Abstract

It is the aim of this thesis to present the textile production tools from the 2012–2014 excavations at Caere, an Etruscan city northwest of Rome. While all textile tool finds — loom weights, spools, and spindle whorls — are presented, the discussion is focused on complete loom weights. The likely loom set-up, thread type, and appearance of the final fabric are suggested.
Acknowledgements

I would like to sincerely thank my supervisor Dr. Fabio Colivicchi, whose enthusiasm for archaeology is infectious and whose expertise in the field is to be aspired to. I would also like to thank Antonella Lepone and Michele Scali for their guidance at the excavations at Caere. Finally, I would like to thank the Soprintendenza Archeologica dell’Etruria Meridionale.
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Chapter 1

Introduction and Historical Background

1.1 Introduction

Textiles, perhaps more vividly than any other class of artifacts, can illuminate the individuals who compose the societies that archaeologists seek to understand. “Textiles express who we are — our gender, age, family affiliation, social status, occupation, religion, and ethnicity.” Individuals are intimately connected to the textiles that surround them, from swaddling cloth to funeral shroud. Unfortunately, textiles are preserved in the archaeological record only under specific (and relatively rare) circumstances. In general, acidic environments are favourable to the preservation of animal material (in the context of textiles, most commonly wool); basic environments to the preservation of plant material (for example, linen). In rare cases, special circumstances or environments can preserve organic material near perfectly. The Iceman of Similaun (Figure 1), dated to the Eneolithic period, was discovered in the alpine province of Bolzano, Italy. The sub-zero temperatures of this mountain region allowed for the complete preservation of his attire — a variety of pieces including tunic, loincloth, leggings, hat, and shoes. Although not true textiles, the well-preserved garments worn by the Iceman of Similaun vividly illustrate the importance and the rich variety of clothing used by humans at the time.

This rich variety, already seen in the Eneolithic period, would grow as textile-making technologies developed.

Extremely dry environments preserve textiles by desiccation (especially in Egypt and the areas of the Middle East). Waterlogged environments (commonly found at Italian and Swiss lake sites) are also highly effective at preserving organic materials. In lieu of dry or waterlogged environments, textiles can also survive if they are carbonized (especially plant based fibres) or mineralized (especially when deposited near iron or bronze). In some cases, impressions of textiles can be found on fired clay or other objects.

Unfortunately, while a number of sites in Italy have yielded numerous well-preserved textiles (e.g. Verucchio), the majority of excavations uncover evidence for textile-making only.

“Textile implements often constitute the single most important and plentiful type of evidence for assessment of the scale of textile production and technology at a given

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site”. At most sites, including at Caere, the study of textiles is synonymous with the study of textile tools. In recent years, researchers have greatly advanced our ability to make informed conclusions about textile production at a site based on the examination of individual textile tools. At Caere for example, where a complete set of weaving implements has not (yet) been discovered, such research is allowing even the small number of tools uncovered to contribute to our understanding of textile production at the site in a meaningful way.

The purpose of this chapter is to outline the textile production process, from the growing and processing of raw materials to the weaving of cloth. Only true textiles — woven cloth — will be considered. While some examples from around the Mediterranean region are cited, the majority of evidence discussed comes from the Apennine Peninsula.

1.2 Flax

Flax, from which linen is made, is the earliest raw material used for making true textiles in the ancient Mediterranean region and was “the most important fibre in European prehistory”. Its properties — cool, non-irritating, strong, and easy to wash — have ensured linen’s importance and continued use in the Mediterranean region from prehistory until modern day. The species of flax from which Linum usitatissimum — domestic flax — is believed to have been derived is native to a vast geographical area. It grows as a perennial along the Mediterranean and Atlantic coasts and as an annual in the

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5 Most notably the research team at the Danish National Research Foundation’s Centre for Textile Research at the University of Copenhagen.
area of modern Iran and Iraq.\textsuperscript{7} The first use of flax for textile production and the time and place for its domestication are difficult to pinpoint accurately for a number of reasons. First, as with any archaeological analyses or conclusions, there is an element of chance at play. Direct evidence of domestication in an undisturbed and dateable context is difficult to find. Furthermore, even if one such context is found, it impossible to prove that such a find is the earliest in existence, but only that it is the earliest found to date. Second, domestication is not a \textit{terminus post quem} for use — wild varieties of plants, later domesticated, would have been used for some period of time before their domestication.\textsuperscript{8} Third, the use of flax for textile production removes from the archaeological record the very evidence – seeds – which would indicate the presence of flax in a particular area. This occurred because flax for textile use was typically harvested before seed development, as young plants yield the best fibres.\textsuperscript{9} However, improved\textsuperscript{10} seeds do sometimes survive, as was the case for in northwestern Iraq, where such seeds were found, dated to the early sixth millennium BC. The presence of these seeds indicates that some seeds were clearly domesticated in that area, by that time.\textsuperscript{11} However, because flax plants are used for a variety of purposes, both in the ancient world and today, the presence of seeds alone (wild or domesticated) cannot be used to definitively suggest linen production.

\textsuperscript{7} Barber, \textit{Prehistoric textiles}, 12.
\textsuperscript{8} Barber, \textit{Prehistoric textiles}, 11.
\textsuperscript{9} Barber, \textit{Prehistoric textiles}, 12.
\textsuperscript{10} Improved seeds are indicative of human interference in the propagation of the plant, but their presence does not necessarily indicate the presence of a fully domesticated species.
\textsuperscript{11} Barber, \textit{Prehistoric textiles}, 12.
1.2.1 Early evidence for linen textiles

A number of carbonized textile remains were found in 1962 at the site of Çatal Hüyük in Anatolia. These remains were indirectly dated using radiocarbon analysis of associated finds to the early sixth millennium BC. The material type of these textiles was not identified conclusively until a few years after their discovery. The original excavator, James Mellaart, together with textile expert Harold Burnham, believed the textile fragments to be wool: Mellaart based on available paleobotanical evidence; Burnham based on a photograph showing what he interpreted to be scales on the fibre—a characteristic of wool. A little later, wool expert M. L. Ryder conclusively proved the textile fragments are linen by carrying out the following experiment: he boiled a sample of the thought-to-be-wool material in a dilute alkali, an action which would have destroyed wool fibres. As the sample was not destroyed, it was not wool. The material was again examined, and the “characteristic cross-striations of flax” were observed, the boiling action having cleaned the fragment. Thus, he conclusively proved that the early sixth millennium BC fibre from Çatal Hüyük is of linen.

Dating to about a millennium later than the Çatal Hüyük textile fragments, evidence of linen production—a piece of coarse linen, spindle whorls, and flax seeds—was discovered at the site of Faiyum in Egypt. While the linen fragment does not demonstrably come from domesticated flax, the seeds found are likely of the domestic variety. A millennium after the Faiyum finds, evidence for linen appears in Europe. From a Swiss “lake-dwelling” site of the Neolithic period, a well-made fragment of linen

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was found. The abundance of flax present, both raw fibre and spun thread, led the original excavator to suggest that linen was locally produced there.\textsuperscript{15} Flax seeds alone do not prove that a plant was used for linen production; however, when seeds are found together with either finished product or textile production implements, a strong case can be made for the harvesting of flax for textile production purposes at a site.

In Italy, the earliest (possibly) linen-related find is a single flax seed from Sammardenchia in northern Italy, dated from the mid-seventh to the mid-sixth millennium BC.\textsuperscript{16} While it is tempting to assign significance to this early flax find, as discussed above, it is impossible to connect a single flax seed to linen production. Nevertheless, flax was already present in Italy, either locally grown or imported, by at least the mid-sixth millennium BC — roughly contemporaneous with the linen fragments from Çatal Hüyük. Seeds and seed capsules, also dated to the sixth millennium BC, have been found at La Marmotta in Lake Bracciano, a site very close to where, in the Iron Age, the city of Caere would develop.\textsuperscript{17} Also from La Marmotta, the oldest linen textile in Italy was recovered. Although textile fragments typically do not survive in that area, the submerged environment at the site allowed for its preservation. The linen from La Marmotta is dated to between 5480 BC and 5260 BC, making it roughly contemporaneous with (perhaps even slightly earlier than, due to the margin of error of radiocarbon dating) the finds from Çatal Hüyük.\textsuperscript{18} Such early evidence for flax seeds and (especially) linen textile fragments on the Apennine Peninsula have raised questions about the previously held belief that linen was imported into Italy from flax-producing

\textsuperscript{15} Barber, \textit{Prehistoric textiles}, 10.
\textsuperscript{16} Gleba, \textit{“Italy: Iron Age,”} 220.
\textsuperscript{17} Gleba, \textit{“Italy: Iron Age,”} 220.
\textsuperscript{18} Gleba, \textit{“Italy: Iron Age”}, 220.
regions such as Egypt; however, as pointed out by Margarita Gleba, “the number and wide chronological and geographical distribution of surviving linen fragments, especially Neolithic and Bronze Age evidence from north Italy seem to indicate indigenous production”.  

1.2.2 Harvesting and processing flax for linen production

Harvesting and processing flax is both time consuming and labour intensive, and requires some level of community organization to execute. Barber, using Egyptian representations and Swiss Neolithic tool assemblages as evidence, describes the ancient process of preparing flax for textile use. To process flax is to separate and remove bast fibres — the only part of the plant used to make linen — from all other parts of the stem. This process changed little until modern industrialization. At the cellular level, linen is produced from phloem cells (the food conducting tissues of a vascular plant) which are relatively large and cylindrical in shape. Harvesting time affects the quality of linen produced: younger plants yield fine, pale fibres; older plants yield coarse, strong fibres. Plants are pulled up from the roots (not cut) to maximize the amount of fibre available per plant. After harvesting, the plants are left out in the sun to cure. The dried plants are then broken up using wooden clubs (Figure 2), a process appropriately termed breaking or braking. After which, they are retted for a period of two to three weeks. Retting allows the material binding the bast fibres to the stem to rot away under controlled conditions. The speed of the retting process affects the final product: retting slowly, by exposing 

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plants to dew either in fields or on rooftops yields more brittle, silvery grey fibres; retting quickly, by submersing them in rivers or ponds yields suppler, golden fibres.\(^{25}\)

The retting process can be expedited by increasing temperature by, for example, placing plants in shallow water pools under direct sunlight.\(^{26}\) In Italy, no special retting installations have been found.\(^{27}\) Retting areas were needed only once a year after harvesting; therefore, creating special facilities when open air areas were readily available would no doubt have been considered a waste of resources. Retting is a delicate process, and care must be taken to ensure plants are not over- or under-retted: the former weakens the bast fibres; the latter makes them difficult to separate from the stem materials.\(^{28}\) After retting, plants are again dried. Harvesting, curing, and retting are time-sensitive activities; the remaining steps needed to turn raw material into usable fibres may be carried out at any time.

These final steps are a combination of processes, all of which aim to separate out the fibres from the unwanted stem material. Scutching is similar to the pre-retting process

\(^{20}\) Gleba, “Italy: Iron Age,” 221.
\(^{22}\) Barber, *Prehistoric textiles*, 13.
\(^{23}\) Gleba, *Textile production in pre-Roman Italy*, 92.
\(^{24}\) Gleba, *Textile production in pre-Roman Italy*, 91.
\(^{26}\) Gleba, *Textile production in pre-Roman Italy*, 92.
\(^{27}\) Gleba, *Textile production in pre-Roman Italy*, 92.
both involve beating the stem with wooden implements to separate bast fibres from waste materials. Lastly, the material is hackled or heckled — combed with a special implement made of wood or bone — to remove the last fragments of stem material (Figure 3).\textsuperscript{29} Scutching knives and flax combs have been found at lake-dwellings in the Alpine region, dated to both the Neolithic period and the Bronze Age.\textsuperscript{30} The process of scutching and hackling not only removes the unwanted stem material, but also separates short, broken tow fibres (used to produce lower grades of linen) from long line fibres (used for high quality linen). The long line fibres are composed of several shorter (approximately two to four centimetre long) fibres adhering to one another end-to-end.\textsuperscript{31} The resulting fibres, which are ready for spinning, are long, slightly wavy, and smooth. Linen textiles produced from the high quality line fibres are smooth, cool, and non-irritating. Because linen is difficult to soil and is quick-drying, it is an ideal utilitarian fabric.\textsuperscript{32}

\textsuperscript{29} Barber, \textit{Prehistoric textiles}, 13.
\textsuperscript{30} Gleba and Mannering, “Introduction: textile preservation, analysis and technology”, 5-6.
\textsuperscript{31} Barber, \textit{Prehistoric textiles}, 14.
\textsuperscript{32} Barber, \textit{Prehistoric textiles}, 14.
1.3 Wool

Wool is an animal textile fibre derived from the hairs of (usually) sheep. The properties of wool fibres are distinctly different from those of linen. Wool’s scaly surface — by which wool and other animal fibres are differentiated from plant based fibres — allows it to be felted. Felt is a non-woven textile produced by applying dampness, heat, and kneading pressure to the wool, causing the scales of neighbouring fibres to become “thoroughly caught in each other and thus cohere in a dense mass without benefit of glue or any other foreign substance.” The individual fibres are kinky and arrange themselves randomly, thus creating many air pockets which give wool its excellent insulating property. Given the curly nature of each individual fibre, it is possible to create two types of yarn during spinning. Fibres combed to lie parallel to one another produce strong, hard, worsted yarn; fibres carded to lie fluffily in all directions will produce a soft, elastic, woolen yarn.

The term “wool” is often used as a blanket term for any fibre harvested from a sheep’s coat; however, a single animal provides three types of fibres: kemps, hairs, and wool. They are differentiated by thickness. Kemps, 100-250μm in diameter, are the thickest of the three types of fibres. At between four and seven centimeters long, kemps are too stiff and brittle (breaking easily under tension or torsion) to spin without the addition of other fibres. Hairs, 50-100μm in diameter, are flexible enough to be spun into yarn, even without the addition of finer wool. It is kemps and hairs which gives wool its

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33 Barber, *Prehistoric textiles*, 20.
34 Barber, *Prehistoric textiles*, 20.
36 1μm = 1.0 x 10^-⁶m
characteristic bristly feel. True wool only refers to the softest fibres of a sheep’s coat. In diameter, medium wool is 30-60μm; fine wool is shorter than 30μm. The finest wool can be as thin as six microns in diameter. The proportion of kelps, hairs, and wool present on any one sheep depends on several factors including breed, age, and sex. In general, domesticated sheep yield more of the desirable wool fibre (in proportion to kelps or hairs) than their wild counterparts.

