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RESEARCH ARTICLE

When did weaving become a male profession?

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ABSTRACT

The article discusses the development and technological changes within weaving in the Middle Ages when it developed into a major craft and one of the most important industries of the Middle Ages in Northern Europe. While prehistoric weaving appears as a predominantly female work domain, weaving became a male profession in urban contexts, organised within guilds. Hence, it has almost become a dogma that the expanding medieval textile industry, and corresponding transition from a female to a male work domain, was caused by new technology – the horizontal treadle loom. By utilising various source categories, documentary, iconographic and archaeological evidence, the article substantiates that the conception of the medieval weaver as a male craftsman should be adjusted and the long-established dichotomy between male professional craftsmen and weavers, and women as homework producers of textiles should be modified, also when related to guilds. The change from a domestic household-based production to a more commercially based industry took place at different times and scales in various areas of Europe and did not only involve men.

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Introduction

This article focuses on the development and technological transformations within weaving in the Middle Ages – a period of expanding urbanisation, commercialisation and specialisation within crafts, often organised as guilds. The aim is to illuminate the interaction between textile production, technology and the actors. Here, gender and the social organisation of the production also play an important role. In prehistory, weaving appears as a predominantly female work domain, and it is first in the Middle Ages weaving becomes a male profession in urban contexts. Hence, it has almost become a dogma that the transition from a female to a male work domain was the result of new technology – the introduction of the horizontal loom. It has been regarded as unlikely that the expanding urban weaving centres in England and elsewhere of the twelfth century and onwards could have been using anything other than the new treadle loom. But were the new looms only used by men, and when did they replace the old vertical looms?

The issues addressed in this article thus concern how, when and where technology in weaving changed and who the agents were behind such change. The answers to these questions may also have consequences for other conceptions of the organisation of crafts, work, productivity, gender roles and relations, and medieval society in general. Next to food production, textile production constituted the most important industry of the Middle Ages (Munro 2000b). The early medieval sources to this technological change are scanty and uncertain. As for gender roles, sources are also more ambiguous than stated in previous research. Here, later conditions, not least related to the establishment of guilds in the High and Late Middle Ages, may have affected earlier interpretations of this technological transformation and shift in gender roles. To address these issues from a more holistic outlook, several source categories have to be considered: contemporary archaeological remains related to textile production in various contexts, iconographic and written evidence, as well as later ethnological sources.

Textile production and weaving clearly represent long achieved competency and expertise within a culturally defined female work sphere centuries before the introduction of the horizontal loom. According to the anthropologist Francesca Bray, one fundamental way in which gender is expressed

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in any society is through technology, where technical skills and domains are generally divided between and within the sexes, thus shaping masculinities and femininities. Such gender systems are generally regarded as more difficult to change than material technologies – and reveal how technology is indicated in gender inequalities. This has also tended to make women 'invisible'. New technologies may, however, also promote processes of boundary work and renegotiations of which is considered masculine and feminine (Bray 2007, pp. 38–42).

It is therefore not unlikely that innovations within textile production were adopted, adapted and developed by those who had the experience and expertise in this field of work. Additionally, transgressing established gender roles could threaten masculinity and cause loss of honour, as evidenced in the Norse sagas (Meulengracht Sørensen 1995). The present hypothesis is that the transition of weaving implements and gender roles may have been a gradual process and that male weavers were not necessarily the main agents in the earliest periods when traditionally men appear as the most visible actors as heads of households.

When was the horizontal loom introduced – and how did it work?

The origin and diffusion of the horizontal treadle loom in Northwestern Europe in the Middle Ages is not so clear. Traditionally it is regarded as a medieval invention, dated to the eleventh century, when it is also first mentioned, although indirectly. It is written in Hebrew, by Rabbi Solomon Izhaqi, better known as Rashi of Troyes (1040–1105) after his home town in France, in his commentary on the tractate Shabbat of the Babylonian Talmud in the context of a discussion about what kind of tasks that should be reckoned as work and thus prohibited on the Sabbath (Shabbath 105a). In a section about weaving, the Talmud seeks to define how many threads a weave may be joined before this is counted as work. It is in this context Rashi comments upon different ways of weaving and makes a reference to '… that part of the loom of weavers who weave by foot which is in place of the rod that goes up and down in the loom used by women ' (translation in Carus-Wilson 1969, p. 69). Others refer to this source less precisely (e.g. Hoffmann 1964, p. 260, Munro 2000a, p. 17), generally replacing 'weavers' who weave by foot by 'men' and without further contextualisation. The passage in Rashi may indicate that the horizontal loom was a rather new implement at that time, and therefore needed to be explained in relation to the better-known vertical loom. His interest in the tool relates to the implications it poses related to definitions of work, not to gendered labour as such.[1] Being a Talmuic reference, it may also be questioned how representative this early mention is for the European area as a whole.[2] This is not so obvious either for its novelty or as for gender. It has, however, often been taken as an indication to be used for wider generalisations (e.g. Hoffmann 1964, Kjellberg 1979, Walton Rogers 1997, Henry 2005). The loom's medieval origins have been doubted and may rather have Oriental beginnings and may have entered Europe from the Byzantine Empire at an early stage (e.g. Endrei 1961, Munro 2000a, p. 18). But on the other hand, the loom may not necessarily have a common origin (Wild 1987, p. 460).[3] According to recent finds of pit houses with possible traces of horizontal looms, it had reached the northern parts of Switzerland by the ninth and tenth centuries (Windler 2008, pp. 213–215). The spread of the loom further north, its relation to earlier types of looms and the actors involved are therefore examined in the following.

