 12.
117 Chamberlain and Crockett 1974, 37; Barber 1991, 13-14. Plin. *Naturalis Historia* 19, 16-18.

thread.[118] Given bast fibres' long and smooth nature, the strands must be intentionally overlapped and spliced together in order to spin a continuous length of thread.[119] Linen fibres result in threads that are smooth, shiny, very strong, cooling, and become softer with wear.[120] and as such it is no wonder that bast fibres have been used in textiles for so long. Considering the laborious process needed to create a linen textile, it is also no wonder that wool became one of the most commonly used fibres for much of our history given its ease of acquisition and preparation.

Modern and Ancient Wools Compared

Different qualities of wool are recorded in Bronze Age texts, and they are often associated with specific regions.[121] Bronze Age Aegean Linear B tablet records indicate differing qualities of wool by its fineness, length, and softness.[122] Classical Greek sources indicate a preference for Milesian wool due to its superior softness.[123] By the early Empire, Romans were able to acquire different qualities of wool, and the first century C.E. writers Columella and Pliny the Elder rated the different breeds of sheep according to their wool qualities.[124] According to Pliny, the best wool came from Apulia, the second best from Greece, and the third best from Milesian sheep.[125] Evidently based on these descriptions, it seems that

[118]Barber 1991, 40-41; Barber 1994, 35-36.
[119] Barber 1991, 41, 47.
[120] Barber 1991, 14.
[121] See Firth and Nosch 2012 for discussion on wool qualities in Bronze Age Ur III texts.
[122] Gleba 2014, 3; Nosch et al 2010.
[123] Gleba and Cutler 2012, 113; Gleba 2014, 3 points to a reference in Aristophanes' *Frogs*, 534 to this preference for Milesian wool.
[124] Plin. *De Re Rustica*, VII.2.
[125] Plin. *Naturalis Historia* 8, 187-199.

specific breeds of sheep differing in colour, fibre length and thickness, were known throughout the Mediterranean by the first century C.E.[126]

In sourcing the materials for this project, it was important to remain conscious of the evolution of sheep and of selective breeding, and the initial concern was whether or not the wool available in Canada would be suitable for this experiment. Modern wool quality is determined by fibre diameter, crimp, yield, colour, and staple length, with fibre diameter being the most important factor in determining the quality of a fleece.[127]

A fleece consists of an outer coat of coarse kemp fibres, hair, and the much finer underwool.[128] Michael Ryder developed the pioneering model for wool based on fibre diameter measurements, which formed the foundation of fibre studies.[129] His classification of wool is divided into six fleece categories: hairy medium fleece (60-100µm, avg. 30µm), generalised medium fleece (up to 55µm, avg. 20µm), medium fleece (60µm, avg. 30-40µm), fine fleece (35µm, avg. 20µm), hairy (up to 100µm, avg. 30-40µm), and short (40µm, avg. 25).[130] In his extensive recording of wool fibres, he proposes that the selective breeding of sheep gradually led to more uniform fleece over time "with underwool becoming less fine and the outer coat becoming less coarse, eventually resulting in the disappearance of kemp and hair."[131]

Overall there does seem to be a difference in wool fineness between modern and very ancient wool, however, by the middle fourth millennium B.C.E. woolly sheep seem to have been developed and bred for their wool. Ryder concluded that earlier breeds of sheep tended to

[126] Gleba 2014, 4.
[127] Gleba 2012, 3644.
[128] Barber 1991, 21, 24.
[129] Ryder 1974; Gleba 2014, 5.
[130] Ryder 1964; 1974; 1983; Gleba 2012, 3664.
[131] Gleba 2012, 3644.

have fleece with more hair and kemp than wool, and the generalised medium fleeces were likely to be the most common type of wool in antiquity, being only slightly hairier than most of the wool we use today.[132] This selective breeding eventually yielded what is now called Merino wool.[133] According to the Canadian Fleece Co-op, Canadian sheep do not produce fleeces with fibre diameters smaller than 22µm. Based on the data recorded by Michael Ryder and others, it was determined that the wool available in Canada would sufficiently approximate the type of wool used by the peoples of the ancient Mediterranean.

Tools

From physical remains, textual sources, and imagery, the existence of many textile tools from Classical Greece and their names are known. The *kalathos* (wool basket) and *kteis* (wool comb) are a few of these items associated with wool working ("*kalathos*", "*kteis*"). While there is evidence to indicate their presence, there often is not information on how these tools were always used. Based on archaeological finds, we know that most of the people in the Mediterranean Bronze Age spun their fibres with a spindle and whorl.[134] Before the invention of the spinning wheel, the spindle was used to spin fibres into thread. This tool consists of a simple shaft (spindle) with a hook on one end and a weight (whorl) affixed to it (Figs. 7 and 8). The whorl provides weight which allows for momentum to keep the shaft of the spindle spinning while it is suspended. The whorl can be positioned at the top, bottom, or middle of the shaft.[135]

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[132] Ryder 1974, 109; Gleba 2014, 5.
[133] Ryder, 1987.
[134] Smith and Tzachili 2012, 144.
[135] Chamberlain and Crockett 1974, 30.

The weight of the tools used for spinning partially determines the outcome of the spun thread, and different weights would be used for different types of fibre, depending on its intended purpose.[136] Wool and flax are fibres which can be spun with heavier tools, and they can create thick, strong thread. Cotton fibres, on the other hand, are very short and must be spun with lighter, more delicate instruments to prevent breaking.[137]

Fig. 7: Spindle whorls, sixth and early fifth centuries B.C.E. From left to right: MC 948, MC 373, MC 365, MC 938. Photographed by Craig Mauzy, 2004. American School of Classical Studies at Athens. Archive number; 2007.01.1273.

When deciding what to use as spinning tools, I attempted to replicate them as best I could to the tools we have evidence of from Classical Greek society. This of course is tricky, due in part to the limitations of relying primarily on written descriptions and images of the tools themselves. Where there were no physical remains, images, or descriptions of specific tools, I filled in the gaps with modern ethnographic information to supplement my knowledge.

[136] Smith and Tzachili 2012, 144; Andersson Strand and Nosch 2019, 17.
[137] Barber 1991, 51.

Fig. 8: Bronze Age stone spindle whorls from Cyprus. ca. 1200 B.C.E.

There is far more material to refer to when spinning thread, or weaving on a loom than there is on how to prepare the wool before the carding process begins. How did Greek women wash their wool? Did they wash it before they carded it, or after? What products did they use to clean the wool, or did they simply use water? These are all questions which required a degree of creative problem solving and a look to more recent practises in wool-working across the globe.

5. Preparing the Fibres

"Well, first as we wash dirty wool so as to cleanse it, so with a pitiless zeal we will scrub through the whole city for all greasy fellows; burrs too, the parasites, off we will rub. That verminous plague of insensate place-seekers soon between thumb and forefinger we'll crack. All who inside Athens' walls have their dwelling into one great common basket we'll pack. Disenfranchised or citizens, allies or aliens, pell-mell the lot of them in we will squeeze. Till they discover humanity's meaning…. As for disjointed and far colonies, them you must never from this time imagine as scattered about just like lost hanks of wool. Each portion we'll take and wind in to this centre, inward to Athens each loyalty pull, Till from the vast heap where all's piled together at last can be woven a strong Cloak of State".

(Aristophanes, Lysistrata, 574-586. Translated by Jack Lindsay. 2014)

In the passage above from Aristophanes, the Athenian woman Lysistrata describes the process of plucking and combing a fleece. This description, while narratively effective, does not provide sufficient detail to be useful as a comprehensive guide for wool processing. The passage was, after all, not intended to be used as instruction for novice weavers.

Whether the fleece is shorn with hand shears or electrical clippers, the wool must undergo several processes in order to prepare it to be spun.[138] First the fleece must be cleaned,

[138] Chamberlain and Crockett 1974, 28. Fleece can be shorn either with hand shears or electric clippers. When wool is commercially produced, speed is the most important factor, and electric clippers are used. While efficient, electric clippers can result in short and uneven fibres. Hand shears tend to be much slower, but if done carefully can result in a fleece with longer undamaged fibres.
See also Pliny, *Naturalis Historia* 8. 190-193; Varro, *On Agriculture* 2.11.9; Written accounts indicate that fleece was primarily shorn in Classical Greece, though it may have been plucked in some cases.

and there are many varying methods and techniques used to accomplish this. The fleece is manually picked free of vegetable matter such as grass, burrs, seeds, and other debris, and then combed out in a process called carding.[139] During the carding process, the wool is combed out and formed into rovings or rolags, before they are ready to be spun into smooth thread (Fig. 9).[140]

Fig. 9. A rolag (left) and a roving (right). Credit: Tatianna Bechal, 2021.

Methods used to prepare the fibres before spinning vary, and may depend on regional differences and cultural traditions such as climate and availability of certain resources (i.e. soapwort, direct access to the sea, etc.).[141] When beginning this process, it was a challenge to find the best and most accurate method of cleaning the fleece, as there seems to be little or no

[139] Chamberlain and Crockett 1974, 22.
[140] Chamberlain and Crockett, 35-37; Barber 1991, 20. Rovings are long carded sections of wool which can be wound around a distaff. Rolags are carded the same way, but instead of a long length of carded wool, the result is a short rolled bundle of fibres.
[141] Bouza 1976, 29, 34.

information from Classical Greek sources detailing the process. Some modern wool workers prefer to card the wool before washing it in order that it may retain as much of the natural lanolin as possible, thereby making it easier to work with.[142] However, a raw unprocessed fleece tends to be very dirty and smelly, and so I chose to avoid handling it too much before washing out some of the dirt and debris (Fig. 10). Washing the fibres required experimentation with several different methods, and the first attempt began by washing the fleece straight off the sheep prior to plucking and hand sorting it. As the fleece directly off the animal was covered in dirt and grease, this initial experiment resulted in wool which came out of the wash still packed with dirt and debris. After this initial attempt I opted instead to pluck and sort the wool prior to washing it to remove any large debris. Many modern spinners pluck their wool prior to washing it in order to remove as much vegetable matter as possible, and a similar process was used of first picking the wool by hand, then washing it, then finally carding it.

Fig. 10: Raw fleece straight off the sheep, un-picked and uncarded. Credit: Tatianna Bechal, 2021.

[142] Chamberlain and Crockett 1974, 35.

First it was necessary to conduct a cursory hand picking of the fleece to remove the larger bits of grass and debris. This process of hand picking involves "gently pulling apart [the] fibres so the mass of the fabric becomes fluffy, airy, and more evenly distributed."[143] This can be done in one of two ways, either by pulling apart the fibres in all directions "encouraging them to lie every which way in a fluffy mass", or by gently pulling apart the fibres while keeping them parallel to each other.[144] During this process, matted sections, burrs, and foreign objects are removed by hand, while much of the smaller dirt and debris falls out naturally as the fleece is handled. While this process of pre-plucking the wool created a rather large mess, this step of hand picking the fleece first made the washing process much easier later on, and resulted in wool which was much easier to card than the wool which was carded before washing (Fig. 11).

I began the hand picking process by pulling a handful of wool off the fleece and pulling apart the fibres haphazardly to fluff them up before washing, while simultaneously picking out debris. The reasoning behind this was to create space between the fibres and allow the dirt and debris to more easily come out during the wash and carding. It was unclear if this was the most accurate way of approaching this process. As there are no detailed references on how wool was washed in Classical Greece, modern ethnographic practises were drawn from when approaching this step. Picking was messy and time consuming, and the first round of wool was sorted this way over the course of several hours. After pulling apart the fibres and removing the vegetable matter I placed the picked wool aside to be washed. To keep the fibres bundled together and in an effort to avoid stray clumps of wool, the fibres were placed into a large

[143] Chamberlain and Crockett 1974, 35; Barber 1994, 36.
[144] Barber 1994, 36. The method chosen to pick the wool and separate the fibres will affect the resulting strength and softness of the thread.

mesh laundry bag to be washed (Fig. 15). As stated above, it is unclear how the women of Classical Greece handled this step or if they employed any strategies to avoid errant fleece escaping during the washing process. There is ethnographic evidence from modern Greece that the fleece may have been washed in its entirety right off the animal, which would eliminate the need for securing the fibres into neat bundles.[145]

Fig. 11: Dirt and vegetable matter that fell out when picking. Credit: Tatianna Bechal, 2021.

After sorting enough wool in this way to fill several laundry bags, a second method of picking the wool clean was used. Rather than haphazardly pulling apart the fibres into small fluffy masses, I instead attempted a more controlled approach. Sheep wool grows in natural sections called locks (Fig. 13), and after observing video from modern artisans I decided to approach the process in a more methodical way based on modern fibre arts techniques.[146]

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[145] Bouza 1976 34; Chamberlain and Crockett 1974, 35.

[146] "How to Wash a Fleece". *YouTube*. Uploaded by The Woolery, 30, August 2013. https://www.youtube.com/watch?v=K_uYU0veoBM&list=PL8tjaVs9XrBL8W0dgYB7dqHqNE-F31XNA&index=4

Fig. 12: This is the initial batch of wool picked clean and washed using the ‘cloud’ method. Credit: Tatianna Bechal, 2021.

Fig. 13: A lock of wool unwashed. Credit: Tatianna Bechal, 2021.

Gently removing a natural lock from the larger fleece, I carefully spread out the fibres, keeping them more or less parallel to each other (Fig.14). Picking the wool this way dislodged much of the dirt and debris with little effort, while the remaining debris could be picked out manually. This diffused lock of wool was then set aside, and they were stacked in an orderly pile of fibres all laying parallel to one another.

Once a few dozen of these locks had been sorted and picked, they were then placed into mesh laundry bags to be washed. Once washed, the resulting wool came out in little bundles of fibres ready to be carded, as opposed to the tangled mass of fibres which were processed using the first method. While the first method certainly worked, the second resulted in much easier carding, and ultimately much easier spinning.

Fig. 14: A natural lock of wool which has been washed and diffused. Credit: Tatianna Bechal, 2021.

By using the method of keeping the wool in its natural locks, the fibres were already inclined to lay parallel to one another, and they were easier to comb out into neat rovings or rolags later on. Keeping the locks intact seemed to retain a little more of the dirt and debris than the first method, and it was necessary to wash them an extra time or two to remove all the dirt. However, the resulting wool was much easier to work with. With the wool picked clean and the fibres gently diffused, it was ready to be washed.

Fig. 15: Locks of wool picked clean of debris and ready to be washed, carefully placed inside a mesh laundry bag. Credit: Tatianna Bechal, 2021.