1.3.1 Domestication of sheep and early evidence for wool textiles

Identifying when, where, and from what species domestic sheep originated is difficult. A number of factors complicate the issue. First, there is the problem of data gathering and reporting. As is often the case in archaeological research, the type of data gathered is often not the data needed for further study by experts in a particular field. Bone assemblages from a site are often grouped into broad categories. This is especially problematic for the study of sheep domestication because assemblages are commonly listed under the combination “sheep/goat” — clearly a problem if one wants to draw conclusions about sheep only. Second, the ovis family tree is complex. Recently, mitochondrial DNA analysis has demonstrated that “there are at present four maternal lineages of ancient sheep, indicating at least three geographically independent sheep domestication events. For each individual event, the number of wild species involved in the domestication process is uncertain, with hypothesis ranging from a single species to

38 Barber, Prehistoric textiles, 21.
more than four. If more than one species was involved, the contribution of each species is unclear and requires further study. Evidence for both wild and domesticated sheep across multiple sites in Iran (Belt Cave, Ali Kosh), Iraq (Zawi Chemi Shanidar, Jarmo), and Thessaly (Argissa-Magula) “points to domestication by or before 7000 BC, and probably considerably before, even in the ninth millennium BC.” At Argissa-Magula, imported domesticated sheep were present by 7200 BC, meaning domestication needed to have occurred in the exporting region prior to that date. Although the pathway from wild to domesticated sheep is unclear, it is certain that woolly sheep were present in the Mediterranean region by the middle of the fourth millennium BC. Before then, all textile evidence for which identification is possible (impressions of textiles or severely deteriorated fragments cannot be identified) is of bast fibre.

Direct evidence for wool on the Italian peninsula is not seen until the Early Bronze Age, much later than the earliest direct evidence for linen which dates, as we have seen, to between 5480 and 5260 BC. At the site of Molina di Ledro, a wool sewing thread was identified in a linen belt. A pure wool fragment is not seen until the Middle Bronze Age, at the Terremare site of Castione dei Marchesi. The best preserved wool textiles date to the Iron Age. Complete (and near-complete), well preserved textiles have been found in eighth century BC tombs at Verucchio. These early textiles all have complex weaves, the execution of which required more than a basic level of weaving

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41 Barber, *Prehistoric textiles*, 22.
42 Barber, *Prehistoric textiles*, 22.
43 Barber, *Prehistoric textiles*, 22.
44 Barber, *Prehistoric textiles*, 22.
47 Gleba, “Italy: Iron Age,” 222.
ability. Thus, our earliest examples of wool must certainly reflect later stages of wool textile development. Earlier, simpler examples have simply not survived or are yet to be discovered.

As with flax, for wool production, domestication of the raw material (sheep) is not synonymous with wool textile production. Initially, sheep (with predominantly hairy coats) were domesticated for their meat and hides — animal products familiar to prehistoric humans. The wish to easily access these familiar products, not the pursuit of woolly coats, was undoubtedly the driving force of domestication as “no prehistoric peoples could have foreseen any possible changes in the predominantly hairy coats of animals.” Secondary products (milk and wool) were discovered quickly and developed. People already skilled in spinning thread from plant fibres would have easily adapted the method to animal fibres. This discovery (after the sheep were already domesticated) led to the selective breeding of more woolly sheep, allowing for more and better quality wool to be harvested from each animal.

1.3.2 Herd composition of domesticated sheep according to use

Domesticated sheep have three primary uses: meat, milk, and wool. The composition of a sheep herd reflects its primary use. The differentiation in herd

48 Gleba, “Italy: Iron Age,” 222.
49 Barber, Prehistoric textiles, 23.
50 Barber, Prehistoric textiles, 23. (After Charles Reed, 1960)
51 Barber, Prehistoric textiles, 24. (After Zeuner)
composition begins to be apparent in the archaeological record in the third millennium BC.52

For meat production, it is most economical (and most delicious) to slaughter an animal as soon as it is fully grown — yielding the maximum amount of tender meat at minimal cost. The majority of animals in a meat herd are young, both male (preferred) and female. Ewes are kept only to maintain the number of animals in the herd. For milk production, ewes dominate the herd; as they age, newborn females are kept to replace them. Young males, unless needed for breeding, are slaughtered. For wool production, the composition of a herd is more complex. Ideally, wethers make up the majority of a wool herd because they grow more of the high quality wool than ewes or rams. Because rams produce both a smaller amount and a poorer quality of wool, the majority are castrated. As with milk herds, enough rams are kept to maintain the herd’s size. Ewes, growing a fair amount of good quality wool, are kept both for their wool and for propagating the herd.

In practice, herds would have been kept for multiple uses. Certain combinations of use were even advantageous. In milk and meat herds, females are kept for milk and young males are slaughtered for meat. Likewise, milk and wool herds would also keep both females and males, simply castrating the latter to ensure production of top-quality wool. Some combinations were problematic: the interests of a meat and wool herd are contradictory. Archaeologically, the presence of wethers is the best indicator that a herd was (purposefully) used for wool production.53

52 Barber, Prehistoric textiles, 28.
53 Barber, Prehistoric textiles, 27.
1.3.3 Harvesting and processing wool for textile production

Compared with flax cultivation and processing, the process of transforming raw wool into yarn is much simpler and faster. Harvesting time is late spring or early summer, which takes advantage of the animal’s freshly grown new spring wool.\textsuperscript{54} Plucking was the earliest harvesting method. It was ideal for newly domesticated breeds whose moulting wool was easily plucked, and thus kept separate from the rough, unwanted kems.\textsuperscript{55}

![Figure 4: Iron shears (approx. 40 cm long) from Gleba.](image)

In the Iron Age, with the introduction of iron shears (Figure 4), as well as the predominance of more woolly sheep, shearing became the preferred method. The development of iron, a more springy metal (a good characteristic for shears) than bronze, may have contributed to the relatively quick and widespread adoption of the tool.\textsuperscript{56} “All ancient shears found in Europe are of the same design, with two triangular blades on a

\textsuperscript{54} Gleba, \textit{Textile production in pre-Roman Italy}, 93.
\textsuperscript{55} Barber, \textit{Prehistoric textiles}, 29.
\textsuperscript{56} Barber, \textit{Prehistoric textiles}, 29
simple U-shaped spring”.57 The best wool was plucked or shorn from the sides and shoulders of the animal.58

Wool may be cleaned before or after its removal from the animal. Combing was the best way to remove debris — twigs, leaves, and grass picked up by the animal — and to separate and arrange individual fibres in preparation for spinning.59 As with hackles used for linen preparation, long-toothed wool combs were usually made of wood or bone, and so they rarely survive in the archaeological record. In pre-Roman Italy, wool was combed straight through, producing parallel lying fibres used in worsted yarn. In Roman times, woolen yarn was spun from carded wool (fluffed up using cards or bows). Carding removes impurities from and allows air to enter the wool.60 Before spinning, wool fibres were sorted by hand according to colour, fineness, crimp, length, strength, and texture. In general, after combing wool fibres were ready for spinning; however, in some cases, further treatments were required (or rather, desired).

Unlike linen which is very difficult to dye, wool takes dye well, provided that the naturally occurring lanolin (a waterproof, fatty substance secreted on the skin by sheep) is thoroughly removed. Because water alone cannot remove the lanolin, wool must be scoured using harsher agents such as urine or soapwort.61 Only wool destined for the dyeing vats should be scoured as any removal of lanolin makes wool more difficult to spin. Natural wool is spun unwashed, with the lanolin intact to help the process.62

58 Gleba, Textile production in pre-Roman Italy, 98.
59 Gleba, Textile production in pre-Roman Italy, 98.
61 Gleba and Mannering, "Introduction: textile preservation, analysis, and technology", 8.
62 Gleba, Textile production in pre-Roman Italy, 98.
1.3.4 Advantages of wool

Wool, the raw material, is significantly faster and less labour intensive to grow, harvest, and process for textile use than bast fibres. Wool herds are pastured on rangeland, saving valuable agricultural land for food production. An entire herd may be looked after by a single individual compared with the many workers needed to plough, sow, weed, and harvest a single flax field. Sheep are less susceptible to types of weather events which could damage or kill an entire year’s flax crop. Herds can be transported over large distances if needed, without the loss of already invested resources. Enough wool can be produced by a single household to meet their own needs.

The properties of wool textiles undoubtedly contributed to its widespread use, especially in colder regions. While linen is ideal for hot, humid climates, wool’s high insulating properties make it well suited for colder, northern climates. Not only does wool come in a variety of natural colours, but it can also be easily dyed. Coloured wool, natural or dyed, was commonly used for creating patterns and borders.

1.4 Other raw materials

Flax and wool were the two most common raw materials for textile production. Hemp, nettle, esparto, and cotton are other plant-based fibres used for textile production in the Mediterranean region. Hemp (Cannabis sativa) fibres are coarser than those of flax. Ideally, if a variety of raw materials were available, hemp would have been used only for ropes and sails rather than for household textiles. Hemp spread into the
Mediterranean region in the Iron Age from the northern and western areas of Europe.\textsuperscript{63} The earliest hemp seeds were found at a Neolithic site in Germany.\textsuperscript{64} In Scandinavia, nettle (\textit{Urtica dioica}), also a bast fibre, was used. The earliest example of a nettle textile in Europe, dating to the early first millennium BC, comes from Denmark.\textsuperscript{65} All bast fibres are harvested and processed into thread in much the same way as flax. Differentiating fibres by type in a preserved textile is difficult (at times impossible) because samples are often too degraded to analyze.

Esparto, a wild grass (not a bast fibre) native to Spain and never domesticated, was used in the region primarily for non-woven materials such as baskets, sandals, caps, and (especially) ship rigging.\textsuperscript{66} Cotton (also not a bast fibre) was first cultivated in India. It was one of the last fibres to arrive in the Mediterranean and was not widely used until Roman times.\textsuperscript{67} Less common raw materials for textile production included silk, lime or linden tree fibres, various grasses (other than esparto), sea-silk (fibres which attach certain shells to the sea floor), and asbestos.\textsuperscript{68}

\subsection*{1.5 Thread-making tools and techniques}

Spinning, the “process by which several single and usually short, pliable filaments are twisted into one long, strong thread”, is by far the most common method used to

\begin{thebibliography}{99}
\bibitem{63} Barber, \textit{Prehistoric textiles}, 19.
\bibitem{64} Barber, \textit{Prehistoric textiles}, 16.
\bibitem{65} Barber, \textit{Prehistoric textiles}, 19.
\bibitem{66} Barber, \textit{Prehistoric textiles}, 34.
\bibitem{67} Barber, \textit{Prehistoric textiles}, 32-33.
\bibitem{68} Gleba, "Italy: Iron Age", 218.
\end{thebibliography}
convert prepared raw fibres into useable thread.69 The earliest direct evidence of twisted thread — a 30 cm imprint of s-twisted fibres70 — was found in the Palaeolithic Lascaux cave in France, and was dated to 15000 BC.71 Indirect evidence strongly suggests that technology to create twisted thread was developed much earlier — dating to 20000 BC, the “Venus” figure from Lespugue, France, wears a twisted thread skirt, which no doubt represents a material already used at that time.72

The conversion of raw fibres into thread could be carried out with a single tool: the spindle. (In fact, it is possible [though much more difficult and time consuming] to spin fibres by hand only, without any tools.) The spindle whorl, although not mandatory, allowed better quality thread to be spun easier and faster. Other tools such as distaffs, situlae, and epinetra were used to assist the thread-maker, but they did not affect the finished product.

Splicing (Figure 5) was likely the earliest thread-making technology used in the Mediterranean region.73 With this technique, useable with bast fibres only, the “ends [of each individual or bunch of fibres] were overlapped by a few centimeters, and twisted [by hand] at the

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69 Barber, Prehistoric textiles, 9.
70 See section 1.5.1 for twist types.
71 Barber, Prehistoric textiles, 40.
72 Barber, Prehistoric textiles, 40.
splice so that it would hold.”74 While this method is most common in Egyptian linen textiles, spliced threads have been recently found at Neolithic Swiss sites.75

1.5.1 Spindle

The spindle is “a simple rod with a hook or dent on one end to attach the thread and to keep the yarn from slipping off the spindle shaft.”76 Like many textile production tools, spindles are usually made of bone or wood, and thus rarely survive in the archaeological record. Although spinning by hand with no implements is possible, it causes problems such as tangling, untwisting, and difficulty keeping the thread under tension — all of these problems are solved by the introduction of the spindle77. This simple tool makes it easier to manage both raw fibres and finished thread. By twirling the spindle, the thread-maker is able to create a uniform thread quicker than by spinning by hand only. The prepared thread can be kept right on the spindle for storage and for use during the weaving process.78 The length of a spindle is its most important characteristic and determines its ease of use. In the first millennium BC, the average length of a spindle has been estimated at about 30 cm.79 Decorated spindle shafts, common on both wooden domestic examples and funerary ones made of precious materials, may have had a

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77 Barber, Prehistoric textiles, 42.
78 Barber, Prehistoric textiles, 42.
79 Gleba, Textile production in pre-Roman Italy, 103. (After Giovannangelo Camporeale.)
utilitarian aspect: the grooves created by the decoration provided extra friction, helping the thread to stay on the spindle.  

Some spindles were fitted with a spindle hook (Figure 6). A spindle hook is “a small object made of thin sheet metal shaped into a cone and ending in a solid hook about 5 cm long, which can be mounted on a wooden spindle shaft.” The spindle hook performs the same function as an indentation on the spindle — it keeps the thread in place and prevents it from leaving the shaft.

The earliest examples of preserved spindles come from the Bronze Age Terremare settlements in northern Italy. A rare example of a decorated wooden spindle, with a spindle whorl still attached, was found at the Iron Age settlement of Gran Carro. In Italy, such examples are extremely rare because they survive only in waterlogged environments, as was the case at Gran Carro.