There is no doubt that the horizontal loom was worked by treadles in a sitting position in contrast to the vertical warp-weighted loom, being worked standing and upwards against the gravity force. Still, the archaeological evidence of the whole construction is meagre and the first illustrations appear several centuries later, and in some cases also in a simplified way. Although the archaeological remains of the different loom categories can only be traced as fragments, they still leave clues about dating and different constructive elements in time and space.

The medieval iconographical evidence of treadle looms from England and other parts of Northern Europe indicates that there were different types of looms in use and that the horizontal loom also changed over time. However, a common characteristic is that it has warp threads stretched out horizontally between two beams, the cloth beam in front of the seated weaver and a warp beam at the far end of the loom frame; to this treadles were connected, linked by pulleys as parts of the mechanism for making the shed. They were joined to the heddles, i.e. loops for the warp threads, and fastened to the

shaft rods that could be lifted and lowered by the treadles, creating the shed, the space between the two layers of warp threads, where the weft threads could pass through (Grenander-Nyberg 1975, p. 36). The pulleys were basically formed as a block wheel with a groove for a string to run over and could be attached to heddle horses,[4] again connected to the heddle rods and the treadles (Figures 1 and 2).

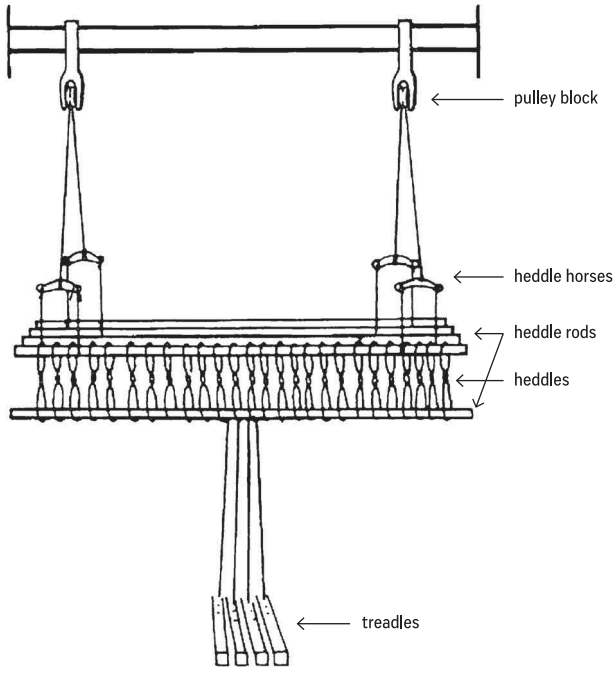

Figure 1. Schematic drawing of the horizontal loom operated by treadles. These were linked by pulleys, joined to heddles – loops for the horizontal warp threads– and fastened to heddle rods to be lifted and lowered by the treadles so that the weft could go through, creating the shed (cf. Figure 3).

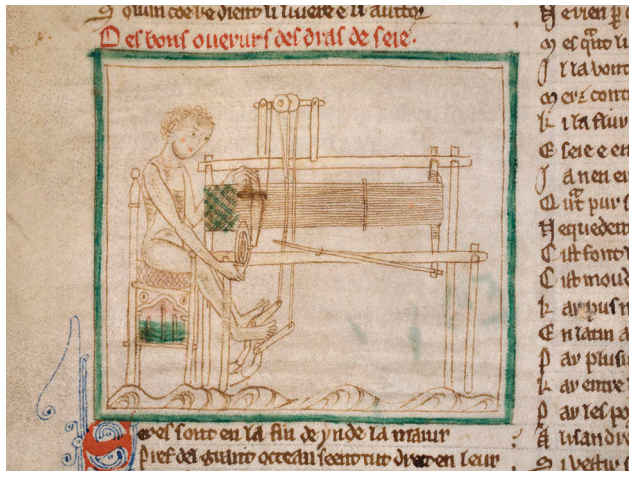

Figure 2. Weaver at the loom *c.* 1250: one of the earliest depictions of the horizontal loom, appearing to be a two-treadle type. A shuttle is used to insert the weft. Here, pulleys are threaded on the upper loom bar without being connected to heddle horses (MS 09.32v with permission from the Master and Fellows of Trinity College Cambridge).

Reeds, frames with vertical slits to separate the warp threads and hold them in positions as it was woven, were also parts of the loom (see Figures 3, 8 and 9).

Archaeological finds, such as pulley blocks and wheels, reeds, heddle rods, heddle horses and treadles, predate the illustrations and the oldest of such finds date back to the eleventh century, matching the oldest documentary indication. Altogether, the archaeological traces provide the best dating evidence but it can be problematic to identify single finds as parts of looms when they are found in unclear contexts. The traces are also *ante quem*

Figure 3. The Weaver's Ordinance Book (*Keurboek*) from Ypres, Flanders, 1366 – the earliest illustration of the broadloom operated by two weavers – a man and a woman. It is also one of the earliest depictions of the new spinning wheel. A woman at a warping board and a spool rack also form parts of the scene. Photo of the original document, taken before the coloured illuminated manuscript was lost in 1914 (photo: Stad Ieper, Stadsarchief, with permission).

dating and show that they were taken into use, but do not necessarily represent the earliest use.