Washing the Wool

There are vague descriptions of the process of wool washing from the ancient Greek world such as the one found in Aristophanes' *Lysistrata*, but nothing in such detail as to be a helpful guide. Even modern wool workers vary in their approach to how they clean their wool, and methods range from using dish soap, commercially available wool detergents, soapwort root, plain warm water, plain cold water, and even sometimes washing the wool while it is still on the animal.[147] Even ethnographic studies indicate differing practises by region. In an article from the Penn Museum *Expedition Magazine* published in 1976, the author describes how the women of Northern Greece rinse their fleeces in the "gentle waves of the Mediterranean sea" and then spread them on the beach to "dry in the strong Greek sun."[148] Other sources refer to scouring, boil washing, bleach-free detergents, urine, and there are also some indications that *saponaria officinalis* (commonly known as soapwort, wild sweet william, and bouncing bet)[149] may have been used as a detergent for cleaning wool and other textiles (Fig. 16).[150] I was unable to find any reliable reference to this practice in the classical Greek world but the plant has certainly been used as a very gentle natural detergent throughout much of European history to clean clothes, and is often still used today to clean and restore antique tapestries ("saponin").[151]

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[147] Barber 1991, 21-22; Chamberlain and Crockett 1974, 35; Bouza 1976, 29.

[148] Bouza 1976, 34.

[149] *United States Department of Agriculture*. https://plants.usda.gov/home/plantProfile?symbol=SAOF4. Accessed 9 Nov. 2021.

[150] Andersson Strand et al., 2010, 160; Chamberlain and Crockett 1974, 28; Pliny, *Naturalis Historia,* 25. 57; Columella 11. 2.

[151] Theophrastus, *Enquiry into Plants*. Volume II. 6.4.3-4. One mention of soapwort appears in Pliny, the Elder, *Natural History* 20. 79; Ray Rogers translated the name 'soapwort' but there is some discussion about this translation; see http://www.herbs2000.com/h_menu/starch.htm, but it turns out the term for *saponaria* was likely a mistranslation.

Fig. 16: *Saponaria Officinalis*. Wikimedia Commons. Aug. 6 2004.

As a guide for how to wash the wool, I yet again relied on the knowledge of several differing traditions both modern and ancient, and eventually settled on a process which suited the available resources. As it is still used today by many to gently and naturally clean delicate textiles, soapwort was the method which I chose to wash the fleece due to its ability to retain some of the natural lanolin in the fibres while still removing the dirt. It is important that the wool retains some of this natural grease, as it helps the fibres retain their strength and suppleness and makes it much easier to spin into thread.[152] While there were no specific mentions of soapwort being used in Classical Greece for washing wool, the plant is native to Europe and has been used throughout much of history as a cleaning agent. It is at least possible

[152] Chamberlain and Crockett 1974, 30.

that soapwort could have been used for this purpose, whether it was recorded or not.[153] This is yet another example of many where knowledge and information used on a daily basis was not alway recorded and where it was necessary to draw on sources outside the ancient Greek world for information on how to proceed.

Fig. 17: Dried soapwort root. Credit: Tatianna Bechal, 2021.

I first purchased dried soapwort root from a local Canadian merchant and created a detergent from it by simmering it in water (Figs. 17, 19). Later during the same summer, I found what I believe to be common soapwort growing in the countryside of Southwestern Ontario (Fig. 18). A natural detergent was created from these plants by boiling and then simmering them in water. The result produced a medium brownish liquid the consistency of

[153] I do not claim that soapwort reflects Classical Greek practises, but it is perhaps possible. At the very least it is a practice which is used today to clean wool, and that was good enough for me to try it out.

water which lathered up when agitated (Fig. 20). The resulting detergents both came out the same, and both worked well to get the fleece clean.

Fig. 18: Dried soapwort root purchased online (right); Dried stems, leaves, and roots harvested in Ontario. Credit: Tatianna Bechal, 2021.

Fig. 19: Soapwort root simmering on the stove. Credit: Tatianna Bechal, 2021.

Since both soapwort and lanolin are natural it was safe to pour the dirty water outside among the trees rather than down the drain.[154] Instead of washing the fleece in the sink, two large buckets were used. With one bucket filled with warm water and the homemade soapwort detergent, two to three mesh laundry bags full of the picked wool were carefully submerged.

Fig. 20: Soapwort root finished simmering, the detergent is ready to be used. Credit: Tatianna Bechal, 2021.

[154] As well because I did not want to risk potentially clogging my drain with lanolin, I chose to pour the water outside.

Agitating the wool can damage its scales, and combined with heat and moisture can result in felting.[155] Since my plan for the wool was to card and spin it into thread, this needed to be avoided. The dirty wool was soaked in a solution of warm water and 1-2 cups of detergent for fifteen to thirty minutes. Once the wool was clean, the water was discarded. Once the wool had soaked in the solution, it needed to be rinsed. To do this I filled the second bucket with water the same temperature as the wash water - shocking the wool with sudden temperature changes can also cause the wool to felt, so it is important that the water be kept around the same temperature throughout the process.[156]

Gently squeezing the dirty water from the wool while being careful not to wring or twist the fibres, I placed the bags into the second pail of clean warm water to rinse. Each batch of wool was rinsed two to three times by letting it soak for another ten to fifteen minutes, and once the rinse water was clear, the wool was finished being washed.

Some of the sections of wool contained more dirt than others, such as the wool from the bottom of the sheep. When processing these areas, they needed to be washed in the soapwort solution several times before the rinse water ran clean. Once the wool was sufficiently clean of dirt, the bags were removed from the rinse water and gently squeezed out one last time. At this point I was left with a bucket full of wet, smelly, but otherwise clean wool.

To dry the wool, it was spread out on a sheet of cloth outside and laid out to dry in the summer sun (Fig. 21). A full afternoon of sun-drying on the warmest of Ontario summer days

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[155] Chamberlain and Crockett 1974, 19, 35. I found no direct information about how this problem was avoided by the people of Classical Greece. With felting being one of the oldest ways of making fabric it stands to reason that the women of the ancient Mediterranean knew of wool's tendency to felt under certain circumstances. Perhaps they too avoided agitating their wool as well, or perhaps they avoided heat during their wash to combat this problem.
[156] Chamberlain and Crockett 1974, 19, 22-25.

was not enough to dry the wool, and in the end the damp wool needed to be brought inside for the evening to continue drying indoors. A laundry drying rack was set up indoors with a fan on and the windows open in order to encourage it to dry. This washing and drying process was a very labour intensive and lengthy task, and in the end it took two consecutive days of bringing the wool outside during the day, and inside at night before it was dry enough to card.[157]

Fig. 21: Washed wool set out to dry in the sun. Credit: Tatianna Bechal, 2021.

Carding

With the wool having been washed, it was time to further prepare the fibres through a process called carding. At this point the majority of the vegetable matter had been plucked out

[157] It is unclear how this may have been done in ancient Greece or how long this drying process may have taken, though it may be possible to hang-dry a fleece in its entirety if it has been kept intact throughout the washing process.

by hand, and the wool was mostly an even cream colour. Some of the locks which were the dirtiest still retained some traces of dirt, but the process of carding helped to release most of the remaining dirt and debris (Fig. 22, 23). Occasionally it was necessary to stop carding and pick out remaining bits of grass, seeds, or burrs by hand before continuing to comb out the fibres. This process took several attempts before I found a method which worked well for me. As with the previous steps in the process, here again there does not seem to be much information on the manner in which Greek women carded their wool. There are references to the Greek *kteis,* and plenty of evidence for a tool called an *epinetron*, but my attempt to recreate these tools met with frustration and I eventually decided to troubleshoot on my own.

Fig. 22: This lock of wool (left) has been washed, but it still contains some dirt and debris. Credit: Tatianna Bechal, 2021.
Fig. 23: This freshly washed wool is still damp (right). Even after washing, there is still some dirt and vegetable matter caught in the fibres. Credit: Tatianna Bechal, 2021.

Ancient Greek women used a device called an *epinetron* or *onos* to card their wool (Fig. 24).[158] The *epinetron* was a semi-cylindrical clay vessel with a closed end and a rough textured surface. This device was meant to fit over the knee like a thimble while seated. It served the dual function of both protecting the wearer's leg from the friction of combing out the fibres, while also holding the wool in place by grabbing onto the fibres as they were combed out. While the majority of the surviving *epinetra* were crafted in sixth and fifth century Attica, a small number of the ones found date back to late Mycenaean Rhodes.[159]

Fig. 24: Greek *epinetron*. Terracotta (Black Figure). 500-480 B.C.E.. The British Museum 1814,0704.1205.

[158] Barber 1991, 77-78

[159] Barber 1991, 78.

While there are several examples of the Greek *epinetron* from classical antiquity, there is little information on how exactly this device was used. By creating a clay imitation based on the artefacts from antiquity, I hoped to learn how the tool was meant to be used. Using a block of air dry clay I replicated a simple one by hand. This experiment would not be used to card the wool itself since it was not made from kiln fired clay, and therefore would be too brittle to withstand the pressures of combing out the wool. The intention behind this trial was primarily to observe how the textured surface of the clay might grab onto the wool fibres.

Fig. 25: First attempt at creating an *epinetron* out of clay. The clay cracked and broke along the edges (left). Credit: Tatianna Bechal, 2021.

The result of this initial attempt was a sad little cylinder which was indeed very brittle and too small to fit over the knee (Fig. 25). However, this experiment revealed that the surface of the clay *epinetron* I created was nowhere near textured enough to grab onto the wool fibres.

The second attempt was made utilising two combs rather than an *epinetron* to card the wool. This method was influenced by modern weavers who employ techniques drawn from Viking textile traditions. In this method two wool combs with long curved metal teeth are used to align and smooth the fibres (Fig 26). To make a version of wool combs, the teeth of two metal toothed hair picks were bent just slightly at the midpoint, then the two combs were strapped together to create a single instrument with curved, slightly off-set teeth (Figs. 27).

Fig. 26: Viking style wool Combs with long metal teeth from valkyriesupply.com.

To comb out the locks of wool, I began by affixing several locks onto one comb (Fig. 28). Holding the comb loaded with fibres vertically in my left hand, and the second empty comb horizontally in my right, I combed in a perpendicular motion gradually transferring the wool from one comb to the other. By gently grabbing only a few fibres at a time, eventually all the fibres were transferred from the first comb to the second. The process was then reversed by switching the full comb back into my left hand and repeating the process. Once each comb was emptied, there were still some tufts of wool left behind in the teeth, which were removed

Fig. 27: Wool carding combs constructed out of metal hair picks and zip ties. The teeth are slightly offset to imitate the style of Viking wool combs. Credit: Tatianna Bechal, 2021.

and discarded. This process of transferring the fibres from one comb to the other can be done as many times as needed in order to align the fibres and remove dirt and debris. This method was a very straightforward process and it worked fairly well to card the fibres. However - even though the Greek *kteis* was a tool which was likely used for wool combing - I was unable to find any sources referring to a similar method used in fourth and fifth century Greece.

Fig. 28: Several locks of wool have been applied to the comb. Credit: Tatianna Bechal, 2021.

Fig. 29: (left) The front of the rough *epinetron* constructed from cardboard, duct tape, and carding cloth. Credit: Tatianna Bechal, 2021.
Fig. 30 : (right) The back of the rough *epinetron* constructed from cardboard, duct tape, and carding cloth. The curve of the cylinder is meant to fit comfortably over the knee. Credit: Tatianna Bechal, 2021.

While the Viking inspired wool combs worked well enough to prepare the fibres, they did not illuminate how the people of Greek antiquity carded their wool. In an effort to replicate Greek practises, I took inspiration from modern wool carding drums (Fig. 31) and brushes as a jumping off point. The resulting device served as a functional *epinetron* which ultimately was used for the remaining duration of the project. This *epinetron* was constructed from cardboard, duct tape, and a sheet of carding cloth purchased from a merchant online. This cloth is a 12x12” sheet of rubber, with small metal teeth protruding from the surface (Figs. 32, 33).

Fig. 31: Modern standard drum carder. The teeth on the drum grabs onto the wool fibres, much like the surface of a Greek *epinetron*. © 2020 Clemes & Clemes, Inc.

Modern drum carders make use of two surfaces with protruding metal teeth (Fig. 31). To imitate this system, a metal toothed brush marketed for pet grooming was selected to be the tool which would assist in combing out the fibres. While not intended for use as wool carding brushes, they resemble the kind of wool carders sold by many textile artists (Fig. 34) - and were much more readily available to me.

Fig. 32: Carding cloth teeth closeup from Okanagan Dye Works. © 2021, Okanagan Dye Works.

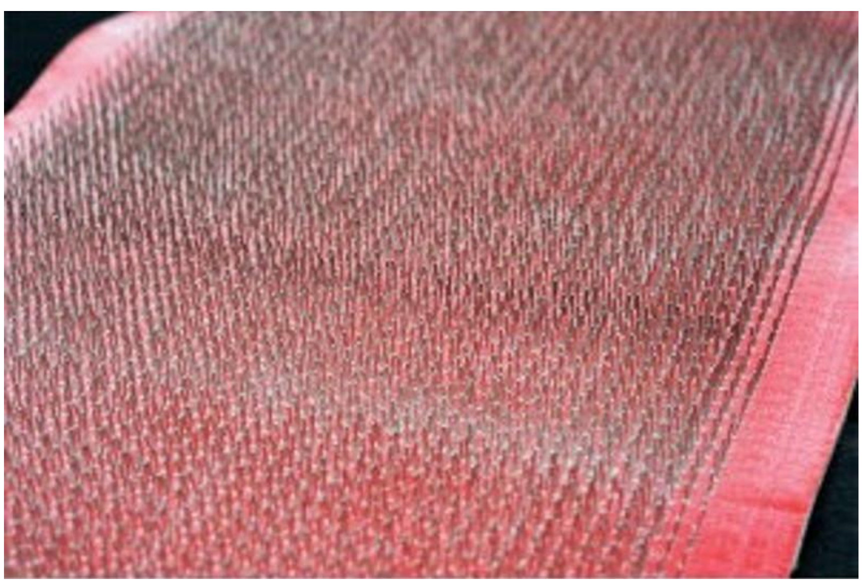

Fig. 33: carding cloth teeth closeup from Okanagan Dye Works. © 2021, Okanagan Dye Works.

Fig. 34: Wool carding brushes. Copyright © 2021 Ashford Handicrafts Ltd.

Fig. 35: Pet grooming brushes. The teeth are very similar to the teeth found on carding brushes. Credit: Tatianna Bechal, 2021.

To begin the carding process with this combination of *epinetron* and carding brushes, a few of the cleaned locks of wool were selected and laid on the teeth of the *epinetron* which was placed over the knee. With the brush in one hand, I gently brushed towards myself in a sweeping motion, catching only a few fibres at a time in the teeth of the brush (Fig. 36).

Fig. 36: *Epinetron* fitted over the knee with locks of wool applied showing the process of carding. Credit: Tatianna Bechal, 2021.

As the fibres were carded, they gradually transferred from the *epinetron* to the brush. This process took awhile, and at first it seemed as though little progress was being made. Eventually though, most of the fibres had been transferred onto the brush, and the *epinetron* was left with only a few loose fibres and matted sections of wool which would not be used in spinning. While doing this quite a lot of dirt and debris had fallen down between the teeth of the *epinetron*, and it was necessary to stop and pick out the remaining bits of vegetable matter from the wool as I worked (Fig. 37).

Fig. 37: The *epinetron* after carding. The remaining dirt and debris in the wool has fallen out during carding and can be seen between the teeth. Credit: Tatianna Bechal, 2021.