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80 Gleba, *Textile production in pre-Roman Italy*, 103.
81 Gleba, *Textile production in pre-Roman Italy*, 103.
82 Gleba, *Textile production in pre-Roman Italy*, 101.
83 Gleba, *Textile production in pre-Roman Italy*, 101.
Thread may be spun as either s-twisted or z-twisted (Figure 7). S-twisted thread is spun counter-clockwise, so that the fibres form a recurring “s” shape. Z-twisted thread is spun clockwise, with the fibres producing a “z” shape. Regional preferences for either s- or z-twisted thread have been identified. In Egypt, linen cloth is almost exclusively s-twisted. In Europe, z-twisted thread is more common; however, more variation exists there than in Egypt. It is possible that twist types contrary to regional preference may be a result of a left-handed spinner. The regional preference for s- or z-twisted thread may also correspond to whorl types — though it is difficult to know if whorl type affected twist type or vice versa. Two threads of opposing twist may be spun together — plied — for increased strength.

1.5.2 Spindle whorl

The spindle whorl is a “symmetrical, centrally pierced object” which “provides weight and tension for spinning fibres into thread.” The spindle whorl magnifies the benefits of the spindle by allowing it to be spun faster and more uniformly, thus creating a stronger, higher quality thread. Spindle whorls, most commonly made of fired clay

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84 Barber, *Prehistoric textiles*, 65.
86 Please see next section for a more detailed discussion of whorl types.
88 Gleba, *Textile production in pre-Roman Italy*, 103.
(except some metal and precious material examples from funerary contexts), have been found at almost every settlement site in Europe starting from the Neolithic period. The presence of an unusually high number of near-identical spindle whorls at a single site (or at a specific area within a site) may indicate an area of specialized production.

Terracotta spindle whorls survive very well in any environment and are therefore the best direct evidence for spindle use, as spindles themselves very rarely survive. Although there is fairly wide variation in whorl shape, these variations do not occur predictably over time, making whorls difficult to date without context.

The most important functional features of a spindle whorl are its diameter to height ratio and weight. The diameter to height ratio is determined by the shape of the whorl. Increasing the diameter of the whorl decreases its rate of spin. A slow moving whorl produces a looser, less twisted final thread. Whorls may be grouped by shape into six types (Figure 8): discoid, cylindrical, globular (spherical, lenticular, or ogival), conical (and truncated conical), biconical, and cuboid. Discoid shaped whorls have a high diameter to height ratio, allowing them to maintain a long, slow rotation. The earliest discoid whorls were wide and flat, and may have been re-purposed pottery shards. These early discoid types, popular in the Bronze Age, disappeared sometime in the Early Iron Age. Cylindrical whorls, with similar characteristics as the discoid type, fell out of favour by the first millennium BC. The Bronze and early Iron Ages saw the greatest

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91 Barber, Prehistoric textiles, 53.
92 Gleba, Textile production in pre-Roman Italy, 104.
93 Gleba, Textile production in pre-Roman Italy, 104.
94 Gleba, Textile production in pre-Roman Italy, 106.
95 Gleba, Textile production in pre-Roman Italy, 104.
variety of whorls at single sites. In later periods, conical/ truncated conical and biconical whorls were by far the most common. Conical whorls are asymmetric in shape. They have a diameter that is equal to or slightly greater than the height. During use, the wider end of the whorl faces the top of the spindle. The conical shape allows the whorl to rotate quickly, and the wide top helps to keep the spun thread from falling off the spindle.\textsuperscript{96} Biconical whorls have similar characteristics to conical ones; however, their diameter is greater than their height. Globular and cuboid whorls, both seen in early contexts, never gained widespread popularity.\textsuperscript{97}

Whatever the shape, it was important that the hole for the spindle shaft was accurately centred to ensure a steady and uniform spin. Citing a study of Middle Eastern whorls by Robert Liu, Barber states that spindle whorls have a hole typically seven to eight millimeters in diameter, reflecting the diameter of the accompanying spindles.\textsuperscript{98}

A slight taper, observable with the

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{spindle_whorl_types.png}
\caption{Spindle whorl types adapted from Gleba.}
\end{figure}

\textsuperscript{96} Gleba, \textit{Textile production in pre-Roman Italy}, 104.
\textsuperscript{97} Gleba, \textit{Textile production in pre-Roman Italy}, 104, 106.
\textsuperscript{98} Barber, \textit{Prehistoric textiles}, 50-51.
naked eye, allows the spindle to fit snugly into the spindle whorl.\textsuperscript{99} This taper may be used to distinguish spindle whorls (especially those made of precious materials\textsuperscript{100}) from beads, which do not require a taper.

A whorl’s weight may indicate the type and quality of fibres spun, as well as the quality of thread produced.\textsuperscript{101} Because most whorls are made of the same material (fired clay), their weight is dictated by their size: the larger the whorl, the heavier it is. In general, small whorls were used to spin fine, delicate fibres such as short wool, flax tow, or cotton; large whorls were used to spin strong, coarse fibres or to ply two or more finished threads together.\textsuperscript{102} The heaviest whorls, weighing over one hundred fifty grams were used to spin full-length flax or to ply wool. Whorls weighing between one hundred and one hundred fifty grams were used to spin long-staple wool; those weighing about thirty grams to spin medium to heavy wool. The lightest whorls, weighting about eight grams, were used to spin short, fine wool.\textsuperscript{103} It is imperative that the weights of spindle whorls found during excavations be recorded in order to be able to make informed conclusions about the type of thread being produced. Unfortunately, few excavators record this essential measurement. In Italy, spindle whorl weights have been analyzed for only a small fraction of archaeological sites.\textsuperscript{104}

Spindle whorls were often decorated. Although it is difficult to date whorls based on decoration alone, general patterns do emerge. The earliest whorls, dating to the

\begin{footnotesize}
\begin{enumerate}
\item Gleba, \textit{Textile production in pre-Roman Italy}, 107.
\item Glass whorls were sometimes found in elite burials of the Orientalising period, especially in north Italy (e.g. Verucchio, Montescudaio, and Bologna). These whorls were likely only status symbols and would not have been used for spinning (Gleba, \textit{Textile production in pre-Roman Italy}, 108-9).
\item Gleba, \textit{Textile production in pre-Roman Italy}, 106.
\item Barber, \textit{Prehistoric textiles}, 52.
\item Barber, \textit{Prehistoric textiles}, 52. (check this)
\item Gleba, \textit{Textile production in pre-Roman Italy}, 107 (Table 5).
\end{enumerate}
\end{footnotesize}
Neolithic period, were incised with simple, geometric patterns. By end of the Iron Age, (especially conical) whorls were moulded to have ribbed or fluted designs (Figure 9).\textsuperscript{105} Decorations could also be incised, impressed, or stamped (rare). Impressions were usually made with a piece of cord or a small tool; stamps were generally simple; graffiti was very rare, and if present, usually in funerary contexts.\textsuperscript{106}

\begin{figure}[h]
\centering
\includegraphics[width=0.4\textwidth]{figure9.png}
\caption{Fluted spindle whorl from Caere \textit{photo by Malakhova}}
\end{figure}

The presence of spindle whorls at a site only confirms that thread-making activities took place. If the whorls were well-decorated or made of precious materials, the status of their owner may be inferred. While spindle whorls are present, often in large numbers, at most archaeological sites, they are rarely properly recorded. Key measurements, especially weight, are often missing. This prevents researchers from hypothesizing about the type and quality of thread for which they may have been used.

\subsection*{1.5.3 Other tools}

The distaff is “a rod or board onto which prepared fibres are fastened to serve as a source of supply during spinning,” allowing the spinner to be mobile.\textsuperscript{107} Distaffs may be grouped into two broad categories: short and long. Short distaffs were hand held and used for short fibres; long distaffs, used for long fibres, were either held under the arm or

\begin{thebibliography}{9}
\bibitem{Gleba105} Gleba, \textit{Textile production in pre-Roman Italy}, 108.
\bibitem{Gleba106} Gleba, \textit{Textile production in pre-Roman Italy}, 108.
\bibitem{Barber107} Barber, \textit{Prehistoric textiles}, 69.
\end{thebibliography}
propped up in the belt. Distaffs, like most textile production tools, were typically made of wood. In fact, a spinner may have simply used a conveniently shaped stick for the purpose instead of spending effort making a proper tool. Distaffs of metal (bronze, iron, silver) and precious material (glass, amber, gold) have been found in elite tombs of the Iron Age and Orientalising Period. Unsurprisingly, these have been interpreted as indicators of status.

Uniquely, there is much variation in distaffs — other textile production tools saw little variation across geographic areas and time periods. Long distaffs (Figure 10) were generally of one type. They measured between a metre and a metre and a half in length; had a forked top with two to eight prongs; and were made of wood covered with bronze; and they may have been used to hold especially long fibres. All examples of this type come from a small area in South Etruria. Distaffs of the short, hand-held variety were much more varied. Margarita Gleba created a typology of distaffs from Italian tombs to reflect their cultural and geographic diversity. Table 1 summarizes the five types of short, hand-held distaffs.

Archaeologically, distaffs are almost always found in association with spindle whorls. Spinning instruments — spindles (assumed to be present because of the presence of whorls), spindle whorls, and distaffs — were typically placed together as sets inside burials.

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Figure 10: Long distaff, 8th c. BC from Civita Casellana from Gleba.

108 Gleba, Textile production in pre-Roman Italy, 109.
109 Gleba, Textile production in pre-Roman Italy, 110.
### Table 1 Distaff typology summary

<table>
<thead>
<tr>
<th>Type</th>
<th>Sub-type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong> Hammered sheet metal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Conical top, convex shaft, 20-25cm long</td>
</tr>
<tr>
<td></td>
<td>• Largest group known</td>
</tr>
<tr>
<td></td>
<td>• Distribution suggests Bologna is production centre</td>
</tr>
<tr>
<td></td>
<td>2. Spherical top, convex shaft, disk at bottom, c.20cm long</td>
</tr>
<tr>
<td></td>
<td>• Rare, examples from Verucchio, Siena area</td>
</tr>
<tr>
<td></td>
<td>• Possible example from Regolini-Galassi Tomb</td>
</tr>
<tr>
<td></td>
<td>3. Flat top, attached rings, incised decoration, 24-29cm long</td>
</tr>
<tr>
<td></td>
<td>• Very rare, three from Osteria dell’Osca</td>
</tr>
<tr>
<td><strong>B</strong> Solid cast bronze, disc on each end, incised decoration on shaft and discs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Three discs on top, one or two discs on bottom, shaft thicker at bottom, 20-30cm long</td>
</tr>
<tr>
<td></td>
<td>2. Relatively short, two or three discs on top, one on bottom, perforated at one or both ends, 18-26cm long</td>
</tr>
<tr>
<td></td>
<td>• Popular in southern Etruria</td>
</tr>
<tr>
<td></td>
<td>• Tarquinia or Veio possible production centres</td>
</tr>
<tr>
<td></td>
<td>3. Very long shaft, numerous discs and chain attachments, thicker at bottom, c.40cm long</td>
</tr>
<tr>
<td></td>
<td>4. Shaft with incises decoration, hole at each end, attached rings or chains, 25-30cm long</td>
</tr>
<tr>
<td></td>
<td>5. Single ring near top, cast together with shaft, 25-30cm long</td>
</tr>
<tr>
<td></td>
<td>6. Miniature distaff, three discs, hook at lower end</td>
</tr>
<tr>
<td></td>
<td>• Single example from a child burial at Guidonia – Le Caprine; found with other miniature textile tools</td>
</tr>
<tr>
<td><strong>C</strong> Composite, conical top, bronze core, amber decorations, 15-20cm long</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>• &gt;20 examples from Verucchio, which appears to be the production centre</td>
</tr>
<tr>
<td><strong>D</strong> Composite, made of bone and/or bronze elements</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Bronze core, decorated bone elements, spherical top, 20cm</td>
</tr>
<tr>
<td></td>
<td>2. Cylindrical shaft, bone elements</td>
</tr>
<tr>
<td></td>
<td>3. Carved, 15-20cm</td>
</tr>
<tr>
<td><strong>E</strong> Glass with metal rod core</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Two complete examples from Cerveteri</td>
</tr>
</tbody>
</table>

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110 Gleba, *Textile production in pre-Roman Italy*, 110-120.
In some cases, other instruments were used during spinning. As with distaffs, these other secondary instruments did not affect the quality of the final product, but rather helped ease the process for the spinner. A special bowl, made of fired clay with a loop inside near its base, was used to wet linen thread, making it easier to work with. Evidence of such “fibre-wetting bowls”, so termed by Barber, who believed them to correspond in shape and use to modern Japanese wetting bowls, is seen in Egypt, the Middle East, and Bronze Age Crete.111

The *situla*, was a special storage container for wool. *Situlae* were common in northern Italy and corresponded roughly to the Greek *kalathos* (wool basket). As with other textile tools such as shears and combs, it is often difficult to relate a particular container to textile production without associated finds. In some cases the identification was easy — in a tomb at the Casa di Ricovero necropolis, a bronze *situla* was found with a bronze spindle, distaff, and two combs dating to the fourth century BC.112

An *epinetron* (knee guard) is an object of fired clay which was placed over the thigh and knee of a seated woman to protect her dress from wool’s natural oils. Functionally, an *epinetron* provided a “suitable working surface on which to form the combed wool into long, soft, fluffy rolls for spinning.”113 The identification of these objects is aided by decorated examples, which often have textile-related motifs such as this fifth century BC example depicting women preparing wool (Figure 11).114

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111 Barber, *Prehistoric textiles*, 75.
112 Gleba, *Textile production in pre-Roman Italy*, 100.
113 Barber, *Prehistoric textiles*, 77-78.
114 Gleba, *Textile production in pre-Roman Italy*, 98-99.
1.6 Weaving tools and techniques

Weaving is the interlacing of threads to form a textile. It is accomplished by holding one set of threads — the warp — under tension as another set — the weft — is passed through it. A loom is “a special frame that keeps the warp system in place, while allowing the weft to be passed in between the warp threads,” thus providing a degree of mechanization to the process.\textsuperscript{115} Looms are incredibly difficult to find in the archaeological record because they are built entirely of organic material. Often, the only surviving evidence of a loom is the carbonized remains of the beams or post holes in the soil. These remains, even if present, are not always detected and/or correctly identified during excavation. In exceptional cases, carbonized remains are accompanied by a line of loom weights. Such a fortunate combination, dated to between the sixth and fifth century BC was discovered at Pozzuolo del Friuli in the northeastern of Italy.\textsuperscript{116} A similar deposit — carbonized wood timbers and an accumulation of loom weights — dated to between

\footnotesize{\textsuperscript{115} Gleba and Mannering, “Introduction: textile preservation, analysis and technology”, 14.}
\footnotesize{\textsuperscript{116} Gleba, “Italy: Iron Age”, 235.}
the fourth and third century BC was found in a building at La Piana in North Etruria.  