Most of the medieval depictions show narrow looms operated by two treadles for one shaft for plain weaves and one weaver – either male or female. Pictorial evidence from the latter part of the fourteenth century shows, however, as many as four treadles and several shafts, able to weave different types of twills. Such looms were operated by two weavers on the so-called broadloom. The earliest depiction of the broadloom operated by two weavers – a man and a woman – stems from Flanders from the Ordinance Book (*Keurboek*) from Ypres (Ieper), Flanders, from 1366[5] (Figure 3). It has been claimed that the broadloom, able to produce wider fabrics, was a Flemish innovation of the mid-thirteenth century, but without providing documentary evidence. The economic textile historian John Munro finds it reasonable that the broadloom probably evolved much earlier but that the development and diffusion did not succeed in displacing the narrow one for perhaps two centuries or more after the introduction of the single operated horizontal treadle loom in the eleventh century. Still, it did not altogether supplant the narrow, single-weaver horizontal loom and long remained the preferred implement for weaving the smaller, less densely woven woollen and narrow worsted fabrics (Munro 2003, pp. 196–197), and probably also linen fabrics of plain weave. Most of the preserved illustrations of horizontal looms are from the fifteenth and sixteenth centuries and were also only operated by one weaver, which may indicate that weaving of broader cloth was still lacking an impetus.

The horizontal loom replaced, or rather partly substituted, the earlier vertical warp-weighted and two-beam looms. On these looms, warp threads are suspended from a horizontal beam and attached either to a beam or to loomweights at the bottom. The warp was prepared by weaving a starting border fastened to the upper beam, but other types of starting borders could also be used (Hoffmann 1964, pp. 63–70, 154–156). On the warp-weighted loom, the warp is divided into front and back by means of a movable horizontal shed or shaft rod fastened to the two uprights by rod-brackets (Figure 4).

Weaving here takes place from top to bottom on the warp-weighted loom; the weft is beaten upwards by a sword-shaped tool, a weaving beater. Placing the loom at an angle allows the back warps to hang vertically over the shed rod, creating a natural shed that prevents the need for heddles on the front threads in plain (tabby) weave and facilitates some twill weaves. By using double-notched rod-brackets for supporting the shed rod, experimental weaving has shown how it was easy to also weave the unbalanced 2/1 twills on the warp-weighted loom (Baxter and Dokkedal 1992). Such double-notched brackets have been uncovered in Trondheim and dated to the

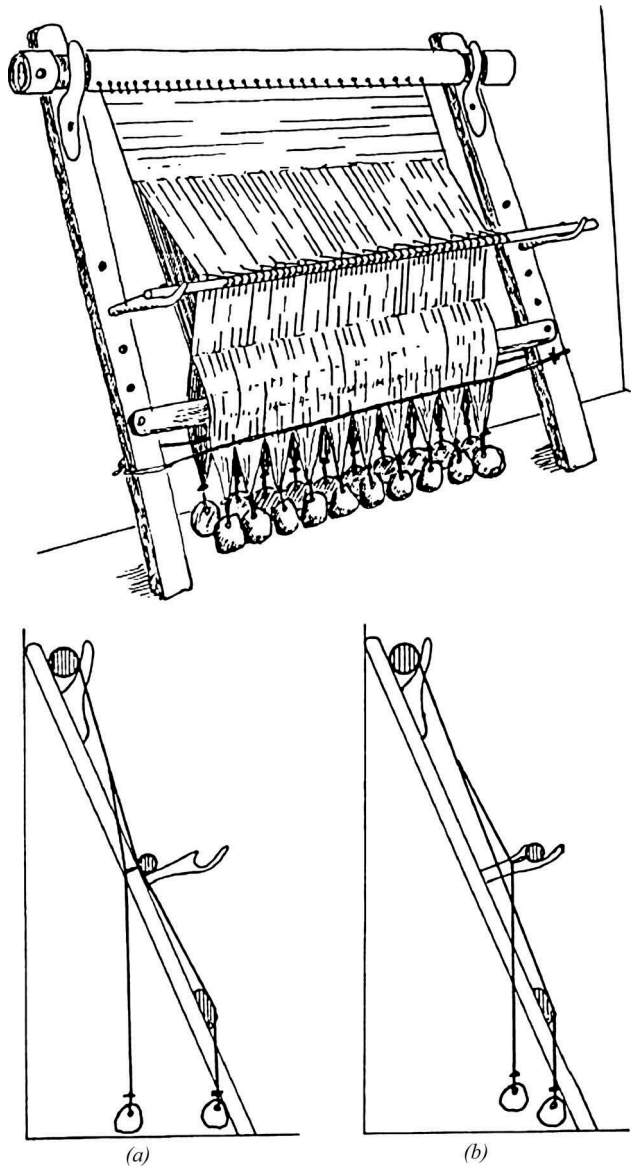

Figure 4. Schematic drawing of the warp-weighted loom in front (a) and section (b): the weaving starts at the top where vertical warp threads are fastened to the horizontal upper beam and are stretched by loomweights at their ends. The warp is divided into front and back by means of a movable horizontal shed rod fastened to the two upright beams by movable brackets.

eleventh century (Nordeide 1994, pp. 230–231, Figure 199).