Once the brush had become packed with fibres, I removed the wool from the teeth, making sure to remove the entire thing in one piece, and placed it back onto the *epinetron* so that the teeth could grab the fibres again (Figs. 38, 39, 40). Just as when using the combs, this process would be repeated as many times as necessary to make them suitable for spinning.

Fig. 38: Carded fibres are removed from the brush once they have all been transferred off the *epinetron*. Credit: Tatianna Bechal, 2021.

Fig. 39: All these fibres have been combed out once and removed from the brush. Credit: Tatianna Bechal, 2021.

Fig. 40: Once all the fibres are transferred to the brush, they are removed and reapplied to the *epinetron* to be carded again. Credit: Tatianna Bechal, 2021.

This process of slowly transferring fibres from *epinetron* to brush was repeated several times. Every time the wool was combed and transferred onto the brush the fibres were smoothed out and any leftover dirt and debris was released. While I did not find there to be a specific number of times necessary to card the wool back and forth, I observed that the fibres needed to be carded a minimum of three times before all the remaining debris was released and the fibres were smoothed out. The locks which were still full of dirt after being washed were carded as many as six or seven times before they were fully clean and smooth. As well, the more times a section of wool was carded, the smoother and silkier the resulting rolag, and the easier it was to spin later on. Once the wool was carded smooth and the dirt had fallen out, I then removed it from the brush for a final time and rolled up this piece of wool into a little rolag or roving of carded wool (Fig. 41).

Fig. 41: A small rolag of wool after it has been carded and removed from the brush. Credit: Tatianna Bechal, 2021.

6. Spinning

To aid in the spinning process, both ancient and modern wool-workers make use of a tool known as a *distaff*. A *distaff* can be as simple as a forked stick, or it can be an elaborately decorated device to which the carded wool is tied.[160] The wool is anchored securely onto the top of the *distaff* with a length of cord or string. The *distaff* functions both to make the task of spinning portable, as well as to make the work of spinning easier by freeing up the spinner's hands to control the flow of fibres onto the spindle. Because *distaffs* were often made of wood or branches, not many identifiable remains are found from pre-classical Greece, and much of the evidence used here will draw from more current sources.[161]

Fig. 42: Jug. Attic ca. 490B.C.-470B.C.. Attributed to the Brygos Painter; A woman stands while holding a short *distaff* in her left hand and spinning thread with her right. The spindle dangles freely as she spins. The Trustees of the British Museum. Museum number 1873,0820.304.

[160] Hom. *Od*. 4.130-2. Alcandre gifts to Helen a set of elaborate weaving implements, including a golden *distaff*.
[161] Barber 1991, 69.

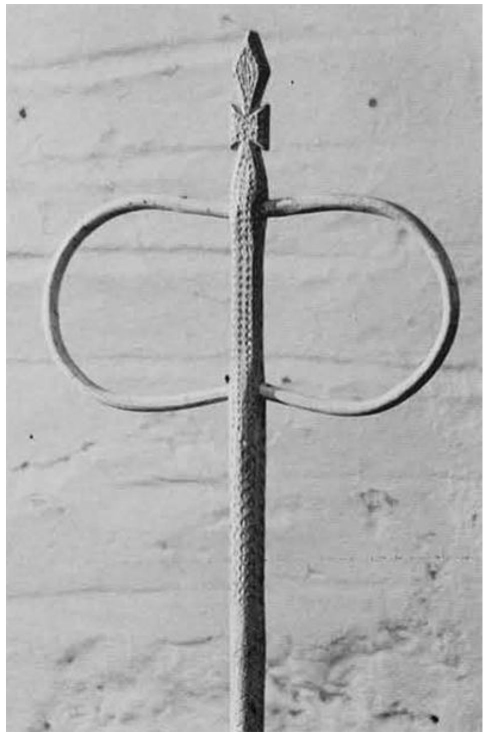

Fig. 43: Example of a modern Greek *distaff* from The Penn Museum magazine article "From Spindle to Loom" *Expedition Magazine* 19.1 (1976): n. p. *Expedition Magazine*. Penn Museum, 1976 Web.

Distaffs can come in a variety of shapes and sizes depending on their intended use and origin, and can be made of many different materials including wood, metal, and bone.[162] A *distaff* can be fashioned from the branch from a tree, or it can be an elaborately crafted heirloom, and many "Classical Greek and Etruscan *distaffs* are so fancy (often in bronze) that there would seem to be a considerable tradition behind them."[163] *Distaffs* come in a variety of sizes and lengths as well as different shapes (Figs. 42-46).[164] Many of the ancient Greek *distaffs* were flat or forked, while later styles tended to have a cage-shaped upper part, rather than a flat or forked holder (Fig. 44). Depending on the length of the *distaff* and the preference of the spinner, it could either be held in one hand or tucked in the belt or waistband of the

[162] Barber 1991, 69.
[163] Barber 1991, 69; Bouza 1976, 34.
[164] Barber 1994, 37.

spinner's garment. The particular mobility which the *distaff* offers plays a significant role in why the use of the spinning wheel was not more widely adopted, even in modern Greece.[165]

The *distaff* represents yet another example of when it was necessary to fill in the gaps where the ancient sources do not offer sufficient detail. Greek imagery of women working with long wool rovings, pulling them out of baskets, and wrapping them around a *distaff* can be seen from antiquity (Fig.1). However, in attempting to re-create this myself based on imagery alone, I encountered a great deal of difficulty in the practical application.

Fig. 44: Wooden *distaff*. Kalymnos. 19th century. Though a modern example, this *distaff* shows an example of the different styles of tool used throughout the world. Copyright Trustees of the British Museum. Museum number Eu1972,Q.2511.

[165] Barber 1991, 69.

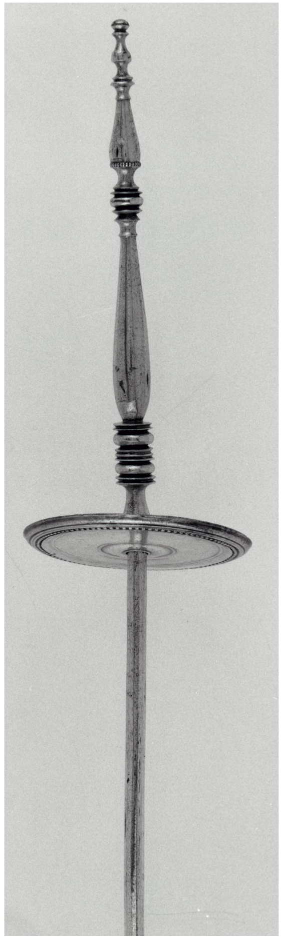 

Fig. 45: Silver *Distaff* (left). Excavated Bursa. 1st century Roman Imperial. 22.5 cm long. Copyright Trustees of the British Museum. Asset number 1913,0531.6.

Fig. 46: Wooden paddle *distaff* (right). Copyright Trustees of the British Museum. Asset number 849675001.

The initial venture into spinning began with an attempt at making long rovings like the ones seen on the Greek *Lekythos* (Fig. 47). However, it was difficult to keep the rovings a consistent thickness and they were tedious and difficult to spin into thread, as there was a constant need to stop spinning in order to unwind the roving from the *distaff*. Overall, the size of the rovings was extremely small in comparison to how they appear in the images - at most a couple of feet long, and very thin in diameter, which very likely contributed to their difficulty in spinning.

Fig. 47: A small roving made using brushes and *epinetron*. Credit: Tatianna Bechal, 2021.

In an effort to press on and learn how a *distaff* was used, I constructed two different sizes of staves out of materials both found and purchased. The first *distaff* was made using a table leg purchased at a hardware store to function as the shaft, and reed salvaged from an old basket to create a flat paddle like surface to tie the roving onto (Fig. 48). This first *distaff* was ultimately too large and awkward to handle, and the gaps created between the reed prongs at the top were too big for the insubstantial rovings to adhere onto and stay in place even after they were tied down. The second *distaff* was made using the wooden handle of a (new) toilet plunger. The same basket reed and twine was used as in the first staff, and I was careful to ensure that the gaps in the top were much narrower than in the first attempt. This second staff was much easier to work with, and I found that I could comfortably tuck it under my arm as I worked the fibres. However, this improved *distaff* did not eliminate the need to stop spinning and continually untie the wool roving from the end in order to feed more fibres onto the spindle.

Fig. 48: Both *distaffs* side by side made from wood and basket reed. The first *distaff* (right) was made from a table leg. Length: 28”. The second *distaff* (left) made from a plunger handle and basket reed. Length: 18 inches. Credit: Tatianna Bechal, 2021.

Fig. 49: Spindle and *distaff* dressed with carded wool. Credit: Tatianna Bechal, 2021.

Having found the *distaff* to hinder my progress rather than help, I chose to try a different method. Taking a note from modern textile traditions, I instead turned the carded wool into rolags rather than rovings. This method of preparation created individual little 'sausages' of wool, slightly larger than the size of my hand (Figs. 41, 50). These small rolags were much easier to manipulate and control while spinning. I suspect the size of roving and the amount of wool carded in a batch might affect how easy it is to operate the *distaff*. As the *distaff* was intended to make the process of spinning easier - to free up a hand while spinning as well as act as a portable wool-dispenser - I opted to forgo using it entirely and focused instead on learning to spin thread.[166]

Fig. 50: Rolag of carded wool (left), and a roving of wool (right). Credit: Tatianna Bechal, 2021.

Without the *distaff* slowing me down I was able to press on and begin spinning. With the carded rolag of wool held in one hand, I was able to use the other hand to draw out the fibres and to give the spindle an occasional twist every so often when it lost momentum (Fig. 51). The hand which was holding the rolag helped to control the feed of the fibres into the other. This method allowed for easier control in the consistency and flow of fibres being fed into the spindle with much more precision than when the *distaff* was used.

[166] Barber 1991, 69.

Fig. 51: To spin fibres, the wool rolag is held in the left hand, and control the flow of fibres and spin of the shaft with the right. Credit: Tatianna Bechal, 2021.

To turn the fibres into thread, a spindle and whorl is used to create spin and momentum. This set of tools consists of a slim shaft often made of wood or other material such as bone and a weight, or whorl, affixed to it. The whorl can be affixed to the shaft in a variety of locations. Low whorl, high whorl, and middle whorl spindles are all methods which have been used globally, and can vary depending on the tradition from which the spinner has learned.[167] While perishable spindle shafts do not often survive in the archaeological record, many objects are found which may have been used as spindle whorls, and it is often difficult to ascertain whether the object in question was used as a spindle whorl or was simply a similar object with a hole pierced through it.[168] The shaft of the spindle has a hook or groove carved into the top which is meant to catch the thread as the spindle turns.[169]

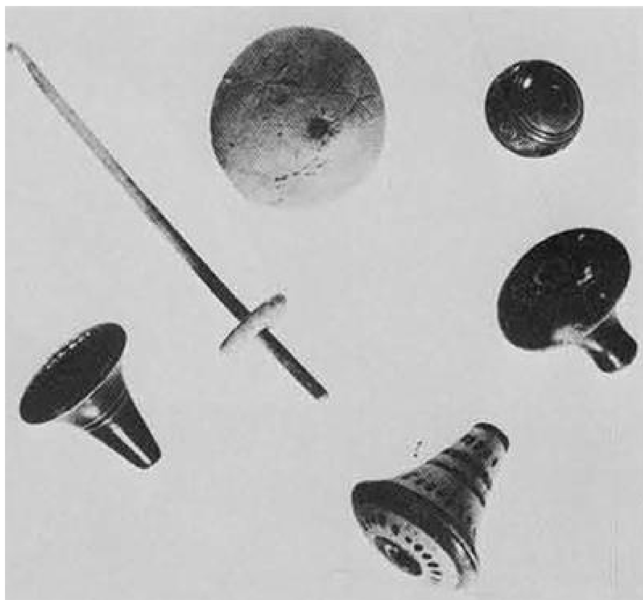

Fig. 52: Greek bottom whorl spindle and several whorls from the Classical Period. *Expedition Magazine*. Penn Museum, 1976.

The basic mechanics of how thread is spun can be demonstrated by simply taking a few fibres and rolling them down your leg, twisting them together to create a short length of thread.[170] While this method is effective it can only create a short length of thread at a time, and as soon as it is released the thread will begin to unwind as there is nothing to hold the twist

[167] Barber 1991, 43.
[168] Barber 1991, 51.
[169] Barber 1991, 42; 53; 59.
[170] Barber 1994, 36.

in it.[171] The spindle and whorl allows the creation of a continuous length of thread to be spun, using gravity and momentum to twist the fibres together.[172] The spindle shaft provides a space around which the thread can be wound once it has been spun, and the weight of the whorl provides tension and its momentum keeps the whole thing spinning as the spinner feeds fibres into the thread. Not only does the shaft of the spindle provide storage for the thread once it has been spun, but by winding the thread around the shaft it can retain its twist and not unwind as soon as the tension is released.[173]

Fig. 53: ⅜ inch dowel rod (left) spindle and wooden whorl. Credit: Tatianna Bechal, 2021.
Fig. 54: The wooden wheel fits snugly onto the rod (right). Credit: Tatianna Bechal, 2021.

A few different materials were tried when sourcing the items to be used for the spindle and whorls, but ultimately the first set of materials which were used ended up being the most

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[171] Barber 1994, 36-38.
[172] Barber 1994, 37.
[173] Barber 1994, 37-38; For a short demonstration of how to spin thread: https://drive.google.com/file/d/1El61LqGpNfdrLmsJQqu3s9bvOLVDPNTg/view?usp=sharing

effective. The spindle was made with ⅜ inch diameter dowel rods, and wooden toy wheels with an inner diameter of ⅜ inch to match the rods were selected to be used as the whorls. The weight and size of the ⅜ inch diameter wheel and dowel rod were perfect for learning to spin wool for the first time. The large spindle and whorl were heavy enough to keep the apparatus spinning for a long time while I learned how to feed the fibres onto the spindle. The wooden tools created a somewhat thick, strong thread which held up to the constant handling of a novice spinner.

Fig. 55: Some of the wheels fit more tightly than others. A small elastic band around the bottom of the spindle helped to keep the whorl from falling off during use. Credit: Tatianna Bechal, 2021.

Into the top of the dowel rod a small hole was drilled and into it a small metal hook was inserted to catch the thread and keep the spindle upright as it rotated (Fig. 57). Some spindles have a spiral groove carved into the top and worn smooth by prolonged use and wear over time. I did attempt to recreate this early on, however the attempt at carving and sanding down the end of one of the rods to approximate this 'self-hook' did not really work as intended. Moving forward with the original metal hook design, the very top of the spindle was lightly sanded down to reduce the harsh edge of the dowel rod at the top in the hopes of reducing unwanted friction from the edge of the wooden rod as it spun. I suspect this edge would likely be worn down on its own over time and with extensive use.