Finding the remains of a set-up loom provides important information about its use. It also provides information about the location of weaving activities in a house and the size of textiles being woven (the width of the loom corresponding to the maximum width of the textile being woven).

Three main loom types were used in antiquity: the horizontal or ground loom, the vertical two-beam loom, and the warp-weighted loom. The horizontal loom was first developed in the northern part of the Fertile Crescent, and was used in Egypt by the middle of the Neolithic period. Extant examples are rare, especially because Egyptian archaeology traditionally focused on funerary rather than domestic contexts.

On a horizontal loom the weaver works from a seated position on the ground, weaving the weft through the warp that is “stretched between the two beams which are fixed in place by pegs driven into the ground”. In Egypt, evidence for the ground loom comes from funerary contexts, such as the example from the tomb of Khnumhotep (Figure 12).

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Figure 12: Egyptian ground loom from Barber.

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118 Barber, Prehistoric textiles, 88.
The loom appears to stand vertically; however, this is a product of drawing convention, rather than a reflection of actual practices.\textsuperscript{120} There is no direct evidence for the ground loom in Europe.\textsuperscript{121}

On the vertical two-beam loom (Figure 13), the warp is stretched between the top and bottom beams of a vertically set-up rectangular wooden frame. Weavers work from the bottom to the top. An extant vertical two-beam loom is yet to be discovered; it is known only through representations.\textsuperscript{122}

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{vertical_two-beam_loom.png}
\caption{Representation of a vertical two-beam loom from Gleba and Mannering.}
\end{figure}

1.6.1 The warp-weighted loom

The warp-weighted loom (Figure 14) was widely used throughout Europe from the Mediterranean region to Scandinavia. The earliest evidence of this loom type, two post

\textsuperscript{120} Barber, \textit{Prehistoric textiles}, 84.
\textsuperscript{121} Gleba and Mannering, “Introduction: textile preservation, analysis and technology”, 16.
\textsuperscript{122} Gleba and Mannering, "Introduction: textile preservation, analysis and technology", 16.
holes near a heap of clay weights, dates to an Early Neolithic site in Hungary.\textsuperscript{123} In Swiss pile-dwellings, dated to the Late Neolithic, loom weights were found together with evidence for textile production consisting of both raw flax and finished linen cloth.\textsuperscript{124}

The warp-weighted loom is set-up by leaning two upright beams (typically against a wall) with a single horizontal (or cloth) beam connecting them at the top. In form, it is similar to the vertical two-beam loom; however, instead of a second beam to which the bottom of the warp is tied, the threads are held taut by a series of loom weights. The weaver would tie multiple warp threads to each loom weigh, either directly or through an “intermediary device” such as a cord or ring.\textsuperscript{125}

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\textsuperscript{123} Barber, \textit{Prehistoric textiles}, 93.
\textsuperscript{124} Barber, \textit{Prehistoric textiles}, 95.
\textsuperscript{125} Gleba, \textit{Textile production in pre-Roman Italy}, 128.
To create a simple weave, the weaver raises every other warp thread (by hand or with the help of a shed or, in some cases, a heddle bar) and passes the shuttle through the opening. A shuttle is simply the mass of weft threads used during weaving, stored either as a ball, on a stick, or directly on the spindle that was used during spinning. The width of the textile being produced on a warp-weighted loom, and in fact on all looms, is limited to the width of the loom itself. Unlike with other looms, the length of a textile produced on a warp-weighted loom may be extended by winding up the finished cloth around the top beam as the weaving progresses. Otherwise, the weaver can simply stand on a stool in the early stages of weaving or, in rare cases, dig a trench under the loom to extend its height, and thus the length of the fabric.

Each edge of a textile woven on the warp-weighted loom required special attention. The heading band, a narrow band attached to the horizontal cloth beam at the top of the loom, can be created using the tablet-weaving technique. Or, more simply, the warp can be affixed directly to the beam. A selvage (reinforced edge) is created by simply looping the weft thread around the outermost warp thread and running it back across the fabric (Figure 15). Doubling-up the warp threads reinforces the selvage. Lastly, once the textile is woven, the remaining length of the warp can be finished into a...

128 A trench under the loom is depicted on a Hallstatt Urn from Sopron, Hungary. See section 1.7 for depictions of warp-weighted looms.
129 See section 1.6.4 for tablet weaving.
130 Also selvedge; Middle English from SELF + EDGE, after Dutch selfegghe. (Canadian Oxford Dictionary, 2nd Edition)
fringe (knotted, plaited, tasseled, etc.), tablet-woven into a border, sewn back into the fabric, or simply allowed to hang loose.\textsuperscript{132}

![Simple selvage and reinforced selvage from Gleba and Mannering.](image)

**Figure 15: Simple and reinforced selvage from Gleba and Mannering.**

### 1.6.2 Loom Weights

Unlike the ground and vertical two-beam looms, the warp-weighted loom leaves behind evidence — loom weights — of its existence long after the deterioration of its wooden structure. Loom weights “keep the warp of the warp-weighted loom taut during weaving” and in Italy, are predominantly made of fired clay. While these implements are unique to the warp-weighted loom, they could have also been used for a variety of non-weaving activities such as holding down roof thatching, tying sacks, or weighting down fishnets.\textsuperscript{133} Loom weights have been found at numerous sites across Italy from the Neolithic period to Roman times. The slightly irregular shape of the majority of loom weights betrays their hand-made nature. Later, in the Hellenistic period, there is evidence for mould-made weights.\textsuperscript{134}


\textsuperscript{133} Gleba, *Textile production in pre-Roman Italy*, 127.

\textsuperscript{134} Gleba, *Textile production in pre-Roman Italy*, 134.
Loom weights, much like spindle whorls, cannot be dated without associated, dateable finds because their shape does not change predictably over time; however, general conclusions may be made. The earliest loom weights in Italy, dated to the fifth and fourth millenniums BC were predominantly cylindrical or conical in shape (Figure 16). In the fourth millennium BC, rheniform, cylindrical, and lenticular shapes appear to have been favoured. In the first millennium BC, trapezoidal loom weights become by far the most common. In the Hellenistic period, discoid weights enjoyed popularity in the Greek colonies on Italy; however, the type was never adopted in the rest of the peninsula (including Etruria).

The above are only broad chronological categorizations; a variety of types regularly existed together, often at a single site. Trapezoidal loom weights can range in form from rectangular prisms (parallelepips) to square, rectangular, triangular, or polygonal pyramids. Having first

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135 Gleba, *Textile production in pre-Roman Italy*, 129.
136 Gleba, *Textile production in pre-Roman Italy*, 128.
appeared in north Italy during the Bronze Age, trapezoidal loom weights are “by far, the most prevalent loom weight type in the 1st millennium BC Italy” and “have been found in the majority of the Iron Age and later sites.”

Loom weights are often decorated. The simplest decorations are incised lines (straight, zigzag, cross, or other) that are usually placed on the top surface of the weight. In later periods, single letters and full or abbreviated words appeared. More complex anthropomorphic and zoomorphic designs were rare. In southern Italy, a large cluster of labyrinth motifs has been found, perhaps reflecting the Greek influence in the region. Decorations on loom weights have been interpreted in several ways. Most convincingly, they are identified as owner’s marks. In her investigation of loom weights bearing Etruscan inscriptions, Laura Ambrosini found that all inscriptions studied were of personal names, usually feminine, in the possessive case, clearly indicative of ownership. In Greek colonial settlements in Lucania, southern Italy, “personalized” loom weights — loom weights into which personal items such as gems, seals, fibulae, or other (usually female-related) objects were impressed — first appeared in the sixth century BC. Indigenous communities in the surrounding areas soon adopted this practice. One find in particular illustrates the high personal value of the objects used as stamps: a fourth century BC disk weight (Greek, as the indigenous peoples in the area never adopted this shape, despite adopting the practice of personalizing these objects)

137 Gleba, *Textile production in pre-Roman Italy*, 131.
138 Gleba, *Textile production in pre-Roman Italy*, 135-137.
was found decorated with a much older stamp, perhaps dating to as far back as the sixth century BC. “It is not fanciful, then, to interpret this stamp as an heirloom that passed through the generations between different female members of the same family,” conclude Quercia and Foxall of the object.¹⁴¹ Such personal touches on otherwise utilitarian objects clearly demonstrate how deeply connected to them were the (usually) women who used them, as a mark of simply, unattached possession could have been made using personal objects.¹⁴² Less probable interpretations of loom weights’ decorations include: decorations corresponding to a particular weight category, maker’s marks, and orders in which weights were placed on a loom. There is no consistent correlation between decoration and weight; therefore, they could not have represented specific, numerical weight values.¹⁴³ Furthermore, an experienced weaver would not rely on weight labels, but would determine, by hand, a loom weight’s suitability for a particular type and number of threads.¹⁴⁴ Likewise, it seems improbable that an experienced weaver would require labels to put the loom weights in order, if indeed a precise order was necessary. It also seems unlikely that decorations were needed to determine which loom weight can be used for what type of cloth. When not in use, loom weights were kept in storage containers, and it would have been natural to store different sets in different containers, much as is done with objects today. Of course, it must be admitted that loom weights, as well as other tools, could have been decorated for aesthetic reasons alone, reflecting only the personal tastes and/or artistic abilities of their makers (at times, likely synonymous

¹⁴¹ Quercia and Foxall, “Temporality, Materiality and Women’s Networks,” 71-72.
¹⁴² Quercia and Foxall, “Temporality, Materiality and Women’s Networks,” 63.
¹⁴³ Gleba, Textile production in pre-Roman Italy, 137.
with owners). “Shape, material, and decoration are non-functional parameters that depend on the available resources, environment, traditions and culture.”

1.6.3 Functional features of loom weights

Until recently, loom weights have been largely disregarded at archaeological sites as indicating little beyond the trivial inference that textiles at the site were indeed woven on a warp-weighted loom. Weight measurements for loom weights are often not collected by excavators. In exceptional cases, when a complete series of loom weights is found in situ, they are given more attention. From such complete series, details about the width of the loom or the number of sheds can be learned; however, individual loom weights are not studied in detail. Now, stress is being placed on the importance of recording weight measurements, even for individual loom weights not belonging to a series.

Experimental research at the Danish National Research Foundation’s Centre for Textile Research is doing much to change how individual loom weights can be analyzed in order to shed light on textile production practices.

Weight and thickness are the key functional features of a loom weight, affecting how the object is used, as well as the type and quality of textiles it was used to produce. Each warp thread requires a specific amount of tension for optimal performance: in general, warp threads with larger diameters (usually composed of more fibres) require more tension (expressed in grams per thread) than those with smaller

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145 Mårtensson, Nosch and Eva Andersson Strand, “Shape of things: understanding a loom weight,” 397.
146 Gleba, Textile production in pre-Roman Italy, 134.
147 Mårtensson, Nosch and Eva Andersson Strand, “Shape of things: understanding a loom weight,” 374.
diameters. First the weaver had to determine the correct number of threads to attach to each loom weight based on the requirements of the individual thread and the weight of each loom weight. Then, the loom weights were attached in (at least) two rows, one hanging in front of the other. In an optimal set-up, each loom weight is attached to no less than five and to no more than thirty warp threads. This is the simplest possible set-up of the warp-weighted loom; it is used to produce tabby, the simplest weave. It is important for the weights in each row to hang at the same level, side-by-side, in order to prevent unnecessary wear on the threads and the potential for tangling during weaving. Using experimental archaeology, researchers have demonstrated that “the total width of the loom weights should be identical or slightly wider than the fabric to be produced.” The experiment carried out by Linda Mårtensson and her team allows archaeologists to “outline the kind of textiles that could have been produced” at any site, using the weight and thickness measurements of a single loom weight. This research is important because it allows a number of (possible) conclusions to be made about textile production at a site from a single loom weight, which has been hitherto impossible. As such advances in analyzing individual textile finds are made, it becomes increasingly important to record and report all measurements for textile production tools at a site.

1.6.4 Tablet weaving

148 Mårtensson, Nosch and Eva Andersson Strand, “Shape of things: understanding a loom weight,” 378.
149 Mårtensson, Nosch and Eva Andersson Strand, “Shape of things: understanding a loom weight,” 392.
151 Mårtensson, Nosch and Eva Andersson Strand, “Shape of things: understanding a loom weight,” 389.
152 The methodology of her experiment will be outlined in a later chapter.
Tablet weaving involves “passing threads through holes in the corners of (usually) square tablets, which, when rotated forward or back, force the threads to form different sheds.” This method of weaving produces narrow bands of fabrics used for belts, decorative borders, and heading bands for the warp-weighted loom. Tablet-woven textiles have been found across western and central Europe. In Italy, evidence from Verucchio, Sasso di Furbara, and Palestrina indicates that the technique was already in use in the Iron Age.

The tools used for tablet weaving are still being identified and investigated. The tablets themselves, made of wood, bone, or hardened leather, rarely survive. In some cases, sets of such tablets have survived, as was the case in Tarquinia, where a set of square, bone tablets with holes at each corner was found. They are typically square (five by five centimeters or smaller), with holes punched through at the corners. Margarita Gleba, building on previous interpretations, suggests that rocchetti (spools) were used in tablet weaving. Gleba correctly questions the traditional interpretation of spools being used to store prepared thread. According to her, transferring spun thread from spindle to spool would have been an unnecessary expenditure of time and resources because thread can be kept on the spindle during storage and used as a shuttle during

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154 Gleba, *Textile production in pre-Roman Italy*, 138.
155 Gleba, *Textile production in pre-Roman Italy*, 139.
158 Spools were interpreted to be weights by Edith Hall Dohan, Lauren Hackworth, and Lise Ræder-Knudsen.
159 Gleba, *Textile production in pre-Roman Italy*, 140-141.
weaving. Furthermore, spools are much too small to accommodate the same volume of thread as a single spindle. According to Gleba, the excess length of thread used in tablet weaving would be wound around the spool and unwound as the weaving progressed. The spool, hanging below the tablets, would act as a weight to keep the threads taut (Figure 17).