When producing a tabby, the loomweights are attached to two warp thread layers; front and back rows representing two sheds (Mårtensson *et al.* 2009). When weaving twills, such as 2/2 twills and the more complex diamond and lozenge-patterned twills, the yarn was divided into four sheds, with the fourth as a natural shed. Remains of textiles, varying weave patterns (Figure 5) and widths, may then also be indicative of the tools used.

The warp-weighted loom is primarily evidenced by archaeological finds of loomweights and also archaeological textiles, and in Scandinavia often with a tablet-woven starting border. Another exceptional find of the warp-weighted loom stems from a medieval site in Greenland and revealed among others a 188-cm-long complete upper loom beam with altogether 81 loomweights clustered around it. A second beam broken at the ends and preserved in a length of *c.* 120 cm was also found, as were remains of two probable fixed shed rods and a pin-beater, all found in situ and dated to *c.* 1200–1250 to the early fifteenth century (Arneberg and Østergård 1993, Guðjonsson 1993). In many cases, rows in varying lengths or heaps of loomweights are found in situ in pit houses from the Anglo-Saxon period (Henry 2005, pp. 51–54), Viking period and Early Middle Ages in West Norse areas (Milek 2012, Øye 2015a) as well as on the Continent (e.g. Zimmermann 1982), and in medieval buildings in both rural and urban contexts. Some rows could be up to 2 m long, and in one case 4 m wide and a warp of 3.5 m in width (Zimmermann 1982), altogether indicating weaving broad fabrics by two persons. The largest medieval towns of Norway, Oslo, Trondheim and Bergen, have all revealed special buildings for textile production from the eleventh to the fourteenth centuries and in situ finds of clusters of loomweights in varying numbers and lengths along the walls. In Oslo, 26 weights were found along a wall, covering a length of 120 cm, while another cluster of weights in another building contained 61 weights and represented a much broader loom. The other towns also showed similar clusters, indicating different widths, varying from around 1–2 m and clusters of more than 60 weights (Øye 2015b, pp. 34–37). Much wider fabrics could then be woven on the warp-weighted loom in contrast to the early horizontal looms in the first phase and was clearly more flexible as for width of the fabric but more limited as for length. The separable parts of the warp-weighted loom also mean that a loom could be set-up temporarily in a domestic setting, where weaving was a seasonal or intermittent activity (Owen-Crocker 2012, p. 344), in contrast to the more stationary and space demanding horizontal loom. Mounting and dismantling of the warp-weighted loom is also referred to in various medieval Norse texts (Falk 1919, p. 15).

On the two-beam loom, the warp was also stretched vertically with the warp beam at the top and the cloth beam below, and the cloth was woven upwards, in contrast to the warp-weighted loom, so that the weaver could be seated. In England and other places, the warp-weighted loom seems to have been displaced by a two-beam vertical loom in urban contexts from the tenth century (Walton Rogers 1997, p. 1824), but remained a little longer in rural areas. When this transition happened – and how – is not so clear as the loom normally leaves no direct traces archaeologically. The only archaeological find is a small two-beam loom found in the spectacular grave mound of Oseberg in Norway from the early ninth century. It is, however, too small and narrow for weaving ordinary fabrics being only *c.* 30 cm across and is interpreted as used for fine tapestry work (Walton Rogers 1997, p. 1760, Hougen 2006, pp. 84–85). Indirectly, single-ended pin-beaters and toothed beaters for

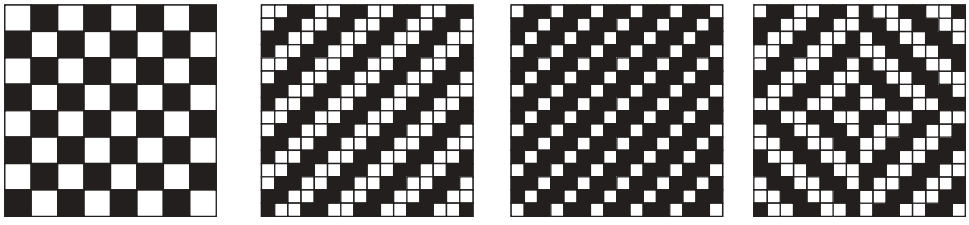

Figure 5. Weaving patterns as referred to in the text: From the left: 1/1 plain tabby, 2/2 twill, 2/1 twill and diamond broken twill. The numbers refer to the pattering of the warp and weft – twills making diagonal patterns.

compressing the weft seem to imply a two-beam looms. An early depiction of a narrow two-beam loom from the mid-twelfth century illustrates weaving and warping in progress.[6] Judging by medieval drawings, it was also used for narrow fabrics (Walton Rogers 1997, p. 1824). A decline of warp weights and an increase in single-ended pin-beaters have been seen as tentative indicators of the two-beam loom (e.g. Walton Rogers 1997, pp. 1759–1760).