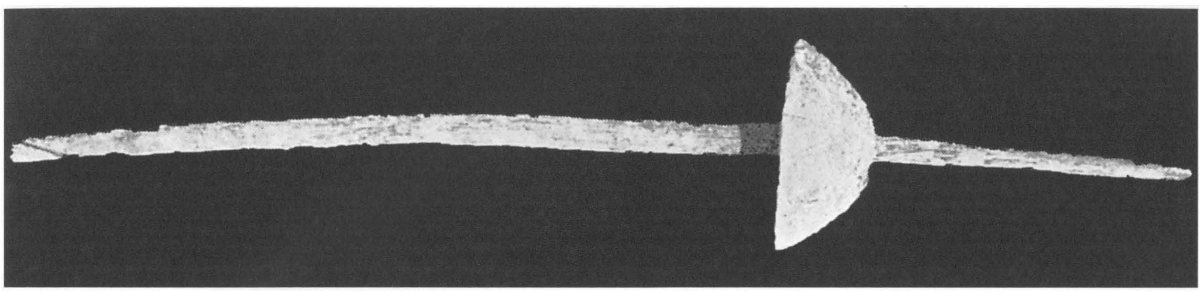

Fig. 56: Egyptian spindle with spiral groove (left) instead of a hook. from Gurob, Tomb 11. From Brunton and Engel bach 1927: pl. XIII: 8. Foreigners at Gurob.

Fig. 57: Small hook at the top of the spindle keeps the thread securely attached to the spindle as it spins. Credit: Tatianna Bechal, 2021.

In a video recording of a workshop from Eva Andersson Strand at the Centre for Textile Research in Copenhagen, she discusses the weights of spindle whorls used in their experimentation.[174] She presented threads spun with whorls that weighed as little as two or three grams each, which prompted an experiment of my own using lighter and smaller whorls.

A second spindle with a rod having a diameter of ¼ inch was paired with two hand made clay whorls. These clay whorls weighed 20g and 30g and were meant to fit onto the new smaller rods (Figs. 58, 59). I found that these lighter tools were more difficult to control than the first heavier ones, as they did not create enough momentum to keep the spindle rotating for very long. Instead the spindle rotated no more than a few seconds, and it was not inclined to twirl fast enough to twist any length of fibres together. I suspect my skill level affected these results, as I may have been attempting to feed too many fibres into the thread for the weight of the spindle. Overall the lighter tools were much more difficult to use, and the wooden whorl allowed me to spin a length of thick yarn almost continuously until it was long enough to touch the ground without having to stop and re-twirl the spindle. However, the small amount of thread produced on the lighter tools resulted in much finer and more delicate thread than that which was spun the heavier implements, and I suspect a more experienced spinner would be able to produce a very fine thread on a similarly weighted tool.

[174] Experimental Session - Eva Andersson Strand (Centre for Textile Research, Copenhagen). https://vimeo.com/87683269 Séminaire d'Histoire et d'Archéologie des Mondes Orientaux (SHAMO) 2014.

Fig. 58: ⅜ inch dowel rod (bottom) and ¼ inch dowel rod (top) used as spindles. Credit: Tatianna Bechal, 2021.

Fig. 59: Wooden whorl with ⅜ inch diameter opening (left), and a smaller ¼ inch diameter spindle with 30g clay weight (right). Credit: Tatianna Bechal, 2021.

Spinning the first spindle was a slow process of learning the correct technique and developing muscle memory. While the process of spinning itself is not particularly difficult to learn, the thread which was produced during the first attempt came out very uneven and bulky. Becoming good enough at turning wool fibres into fine even threads is a skill that takes an experienced hand. Though still fairly uneven in places, by the time my fourth spindle was filled, the thread produced had become significantly more consistent than the first spool (Fig. 60).

Fig. 60: The very first spindle (left) contrasted to the fourth spindle (right). The threads on the left spindle are bulky and uneven, while the thread on the right spindle is much finer, more consistent, and more tightly spun. Credit: Tatianna Bechal, 2021.

It was at this point when I discovered just how much the carding process influences the ease of spinning. The wool which was carded six or seven times produced silky fluffy rolags which were the smoothest to handle and fastest to spin. They also produced finer, more consistent thread, and the fibres were generally easier to feed into the spindle at a consistent rate. The fibres of these softer rolags did not resist my hands as they were fed onto the spindle, and they seemed almost as though they were already inclined to twist into thread without much coaxing. Some of the rolags which were carded only two or three times still contained some debris and matted tufts of fibre in them, making them somewhat resistant to spinning. Particularly, the first round of wool which had been washed and plucked without leaving the natural locks intact resulted in rough and uneven threads which were difficult to spin.[175]

I often found myself standing or walking around as I spun thread. The extra height gained from standing as opposed to sitting made it easier to spin a longer length of thread at a time, and the heavy spinning tools allowed for the spindle to twirl almost continuously until my height and arm span could not accommodate a longer thread. It was not necessary to stop as often to wind the thread around the spindle, which significantly increased the speed and efficiency of spinning.

Of all the steps in the process of turning raw fleece into a usable textile, I enjoyed the spinning process the most. While becoming a true master undoubtedly takes a lifetime of practice, I found the basic mechanics of spinning thread to be an easy skill to pick up as a beginner. As well, the process itself has a relaxing and almost meditative quality to it. Because

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[175] Barber 1994, 36.

of this, I found spinning thread to be a rewarding task, conducive to multitasking, portable, and requiring only a few small tools.

7. Weaving

Anatomy and Set-up of the Loom

Setting up the loom is an important, involved, and time consuming task, as such the final leg of this process is divided into two sections. The first section will document the process of setting up the loom and preparing it to weave. The second section will cover the weaving process itself, in which the threads were finally woven into a piece of cloth.

Many different types of loom exist throughout human history and their use has been recorded in different eras and locations. The oldest style of loom is known as the horizontal ground loom, which appears in Egyptian imagery from the Predynastic period. The slightly later vertical loom, made with an upper and lower beam appears in the same region during the eighteenth and nineteenth dynasties, and also appears in later Roman communities.[176] Finally, there is the vertical warp weighted loom, which was the loom used in the ancient Greek world and throughout much of Europe.[177] All of these different types of loom function in similar ways by holding tight of one set of threads, called the warp threads, so that the weft threads can be interlaced in alternating patterns between the warp threads. In order to do this the warp threads must be first anchored on one end to something. This part of the loom to which the warp is anchored is called the cloth beam. On a vertical warp-weighted loom this beam is located at the top of a frame, and is the horizontal bar running parallel to the ground, suspended by two vertical upright beams which form the frame (Fig. 61).

[176] Crowfoot 1936, 36; Roth 1950, 9-26, 38, 45.
[177] Crowfoot 1936, 36..

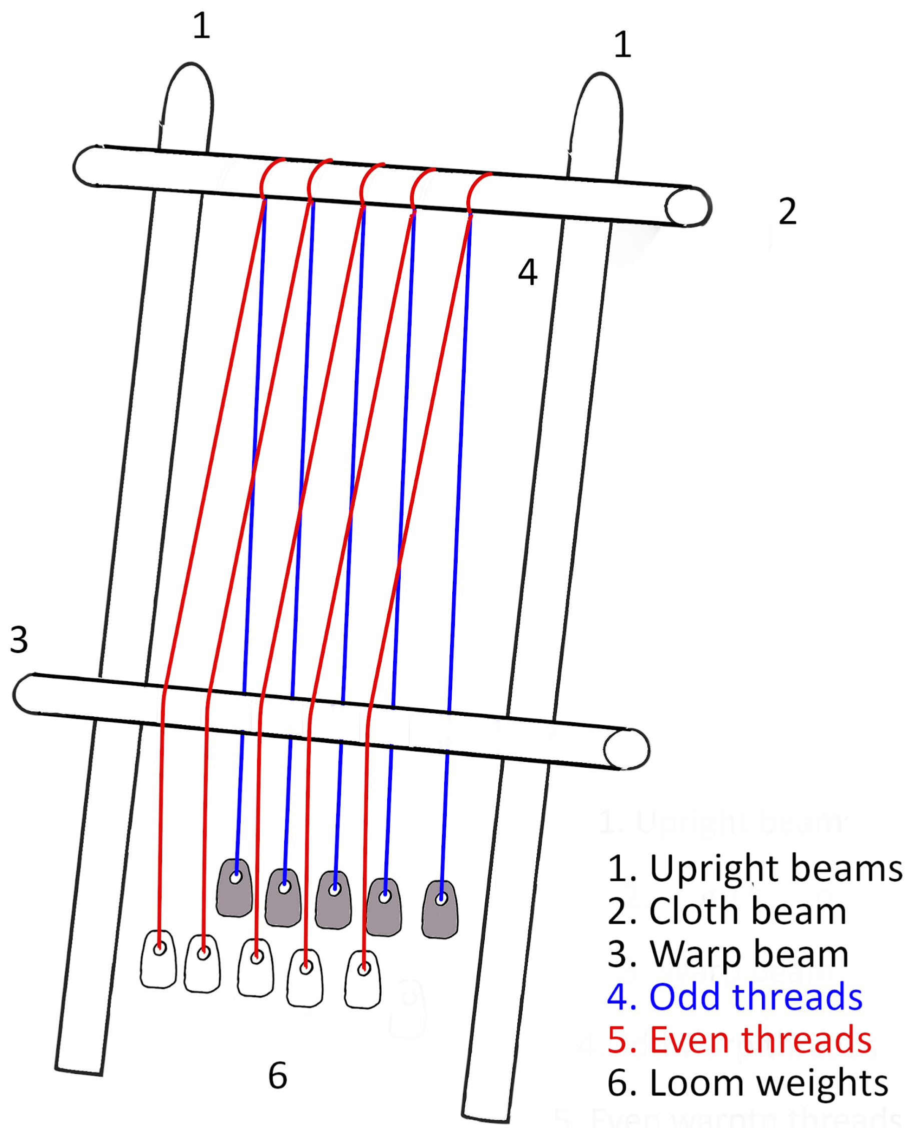

Fig. 61: Illustration of the front view of a warp weighted loom, indicating the cloth beam, warp beam, and uprights. Credit: Tatianna Bechal, 2021.

The warp threads are tied onto the cloth beam of this simple frame and hang down perpendicular to the ground. By adding a second beam at the bottom or middle of the frame, the weaver has more control over the tension and movement of the threads. This secondary beam also aids in separating the threads in front (even threads) from the threads in the back (odd threads). Without some kind of tension holding these warp threads taut it is near impossible to weave in the weft threads, and therefore they must be weighted down by something heavy.[178] The type of loom used throughout much of ancient Greece was of this design, and the warp threads were held taut in groups by clay or stone weights. Thus the vertical warp-weighted loom was created.

Focusing primarily on learning the mechanics of weaving, I constructed a small loom out of scrap lumber with an inner working space of nineteen inches wide, and standing forty-six inches high. As the intention of this project was to learn the basic mechanics of weaving, the size of the frame was kept small and in the end the working space was determined by the size of available lumber. A second beam was attached just below the midpoint of the frame to serve as the warp beam. With the warp beam added to the frame, the resulting workspace measured nineteen inches wide by twenty six inches long.

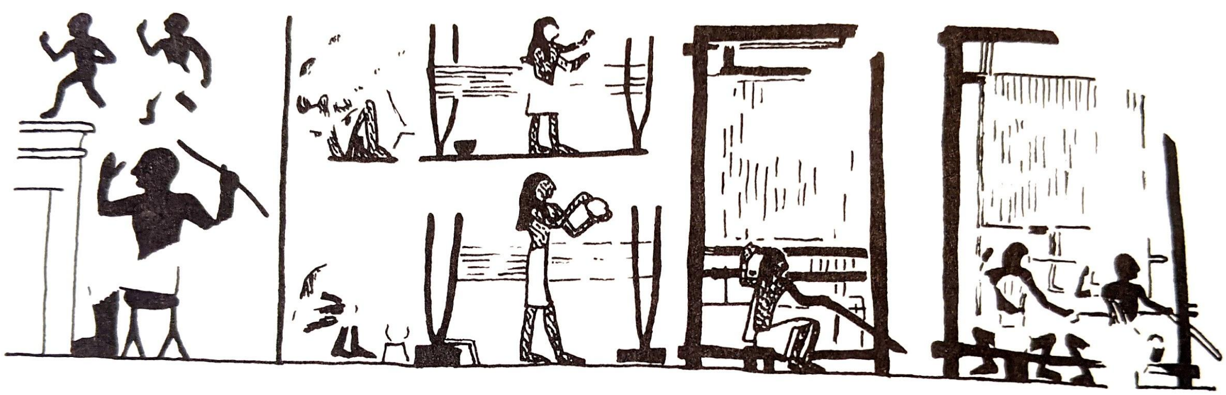

Fig. 62: Egyptian weaving shop with vertical looms. Weavers measure out threads on upright pegs (centre). Tomb of Neferronpet, Thebes. Illustration by Elizabeth Barber 1994, 262. After Davies.

[178] Roth 1950, 3.

In the absence of Greek visual evidence it is useful to look to imagery such as that found in the tomb of Neferronpet for direction on how warp threads may have been measured (Fig. 62).To set up the warp threads they must be cut to the length. Imagery of Egyptian weavers measuring out lengths of warp thread shows them winding lengths of thread around pegs placed in a wall, and this prompted me to try using a similar method (Fig. 62). Two vice clamps were used to measure out several identical lengths of thread (Figs. 63, 64). The warp threads were measured so that when doubled they could be wrapped around the cloth beam at the midpoint of the thread, with enough length to hand past the warp beam. A few extra feet were allowed at the ends onto which the loom-weights would be tied. By wrapping the thread around the clamps, roughly half of the thread from the first spindle was measured out. Once the threads were measured, the entire thickness of the threads was cut through to release them from the clamps. This resulted in a bundle of threads of equal length.

Fig. 63: To measure out the warp threads, two clamps were spaced a little over a metre apart and wound a continuous length of thread around both of them. Credit:Tatianna Bechal, 2021.

Fig. 64: A closeup of the threads wound around clamps. Credit: Tatianna Bechal, 2021.

Fig. 65: Lengths of warp threads tangled around themselves. Credit: Tatianna Bechal, 2021.

Once the threads had been released from the clamps they immediately curled and tangled up onto themselves. The first time the warp threads were measured I failed to account for this factor and was left with a mess of threads to untangle (Fig. 65). While the thread was wrapped around the spindle the shaft had been doing the job of holding the twist. As soon as the threads were released from the clamps, all the threads tangled into a single thick twisted cord. It took a full afternoon to untangle this mess of threads, but eventually they were freed from each other and were then bundled into groups of twelve. This number was an initial estimate of how many warp threads could be held taut by a single weight, and later during the process adjustments to this number were made, as a single weight was not quite heavy enough to hold twelve threads taut. Once the threads were measured and untangled they were attached to the loom (Fig. 67). This was done by folding and looping each group of warp threads around the cloth beam with a simple cow hitch knot to anchor them at the midpoint (Fig. 68).
[179]

Fig. 66: The second attempt at measuring out warp threads using a more controlled method, measuring out only a few threads at a time. Credit: Tatianna Bechal, 2021.

[179] Emery 1966, 37. This is also sometimes referred to as a lark's head knot.