Two well preserved mantles from the Iron Age site of Verucchio have been demonstrated to have tablet-woven borders. Røder Knudsen concluded that the borders of the mantles were woven after the textiles were completed on the warp-weighted loom. The execution of the work is of very high quality. Weft threads, two at a time from the body of the mantle, were combined to create a single, plied weft for the tablet-woven border. This plied thread is then passed back through the tablet-woven border toward the mantle’s fabric, making the ends of

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160Spindles used as shuttles are frequently depicted on Greek painted pottery. See section 1.7 for depictions of the warp-weighted loom.
the threads nearly unnoticeable. The quality of these textiles reflects the expertise of the weavers, and of course, the status of the individual(s) for whom they were made.

Spools appear in Italy in the Late Bronze Age, and quickly gain widespread use. According to Gleba, their early appearance in northern Italy “seems to indicate that the technique arrived from Europe via the Alps”. Spools from Swiss Bronze Age sites and tablet-woven textiles from the Hallstatt area support this theory. In Italy, spools are frequently found in both domestic and funerary contexts and “are particularly common on sites associated with Villanovan culture”. Decorations, if present, appear on the ends and consist of simple incised or impressed designs. The utilitarian portion — the shaft — is never decorated. Inscriptions are extremely rare.

Bronze clasps may have also been used for tablet weaving. A clasp “consists of two long, thin rectangular pieces of bronze, fixed together with a rivet on one end and fastened together with a clasp on the other, and ending in thin coiling strips.” The majority of clasps come from Southern Etruria, and date to the eighth and seventh centuries BC. Clasps were used in much the same way as a safety pin holding a bracelet in place during braiding: by using a clasp to hold the band in place, the weaver is able to use both hands to operate the tablets and weft (Figure 18). Their association with textile production was solidified when a textile fragment was discovered between the two

162 Gleba, Textile production in pre-Roman Italy, 145.
163 Gleba, Textile production in pre-Roman Italy, 148.
164 Gleba, Textile production in pre-Roman Italy, 150.
bronze plates of a clasp found at Falerii.\textsuperscript{165} Funerary assemblages in which clasps and spools appear together further support their association to textile production.\textsuperscript{166}

Figure 18: Tablet weaving with clasp from Lise Ræder Knudsen.

1.6.5 Types of weaves

Textiles are defined by their weave structure. Weave structure is determined by how the weft is passed through the warp. Plain weave or tabby is the simplest weave; it involves passing the weft thread alternately over and under the warp (Figure 19). Tabby can be balanced, warp-, or weft-faced. Balanced tabby is produced when the warp and weft threads are of the same diameter; warp-faced when the warp threads have a larger diameter than the weft; weft-faced when the weft is larger than the warp. The mechanics of the weave are identical in all three cases; however, the final appearance of each textile

\textsuperscript{165} Gleba, \textit{Textile production in pre-Roman Italy}, 151.
\textsuperscript{166} Gleba, \textit{Textile production in pre-Roman Italy}, 151. (Based on available data.)
is different. Unsurprisingly, plain weave linens were typical of Neolithic period and Bronze Age finds, remaining prevalent into the Early Iron Age.\textsuperscript{167}

More complex weave types emerged quickly. Twill appeared during the Bronze Age, and was already in widespread use during the Iron Age. A twill weave is created by passing the weft through the warp at a regular, staggered pattern. Variations create a visually different final product: 2/2 twill (weft is passed under then over two warp threads at a time), 2/1 twill (weft is passed under two then over one thread), 1/2 twill (weft is passed under one then over two threads) — each variation produces a unique staircase pattern (Figure 19). More advanced twill variations include chevron and diamond twills, and dogtooth patterns. Gleba points out that “the sophistication of twills from Verucchio, Sasso di Furbara, and Tarquinia indicate a well-established and settled technology.”\textsuperscript{168} Additional patterns and/or decorative motifs may be added during weaving by using threads of different colour, thickness, or twist type.\textsuperscript{169}

Patterns can be used to identify the type of material

\textsuperscript{167} Gleba, “Italy: Iron Age”, 228.
\textsuperscript{168} Gleba, “Italy: Iron Age”, 228.
\textsuperscript{169} Gleba and Mannering, "Introduction: textile preservation, analysis and technology", 13.
depicted in artistic representations of textiles. In general, wool was shown in a coloured plaid design. Linen, a material difficult both to dye and to weave into patterns, was typically left white.\footnote{Larissa Bonfante, \textit{Etruscan Dress}, (Baltimore: The Johns Hopkins University Press, 1975), 12.}

### 1.7 Depictions of the warp-weighted loom

The earliest depiction of a warp-weighted loom is a group of six carved images dated to the second millennium BC on the Great Rock at Naquane in northern Italy (Figure 20).\footnote{Barber, \textit{Prehistoric textiles}, 91.}

![Figure 20: Drawing after representations of (probably) warp-weighted looms carved on the Great Rock at Naquane from Barber.](image)

The dots at the bottom, between the two vertical beams of the frame, appear to be loom weights. If the depictions were of a vertical two-beam loom, the bottom of the frame would have a solid beam (line), rather than loom weights (dots seen in four of the six depictions). The horizontal lines, which extend past the vertical beams and so cannot be a design element of the actual fabric, may represent a shed rod. The same basic elements

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\footnote{Larissa Bonfante, \textit{Etruscan Dress}, (Baltimore: The Johns Hopkins University Press, 1975), 12.}
\footnote{Barber, \textit{Prehistoric textiles}, 91.}
appear on the early first millennium BC Hallstatt Urn from Sopron (Ödenburg), Hungary (Figure 21).\textsuperscript{172}

![Figure 21: Drawing after representation on Hallstatt Urn from Sopron from Hoffmann.](image)

The elements of the warp-weighted loom depicted on this vase are: two sets of warp threads, one hanging in front of the other; double row of loom weights (depicted hanging one above the other) indicating the presence of two sheds; horizontal lines, running perpendicularly across the warp, which seem to be shed and/or heddle rods; and the bottom-most rod, likely a heddle bar held by brackets (diagonal lines).\textsuperscript{173} The ball of thread extending from the finished section of the textile near the top of the loom out over the head of the weaver is the shuttle. The figure standing behind the weaver appears to be using a spindle with spindle whorl.

Dated to ca. 600BC, the Etruscan bronze \textit{tintinnabulum} from Tomb 5 of the Arsenale Militare necropolis near Bologna is "one of the most significant representations

\textsuperscript{172} Barber, \textit{Prehistoric textiles}, 56, 295; Hoffmann, \textit{The warp-weighted loom}, 317-318.

\textsuperscript{173} Hoffmann, \textit{The warp-weighted loom}, 318.
of textile production in the ancient world.”¹⁷⁴ Four separate scenes are depicted on the *tintinnabulum*: two scenes depict thread-making activities (side A), and two scenes depict textile making activities (side B) (Figure 22).

![Tintinnabulum](image)

**Figure 22:** *Tintinnabulum*, A depicts thread-making scenes; B depicts weaving scenes from Gleba and Mannering (*Bologna Museo Civico Archeologico*).

The bottom scene on side A shows two women pulling fibres out of a central basket and placing them on distaffs while seated in throne-like chairs which appear similar to the decorated wooden throne from Verucchio. In the scene above, a single female figure spins fibres into thread using a distaff in her left hand and spinning with her right. The spindle hangs down near her feet. The scene on the bottom of side B has been identified to be the weaving of a starting border for the warp-weighted loom.¹⁷⁵ Although this may be a representation of a band loom, the angle at which it is depicted unfortunately

¹⁷⁴ Gleba, “Italy: Iron Age,” 236.
¹⁷⁵ Gleba, “Italy: Iron Age,” 236.
prevents conclusions about its functional aspects to be made.\textsuperscript{176} The last scene depicts a warp-weighted loom, easily identifiable by the loom weights hanging at the bottom of the warp. This depiction is unique because it is the only known example of a two-storied loom — a seated figure works above the reach of a standing figure below.\textsuperscript{177} The woman below holds a basket, likely containing the weft thread. As in other depictions, the horizontal bars stretched across the warp threads are likely shed and/or heddle bars.

Examples of textile production scenes on painted Greek vases offer a level of detail that is often absent from other depictions. While painted images are not, and were not intended to be technically correct representations of ancient weaving, they provide a valuable addition to our understanding of ancient weaving. A \textit{lekythos} from the Metropolitan Museum of Art (Figure 23), dated to ca. 560 BC, shows scenes of spinning, weaving, and measuring wool which are carried out “more vividly and with more detail than any others known from Classical Antiquity.”\textsuperscript{178}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure23.png}
\caption{\textit{Lekythos} with weaving scenes \textit{from Hoffmann (The Metropolitan Museum of Art)}.}
\end{figure}

\begin{flushright}
\footnotesize
\textsuperscript{176} Barber, \textit{Prehistoric textiles}, 116-117. \\
\textsuperscript{177} Gleba, “Italy: Iron Age,” 236. \\
\textsuperscript{178} Hoffmann, \textit{The warp-weighted loom}, 307. 
\end{flushright}
While some technical aspects represented are disputed, namely the identification of two (or perhaps three) horizontal lines running across the warp threads, there are many aspects which seem to accurately reflect the weaving process. The pyramidal loom weights are correctly depicted as being attached to multiple warp threads; three shuttles (two stored at the side, one being passed through the warp) are being used, likely to create a patterned textile. To the right of the loom, two women are taking spun wool out of a *situla* and weighing it to determine how much is needed. The two women on the left are spinning: the distaff, spindle, and spindle whorl are easily identified.

Perhaps the most recognizable weaving scene appears on the fifth century Attic red-figure *skyphos* from Chiusi, which shows Penelope sitting by her loom (Figure 24).

The depiction of additional bobbins or shuttles — the intricacy of the figured fabric no doubt required these additional threads — along the topmost horizontal beam is unique.\(^{179}\) The loom weights are depicted in two rows, one above the other. It seems likely that the artist intended this to represent two rows one behind the other to

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\(^{179}\) Hoffmann, *The warp-weighted loom*, 305.
realistically reflect the proper set-up of the warp-weighted loom. As the majority of depictions show the loom *en face*, it is difficult to have a clear understanding of its set-up. The Pisticci *krater*, dated to the fifth century BC, depicts the warp-weighted loom in profile. Although the image does not solve the question of how the shed and/or heddle rods were attached to the loom’s frame, it does illustrate that the warp threads hung parallel to the weaver, at an angle to the leaning frame of the loom. Finally, a rather simple depiction on a fourth century BC Boeotian *skyphos* (Figure 25) illustrates the basic mechanics of the loom: the shuttle of weft threads is passing through the tautly drawn, weighted warp.

![Figure 25: Boeotian skyphos from Hoffmann (Ashmolean Museum, Oxford).](image)

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180 For figured fabrics, there may not be a separation of sheds – each warp being lifted manually as needed to achieve the correct design.

2.1 Textiles and textile production

Since its publication in 1991, E. J. W. Barber’s seminal book *Prehistoric Textiles* has provided the foundation for nearly all subsequent publications on textile production. His focus on the textiles and textile tools of the Mediterranean region is especially useful to this discussion. Margarita Gleba, who has published a number of works, the most comprehensive on the subject being *Textile Production in Pre-Roman Italy* (and in fact, the majority of her other work simply re-states or condenses material presented in this text), relies heavily on Barber. Combined, these two books are indispensable to the study of textile production in Italy — Barber provides a broad overview of textile production techniques and tools in the region; Gleba discusses the same topics through an Etrusco-centric approach.

Ethnographic research and experimental archaeology are vital to our understanding of how textile tools — common finds at nearly every site in Italy, however, finds that are often ignored — were used in ancient times. After spending over a decade observing Lapish women using the warp-weighted loom in the 1950s and 1960s, Marta Hoffmann published a detailed account of her observations. These have contributed greatly to our understanding of how the tools were used by skilled weavers. Her work does much to stress the importance of practicality in textile (and other craft) production. Recently, experimental archaeology research conducted at the Danish
National Research Foundation’s Centre for Textile Research has provided archaeologists with a way to analyze single loom weights in order to suggest possible loom set-ups, type of thread used, and appearance of final fabric. This is important research, especially for sites (such as Caere) which yield only a handful of textile tools, none of which have been found in situ or as part of a complete set. The Centre has published a number of works, from a pocket guide to treating textiles in the field to a comprehensive work which looks at textile production throughout Europe by area (e.g. Sweden, Spain, and Switzerland).

Finally, a word must be said of the oft-cited *Etruscan Dress* by Larissa Bonfante. While it is indeed well-focused and organized, the conclusions she draws are incredibly broad and at times do not reflect current scholarship. Perhaps the most useful section of her book is the large “Illustrations” section which provides examples of textiles from tomb paintings, sarcophagi, and figurines conveniently in one place.

### 2.2 Etruscans and the City of Caere

Several good, comprehensive texts deal with the history of the Etruscans. Sybille Haynes’ *Etruscan Civilizations* provides an excellent overview. While overarching themes are discussed, the text also focuses on specific regions and cities (several sections focus on Caere), which emphasizes both the individuality and the connectedness of Etruscan cities. A recently published *The Etruscan World* is also an excellent source.