The advance of the new horizontal loom provided several advantages over the vertical looms, in that it produced more uniform and densely woven fabrics, and not least, much faster. By stretching the warps more tightly on the two beams and with more even tension and by beating the wefts more firmly and evenly, the ratio of weft to warp increased in relation to weaving on the warp-weighted loom. The treadle-operated heddle harnesses further improved the control of the weaving sheds, and not least importantly, the two separate rotating beams for winding the warps and winding up the cloth made it possible to produce far longer lengths of cloth than on the vertical looms. Altogether, the horizontal loom represented a significant increase in productivity. It has been estimated to have been more than a three-fold increase compared to the warp-weighted loom (Rast-Eicher and Windler 2006, p. 32). A chief limitation though of the original horizontal loom was that it was too narrow, limiting the cloth to the arm stretch of a single weaver, while the warp-weighted loom even at an early stage seems to have been producing cloth of 2 m or more in width but then operated by two weavers, one on each side (Munro 2003, p. 196, Rast-Eicher and Windler 2006, p. 30). That two weavers were needed to lift the heavy heddle rod when changing the shift, and to hand the weft bobbin from side to side, is also observed in Marta Hoffmann's study of the warp-weighted loom (Hoffmann 1964, p. 44). Narrower weaves needed only one weaver when, for instance, weaving the standard cloth of wadmal as defined in the Icelandic law *Grágás* in the thirteenth century as an economic measure and means of currency. It should be woven in 2/2 twill technique and of two ells (at 47.4 cm) or 90 cm as the standard width (Þorláksson 1991).

A major difference between the two looms was the length of the cloth where the horizontal loom made it possible to operate 20–30-m-long threads and weave a corresponding long cloth to be rolled onto the cloth beam (Rast-Eicher and Windler 2006, p. 31). Winding woven cloth onto the upper beam of the warp-weighted loom is also documented in medieval sources both directly (Falk 1919, p. 15) and indirectly when lengths of 6 ells, *c.* 2.8 m, and 20 ells or 9.5 m became standard measures in medieval Iceland (Þorláksson 1991). Being longer cloth than the loom itself, it had to be wound onto the upper beam while the weights were attached lower down on the warp bundles. This is a method also known from later periods (Hoffmann 1964, p. 67).

There existed, then, different types of looms for producing different cloth qualities, both vertical – the warp-weighted and two-beam loom – and horizontal treadle looms, either operated by a single weaver or later by two weavers on the broadloom able to produce broader and longer fabrics. These differences should also be considered when discussing the spread of the horizontal loom in time and space, and as for gender.

It is therefore interesting to look closer at the archaeological traces, written evidence and medieval illustrations depicting both the constructions and the weavers themselves to trace the diffusion of the horizontal loom in different areas and possible coexistence of old and new technology in different areas of Northern Europe.

The advent of the horizontal loom

According to archaeological evidence, the horizontal loom driven by treadles seems to have reached Northwestern Europe during the eleventh century. It is, however, unclear how quickly this would have been adopted and quite when the vertical looms would have been phased out in different areas. Due to the fragmentary state of preservation of wooden fragments of the loom, and since loomweights generally have until recently been rather neglected archaeological artefacts,[7] it is difficult to give clear-cut and representative direct or indirect documentation of its advance. To assess the issues of adoption and adaption of the horizontal loom and how long the vertical loom was still in use, all available sources have to be taken into account and assessed contextually. Although sparse, the archaeological evidence plays a key role as for technical details and for *ante quem* dating.

The presence of the horizontal loom is marked in different ways – by direct finds of parts belonging to the loom, such as heddle horses, heddle rods and pulleys, and in rare cases also other parts of the loom, such as reeds, treadles and shuttles. An overview and map of such findings from various urban centres in northwestern and eastern parts of Europe has been presented by Dominique Cardon and Renata Windler (Windler 1994, 2008, Cardon 1999). The best-documented finds as for identification of the horizontal loom come from towns in England (York), Norway (Bergen), Sweden (Sigtuna, Lund), Germany (Haithabu/Hedeby and Braunschweig), Poland (Gdansk, Opole), Latvia (Riga), Russia (Novgorod) and Switzerland (Winterthur). Since then, however, the dating has been corrected or modified in some cases. The following updated survey is shown chronologically to better trace possible geographical patterns or changes, and focuses on the earliest and best-documented finds (cf. Table 1).

The oldest possible archaeological remains of the horizontal loom from the eleventh century come from the Viking Age town of Hedeby/Haithabu in present Germany, at that time within the Danish realm, York in England and Gdansk in Poland. Other sporadic and possible remains of the loom dating to the twelfth century come from York in England, Bergen in Norway, Sigtuna and Lund in Sweden, and Opole and Gdansk in Poland. By the thirteenth century, the finds increase in number: from among others, York, Bergen, Braunschweig, Riga, Winterthur and Novgorod.

The possibly oldest finding of the horizontal loom from Hedeby is a complete pulley made of oak, 23.3 cm long, with an intact wheel, 3.7 cm in diameter, with a groove for the string and a central hold for the transverse pin connecting it to the pulley block (Grenander-Nyberg 1984, p. 145, 1994a, p. 204). When also depicted and described among the ship-related finds from Hedeby, it appears as clearly smaller than pulleys used in ships (Crumlin-Pedersen 1997, p. 135), which substantiates the use in a loom. At York, a heddle horse/heddle cradle, *c.* 20 cm long with one central and two drilled outer holes, is dated to the late eleventh century. An incomplete wooden rod, 46 cm long and 2 cm in diameter with a knob-like terminal at the intact end, has been identified as a heddle rod and dated to the twelfth or early thirteenth century (Walton Rogers 1997, p. 1763). The identification as

Table 1. Towns with archaeological remains of the horizontal loom, chronologically ordered.