Many months later when setting up the loom for the second time, I began by using a similar technique in which the warp thread was wound around the same measuring clamps and cut free. This second time however, the threads were measured out only six lengths at a time to avoid excessive tangling (Fig. 66). Once the thread was wrapped around the pegs six times, a heavy weight was placed on one end and was to retain tension on the threads and prevent them from curling up on themselves once they were cut free. Once the threads were cut I continued to hold onto the free end in one hand, maintaining a gentle tension. By this point the bundle of threads formed a 'V' shape, with one end held taught by a weight, the midpoint of the threads still wrapped around one peg, and the other end of the threads held in my hand. With this set of warp threads cut, one end was carefully tied to a loom-weight. Once the weight was attached, this end of the bundle could be released to hang freely off the edge of the

Fig. 67: The undressed loom showing the first few warp threads attached. The warp threads are measured and cut to length. Credit: Tatianna Bechal, 2021.

table since there was tension holding the twist. It was then possible to release the other end of the thread from the heavy weight and another clay loom-weight was tied to the opposite end. With six threads in a bundle measuring about 100 inches long, and a loom-weight tied to each end, the centre of each bundle was looped around the cloth beam at the top of the loom with another cow hitch knot where it hung freely while the rest of the warp threads were measured out.

Fig. 68: The warp threads are measured and have been looped to the warp beam. Credit: Tatianna Bechal, 2021.

Twenty loom-weights were created out of polymer clay, and into the top of each a hole was pierced through which a short length of twine was fed to attach the warp bundles (Fig. 69). There do seem to be somewhat standard sizes and heaviness of weights from antiquity, however these figures can vary depending on the occasion and materials used. A thick and sturdy thread might require heavier loom-weights to produce a dense fabric, while a fine thread might require lighter weights to achieve a more delicate finished textile.[180] In an examination of

[180] Barber 1991, 103-104.

Scandinavian weaving traditions, Marta Hoffmann observed that weavers sometimes tied "proportionately more warp threads to heavier weights, and fewer to lighter ones."[181] There is

Fig. 69: Experimentation with designs by using various found objects to create impressions in the weights. Credit: Tatianna Bechal, 2021.

also evidence to suggest that heavier weights are sometimes used for the outermost sets of warp threads to stabilise and strengthen the selvage of the finished piece.[182] The number and heaviness of the weights made from polymer clay allowed for ten bundles of warp thread, each with six threads. This method of measuring out only a few threads at a time resulted in a much easier setup than the first attempt. Although at the time it seemed somewhat inefficient as I measured out the threads carefully in small sets, considering the time it took to untangle the

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181 Barber 1991, 96; See also Hoffman 1964.

182 Barber 1991, 9, 96. Selvage='self-edge'. The long edge of the fabric running along the entire length of the warp. This edge is usually woven tighter than the rest of the weaving to strengthen the edges which are exposed to excessive wear.

bundles during the first attempt, I certainly saved myself a considerable amount of frustration by taking it slow and carefully measuring out each bundle of warp threads separately.

A simple plain, or tabby weave is one in which a single weft thread is woven over and then under each warp thread in an alternating pattern.[183] While it is possible to weave in the weft thread at this point by darning in a single weft at a time with a needle, it is much more effective and efficient to separate the warp threads into groups so that an entire group of warp threads can be separated at once and the weft can be woven across the entire warp in one motion.

Fig. 70: The warp beam holds one set of threads (even threads) forward and away from the other set (odd threads). Credit: Tatianna Bechal, 2021.

Once the warp threads had been fastened to the cloth beam at the top and the ends weighed down with loom-weights, the bundles were then separated into two groups by bringing one half of each thread bundle forward to rest in front of the warp beam (Fig. 70). This is where the warp beam becomes essential, as it holds one set of even warp threads forward and

183 Barber 1994, 40; Emery 1966, 76.

separate from the odd threads which hang down at the back of the loom perpendicular to the ground. This separation of odd and even threads creates a gap called the natural shed through which the entire weft thread can be passed. In the first venture at setting up the loom, the warp was divided with the intention of creating a simple tabby weave in an alternating pattern of one thread brought forward to rest over the warp beam, and one thread left to hang at the back.

Fig. 71: Attic red figure cup (side B), c. 440 B.C.E.. Penelope sitting at her loom. Loom-weights can be clearly seen hanging from the warp threads. The warp threads appear evenly spaced. Museo Nazionale; Chiusi, Italy. Image via Wikimedia Commons.

It became immediately clear that merely separating the odd and even threads via the warp beam would not be sufficient to keep the threads organised, as any movement of the loom threatened to tangle the bundles of thread as the weights dangled freely. It was also evident that this simple setup did nothing to keep the threads evenly spaced, and therefore some way of further anchoring the warp threads was needed.[184] It is unclear how ancient Greek women

[184] Crowfoot 1936, 42-43. Depictions of looms from antiquity do not clearly indicate how or if this was solved. Crowfoot suggests some of the rods appearing in the imagery may have been used to solve this problem, rather than functioning as a heddle or shed rod.

anchored their warp threads beyond only using clay weights. Imagery from antiquity clearly shows loom-weights tied to groups of warp threads (Fig. 71), but there is no clear indication on the specific method used to keep the threads in place and evenly spaced.[185] The solution to this resided in the knowledge of modern textile artists.[186]

Fig. 72: Chain stitch running across the bottom of the warp threads holding them in place. Credit: Tatianna Bechal, 2021.

To create stability and provide control over the movement of the threads, I created a chain stitch with a length of yarn which ran across the bottom of the front warp threads (Fig. 72). Each loop of this chain stitch captured a single warp thread, effectively creating an individual channel through which each thread would pass. Each end of this yarn was anchored

[185] Barber 1991, 93, 104-105. The location and positioning of loom-weight found at Aphrodisias in Southwestern Turkey suggest that they may have been attached to each other with a bar of some kind, which could have solved this problem and kept the warp threads in place.
[186] "Making a Warp Weighted Loom, Part Five: Attaching Loom-Weights and Chaining the Warp". Youtube. Uploaded by Sally Pointer, 3 May 2020.
https://www.youtube.com/watch?v=KAZ_4WcxYYk&list=PL5zgizOgAtq3Myw1vOYXDGslGQjyMktuf&index=5

to the upright beams on either end. This chain served the dual purpose of keeping the warp threads from tangling, as well as evenly spacing each thread across the width of the warp beam. Without anchoring these threads the bundles of warp would easily twist and tangle as the cloth was woven. Further, with the warp having been evenly spaced and held in place, the consistency and tension of the weave would be easier to control. A second chain stitch was also used to anchor and space out the back warp threads in the same way as the front warp was anchored.

Knitting the Heddle

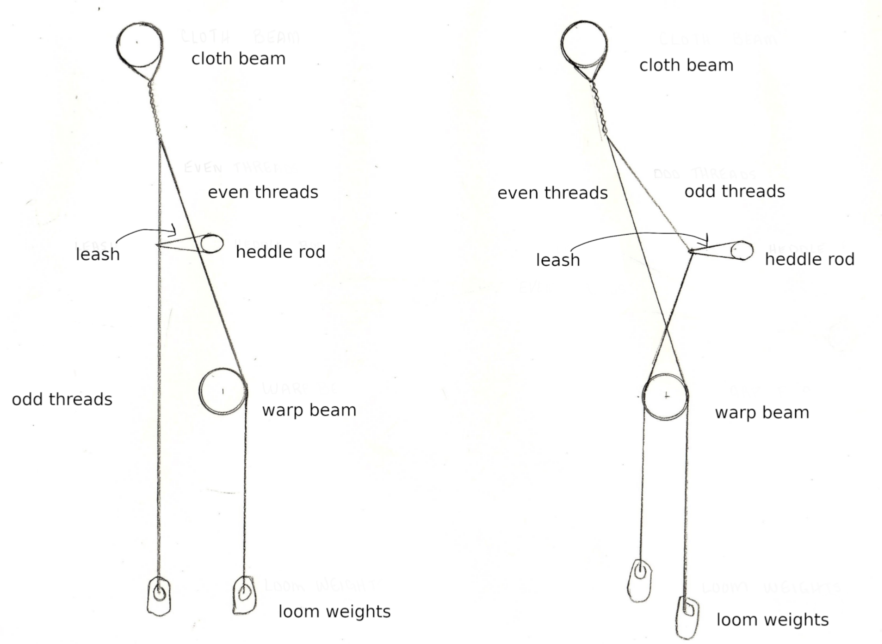

Fig. 73: Side view of a warp weighted loom. The natural shed is created when the odd threads are left to hang straight down (left).The counter shed is created by pulling the odd threads through the heaven threads via the heddle rod (right). Credit: Tatianna Bechal, 2021.

At this point in the setup process the threads were anchored to the cloth beam at the top, weighed down in bundles by loom-weights at the bottom, and had been held evenly in place by a chain stitch both in the front and back. There was already a natural shed created by the warp beam through which the weft could be passed in one direction, but in order to weave a second row in the opposite direction it was necessary for the shed to be changed: the warp threads in the back (odd) needed to be be brought forward between the front (even) warp threads (Fig. 73). If the shed were not changed and the weft were simply fed back through the natural shed created by gravity and the warp beam, the first row of weaving would be unravelled. This second row of weft can be manually woven in with a needle, carefully stitched in the reverse direction over and under the opposite warp threads through which it had just been woven.[187] This method is very inefficient, and in order to speed up the weaving process in both directions one must be able to change the natural shed which is created by the warp beam to the counter shed. Once the counter shed is created, the entire weft can be passed over and under the opposite warp threads in one single motion, thus weaving the second row. To solve this problem, the heddle was created.

On a warp weighted loom, the heddle is a moveable bar which rests on the frame of the loom and is positioned in front of the warp threads. It allows the weaver to change the shed easily in one motion. When resting on the frame, the odd warp threads are left to hang in a natural shed. When the weaver pulls this bar towards themself, the back warp threads pass between the front warp threads and a counter shed is created (Fig. 73). The development of the heddle revolutionised weaving across the globe, speeding up the process significantly.[188] While some looms have a built in heddle to pull the odd warp threads forward, many weaving traditions make use of a leash.

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[187] Barber 1994, 40.
[188] Barber 1994, 41.

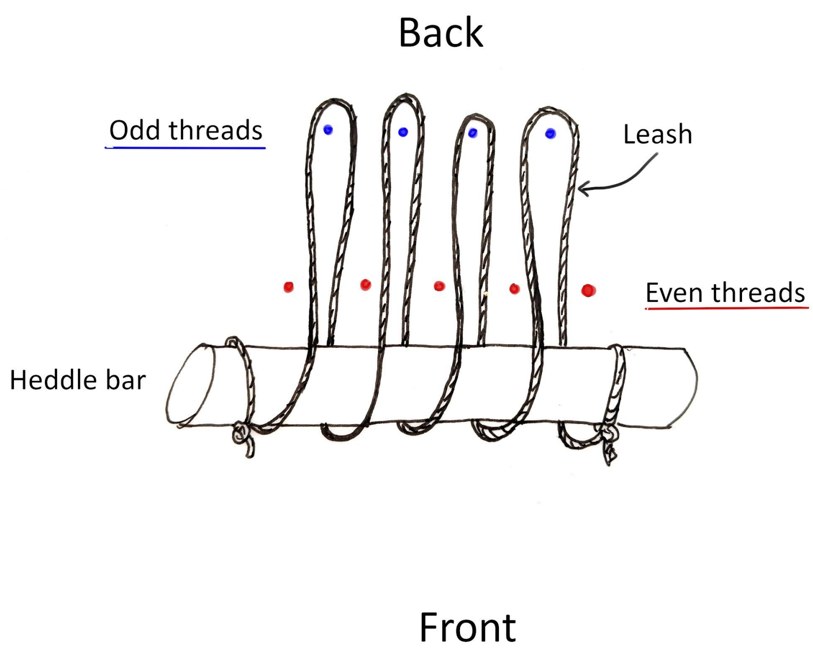

Fig. 74: Leash thread wrapped around the heddle bar in a spiral. The leash passes between the front (even) warp threads and loops around the back (odd) warp threads. Credit: Tatianna Bechal, 2021.

The leash is a cord or string which is wound around the heddle bar and picks up the back warp threads. When the weaver pulls the bar towards themself, they pull the entire rear warp forward along with it. This continuous length of cord wraps around the heddle bar, then travels between two front warp threads. It loops behind and picks up a single rear warp thread before it is fed back through the same gap between the two front warp threads and back around the heddle bar (Fig. 74).[189] A simple spiral of cord wrapped around the bar, picking up the rear warp is enough to perform the function of changing the shed. While there are different methods of knitting the heddle used throughout the world which stem from different traditions,

[189] Depending on the pattern of weave. If weaving a simple tabby weave, the pattern is over one, under one, therefore the leash passes between two single front warp threads and picks up a single back warp thread.

they all function in essentially the same way to pull the odd warp forward and create a counter-shed.[190]

I discovered throughout this experiment, it is essential that this step in the process is done carefully and correctly, as any mistakes made here will be apparent as the weaving progresses. While setting up the loom the first time, I thought I had been adequately careful and diligent in knitting the heddle. However without realising somehow one entire odd warp thread was skipped while the leash was tied. This mistake was not realised until several inches of the cloth had been woven, and only after which I realised one thread had been hanging free in the back the whole time (Fig. 75). It is possible to take a needle and manually darn this thread back into the piece, but this error alters the 'over-under' pattern created by pulling one odd warp thread between the front warp threads.

As this mistake demonstrated, it is imperative that the weaver take their time in setting up the heddle carefully. As the weaving progressed down the length of the warp several other small mistakes made during the initial setup of the heddle were discovered which later distorted the tabby pattern. While knitting the heddle, multiple odd warp threads mistakenly picked up together instead of a single thread. As well as errors in setting up the heddle, several of the warp threads were too weak to withstand the process and they broke during the weaving, creating gaps in the pattern. Had the plan been to create a specific pattern of weave, this would

[190] Roth 1950, 2, 13, 21,24, 51, 75,127. There are many excellent illustrations throughout his book of different types of heddles throughout the world.

Fig. 75: Even after taking multiple days setting up the heddle an entire odd warp thread was missed in the leash. Credit: Tatianna Bechal, 2021.

have been a much bigger problem than it was, and would likely have been very noticeable throughout the whole length of the finished piece. This mistake also meant that by the time the leash had been knit across the entire warp, there were extra threads remaining and it was necessary to pick up multiple warp threads in the last few passes of the leash. This was a valuable learning experience in how important it is to take one's time in setting up the heddle properly. Learning to set up the heddle took a full day of trial and error, and even after I had figured out the basic mechanics of the process, it took another full day of work to fully set up the loom before weaving could begin. Even after I managed to get the hang of how the heddle and leash are set up, the first attempt resulted in many mistakes. Even with such a small working space this process took several days to complete, and I can only imagine the time commitment and focus required to set up a larger loom or a more complicated pattern.