When the results of the current excavations in the urban area of Caere are published, they will add much to our understanding of Etruscan urban centres — previous conclusions have been drawn from burial spaces, and only limited urban excavations.
3.1 The city of Caere

Caere is unique among ancient Etruscan cities due to the high density of archaeological exploration carried out in its urban area. The city sits on a plateau a few kilometers inland from the Tyrrhenian Sea, almost equidistantly between Rome to the south and Tarquinia to the north. The earliest evidence for human occupation in the area dates to the late tenth century BC. On the highest mountain peak visible from the plateau, called “Il Sasso”, was found evidence of Iron Age huts and caves, the latter being used for ritual not residential purposes. Caere was among the earliest Etruscan cities to undergo urbanization. 182 Early in its history Caere experienced a change in land use patterns similar to those seen at Tarquinia and Rome. 183 Tarquinia began as a collection of about fifteen small villages perched on nearby hills. Each village had its own burial place and was more or less independent. The reorganization of space at Tarquinia saw people from these nearby villages begin to live together in a designated urban area and to bury their dead in a newly designated cemetery space. This reorganization of space on a large scale must have been overseen by a central authority, without which, this kind of change in living and burial space could not have been carried out and enforced. In Rome,

too, there was a similar reorganization. By the end of the eighth century BC, the small villages of Rome all shared a common burial ground on the Esquiline Hill. Caere underwent similar changes in the organization of space, after which the urban population occupied the plateau (a section of which is currently under excavation) and the necropoleis occupied the surrounding areas. The best known and investigated of the burial areas is the Banditaccia Necropolis to the north.

The Banditaccia Necropolis offers us an understanding of the social, political, and economic dynamics in Caere’s urban centre.\(^{184}\) In general, the pattern of tumuli in the necropolis consists of larger, older mounds surrounded by clusters of smaller, younger ones. The physical proximity of smaller mounds and non-tumuli type tombs to the larger tumuli reflects the social relationships of the deceased in life. For example, in the Tomb of the Hut, in use for three generations from the beginning of the seventh century BC, the burials on either side of the long *dromos* were likely for individuals associated with, but not directly related, to the family, or for family members who died before reaching the age of adulthood.\(^{185}\) The Tomb of the Hut also sheds light on the domestic architecture of the early seventh century BC.\(^{186}\) The tomb, like the earlier Villanovan hut urns, reflects in stone the domestic architecture of the time which would have been carried out in organic, thus perishable, materials. The shape of this tomb reflects a mud brick hut with thatched roof. A little later, in the Tomb of the Dolia dated to ca. 650 BC, the architecture of the

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184 See Helle Damgaard Andersen, “The Archaeological Evidence for the Origin and Development of the Etruscan City in the 7th and 6th Centuries BC.” In Andersen et al., 1997: 343–382 for a discussion on how necropoleis correspond to and may be accurate indicators of living settlements.


roof changes. The flat roof of this tomb most likely reflects a terracotta one. If so, terracotta roof technology came to Italy very quickly after first originating in Greece.

Beginning in the second half of the sixth century BC, a newer section of the necropolis with a different organization of space developed. This part of the necropolis had equally divided funerary plots organized in a regular orthogonal plan in which were tombs of equal design. The change seen in the necropolis undoubtedly reflected the changes in the social order of the living society. The social stratification seen previously with the tumuli tombs is no longer on display. This type of change could not have been organized and executed without a central authority which was strong enough to enforce the new communal beliefs. However, it is going too far to suggest that such equality in the necropolis reflects a demise of the elites as a class. Simply, the ostentatious display of wealth, in the form of, for example a tumulus, is no longer visible in the archaeological record.

Caere underwent urbanization before Rome’s power and influence expanded into Etruria; therefore, archaeological exploration has given and will continue to give us an idea of how Etruscan urban centres looked and functioned before exposure to Roman influences. Unlike other Etruscan cities, Caere enjoyed a mostly friendly relationship with Rome. When the Gauls sacked Rome in 390 BC, the Roman sacra were moved for safekeeping to Caere. In 273 BC, Caere, a *civitas sine suffragio*, was made a prefecture of Rome, perhaps as punishment for participating in a rebellion, marking the end of the

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equal relationship the two cities previously enjoyed. Despite this change in the official administration of the city, in reality, no massive cultural change was observed. The population of Caere continued to speak and write Etruscan, with the only inscription in Latin before 90 BC being in the Hypogeum of Clepsina, a monument built by the first Roman praefectus. However, the city did see the reorganization of its public spaces, likely under the supervision of the newly appointed praefectus, who also oversaw the new foundation of the city.

3.2 Previous Excavations

The area of the plateau under investigation lies just outside and to the northeast of the modern town of Cerveteri (Figure 26). In the nineteenth century AD, before the Italian unification, the privately-owned vineyard fields in the area — Vigna Parrocchiale, Vigna Marini-Vitalini, and Vigna Grande — were “excavated” for monetary rather than academic gains. Illicit excavations were common at the site, especially after a series of imperial statues was discovered nearby. Proper excavations began in the 1980s when the Consiglio Nazionale delle Ricerche began work in the Vigna Parrocchiale. There, they uncovered a temple built on top of a back filled quarry and a large, unidentified, elliptical building. A Roman theatre, the remains of which were already visible in the nineteenth century AD, was also investigated. This excavation was extended into the Vigna Marini-Vitalini (the area under excavation by Queen’s University) where an underground chamber, now known as the Hypogeum of Clepsina, was discovered. In the early 2000s, a

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team from the University of Perugia further investigated the Hypogeum and its surrounding areas. These excavations brought to light a complex system of tunnels, stairways, windows, and wells, which were all associated with the underground chamber.\footnote{The outcomes of each of these excavations are summarized in greater detail in Fabio Colivicchi, et. al. “New excavation in the urban area of Caere,” \textit{Mouseion} (forthcoming).}
3.3 Excavations 2012–2014

The Queen’s University excavations at Caere, led by Dr. Fabio Colivicchi, began in May 2012. In 2010 a geomagnetic survey was conducted of Vigna Marini-Vitalini and its surrounding areas. This survey revealed a system of linear anomalies which were parallel or orthogonal to one another. The excavations of 2012–2014 focused on the central area of the city — the area immediately around the Hypogeum of Clepsina and on the area around one of the linear anomalies west of the Hypogeum. The excavations have revealed continuous occupation from the Late Iron Age (the earliest contexts) to the second century AD.

The Queen’s University excavations have focused on two areas: Area 1 and Area 3 (excavated in 2012 and 2014, respectively) are located northeast of the entrance to the hypogeum; Area 2 (excavated in 2012-2015) is located south of the hypogeum complex. In 2014, it was determined that Area 3 contained very ancient layers, with building phases dating as far back as the Late Iron Age. Unsurprisingly, due to their proximity to the hypogeum, Areas 1 and 3 were likely ritual spaces, separated from the surrounding city by a drainage pipe (uncovered near the northern limit of Area 3) and a wall running along the south side of the street in Area 2. Excavations in Area 2 have revealed substantial architectural remains dating from the third century BC to the Julio-Claudian Period and traces of earlier buildings. Evidence for ritual activity is also present in Area 2. A semi-underground room was discovered, inside of which were a basalt-like stone, an

\[\text{Colivicchi, et al. Mouseion (forthcoming).}\]
\[\text{Colivicchi, et al. Mouseion (forthcoming).}\]
antefix, and a votive terracotta finger. In general, the areas under excavation correspond to Caere’s religious and public centres and underwent a series of building phases from the Late Iron Age on.

In 2014, the animal remains from the 2012–2014 excavations were analyzed by Dr. Angela Trentacoste of Sheffield University. The animal remains have been dated from the seventh century BC to the first century AD. Unfortunately, sheep and goat remains were analysed together, making it impossible to accurately interpret the data with respect to possible wool production at the site; however, the general conclusions are still relevant. First, “sheep/goat husbandry occurred within or very close to the settlement”; second, the animals appear to have been slaughtered in later stages of life; and third, the remains suggest that sheep/goats were used for a combination of products, including wool. In future, an analysis of gender to determine the presence of wethers would conclusively prove that sheep flocks were kept for wool production. The fact that animals were slaughtered at an old age is suggestive; however, if these animals were predominantly ewes, the primary purpose of the flock would be for milk, not wool production.

3.4 Summary of textile tool finds

The following will present a selection of textile finds — complete or near complete examples and those with decorative elements. For a complete list of textile

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195 This is commonly done as sheep and goat remains are difficult to distinguish, and for most analyses (except those concerning wool production) it is not detrimental to have this combined grouping.
196 Colivicchi, *et al. Mouseion, forthcoming*
production tools found during the 2012–2014 excavations at Caere please see Appendix A. The dates reflect the date of the archaeological context in which tools were found, thus they are a *terminus post quem*. Because the site saw a number of disturbances — illicit excavations, vineyard farming — it is common for finds to be displaced from their original context. Furthermore, “residual finds” are common in layers deposited much later.

3.4.1 Loom weights

A total of 29 loom weights (including fragments) were recovered during the first three excavation seasons (2012–2013) at Caere. The seven complete and near complete examples are illustrated and described in Table 2. The weight was measured in grams to three significant figures, using an electronic scale. The thickness was measured at the widest part of the loom weight in centimeters to three significant figures (Figure 27).
Table 2: Summary of Complete Loom Weights from Caere, 2012–2014 (*Drawings by Malakhova*).

<table>
<thead>
<tr>
<th>Object</th>
<th>Weight</th>
<th>Thickness</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>C12.23.81</td>
<td>652.9 g</td>
<td>6.95 cm</td>
<td>9.87 cm</td>
</tr>
<tr>
<td></td>
<td>Trapezoidal; off centered “X” incised on top surface.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Date of archeological context: unknown.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| C12.42.171 | 492.6 g | 5.97 cm | 9.07 cm |
| | Parallelepiped; rectangular base; smooth edges. | | |
| | Date of archeological context: unknown. | | |
**C13.65.59**

Parallelepipedal; very smooth surfaces; angular edges.

Date of archeological context: unknown.

**C13.133.197**

Trapezoidal; incised decoration on top in the shape of an arrow’s tail; hole off centre.

Date of archeological context: late 4th to early 3rd c. BC.
**C13.133.198**

Parallelepipedal; incised “——” on top surface; smooth irregular edges.
Date of archeological context: late 4th to early 3rd c. BC.

**C13.133.200**

Parallelepipedal; stamped decoration on top consisting of two “+”, each in a circle, on either side of an incised line.
Date of archeological context: late 4th to early 3rd c. BC.
A total of twelve loom weights were decorated. Decorations, when present, always appear on the top surface of the loom weight. Four loom weights were decorated with a simple “X” drawn diagonally from corner to corner, with the lines intersecting a little off centre (e.g. C12.23.81 in Table 2). Three loom weights were decorated with a simple horizontal line across the top surface (e.g. C13.65.59 in Table 2). The remaining five loom weights had more unique decorations and these are illustrated in Table 3.
Table 3: Decorated Loom Weights from Caere, 2012–2014 (Photos and drawings by Malakhova).

<table>
<thead>
<tr>
<th>C13.104.3</th>
<th><img src="image1.jpg" alt="Image" /></th>
<th><img src="image2.jpg" alt="Image" /></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C13.133.197</strong></td>
<td><img src="image3.jpg" alt="Image" /></td>
<td><img src="image4.jpg" alt="Image" /></td>
</tr>
<tr>
<td>C13.133.199</td>
<td><img src="image5.jpg" alt="Image" /></td>
<td><img src="image6.jpg" alt="Image" /></td>
</tr>
</tbody>
</table>
3.4.2 Spools

A total of 21 spools (including fragments) were recovered during the 2012–2014 excavation seasons. The five complete and near complete examples are illustrated and described in Table 4. The weight was measured in grams to three significant figures, using an electronic scale. The length was measured at the longest part in centimeters to three significant figures.
Table 4: Summary of Complete Spools from Caere, 2012–2014 *(Photos and drawings by Malakhova).*

<table>
<thead>
<tr>
<th>Spool Number</th>
<th>Description</th>
<th>Weight</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>C12.34.1</td>
<td>Disc ends; roughly shaped; ends not symmetrical; smooth surface; not decorated.</td>
<td>78.9 g</td>
<td>6.25 cm</td>
</tr>
<tr>
<td>C12.44.9</td>
<td>Disk ends not well defined; slightly damaged on one end; not decorated.</td>
<td>80.1 g</td>
<td>5.55 cm</td>
</tr>
<tr>
<td>C13.218.8</td>
<td>Disk ends; roughly shaped; coarse fabric; not decorated.</td>
<td>96.5 g</td>
<td>6.15 cm</td>
</tr>
</tbody>
</table>
C13.295.4

Conical ends well defined; well made; very smooth; not decorated.

Date of archeological context: late 4\textsuperscript{th} to early 3\textsuperscript{rd} c. BC.

Weight: 23.8 g

Length: 5.31

C13.295.5

Conical ends; well made, smooth surface; not decorated.

Date of archeological context: late 4\textsuperscript{th} to early 3\textsuperscript{rd} c. BC.

Weight: 23.1 g

Length: 4.85

Only one spool (fragment) was decorated. The surviving disk shaped end was decorated with a simple “+” (Figure 28).