Place	Pulley block	Pulley wheel	Heddle horse	Heddle rod	Reed	Shuttle	Treadles	Beam	Side-support/posts
Haithabu	11th c.								
York			11th c.	12th– 13th c.					
Gdansk		11th and 12th c.	12th c.					12th c.	12th c.
Opole	c. 1200					12th and 13th c.			12th c.
Sigtuna	12th c.	12th c.							
Lund	12th c.								
Bergen	13th and 14th c.	12th c.	13th and 14th c.						
Riga	c. 1200		c. 1200	c. 1200	12th c.	c. 1200	c. 1200	c. 1200	
Braunschweig	13th c.		13th c.		13th c.	13th c.			
Novgorod		13th–15th c	13th–15th c	13th–15th c			13th– 15th c		
Winterthur			13th c.		13th c.		14th c.		
Turku	Late Middle Ages		Late Middle Ages			Late Middle Ages			

Note: c.: century/centuries.

a heddle rod has, however, been questioned (Windler 2008, p. 208). In Gdansk, another find of a small possible pulley wheel is dated to the eleventh century, while another pulley wheel here from the twelfth century (Kamińska and Nahlik 1960, p. 94) is interpreted as having been threaded directly on an upper loom bar in the same way as shown in an English depiction from the middle of the thirteenth century (Grenander-Nyberg 1994a, pp. 203–204; cf. Figure 2). Larger parts of a twelfth-century loom including a beam, side supports and parts of the structure were also found in situ in the ground of a wooden floor (Kamińska and Nahlik 1960, pp. 94–97).

Two pulleys were also found in Opole, dated to around 1200 and of about the same type as found in Hedeby and Bergen (cf. Figure 6) as well as four shuttles from the twelfth and thirteenth centuries (Endrei 1961, pp. 127–128, Grenander-Nyberg 1994a, pp. 203, 205).

A pulley block and a single-block wheel are found in medieval Sigtuna, both made of elk horn, and dated to the twelfth century. The pulley block, 10 cm long, is only about half the size of the Hedeby pulley, but principally of the same type (Geijer and Andersbjörk 1939, p. 236, Grenander-Nyberg 1994a, p. 205). A pulley of spindle tree from Lund, Sweden, is also dated to the twelfth century (Grenander-Nyberg 1994a, pp. 205, 211, note 3).

The excavations at Bryggen in Bergen with good preservation conditions for organic material in the damp harbour area revealed several scattered remains possibly belonging to the horizontal loom in layers dated from the late twelfth, and the latter part of the thirteenth and the fourteenth centuries (Figure 6(a, b)). The oldest is a small single wheel with a groove for the string in a pulley. It is made of birch wood, 3.4–4 cm in diameter. An almost complete pulley block of pine, 15.5 cm long, was found in layers from the late thirteenth century. The connected pulley wheel was of about the same size as the older single wheel, 3.2 cm in diameter and 1.8 cm thick, revolving on a small wooden axle. Another possible somewhat damaged fork-shaped pulley block of unidentified hardwood, 16.8 cm long, is dated to the latter part of the fourteenth century. It is more like the Hedeby pulley with a hole for suspension but somewhat smaller. A possible heddle horse of juniper, 22.5 cm long, is dated to the latter part of the thirteenth century/early fourteenth century (Øye 1988, pp. 74–75).

In Riga, one of the best-documented textile workshops has been excavated and is dated stratigraphically to the early thirteenth century, radiocarbon dated to the early part, AD 1210±. Here, charred remains of the rear part of a horizontal loom were found – parts of a warp cross beam with remains of a thick layer of linen warp ends, a reed for distributing warp threads over a certain width, a weaving comb with 11 preserved teeth, remains of 4 pulleys, a heddle horse – of the same type as found in Bergen