Again it is unclear how the Greeks went about creating a counter shed. Plenty of images of Greek looms from the ancient world appear which do indicate the frame and structure of a warp weighted-loom (Figs. 1, 71). However, they lack the smaller details of the heddle and leash.[191] The absence of the heddle rod in the imagery does not mean it was not used, rather this may have been a stylistic or poetic choice in which it was assumed the viewer would "pick up any witty or fanciful allusion… to any tool or operation connected with them."[192] Perhaps the basic loom frame and warp threads would have been enough to give an impression for the viewer to understand what they were seeing.

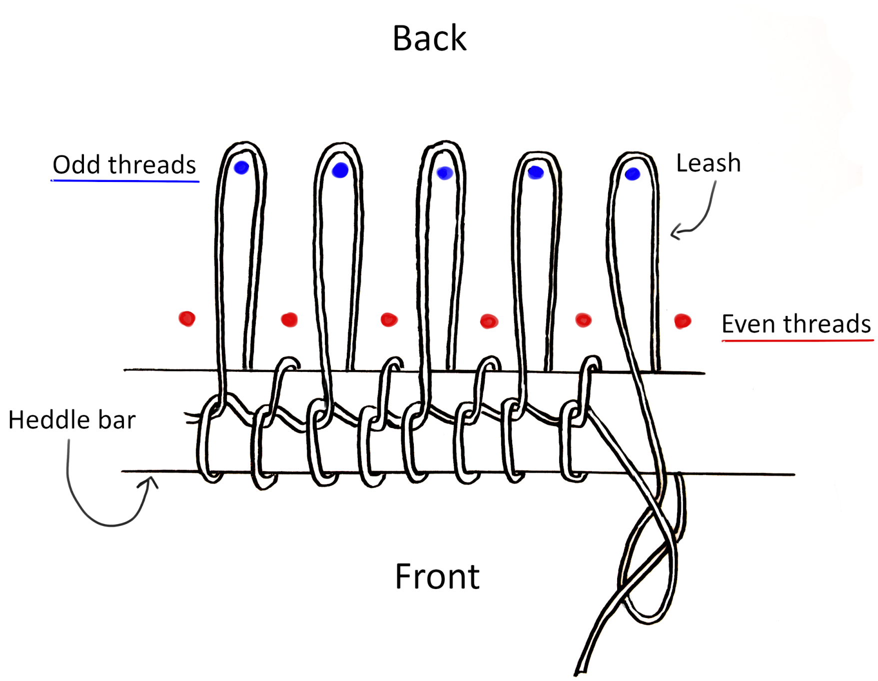

Fig. 76: Top down illustration of the heddle bar and leash tied with a buttonhole thread for stability. Credit: Tatianna Bechal, 2021.

[191] Crowfoot 1937, 43.
[192] Crowfoot 1937, 38. Grace Crowfoot uses linguistic evidence to indicate the use of the heddle in Homer where the word *κανών* is used to refer to a 'weaving rod', which the weaver pulls forward toward her chest.

Since there is little detailed information regarding how ancient Greek peoples set up the heddle, I yet again looked to modern weavers for instruction on how this could be done. Working from Viking weaving traditions, modern textile artist Sally Pointer creates a very detailed explanation of how the heddle is set up.[193] It is important to use a strong, smooth thread when creating the leash. A soft or fuzzy thread is likely to tangle and catch the fibres of the warp threads as friction is created from being pulled forward and backward. To create the leash, a continuous length of waxed linen thread made for leatherworking was used, and two pegs were placed about a few inches above the warp beam, on which the heddle rod could be rested (Fig. 77).

Fig. 77: The heddle rod is placed in front of the warp in preparation for the leash. Credit: Tatianna Bechal, 2021.

[193] Sally Pointer. *"Knitting the Heddle"* Youtube. Uploaded 11 May 2020. https://www.youtube.com/c/SallyPointer/videos

Referring to the techniques demonstrated in the video, I then took a spare rod and temporarily anchored it across the back of the odd warp threads, gently pushing them forward a few inches and making the natural shed a few inches smaller (Fig. 78). This bar is meant to be removed after the leash has been tied, and is meant to provide a foundation around which the leash can be anchored in the back. This bar also allows the weaver to create a consistent tension across the entirety of the leash as the back warp is picked up, and it provides stability during the process so that the odd warp threads will be held stationary while the leash is passed between them. To help make this process easier both the heddle rod and the temporary rod at the back were firmly tied to the loom as well as to each other where they rested on the frame so that they would not move around as the leash was being tied.

Fig. 78: Temporary spare rod placed behind the back warp and anchored to the loom. Credit: Tatianna Bechal, 2021.

Working from left to right the leash thread was anchored to the left side of the heddle rod and carefully passed over the heddle rod between the first two front warp threads toward the back of the loom (Fig. 76). Once the leash had been passed between the first two even warp threads, I then continued to pass it over the temporary back rod, keeping the first odd warp thread on the right of the leash. Then the leash thread was passed behind the temporary rod in the back, wrapping around it and emerging on the opposite side of the first odd warp thread. The leash was then brought forward, this time travelling under the heddle rod in front, and emerging from the same gap between the two even warp threads through which it had been previously passed backward. What this effectively does is anchor the leash thread to the heddle rod in front, and creates a little loop or channel which picks up a single odd warp thread. When this loop is pulled forward, the odd warp thread can be pulled between two even warp threads, thus creating a counter shed.

Fig. 79: The leash (black thread) is being tied to the heddle bar in front, passing between alternating odd and even warp threads. Behind the odd warp threads in the back rests a temporary rod used to space out the leash and control the tension. Credit: Tatianna Bechal, 2021.

Fig. 80: The heddle and leash are set up and the temporary spacer bar has been removed. The odd threads can be pulled forward between the even threads when the weaver pulls the heddle bar towards themself. Credit: Tatianna Bechal, 2021.

Once the leash thread was back where it started between the two front warp threads, it was given a twist and passed through the loop creating a buttonhole stitch (Fig. 76). This extra stitch was tied to ensure that the leash was securely fastened to the heddle bar and would not unravel or move during the weaving process. This stitch was made twice to make sure it was well anchored, and I then continued to run the spool between the next two warp threads in exactly the same way as the first two. Working across the entire width of the heddle bar, the spool of leash thread was wrapped around the back bar and knotted around the heddle bar until every odd thread had been picked up by the leash. Once the entire heddle and leash was set up and every odd warp thread was looped by the leash, the entire heddle bar could be pulled forward and all the odd warp threads could pass between alternating even warp threads, creating the counter shed across the entire width of the loom and allowing for the weft to be woven across in one motion.

Fig. 81: The heddle is completely set up with a functioning counter shed. Credit: Tatianna Bechal, 2021.

After the heddle and leash were installed they were checked to make sure everything had been set up properly (Fig. 80). As stated above, this is where I failed to notice an error made while knitting the heddle in which an entire odd warp thread was skipped over by the leash (Fig. 77). The process of setting up the heddle was tedious, and it required a lot of patience and attention. I found this to be the only step in the entire process of wool working that really required complete and focused concentration. It was the most frustrating step, and it took several tries before I was able to fully grasp the concept and could visualise what exactly was happening as the leash was carefully looped around each thread. While still requiring a great deal of focus, once I was able to visualise the pattern of how the leash needed to loop around each thread, it became somewhat easier to set up.

With the heddle finally set up, the spare rod used to space out the leash was removed. Removing this temporary rod loosened some of the tension on the back threads and they fell back into the space which the rod had been occupying. When done correctly the back warp threads should easily pass between the front warp threads when the heddle is pulled forward and when left to rest on the pegs the natural shed is created by gravity (Fig. 81). Once the counter shed was created it was then possible to pass the weft thread across the warp in both directions in a single motion.

Beginning to Weave

With the warp threads and heddle bar set up, it was time to begin the process of weaving. Having never attempted this before, I dove right in without looking too much into the specifics of how a piece of weaving should be started. From images seen both in modern weaving setups and in ancient sources, it is clear that there is meant to be some kind of heading band of tight weaving or heavy cord across the top of the warp threads to help anchor everything in place, and was most likely woven on a separate, much smaller band loom (Fig. 84).[194]

[194] Barber 1991, 116-117; Barber 1994, 92, 222-223; Roth 1950, 24-25.

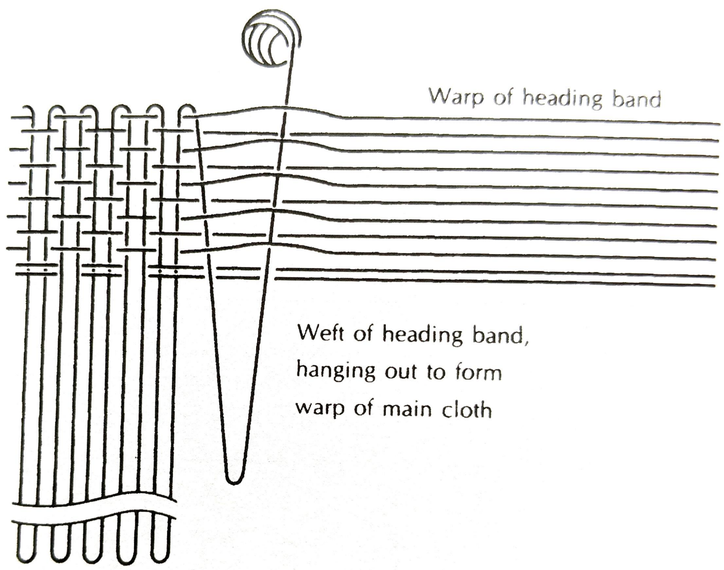

Fig. 82: Diagram of the construction of a heading band. Illustrated by Barber 1991, 135.

I intended first to try and troubleshoot the process with minimal instruction, in an attempt to learn what the results would be by omitting this step. This approach was intentional, and the purpose behind it was to encounter issues as they arose and to discover what solutions might naturally develop through trial and error. By troubleshooting issues as they arose, I hoped to gain insight into how weaving practises and technologies may have developed and been improved upon over time.

Guiding the weft through the natural shed, it became immediately clear that the weft was inclined to tangle in the warp threads. To solve this issue, a metal toothed comb was used to push the newly woven weft thread up tight against the top of the loom. After the first pass of the weft through the natural shed, the heddle bar could be pulled forward to create the counter shed.

Even at this early stage of weaving, problems were beginning to present themselves. The spindle used for both the warp and weft in this first trial came from the first spindle of thread which had been spun. This thread was bulky and inconsistent in thickness and twist, which resulted in the loose fibres snagging and catching on each other every time the shed was changed. After only a few rows of passing the weft back and forth through the warp, the fibres of the warp threads had become increasingly more frizzy from the constant friction. Eventually the threads became so difficult to work with that they needed to be separated by hand every time the heddle was pulled forward by carefully slipping one hand into the shed and gently prying apart the threads to create enough space for the weft to be passed through. Once the warp threads had been untangled and the shed fully opened, it was then possible to insert a spare narrow rod in the shed, called a shed stick, to keep the counter shed open while the heddle bar was rested back on its pegs the weft was prepared to be fed back through (Fig. 83).

Fig. 83: A shed stick (chopstick) holding open the counter shed allowing me to let go of the heddle rod.
Credit: Tatianna Bechal, 2021.

The poor quality of the thread caused a second problem during this experiment. While some sections of the thread from the first spindle were too thick, loosely spun, and prone to tangling, other sections were too thin and unable to withstand the friction created while changing the shed. During the weaving process many of the weaker warp threads broke under the stress of being pulled back and forth by the heddle. Some of these could be fixed if caught early by tying the broken end back onto itself. Other threads however were not able to be tied off due to the weakness of the thread, and several warp threads broke which went unnoticed until it was too late to fix them. Not only did this breaking of warp threads alter the pattern of the weave, it also affected the tension of the leash across the heddle, leading to an uneven and ineffective leash (Fig. 84). When several of the rear warp threads broke, tension on the loop which had been holding it was released. The broken loop would hang loose, and eventually it would release its tension into the adjacent loops. This gradual loosening of tension across the heddle made it increasingly difficult to fully open the counter shed, as some of the odd warp threads could be pulled forward, while others could not. This problem only grew as the weaving continued. While the heddle more or less still served its purpose - even with these problems - it made the process much more difficult than it needed to be as it was necessary to reach into the shed every time and adjust the tension on the warp threads individually. Had the warp threads been set up to weave a specific and more complicated design, these broken threads would have created a noticeable problem in the finished pattern. However since the primary concern was to learn the mechanics of the process I continued weaving down the length of the piece in hopes of revealing how these mistakes would grow and affect the work.

Fig. 84: The first leash setup after several threads have broken. The leash has become uneven over time due to several broken warp threads. Credit: Tatianna Bechal, 2021.

With the shed stick holding the counter shed open, both hands were free to guide the spindle of weft thread back through the opening. Once prepared to weave the next row, the heddle bar was pulled forward and the weft was fed through. With the shed stick keeping the counter shed open, the heddle rod could be released and left to rest on the pegs for as long as needed. Once the spindle was fed back through the opposite direction, a metal toothed comb was used to comb upward along the length of the warp, pushing the newly woven weft thread up tight against the previous row. Once the weft had been woven through and combed up, the shed could be changed to prepare for the next row of weaving. Once the shed was changed, before running the weft back through to weave the next row the spare rod which had been used as a shed stick was inserted into the new shed and pushed upward against gravity, tightening the previous row of weaving. By pushing up the stick, the odd and even threads were forced apart and the weft thread which had just been woven was packed tightly against the previous row. This rod is referred to as a 'beater-in': an often smooth and flat sword shaped stick which is inserted into the shed and then pushed upward to aid in separating the odd and even warp threads.[195] This tightening of the weave forces the previous row of weft to lay snugly against the row before it (Fig. 85). In this experiment the same shed stick which had been used to hold the counter shed open was repurposed in this step and used as a beater-in. Had I been working on a much larger loom a larger stick designated as a beater-in would likely be beneficial, requiring a stronger rod to repeatedly beat in the weft. However, as this experiment was a rather small piece of weaving the same stick sufficed for both purposes.

Fig. 85: Here the shed stick is used as a 'beater-in' to force the new shed open and tighten the weft. Credit: Tatianna Bechal, 2020.

[195] Roth 1950, 2; Barber 1991, 84, 92.

There is evidence to suggest that in some areas it was a common practice to have multiple smaller shed sticks inserted into the shed across the width of the loom rather than a single one.[196] This would have been particularly useful for very wide weaving projects where a single shed stick the entire width of the loom would have been far too heavy and difficult for the weaver to lift on their own, and would have allowed the operator to open small sections of warp at a time.[197] This way when weaving a very large piece of cloth the weaver could simply grab a hold of one of the shorter shed sticks to open up a small section of the counter shed to feed the weft through.

Fig. 86: The first attempt at weaving a simple tabby weave. The top of the warp is not stabilised by a band, resulting in loose and uneven weaving at the top. Credit: Tatianna Bechal.

[196] Barber 1991, 88, 110. Though she points out that the small details seen in ancient representations are difficult to interpret and have led many scholars to believe that Classical Greek looms did not make use of the heddle and shed in the same way as later European looms.
[197] Barber 1991, 110-113; See Fig. 1: Greek *Lekythos*, it appears as though there may be multiple thin rods inserted into the shed directly above the heddle bar.