Figure 28: Decorated spool fragment from Caere (C14.379.1) (Photo and drawing by Malakhova).
3.4.3 Spindle whorls

A total of seven spindle whorls (four complete, three fragments) were recovered during the 2012–2014 excavation seasons. The six spindle whorls with decorative elements are illustrated and described in Table 5. The diameter and height were measured in centimeters to three significant figures.\textsuperscript{197}

Table 5: Decorated spools from Caere, 2012–2014 (Drawings by Malakhova).

| C13.295.6 | Height: 2.40 cm  
Height: (approx.) 1.90 cm  
Diameter: 2.57 cm  
Diameter: (approx.) 2.58 cm  
Conical; black impasto; fluted decoration is not highly articulated.  
Description:  
Date of archeological context: late 4\textsuperscript{th} to early 3\textsuperscript{rd} c. BC.  
Date of archeological context: 7\textsuperscript{th} to 6\textsuperscript{th} c. BC, possibly earlier. |
|-----------|---------------------------------------------------------------|
| C14.432.2 | Height: 2.40 cm  
Diameter: 2.57 cm  
Conical; black impasto; fluted decoration is not highly articulated.  
Date of archeological context: late 4\textsuperscript{th} to early 3\textsuperscript{rd} c. BC.  |

\textsuperscript{197} Unfortunately, the opportunity to record the weights of the whorls was missed.
<table>
<thead>
<tr>
<th>Reference</th>
<th>Height</th>
<th>Diameter</th>
<th>Description</th>
<th>Date of archeological context</th>
</tr>
</thead>
<tbody>
<tr>
<td>C14.438.1</td>
<td>1.89 cm</td>
<td>2.12 cm</td>
<td>Truncated conical; very finely fluted decoration. Date of archeological context: unknown.</td>
<td></td>
</tr>
<tr>
<td>C14.448.61</td>
<td>2.98 cm</td>
<td>3.44 cm</td>
<td>Biconical; decorated with incised rope pattern extending in double lines from top to bottom, repeated four times; slightly damaged around the hole, perhaps from use. Date of archeological context: early 7th c. BC.</td>
<td></td>
</tr>
<tr>
<td>C14.448.62</td>
<td>2.30 cm</td>
<td>2.98 cm</td>
<td>Truncated conical; fluted decoration well defined; slight damage around bottom hole. Date of archeological context: early 7th c. BC.</td>
<td></td>
</tr>
<tr>
<td>C14.448.63</td>
<td>2.40 cm</td>
<td>(approx.) 3.02 cm</td>
<td>Truncated conical; wide fluted decoration; very smooth finish. Date of archeological context: early 7th c. BC.</td>
<td></td>
</tr>
</tbody>
</table>
Chapter 4
Discussion and Conclusions

4.1 Loom Weights

The key functional features of a loom weight — weight and thickness — were recorded for the seven complete loom weights recovered from Caere during the 2012–2014 excavation seasons (Chapter 3, Table 2). Because a relatively small number of complete loom weights have been discovered, none of which were recovered in situ or as part of a complete set, each loom weight must be studied individually. The seven complete loom weights were analyzed using calculations developed through experimental research at the Danish National Research Foundation’s Centre for Textile Research and published in the Oxford Journal of Archaeology in 2009.198 As a result of this research, it possible to “outline the kinds of textiles that could have been produced” at a site by applying the calculations developed by Linda Märtensson and her team to any loom weight of known weight and thickness.199 This breakthrough study is not without limitations. The methodology was developed for tabby textiles — the simplest, most widely used technique — woven with wool yarn.200 In Italy, more complex weaves were already well developed in the Iron Age (Verucchio textiles); therefore, it seems likely that more complex textiles were being produced, centuries later, at Caere.

4.1.1 Calculations

The following tables (Table 6 – Table 12) demonstrate the possible loom set-ups depending on type of warp thread used. Calculations are based on weaving a one square metre cloth in plain weave (tabby). A full sample calculation appears in Appendix B. The following guidelines were used to determine if a set-up was optimal, possible, or unlikely: 201

Optimal:

- Warp threads per loom weight: 5–30.
- Thread count per cm: 5–30 (for 10 and 20g thread); 5–20 (for 30g thread); 5–10 (for 40 and 50g thread).

Possible:

- Warp threads per loom weight: 4 or 30–40.
- Thread count per cm: 30–40 (for 10 and 20g thread); 3 (for 40g thread).

A set-up which does not meet the above is considered unlikely.

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201 Märtensson et al., “Shape of Things: Understanding a Loom Weight,” 392-393.
Table 6: Loom weight C12.23.81; weight of 652.9g, thickness of 6.95cm.

<table>
<thead>
<tr>
<th>Warp thread tension</th>
<th>10g</th>
<th>20g</th>
<th>30g</th>
<th>40g</th>
<th>50g</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of warp threads/loom weight</td>
<td>~ 65</td>
<td>~ 33</td>
<td>~ 22</td>
<td>~ 16</td>
<td>~ 13</td>
</tr>
<tr>
<td>No. of warp threads x 2 loom weights</td>
<td>130</td>
<td>66</td>
<td>44</td>
<td>32</td>
<td>26</td>
</tr>
<tr>
<td>Warp threads/cm</td>
<td>~ 18</td>
<td>~ 9</td>
<td>~ 6</td>
<td>~ 5</td>
<td>~ 4</td>
</tr>
<tr>
<td>No. of loom weights</td>
<td>~ 28</td>
<td>~ 28</td>
<td>~ 28</td>
<td>~ 28</td>
<td>~ 28</td>
</tr>
<tr>
<td>No. of warp threads</td>
<td>1800</td>
<td>900</td>
<td>600</td>
<td>500</td>
<td>400</td>
</tr>
<tr>
<td>Amount of warp yarn</td>
<td>1800 m</td>
<td>900 m</td>
<td>600 m</td>
<td>500 m</td>
<td>400 m</td>
</tr>
<tr>
<td>Amount of weft yarn</td>
<td>1800 m</td>
<td>900 m</td>
<td>600 m</td>
<td>500 m</td>
<td>400 m</td>
</tr>
<tr>
<td>Yarn consumption for 1 m² cloth</td>
<td>3672 m</td>
<td>1632 m</td>
<td>1224 m</td>
<td>816 m</td>
<td>408 m</td>
</tr>
<tr>
<td>Time consumption for spinning yarn</td>
<td>~ 105 h</td>
<td>~ 41 h</td>
<td>~ 25 h</td>
<td>~ 16 h</td>
<td>~ 8 h</td>
</tr>
<tr>
<td>Technical evaluation of tool’s suitability</td>
<td>Unlikely: too many threads/loom weight</td>
<td>Possible</td>
<td>Optimal</td>
<td>Optimal</td>
<td>Unlikely: too few threads/cm</td>
</tr>
</tbody>
</table>

Table 7: Loom weight C12.42.171; weight of 492.6g, thickness of 5.97cm.

<table>
<thead>
<tr>
<th>Warp thread tension</th>
<th>10g</th>
<th>20g</th>
<th>30g</th>
<th>40g</th>
<th>50g</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of warp threads/loom weight</td>
<td>~ 49</td>
<td>~ 25</td>
<td>~ 16</td>
<td>~ 12</td>
<td>~ 10</td>
</tr>
<tr>
<td>No. of warp threads x 2 loom weights</td>
<td>98</td>
<td>50</td>
<td>32</td>
<td>24</td>
<td>20</td>
</tr>
<tr>
<td>Warp threads/cm</td>
<td>~ 16</td>
<td>~ 8</td>
<td>~ 5</td>
<td>~ 4</td>
<td>~ 3</td>
</tr>
<tr>
<td>No. of loom weights</td>
<td>~ 34</td>
<td>~ 34</td>
<td>~ 34</td>
<td>~ 34</td>
<td>~ 34</td>
</tr>
<tr>
<td>No. of warp threads</td>
<td>1600</td>
<td>800</td>
<td>500</td>
<td>400</td>
<td>300</td>
</tr>
<tr>
<td>Amount of warp yarn</td>
<td>1600 m</td>
<td>800 m</td>
<td>500 m</td>
<td>400 m</td>
<td>300 m</td>
</tr>
<tr>
<td>Amount of weft yarn</td>
<td>1600 m</td>
<td>800 m</td>
<td>500 m</td>
<td>400 m</td>
<td>300 m</td>
</tr>
<tr>
<td>Yarn consumption for 1 m² cloth</td>
<td>3264 m</td>
<td>1632 m</td>
<td>1020 m</td>
<td>816 m</td>
<td>612 m</td>
</tr>
<tr>
<td>Time consumption for spinning yarn</td>
<td>~ 93 h</td>
<td>~ 41 h</td>
<td>~ 20 h</td>
<td>~ 16 h</td>
<td>~ 12 h</td>
</tr>
<tr>
<td>Technical evaluation of tool’s suitability</td>
<td>Unlikely: too many threads/loom weight</td>
<td>Optimal</td>
<td>Optimal</td>
<td>Possible</td>
<td>Unlikely: too few threads/cm</td>
</tr>
</tbody>
</table>
Table 8: Loom weight C13.65.59; weight of 499.8g, thickness of 6.64cm.

<table>
<thead>
<tr>
<th>Warp thread tension</th>
<th>10g</th>
<th>20g</th>
<th>30g</th>
<th>40g</th>
<th>50g</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of warp threads/loom weight</td>
<td>~ 50</td>
<td>~ 23</td>
<td>~ 17</td>
<td>~ 12</td>
<td>~ 10</td>
</tr>
<tr>
<td>No. of warp threads x 2 loom weights</td>
<td>100</td>
<td>46</td>
<td>34</td>
<td>24</td>
<td>20</td>
</tr>
<tr>
<td>Warp threads/cm</td>
<td>~ 15</td>
<td>~ 7</td>
<td>~ 5</td>
<td>~ 4</td>
<td>~ 3</td>
</tr>
<tr>
<td>No. of loom weights</td>
<td>~ 30</td>
<td>~ 30</td>
<td>~ 30</td>
<td>~ 30</td>
<td>~ 30</td>
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<tr>
<td>No. of warp threads</td>
<td>1500</td>
<td>700</td>
<td>500</td>
<td>400</td>
<td>300</td>
</tr>
<tr>
<td>Amount of warp yarn</td>
<td>1500 m</td>
<td>700 m</td>
<td>500 m</td>
<td>400 m</td>
<td>300 m</td>
</tr>
<tr>
<td>Amount of warp threads x 2 loom weights</td>
<td>118</td>
<td>58</td>
<td>40</td>
<td>30</td>
<td>24</td>
</tr>
<tr>
<td>Warp threads/cm</td>
<td>~ 18</td>
<td>~ 9</td>
<td>~ 6</td>
<td>~ 5</td>
<td>~ 4</td>
</tr>
<tr>
<td>No. of loom weights</td>
<td>~ 30</td>
<td>~ 30</td>
<td>~ 30</td>
<td>~ 30</td>
<td>~ 30</td>
</tr>
<tr>
<td>No. of warp threads</td>
<td>1800</td>
<td>900</td>
<td>600</td>
<td>500</td>
<td>400</td>
</tr>
<tr>
<td>Amount of warp yarn</td>
<td>1800 m</td>
<td>900 m</td>
<td>600 m</td>
<td>500 m</td>
<td>400 m</td>
</tr>
<tr>
<td>Amount of warp threads x 2 loom weights</td>
<td>3672</td>
<td>1836 m</td>
<td>1224 m</td>
<td>1020 m</td>
<td>816 m</td>
</tr>
<tr>
<td>Time consumption for spinning yarn</td>
<td>~ 105 h</td>
<td>~ 46 h</td>
<td>~ 24 h</td>
<td>~ 20 h</td>
<td>~ 16 h</td>
</tr>
<tr>
<td>Technical evaluation of tool’s suitability</td>
<td>Unlikely: too many threads/loom weight</td>
<td>Optimal</td>
<td>Optimal</td>
<td>Possible</td>
<td>Unlikely: too few threads/cm</td>
</tr>
</tbody>
</table>

Table 9: Loom weight C13.133.197; weight of 586.0g, thickness of 6.55cm.

<table>
<thead>
<tr>
<th>Warp thread tension</th>
<th>10g</th>
<th>20g</th>
<th>30g</th>
<th>40g</th>
<th>50g</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of warp threads/loom weight</td>
<td>~ 59</td>
<td>~ 29</td>
<td>~ 20</td>
<td>~15</td>
<td>~ 12</td>
</tr>
<tr>
<td>No. of warp threads x 2 loom weights</td>
<td>118</td>
<td>58</td>
<td>40</td>
<td>30</td>
<td>24</td>
</tr>
<tr>
<td>Warp threads/cm</td>
<td>~ 18</td>
<td>~ 9</td>
<td>~ 6</td>
<td>~ 5</td>
<td>~ 4</td>
</tr>
<tr>
<td>No. of loom weights</td>
<td>~ 30</td>
<td>~ 30</td>
<td>~ 30</td>
<td>~ 30</td>
<td>~ 30</td>
</tr>
<tr>
<td>No. of warp threads</td>
<td>1800</td>
<td>900</td>
<td>600</td>
<td>500</td>
<td>400</td>
</tr>
<tr>
<td>Amount of warp yarn</td>
<td>1800 m</td>
<td>900 m</td>
<td>600 m</td>
<td>500 m</td>
<td>400 m</td>
</tr>
<tr>
<td>Amount of warp threads x 2 loom weights</td>
<td>3672</td>
<td>1836 m</td>
<td>1224 m</td>
<td>1020 m</td>
<td>816 m</td>
</tr>
<tr>
<td>Time consumption for spinning yarn</td>
<td>~ 105 h</td>
<td>~ 46 h</td>
<td>~ 24 h</td>
<td>~ 20 h</td>
<td>~ 16 h</td>
</tr>
<tr>
<td>Technical evaluation of tool’s suitability</td>
<td>Unlikely: too many threads/loom weight</td>
<td>Optimal</td>
<td>Optimal</td>
<td>Possible</td>
<td></td>
</tr>
</tbody>
</table>
Table 10: Loom weight C13.133.198; weight of 582.7g, thickness of 6.50cm.

<table>
<thead>
<tr>
<th>Warp thread tension</th>
<th>10g</th>
<th>20g</th>
<th>30g</th>
<th>40g</th>
<th>50g</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of warp threads/loom weight</td>
<td>~ 58</td>
<td>~ 29</td>
<td>~ 19</td>
<td>~ 15</td>
<td>~ 12</td>
</tr>
<tr>
<td>No. of warp threads x 2 loom weights</td>
<td>116</td>
<td>58</td>
<td>38</td>
<td>30</td>
<td>24</td>
</tr>
<tr>
<td>Warp threads/cm</td>
<td>~ 18</td>
<td>~ 9</td>
<td>~ 6</td>
<td>~ 5</td>
<td>~ 4</td>
</tr>
<tr>
<td>No. of loom weights</td>
<td>~ 30</td>
<td>~ 30</td>
<td>~ 30</td>
<td>~ 30</td>
<td>~ 30</td>
</tr>
<tr>
<td>No. of warp threads</td>
<td>1800</td>
<td>900</td>
<td>600</td>
<td>500</td>
<td>400</td>
</tr>
<tr>
<td>Amount of warp yarn</td>
<td>1800 m</td>
<td>900 m</td>
<td>600 m</td>
<td>500 m</td>
<td>400 m</td>
</tr>
<tr>
<td>Yarn consumption for 1 m² cloth</td>
<td>3672 m</td>
<td>1836 m</td>
<td>1224 m</td>
<td>1020 m</td>
<td>816 m</td>
</tr>
<tr>
<td>Time consumption for spinning yarn</td>
<td>~ 105 h</td>
<td>~ 46 h</td>
<td>~ 24 h</td>
<td>~ 20 h</td>
<td>~ 16 h</td>
</tr>
<tr>
<td>Technical evaluation of tool’s suitability</td>
<td>Unlikely: too many threads/loom weight</td>
<td>Optimal</td>
<td>Optimal</td>
<td>Optimal</td>
<td>Possible</td>
</tr>
</tbody>
</table>

Table 11: Loom weight C13.133.200; weight of 445.1g, thickness of 5.75cm.