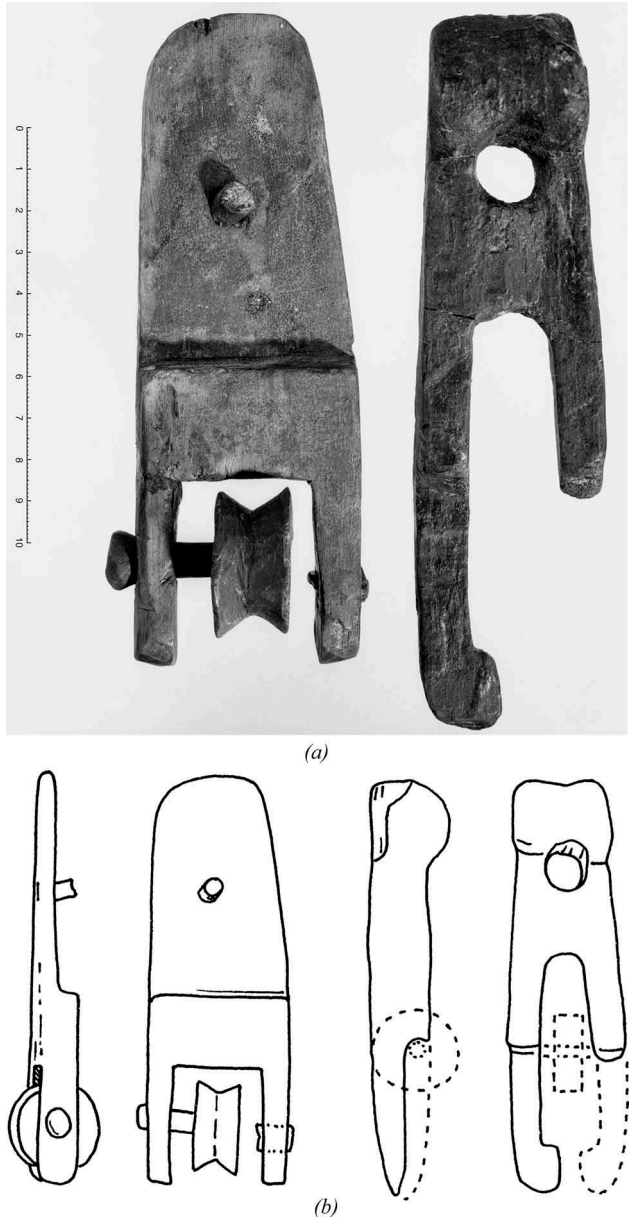

Figure 6. Pulley blocks from Bryggen in Bergen. (a) The most complete to the left, dated to the thirteenth/early fourteenth centuries, the other to the fourteenth century. (b) Drawing: seen in front and as cross section (photo: University Museum of Bergen ©. Drawing: Per Bækken).

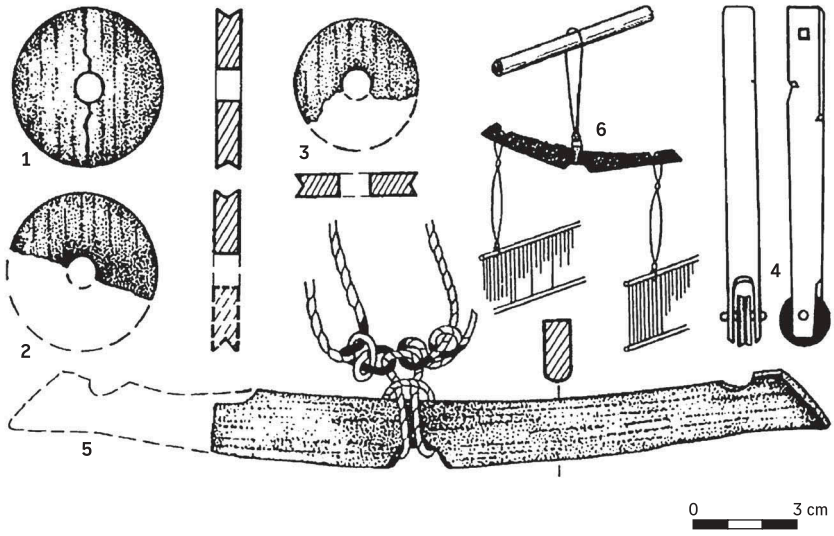

Figure 7. Loom parts found in Riga: (1–3) block wheels, (4) pulley and (6) suggested reconstruction of the loom parts.

– fragments of a shed rod, a half finished shuttle, a ball of linen yarn and remains of 2 treadles (Zariņa 1992) (Figure 7). Woven fragments of linens (1/1) were also found. This loom may have had two pulleys or two shed rods, or four of them (Zariņa 1992, Caune and Ose 2006, p. 49). This is the most complete find of a horizontal loom found in a closed archaeological context so far.

A loom with four pulleys and four treadles is shown in later depictions from the early fifteenth century, but still only operated by one weaver (Figure 8). The finds from Riga also substantiate the interpretations of the more fragmentary finds, among others the heddle horses from Bergen and Braunschweig. In Germany, the oldest evidence of the horizontal loom is found in Braunschweig in an area also called *Wevestrasse*: three wooden shuttles – the most complete 20 cm long – several heddle horses and three pulleys, all dated to the second part of the thirteenth century (Alper 2006, pp. 169–171).

Another key find of the horizontal loom besides Riga appeared in Winterthur in Switzerland, where a whole weaving workshop from the fourteenth century was uncovered. It was found in a 1.8-m-deep pit house with parts of the loom that had been in work when the building burnt. Here, strings for the shed rod, identical with the one from Riga, textiles of linen and treadles were found in a 10–20-cm-deep trapezoid pit. The loom itself had been 1.5–2 m wide (Windler 2008, pp. 209–210). In the old town of Winterthur, remains of altogether four to five workshops have been identified with traces of horizontal looms in sunken floor buildings dated from the thirteenth to the fifteenth centuries. One of them