The first several rows of the first experiment resulted in a loose and uneven piece of cloth.[198] Since the very top of the warp threads were not anchored and evenly spaced by a band the same way the bottom of them was, the resulting weave was loose and inconsistent (Fig. 86). Without a band anchoring the threads across the top, the warp threads were inclined to shift around and spread out across the cloth beam of the loom. In setting up the loom the second time, an effort was made to stabilise the top of the warp by weaving a group of eight weft threads back and forth through the shed and counter shed three times, creating a sturdy band along the width of the warp (Fig. 87). This bundle of threads functioned to hold the warp

Fig. 87: The second setup with a thick band of weaving at top for stability. The warp has been separated into sets of two, creating a half basket weave. Credit: Tatianna Bechal, 2021.

threads in place across the cloth beam and keep them evenly spaced. The intention behind this band was to create a stable anchor point against which the weft threads could be beaten every time the shed was changed. As suspected, part of the problem encountered in the first experiment of weaving was due to not having a solid starting point against which to beat the weft threads as they were combed into place. This band proved to be very helpful, as it seemed

[198] I use "cloth" here very generously, as I doubt the first experiment can be called anything resembling actual fabric.

to do the job of anchoring the warp threads in place and holding the tension across the warp. When compared to the first attempt at weaving, it is clear that by starting the piece with a heavy band to anchor it, the finished product came out much more even than the first one throughout the length of the piece.

During this second weaving experiment the warp threads were set up in a different pattern in an attempt to solve the problem encountered the first time where many of the warp threads broke after the loom had been set up. The threads created on the most recent of my spindles were significantly more fine, consistent, and tightly spun. However, even given the improved quality of my thread, there was concern that some of the threads could break during the process again. To ensure strength during weaving, the warp threads were grouped in sets of two to guarantee that even if one thread broke there would still be one remaining to hold the leash tension and retain the pattern. This pattern of weave is referred to as a half basket weave. [199]

Having separated the warp threads by twos, the resulting piece of weaving was much tighter, more even, and was far easier to weave than the first attempt. The threads themselves were far less prone to tangling while changing the shed than the first attempt, which was likely due to the fact that the threads themselves were of a higher quality than the first time I attempted weaving. It was not necessary to manually separate the warp and open the shed in the same way as the first experiment. Overall the second attempt was much more successful: the tension was more even, the threads were stronger, and the finished piece was much cleaner looking than the first (Figs. 88, 89).

[199] Barber 1991, 187.

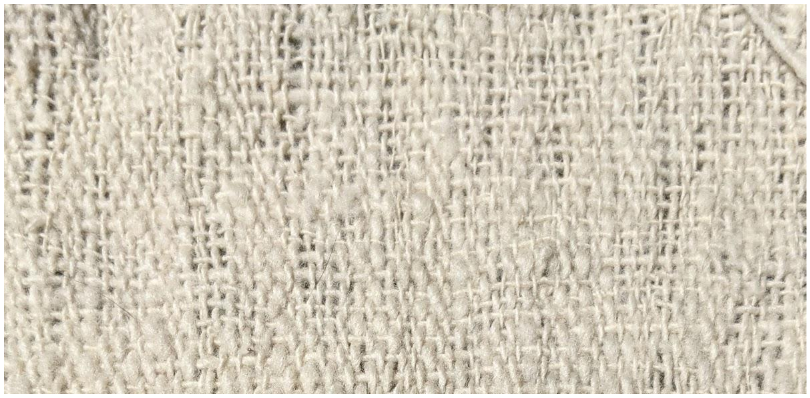

Fig. 88: Close up of the first setup using a plain basket weave. Credit: Tatianna Bechal, 2021.

The first experiment made it clear that the tension of the weft across the warp was inconsistent, and therefore going forward with this second attempt I was careful when weaving not to pull the weft too tight when it was fed through the shed. In the first piece of weaving, it was clear that the horizontal tension across the length was inconsistent, resulting in a strip of cloth that was wider in some areas and narrower in others. When attempting this first experiment I wove only seven inches down the length of the warp before removing it from the frame (Fig. 90).

Fig. 89: Close up of the half basket weave. The threads are tightly woven and parallel. Credit: Tatianna Bechal, 2021.

Once the weft had been combed up tight against the previous row, the shed could be changed again. From this point onward the process remained fairly consistent: weave a row, comb upward, change shed, beat in the weft, weave the next row, and so on. As the work continues to expand and out-grow the working space, the cloth beam can be rotated and the woven cloth wound onto it. When the cloth has been rolled onto the cloth beam, the loom-weights are removed and repositioned further down the length of the warp. By doing

Fig. 90: The first piece of weaving. The long edges of the piece are uneven. The warp threads were left long and tied in a bundle. Credit: Tatianna Bechal, 2021.

this, the finished piece can be any length depending on how long the original warp threads were cut. When the end of the warp threads are reached, the piece can be unrolled from the cloth beam and removed from the loom. When about seven inches of cloth were woven, the first experiment in weaving was released from the loom and the warp threads were left long and tied in a bundle (Fig. 90).

The changes made the second time the loom was set up proved to yield positive results. The combination of thread quality, heddle errors, and absence of a starting band in the first experiment resulted in a loose and uneven weave (Fig. 88). The second attempt in which the warp threads were grouped into twos produced a tight even weave (Fig. 89). The quality of the thread used in the second attempt proved much easier to work with than the thread from the first spindle, as it was not inclined to tangle in the warp and break. The thick band of weft anchoring the warp in place across the top provided a sturdy base which helped control the tension of the weft.

Conclusion

With so much of the details of this work missing from the record, it was often necessary to rely on modern traditions to fill in the gaps. While re-creation is uniquely equipped to appeal to general audiences and gain insight into the lives of ancient peoples, it is important to maintain a "clear distinction between what is 'experimental' and what is 'experiential.'"[200] Whenever possible I chose to troubleshoot the issues as they arose with minimal direction from modern sources, instead relying on ancient imagery and literature as a starting point. This was done in an attempt to avoid straying too far into the weaving traditions and techniques of other cultures. The aim was to gain insight not only into how textile work was performed in fourth and fifth century Greece, but also how the technology might have developed and adapted over time. Several times during the work this approach proved very informative and enlightening. In weaving the first time, the importance of including a heading band at the top of the piece became immediately evident. It was only after experimenting with the first setup when I realised the second attempt would need to be set up differently, and thus the second piece was started with a thick row of weft, which ended up functioning in much the same way as a traditional heading band.

From washing a raw fleece, to how a distaff was used, to setting up the heddle, almost every step in the process lacked complete information from the ancient sources, emphasising the need to look to more modern traditions for instruction. This lack of detailed information highlights the unique and perishable nature of women's work. I have thought a lot about the nature of domestic work throughout this project. The culture of craftsmanship and the

[200] Outram 2008, 3-4.

transmission of technologies and traditions through female hands. So much of the work women did left little or no physical trace, not only the physical objects themselves, but also the knowledge of how to create those objects. This knowledge has survived the centuries though the work of modern artisans passed down through the generations. How exactly was this knowledge of washing, carding, and setting up a heddle passed on from mother to daughter? Did the women of these ancient societies have their own songs and stories which they used to teach these skills to the following generations? Or perhaps, was the work such a ubiquitous part of daily life that the details were never recorded or memorised. I would argue that this knowledge has not disappeared over time, rather it has survived in the traditions passed down through the generations, and lives on today in the practises of modern textile artists.

As well as the immense time, skill, and resources required to turn raw materials into usable textiles, textile studies can illuminate some of the broader social realities of daily life in fourth and fifth century Greece. The implications of textile work in the social, religious, and economic lives of ancient peoples and the various processes involved are numerous. How domestic space was used and designated for specific tasks, the flexibility of women's space within the home, social connections between household and community members, resource management, and transmission of knowledge are all important areas which research into textile work can help illuminate.

Textiles are an important and relevant area of study due as well to the vital role they played in the performance of Greek religion and ritual. The ritual offering of cloth and clothing to the gods "has been attested as far back as the 2nd millennium."[201] Through textile work

[201] Brøns and Noch 2017, 3.

Classical Greek women played important roles in the religious life of their communities. While the *Panathenaic* festival is a well known celebration involving woven goods to honour the goddess Athena, it was certainly not the only occasion which involved such offerings. Construction of the famous peplos of Athena presented at this festival was begun during the *Chalkeia* by specially selected girls. This was a slightly lesser festival linked to craftsmanship (associated with both Athena and Hephaistos) and it coincided with the cultivation of the fields. [202] Outside of larger festivals, textiles likely played a key role in other religious rituals, and were central to a woman's religious life where they may be given as votive offerings to other deities such as Artemis, Hera, and Aphrodite.[203] It has been postulated by many that much imagery from the ancient world where women appear in religious scenes shows them engaged in dedicating textiles to the gods, and it was common for women to give textiles as votives to Artemis to mark pivotal rites of passage such as menstruation and childbirth.[204] Not only did textile work function as a practical and economic element of daily life, it played a pivotal role in the spiritual lives of women allowing them to actively participate in Greek religious life.

The communal aspect of textile work was and is an important factor in how these traditions survived, and it undoubtedly played a significant role in the social lives of the women who performed this work. Did women of different households come together to tackle large projects? Perhaps the many hours of washing, carding, spinning, and weaving were also spent telling stories or singing traditional songs not unlike modern artisans who "often sing or chant ritual songs set to the rhythm of the endless repetitive motions of handiwork in the

[202] Brøns and Noch 2017, 36-38, 43-46.
[203] Brøns and Noch 2017, 54; Brøns 2017, 38, 195, 208-213.
[204] Brøns 2017, 195; Brøns and Nosch 2017 55.

fields."[205] Imagery from the ancient world supports this idea, and is indicated on the Greek lekythos (Fig. 1) on which scenes of women engaged in textile work appear on the body of the vessel, while imagery of women dancing together appear around the neck, thereby linking song and dance to textile work and the social lives of women. As I washed, carded, and spun wool, I was able to set up the work wherever needed and was able to engage my mind in other tasks while my hands did the work. Described by John Bouza Koster in his 1976 article *From Spindle to Loom: Weaving in the Southern Argolid*: "Whether she is herding a flock or gossiping with neighbours, the village woman keeps her agile fingers spinning yards of yarn for blankets, rugs, sweaters and socks."[206] I visited with neighbours as I washed wool in my backyard. I watched television, listened to music, and made phone calls to family as I spun wool into thread. The portable nature of spinning allowed me to take my tools out of doors where I worked in the park while visiting friends. Aside from the washing process, weaving was the only step in which I was bound to a single location, though even this may not have been done alone, and may have been set up in communal household spaces in ancient Greece. [207] The nature of this work undoubtedly played a role in the social lives of ancient women, and hands-on experimental approach was uniquely equipped to illuminate the realities and implications of that work. As well as family and community members, what role did textile work play in the relationships between members of different social status within the home? Presumably all women wove, whether they were enslaved people or free women. As well as performing the work herself, it was part of the wife's role to manage and oversee the work of

[205] Barber 1994, 85.
[206] Bouza 1976, 29.
[207] Barber 1994, 83, 87;

those enslaved within the *oikos*.[208] What role might textile work have played in the interpersonal relationships between these groups?

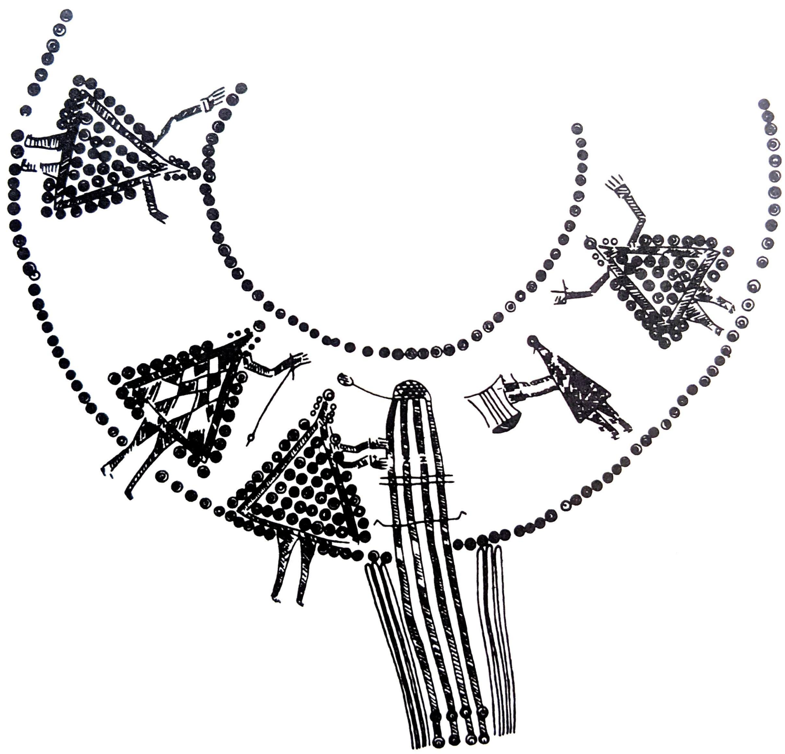

Fig. 91: Hallstatt-era urn. By A. Eibner-Persy. Women are seen spinning thread and entertaining each other with song and dance. In Barber 1994, 88.

In studying textile work and the management of resources, materials, and labour, insight might be gained into how members of a family communicated with each other, and with those of their communities. Did men serve as conduits to the outside world? Did women and men communicate with each other about their preferences and the qualities of their materials? Imagery from a pyxis by the Veii Painter (ca. 470-460 B.C.E) shows a scene in which a husband (centre) stands before his wife (left) offering her a ball of wool in one hand and

[208] Nevett 1999, 14; Xen. *Oec*. 9.14-15.

holding a leg of meat in the other (Fig. 92). The woman sits before a *kalathos* with a ball of wool in her hand as well.[209] Images such as this one may indicate not only the specific roles associated with the sexes, but may also hint at the lines of communication between different groups within the household which must have been necessary in order for the *oikos* to function smoothly. While in the past it has been thought that women's domestic textile work in the Classical Greek world kept them cloistered, the significance of a woman's economic role within the home through the products she created represents the "important economic and managerial contributions of women to the household."[210] It is now thought by many that the imagery of women engaged in textile work in fact demonstrates "a woman's ability to maintain the household by providing for it and thus constructs women as sharers in their own *oikos*."[211]

Fig. 92: Greek *Pyxis*, Attica, 470-460 B.C.E. Ceramic. Attributed to the Veii painter. A woman sits (left) before a basket holding a ball of wool. Before her (centre) stands her husband holding a leg of meat in one hand offering her a ball of wool in his other. Mount Holyoke College Art Museum. MH 1932.5.B.SII. Circumference photograph by Laura Shea.

[209] Bundrick 2008, 306-307; Trinkl 2015, 190-203.
[210] Brøns 2017, 197.
[211] Brøns 2017, 197-198.