<table>
<thead>
<tr>
<th>Warp thread tension</th>
<th>10g</th>
<th>20g</th>
<th>30g</th>
<th>40g</th>
<th>50g</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of warp threads/loom weight</td>
<td>~ 45</td>
<td>~ 22</td>
<td>~ 15</td>
<td>~ 11</td>
<td>~ 9</td>
</tr>
<tr>
<td>No. of warp threads x 2 loom weights</td>
<td>90</td>
<td>44</td>
<td>30</td>
<td>22</td>
<td>18</td>
</tr>
<tr>
<td>Warp threads/cm</td>
<td>~ 16</td>
<td>~ 8</td>
<td>~ 5</td>
<td>~ 4</td>
<td>~ 3</td>
</tr>
<tr>
<td>No. of loom weights</td>
<td>~ 34</td>
<td>~ 34</td>
<td>~ 34</td>
<td>~ 34</td>
<td>~ 34</td>
</tr>
<tr>
<td>No. of warp threads</td>
<td>1600</td>
<td>800</td>
<td>500</td>
<td>400</td>
<td>300</td>
</tr>
<tr>
<td>Amount of warp yarn</td>
<td>1600 m</td>
<td>800 m</td>
<td>500 m</td>
<td>400 m</td>
<td>300 m</td>
</tr>
<tr>
<td>Amount of weft yarn</td>
<td>1600 m</td>
<td>800 m</td>
<td>500 m</td>
<td>400 m</td>
<td>300 m</td>
</tr>
<tr>
<td>Yarn consumption for 1 m² cloth</td>
<td>3264 m</td>
<td>1632 m</td>
<td>1020 m</td>
<td>816 m</td>
<td>612 m</td>
</tr>
<tr>
<td>Time consumption for spinning yarn</td>
<td>~ 93 h</td>
<td>~ 41 h</td>
<td>~ 20 h</td>
<td>~ 16 h</td>
<td>~ 12 h</td>
</tr>
<tr>
<td>Technical evaluation of tool’s suitability</td>
<td>Unlikely: too many threads/loom weight</td>
<td>Optimal</td>
<td>Optimal</td>
<td>Possible</td>
<td>Possible</td>
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</table>
Table 12: Loom weight C13.248.64; weight of 616.4g, thickness of 5.84cm.

<table>
<thead>
<tr>
<th>Warp thread tension</th>
<th>10g</th>
<th>20g</th>
<th>30g</th>
<th>40g</th>
<th>50g</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of warp threads/loom weight</td>
<td>~ 62</td>
<td>~ 31</td>
<td>~ 21</td>
<td>~ 15</td>
<td>~ 12</td>
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<tr>
<td>No. of warp threads x 2 loom weights</td>
<td>124</td>
<td>62</td>
<td>42</td>
<td>30</td>
<td>24</td>
</tr>
<tr>
<td>Warp threads/cm</td>
<td>~ 21</td>
<td>~ 11</td>
<td>~ 7</td>
<td>~ 5</td>
<td>~ 4</td>
</tr>
<tr>
<td>No. of loom weights</td>
<td>~ 34</td>
<td>~ 34</td>
<td>~ 34</td>
<td>~ 34</td>
<td>~ 34</td>
</tr>
<tr>
<td>No. of warp threads</td>
<td>2100</td>
<td>1100</td>
<td>700</td>
<td>500</td>
<td>400</td>
</tr>
<tr>
<td>Amount of warp yarn</td>
<td>2100 m</td>
<td>1100 m</td>
<td>700 m</td>
<td>500 m</td>
<td>400 m</td>
</tr>
<tr>
<td>Amount of weft yarn</td>
<td>2100 m</td>
<td>1100 m</td>
<td>700 m</td>
<td>500 m</td>
<td>400 m</td>
</tr>
<tr>
<td>Yarn consumption for 1 m² cloth</td>
<td>4284 m</td>
<td>2244 m</td>
<td>1428 m</td>
<td>1020 m</td>
<td>816 m</td>
</tr>
<tr>
<td>Time consumption for spinning yarn</td>
<td>~ 122 h</td>
<td>~ 56 h</td>
<td>~ 29 h</td>
<td>~ 20 h</td>
<td>~ 16 h</td>
</tr>
<tr>
<td>Technical evaluation of tool’s suitability</td>
<td>Unlikely: too many threads/loom weight</td>
<td>Possible</td>
<td>Optimal</td>
<td>Optimal</td>
<td>Possible</td>
</tr>
</tbody>
</table>
4.1.2 Loom weight conclusions

General patterns emerged after the various set-ups were analyzed for each loom weight. As an example, consider loom weight C13.133.197. For this loom weight, 20g, 30g, and 40g warp threads would allow an optimal set-up of the loom. Of these, the 40g seems least likely because it would yield a very open fabric at 5 threads per centimetre. While the 20g set-up would yield a denser fabric, at 29 warp threads per loom, such a set-up may be more cumbersome to operate. Furthermore, the time required to spin enough yarn for such a set-up is nearly double the amount required for the 30g set-up. For this loom weight, the 30g set-up is ideal. The 20 warp threads attached per loom weight would be easy to manage. The set-up would yield a relatively open fabric. A 10g set-up is unlikely as it would require too many threads (59) per loom weight, which would be very difficult to manage.

For all seven loom weights analyzed, the 10g set-up was deemed unlikely. The 50g set-up, although possible for the majority of loom weights was deemed unlikely because such a set-up would yield a very open weave. The 30g set-up was one of the optimal options for all seven loom weights.

The total number of loom weights required to produce a one metre wide cloth range from 28 (for the thickest loom weight) to 34 (for the thinnest). The difference between thickest and thinnest is only 1.2cm.

The number of warp threads attached to each loom (30g set-up) ranged from 15 (for the lightest loom weight) to 22 (for the heaviest). The difference between lightest and heaviest is 207.8g.
These analyses demonstrate that the seven fully intact loom weights from Caere, despite appearing unique when examined — compare C13.248.64 to C12.42.171 (Chapter 3, Table 2) — and coming from various contexts, all appear to favour a similar set-up. When set-up for a warp thread of 30g tension, the final product in all cases is a relatively open fabric, requiring (on average) 1165m of yarn to produce.

In conclusion, by following the methodology outlined by Linda Märtensson’s team at the Danish National Research Foundation’s Centre for Textile Research, individual loom weights from Caere were analysed to suggest: the most likely set-up of the warp-weighted loom, the type of thread used, and the look of the final fabric produced.

4.2 Other textile tools

In the absence of experimental archaeology that could facilitate the study of individual spools and spindle whorls, it is not possible to make a meaningful addition to the research already published on these tools. At Caere, the number of finds is relatively low — five spools complete out of 21 total; five whorls complete out of eight total. So far, spindle whorls typically appear in earlier contexts. A number of well-made, fluted whorls, dated to the early seventh century BC were found in Area 3, to the northeast of the entrance of the hypogeum.

Future excavations will undoubtedly yield more material. Experimental archaeology may soon develop methods similar to the one used above for loom weights to analyze spools and spindle whorls; therefore, it is imperative that appropriate
measurements (especially weight) be taken for each textile tool found at the site to facilitate more detailed examination as new techniques are developed.
### Appendix A

**List of Textile Tool Finds from Caere, 2012 – 2014.**

<table>
<thead>
<tr>
<th>Loom weights, complete:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C12.23.81*</td>
<td>C13.133.198*</td>
</tr>
<tr>
<td>C12.42.171*</td>
<td>C13.133.200*</td>
</tr>
<tr>
<td>C13.65.59*</td>
<td>C13.248.64*</td>
</tr>
<tr>
<td>C13.133.197*</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Loom weights, fragment:</th>
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</thead>
<tbody>
<tr>
<td>C12.22.65</td>
<td>C13.104.3*</td>
</tr>
<tr>
<td>C12.32.100</td>
<td>C13.133.199*</td>
</tr>
<tr>
<td>C12.32.101</td>
<td>C13.133.201*</td>
</tr>
<tr>
<td>C12.32.102</td>
<td>C13.133.202</td>
</tr>
<tr>
<td>C12.42.168</td>
<td>C13.295.63</td>
</tr>
<tr>
<td>C12.42.170</td>
<td>C13.320.3*</td>
</tr>
<tr>
<td>C12.51.107</td>
<td>C13.338.1</td>
</tr>
<tr>
<td>C12.74.42</td>
<td>COMMUNI 107 (2 loom weights)</td>
</tr>
<tr>
<td>C12.87.46</td>
<td>COMMUNI 33 (3 loom weights)</td>
</tr>
<tr>
<td>C13.93.23</td>
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</tr>
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</table>

<table>
<thead>
<tr>
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<td>C12.34.1</td>
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<td>C12.44.9</td>
<td>C13.295.5</td>
</tr>
<tr>
<td>C13.218.8</td>
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</tr>
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</table>

<table>
<thead>
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</thead>
<tbody>
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<td>C12.44.8</td>
<td>C14.412.2</td>
</tr>
<tr>
<td>C12.106.27</td>
<td>C14.432b.1</td>
</tr>
<tr>
<td>C13.218.13</td>
<td>C14.464.1</td>
</tr>
<tr>
<td>C13.269.2</td>
<td>C14.464.3</td>
</tr>
<tr>
<td>C13.269.3</td>
<td>C14.464.4</td>
</tr>
<tr>
<td>C14.379.1*</td>
<td>C14.471.1</td>
</tr>
<tr>
<td>C14.408.1</td>
<td>C14.471.2</td>
</tr>
<tr>
<td>C14.412.1</td>
<td>COMMUNI 404 (1 spool)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spindle whorls, compete:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C13.295.6*</td>
<td>C14.438.1*</td>
</tr>
<tr>
<td>C14.448.61*</td>
<td>C14.468.1</td>
</tr>
<tr>
<td>C14.448.62*</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spindle whorls, fragment:</th>
<th></th>
</tr>
</thead>
<tbody>
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<td>C14.432.2*</td>
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<tr>
<td>C14.448.63*</td>
<td></td>
</tr>
<tr>
<td>C14.468.2</td>
<td></td>
</tr>
</tbody>
</table>

*Denotes presence of decorative elements.*
Appendix B

Sample Calculation

Loom weight C12.23.81 (weight of 652.9 g; thickness of 6.95 cm) set-up for 30g tension thread. Calculations are rounded to the nearest whole number.

Warp threads per loom weight:
\[ \frac{652.9}{30} = 22 \]
(weight (g) \div warp thread tension)

Warp threads \times 2 loom weights:
\[ 22 \times 2 = 44 \]

Warp threads per centimeter:
\[ \frac{44}{6.95} = 6 \]
(Warp threads per 2 loom weights \div thickness (cm))

Number of loom weights:
\[ \frac{(100}{6.95}) \times 2 = 28 \]
(width of fabric (cm) \div thickness (cm) \times number of sheds)

Number of warp threads:
\[ 6 \times 100 = 600 \]
(thread count per cm \times width of fabric in cm)

Amount of warp yarn:
\[ 6 \times 100 \times 1 = 600m \]
(thread count per cm \times width of fabric in cm \times length of warp threads in m)

Amount of weft yarn:
600m
(in tabby, equal to amount of warp yarn)

Yarn consumption for 1m² cloth:
\[ (600 + 600) \times 1.02 = 1224m \]
(amount of warp plus weft, plus an additional 2% of this total)

Time consumption for spinning required yarn:
\[ 1224 \div 50 = 25h \]
(divide the total length of yarn required by the length of yarn spun per hour for that given thread type: 35m/h for 10g; 40m/h for 20g; 50m/h for 30g; 51m/h for 40g and 50g)
Appendix C

Glossary

**Distaff** At its most basic, a simple stick used to hold the prepared fibres during spinning.

**Linen** A plant-based textile material derived from the stem material of flax plants (*Linum usitatissimum*).

**Loom weight** A pierced object (typically of clay) which keeps the warp of a warp-weighted loom taut during weaving.

**Plain weave** See *tabby*.

**Shed** The opening created either manually or mechanically in the warp through which the weft is passed.

**Spindle** A simple rod (typically of wood) with a hook or dent to attach the thread.

**Spindle whorl** A symmetrical, centrally pierced object (typically of clay) used in conjunction with the spindle to provide weight and tension during spinning.

**Spool** (Italian *rocchetto*) A cylindrical object (typically of clay) possibly used as weights around which excess warp was wound during tablet weaving.

**Tabby** A simple weave created by passing the weft alternately over and under the warp.

**Tablet weaving** A weaving technique which uses the rotation of (typically) square tablets to create different sheds through which the weft is passed. This technique was used to weave narrow bands such as borders.

**Thread** The final product of spinning raw textile materials, ready to be used for weaving. For wool, yarn is typically used instead of thread.

**True textiles** A textile produced by weaving rather than other methods of textile production such as felting.

**Twill** A complex weave created by passing the weft through the warp at a regular, staggered pattern.

**Warp tension** The amount of weight a warp threads requires to keep it taut during weaving, typically expressed in grams (g).

**Warp** The set of threads held taut during weaving. In a warp-weighted loom this is done by attaching the warp threads to a series of loom weights.

**Warp-weighted loom** A loom which uses a series of loom weights to hold taut the warp during weaving. This loom type was common throughout ancient Europe.

**Weaving** A method of textile production whereby one set of thread (weft) is passed through another set (warp) to produce a fabric.

**Weft** The set of threads passed through the warp during weaving.

**Wether** A castrated male sheep. A predominance of wethers in a sheep herd indicates its primary purpose was wool production.

**Wool** An animal-based textile material derived from sheep. The best wool is harvested from wethers.

**Yarn** See *thread*.
Bibliography