As well as its social role in the lives of ancient women, experimental archaeology can open the door to understanding the enormous commitment of time, resources, and skill which textile work required. Sourcing the wool and learning to prepare it for spinning took the better part of a summer and in the end I filled only four spindles with thread.[212] I spent a full day knitting the heddle on the first loom setup only later to discover several crucial mistakes. Even after having learned how to properly set up the heddle and leash, it still took a full day to knit the heddle across a width of only a few dozen warp threads. As I sat for hours carefully feeding the leash between warp threads, I imagined the momentous work of setting up a loom the size of an entire room and wondered at the time and skill needed for such a task. While most of the steps in the process were fairly easy to grasp, it undoubtedly takes years to become skilled, and a lifetime to master.

Certainly it is dangerous to use archaeological remains alone to assess social and economic status due to the "partial nature of the archaeological record."[213] However physical remains have been able to shed light on how space within the Greek *oikos* may have been used which is not reflected by other sources. Locations of tools such as loom-weights, spindle whorls, and the placement and size of loom frames can indicate how and for what a space may have been used, and first hand knowledge of how those tools were used can assist in deciphering the meaning of archaeological finds. Many researchers have come to understand that previous assumptions about gendered segregation and household division may not accurately reflect the reality of daily life in Classical Greece.[214] Whereas it was thought that

[212] Admittedly I do not own my own sheep which I can shear at my discretion. However I was able to source and procure two fleeces with a very short turnaround of about a week.
[213] Nevett 1999, 56
[214] Nevett 1999 15-17, 30-31, 155; 2010, 42, 49; Bundrick 2008, 313.

household spaces were strictly delineated for specific uses by men and women, artifactual remains support the view that household space may have been far more fluid than ideology and literature has previously led researchers to believe. Again, the Greek lekythos (Fig. 1) offers potential evidence to support this argument, where women are depicted with many small and portable textile tools such as spindles and baskets. The dispersal of textile tools throughout different areas of the home as well as imagery can reveal the flexibility of domestic space, and challenges earlier ideas about strict gendered segregation.[215]

The role of textiles in humanity's journey has long been one of importance. From the invention of string to the development of clothing, the ability to create textiles from a variety of natural resources is representative of human ingenuity and adaptability. The skills and technologies developed over time offer valuable insight into the needs, beliefs, resources, and creativity of ancient peoples. This hands-on experimental approach was uniquely able to provide insight into a subject for which the physical evidence has largely been lost to the passage of time, and which might not have been learned from traditional sources alone. Through the act of re-creating the steps involved in this ancient craft, one is able to better understand the lived experiences of those for whom this work was a daily event. The value of imagery, literature, and archaeological remains is not diminished by the addition of hands-on re-creation; rather, "combining the results from experimental testing with contextual analyses helps to answer questions that are difficult to address by studying the tools alone."[216]

[215] Nevett 1999, 155; 2010, 49; Ault and Nevett 2005, 58-59, 76, 110-111.
[216] Andersson et. al. 2010, 163; See also Outram 2008, 2.

Bibliography

Andersson Strand, E. B., & Nosch, M. L. B. "With a Little Help from My Friends. Investigating Mycenaean Textiles with Help from Scandinavian Experimental Archaeology." METRON. Measuring the Aegean Bronze Age. Proceedings of the 9th International Agean Conference, New Haven, Yale University, 18-21 April 2002 (2003): n. pag. Print.

Andersson, E. B., et al. "Old textiles–new approaches." *European Journal of Archaeology* 13.2 (2010): 149-173.

Andersson Strand, E. Experimental Session. Centre for Textile Research, Copenhagen. Vimeo. Uploaded by La Maison des Sciences de l'Homme Mondes. February 26, 2014. https://vimeo.com/87683269 Séminaire d'Histoire et d'Archéologie des Mondes Orientaux (SHAMO) 2014.

Andersson Strand, E. B., & Nosch, M. L. B. (2019). The Wool Zone in Aegean Prehistory and Protohistory. In S. Bergerbrandt, & S. Sabatini (Eds.), *The Textile Revolution in Bronze Age Europe : Production, Specialisation, Consumption* (pp. 15-38). Cambridge University Press.

Arthur, Marylin B. "Early Greece: The Origins of the Western Attitude Toward Women." *Arethusa*, vol. 6, no. 1, 1973, pp. 7. *ProQuest*, http://search.proquest.com.proxy.lib.uwaterloo.ca/scholarly-journals/early-greece-origins-western-attitude-toward/docview/1307024906/se-2?accountid=14906.

Ault, Bradley A., and Lisa C. Nevett. Ancient Greek Houses and Households : Chronological, Regional, and Social Diversity . University of Pennsylvania Press, 2005.

Barber, Elizabeth Jane Wayland. *Prehistoric textiles: the development of cloth in the Neolithic and Bronze Ages with special reference to the Aegean*. Princeton University Press, 1991.

Barber, Elizabeth Jane Wayland. *Women's work: The first 20,000 years: Women, cloth, and society in early times*. WW Norton & Company, 1994.

Blundell, Sue. Women in Ancient Greece . Harvard University Press, 1995.

Bouza Koster, John"From Spindle to Loom" *Expedition Magazine* 19.1 (1976): n. pag. *Expedition Magazine*. Penn Museum, 1976 Web. 24 Jul 2020 <http://www.penn.museum/sites/expedition/?p=3861>

Bundrick, Sheramy D. "The Fabric of the City: Imaging Textile Production in Classical Athens." Hesperia: The Journal of the American School of Classical Studies at Athens 77.2 283–334. 2008, Web.

Chamberlain, Marcia., and Candace Crockett. Beyond Weaving, by Marcia Chamberlain and Candace Crockett. Photos. by David Donoho. New York, Watson-Guptill Publications 1974: N.p. Print.

Cohen, David. "Seclusion, Separation, and the Status of Women in Classical Athens." Greece and Rome, vol. 36, no. 1, Cambridge University Press, 1989, pp. 3–15, doi:10.1017/S0017383500029284.

Crowfoot, Grace M. "Of the Warp-Weighted Loom." *The Annual of the British School at Athens*, vol. 37, 1936, pp. 36–47. *JSTOR*, www.jstor.org/stable/30096659. Accessed 11 May 2020.

Dova, Stamatia. "Procne, Philomela, And The Voice Of The *Peplos*." *Arethusa*, vol. 53 no. 2, 2020, p. 69-88. *Project MUSE*, doi:10.1353/are.2020.0005.

Firth, Richard, and Marie-Louise Nosch. "SPINNING AND WEAVING WOOL IN UR III ADMINISTRATIVE TEXTS." Journal of Cuneiform Studies, vol. 64, no. 1, The American Schools of Oriental Research (ASOR), 2012, pp. 65–82, https://doi.org/10.5615/jcunestud.64.0065.

Gleba, Margarita, and Joanne Cutler. "Textile Production in Bronze Age Miletos: First Observations." KOSMOS. Jewelry, Adornment and Textiles in the Aegean Bronze Age (Aegaeum 33). Eds. M.-L. Nosch and R. Laffineur. Liège: Université de Liège, 113-120. (2012): n. pag. Print.

Gleba, Margarita, and Ulla Mannering. *Textiles and textile production in Europe from prehistory to AD 500*. Oxbow Books, 2012. (Spantidaki, Y. & C. Moulhérat. 2012. Greece, in M. Gleba & U. Mannering (ed.) *Textiles and textile production in Europe from prehistory to AD 500*: 182-200. Oxford: Oxbow Books).

Gleba, M. (2014). *Sheep to Textiles: Approaches to Investigating Ancient Wool Trade*. [Book chapter]. https://www.repository.cam.ac.uk/handle/1810/254046

Good, Irene. "Archaeological textiles: a review of current research." *Annual Review of Anthropology* 30.1 (2001): 209-226.

Gould, John. "Law, Custom and Myth: Aspects of the Social Position of Women in Classical Athens." The Journal of Hellenic Studies, vol. 100, Cambridge University Press, 1980, pp. 38–59, https://doi.org/10.2307/630731.

Halstead, Paul. "Missing Sheep: On the Meaning and Wider Significance of O in Knossos Sheep Records." *The Annual of the British School at Athens*, vol. 94, 1999, pp. 145–166. *JSTOR*, www.jstor.org/stable/30103456. Accessed 23 Sept. 2020.

Harlow, Mary, and Marie-Louise Nosch. Greek and Roman Textiles and Dress : an Interdisciplinary Anthology . Oxbow Books, 2015.

"Kalathos." (κάλαθος, ὁ) Henry George Liddell. Robert Scott. *A Greek-English Lexicon*. revised and augmented throughout by. Sir Henry Stuart Jones. with the assistance of. Roderick McKenzie. Oxford. Clarendon Press. 1940. http://www.perseus.tufts.edu/hopper/text?doc=Perseus%3Atext%3A1999.04.0057%3Aentry%3Dka%2Flaqos. Accessed 10 Jan. 2022.

Karanika, Andromache.*Voices at work: women, performance, and labor in ancient Greece*. JHU Press, 2014.

Killen, J. T. "The Wool Industry of Crete in the Late Bronze Age." *The Annual of the British School at Athens*, vol. 59, 1964, pp. 1–15. *JSTOR*, www.jstor.org/stable/30103132. Accessed 22 Sept. 2020.

"Kteis." (κτείς, κτενός, ὁ) Henry George Liddell. Robert Scott. *A Greek-English Lexicon*. revised and augmented throughout by. Sir Henry Stuart Jones. with the assistance of. Roderick McKenzie. Oxford. Clarendon Press. 1940. http://www.perseus.tufts.edu/hopper/morph?l=kteno%2Fs&la=greek&can=kteno%2Fs0&prior=ktei/s&d=Perseus:text:1999.04.0057:entry=ktei/s&i=1. Accessed 10 Jan. 2022.

Lyons, Deborah. "Dangerous Gifts: Ideologies of Marriage and Exchange in Ancient Greece." Classical Antiquity, vol. 22, no. 1, University of California Press, 2003, pp. 93–134, doi:10.1525/ca.2003.22.1.93.

Mannering, Ulla, et al. "Dating Danish Textiles and Skins from Bog Finds by Means of 14C AMS." Journal of Archaeological Science, vol. 37, no. 2, Elsevier Ltd, 2010, pp. 261–68, doi:10.1016/j.jas.2009.09.037.

Mueller, Melissa. "Helen's Hands Weaving for Kleos in the Odyssey." Helios (Lubbock), vol. 37, no. 1, TEXAS TECH UNIV PRESS, 2010, pp. 1–21.

Nevett, Lisa C. House and Society in the Ancient Greek World. Cambridge University Press, 1999.

Nevett, Lisa C. Domestic Space in Classical Antiquity . Cambridge University Press, 2010.

Nosch, M-L & Del Freo, Maurizio & Rougemont, Francoise (2010). The Terminology of Textiles in the Linear B Tablets, including Some Considerations on Linear A Logograms and Abbreviations 338-373.

Nosch, M-L. (2014). The Aegean Wool Economies of the Bronze Age.

Pomeroy, Sarah. Goddesses, Whores, Wives, and Slaves: Women in Classical Antiquity. Westminster: Knopf Doubleday Publishing Group, 2011. Print.

Outram, Alan K. "Introduction to Experimental Archaeology." *World Archaeology*, vol. 40, no. 1, Taylor & Francis, Ltd., 2008, pp. 1–6, http://www.jstor.org/stable/40025310.

Pantelia, Maria C. "Spinning and Weaving: Ideas of Domestic Order in Homer." American Journal of Philology, vol. 114, no. 4, Johns Hopkins University Press, 1993, pp. 493–501, https://doi.org/10.2307/295422.

Ryder, M. L. "Fleece Evolution in Domestic Sheep." Nature 204.4958 (1964): 555–559. Web.

Ryder, M. L. "Wools From Antiquity." Textile History 5.1 (1974): 100–110. Web.

Ryder, M. L. "Merino History in Old Wool." Textile History, vol. 18, no. 2, Published by Butterworths for the Pasold Research Fund, 1987, p. 117–.

"Saponin." A Dictionary of Environment and Conservation, 3rd ed., Oxford University Press, 2017.

Sherwood, Andrew N. (Andrew Neil), et al. Greek and Roman Technology : a Sourcebook of Translated Greek and Roman Texts . Second edition., Routledge, Taylor &

Francis Group, 2020.

Smith, Joanna S., and Iris Tzachili. “Cloth in Crete and Cyprus.” *British School at Athens Studies*, vol. 20, 2012, pp. 141–155. *JSTOR*, www.jstor.org/stable/23541206. Accessed 22 Jan. 2020.

Soffer, O., et al. “The ‘Venus’ Figurines - Textiles, Basketry, Gender, and Status in the Upper Paleolithic.” Current Anthropology, vol. 41, no. 4, UNIV CHICAGO PRESS, 2000, pp. 511–37, doi:10.1086/317381.

STAMATOPOULOU, ZOE. “WEAVING TITANS FOR ATHENA: EURIPIDES AND THE PANATHENAIC PEPLOS (HEC. 466-74 AND IT 218–24).” Classical Quarterly, vol. 62, no. 1, Cambridge University Press, 2012, pp. 72–80, doi:10.1017/S0009838811000668.

Thompson, Wesley. “Weaving: A Man’s Work.” The Classical World, vol. 75, no. 4, Classical Association of the Atlantic States, Mar. 1982, pp. 217–22, doi:10.2307/4349364.

Trinkl, Elizabeth. “The Wool Basket: function, depiction and meaning of the kalathos.” *Greek and Roman Textile and Dress. An Interdisciplinary Anthology*, edited by Harlow, Mary and Marie-Louise Nosch. Oxbow Books, 2015, pp. 190-203.

WOHL, VICTORIA J. "Standing by the Stathmos: The Creation of Sexual Ideology in the "Odyssey"." *Arethusa*, vol. 26, no. 1, 1993, pp. 19. *ProQuest*, http://search.proquest.com.proxy.lib.uwaterloo.ca/scholarly-journals/standing-stathmos-creation-sexual-ideology/docview/1307025168/se-2?accountid=14906.

“Women of The Outer Hebrides - Waulking Song | AI Enhanced 1941 Film”. Youtube. Uploaded by glamourdaze. 22 Mar 2021. https://www.youtube.com/watch?v=QeSrkZfpAjc

Ancient Sources

Aristophanes, *Lysistrata* 574-586, ed. Jack Lindsay. 2014. http://www.perseus.tufts.edu/hopper/text?doc=urn:cts:greekLit:tlg0019.tlg007.perseus-eng1:551-597

Columella, Lucius Junius Moderatus, *De Re Rustica*.

Hom. *Illiad*.

Hom. *Odyssey*. Translated by A. S. Kline © Copyright 2004 All Rights Reserved. https://www.poetryintranslation.com/PITBR/Greek/Odyssey15.php#anchor_Toc90268268

Ovid, *Fasti*.

Pliny, the Elder, *Natural History*.

Theophrastus, and Arthur Hort. *Enquiry into Plants* . Harvard University Press, 1916.

Xenophon, *Oeconomicus*. Translation by E.C. Marchant William Heinemann, Ltd., London. 1979