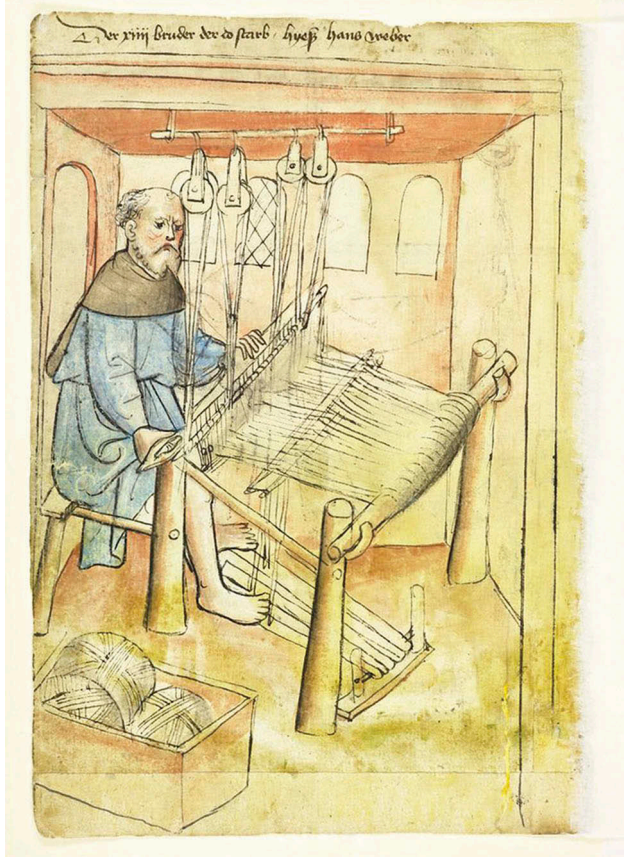

Figure 8. Wool weaver operating the loom by four treadles. Illustration from Nuremberg Mendelsche Zwölfbrüderstiftung (1425), Mendelschen Stiftungsbuch. (Stadtbibliothek Nürnberg, Amb. 317.2°, f. 4v, with permission).

had traces of four looms, one of them, dated to the fourteenth century, contained three treadles for three shafts (Windler 2008, pp. 210–211).

Excavations in Novgorod with its good preservation conditions for organic material have revealed the largest number of remains of the horizontal loom dated from the thirteenth to the fifteenth centuries: possible block wheels, treadles and heddle rods and heddle horses (Kolčin 1968, p. 70, Thompson 1968). In Åbo/Turku, presently in Finland, fragments of treadles and other parts of the horizontal looms, part of heddle horse, a pulley as well as a shuttle were also found in late medieval layers (Hiekkanen and Harjula 2006, pp. 529–530).

Altogether, pulley blocks, and especially wheels, probably belonging to the pulley, heddle horses and remains of heddle rods, sometimes with preserved threads attached, are among the most frequent finds from the twelfth and thirteenth centuries. But as a whole, the direct traces of the horizontal loom are few and date from the eleventh century into the Late Middle Ages. The oldest finds from the eleventh century come from York furthest west to Gdansk in the east, but are more solidly represented in the twelfth and thirteenth centuries. They reveal different types of looms from a simple horizontal loom with two pedals to a more advanced loom with four treadles in the early thirteenth century.

Substitution or concurrence in weaving technologies?

In many places, the finds of the horizontal loom coincide with traces of the vertical loom in the same surroundings. In Hedeby, the warp-weighted loom seems to have been the main type of loom, judging by the more than 3000 fragments of loomweights, representing different weight groups able to produce different qualities. They were found from the whole occupation period from around AD 800 to the middle of the eleventh century, but without a closer chronology for their temporal distribution and a possible decline (Andersson 2003, pp. 121, 124, 131). The pulley then indicates that the two types of looms have overlapped in time.

In York, the number of excavated loomweights also declined considerably from the early tenth century. At that time, the warp-weighted loom seems to have been displaced by the two-beam loom for a shorter time before the introduction of the horizontal treadle loom in the eleventh century (Walton Rogers 1997, pp. 1751–1753). A similar pattern is also revealed in London where loomweights disappear from the archaeological record between the ninth and eleventh centuries (Prichard 1984). A technological change attributed to the horizontal treadle loom has also been seen by a marked change in archaeological textiles of fabrics of threshed 2/1 twills spun with z-spun (twisted to the right) warp and softer s-spun (twisted to the left) weft and replaced the mainly 2/2 twill and z/z spun yarn that was produced on the warp-weighted loom (cf. Figure 5). This interpretation may, however, be too one-sided as also warp-weighted looms with two-notched brackets could just as easily be used as on the counterbalanced treadle loom (Crowfoot *et al.* [1992] 2001, p. 27 with references).

Various looms, both horizontal and vertical, seem to be also in use in urban areas. For instance, Beverly in northeastern England, where cloth production formed the town's major craft in the Middle Ages, finds of one-ended pin-beaters used at the two-beam loom were still present in twelfth- and fourteenth-century contexts and suggest that some of the vertical loom was still in use as late as in the fourteenth century (Evans 2006, pp. 71, 76).

It has been a common conception that the foot-operated horizontal loom quickly spread from the west eastwards to the newly established Hanseatic towns (Tidow 2009). The finds from Gdansk, Riga and Opole are, however, just as early as, and even earlier than the earliest documentation from both English and German towns. In Germany, a similar shift of looms is observed but not always synchronically and where the two technologies could overlap. In Braunschweig where weaving on the horizontal loom is documented in the thirteenth century at the latest, weaving on the upright loom is also evidenced by remains of loomweights from the oldest phases into the eleventh and twelfth centuries, thus indicating a technological shift first into the High Middle Ages (Alper 2006, pp. 169–171). A similar time frame for the presence of the vertical loom is also evidenced in Göttingen, where weaving on the horizontal loom is first proven by documentary evidence and textiles from the first half of the fourteenth century (Arndt 2006, pp. 187–189). In Stade, the vertical loom was used only into the eleventh century, and where loomweights were found close to the market and in an

area where textiles were later sold (Lüdecke 2006, pp. 227–228). In Bremen, loomweights occur even later, into the thirteenth century, and the warp-weighted loom seems to have only gradually been replaced by the horizontal loom (Rech 2004, pp. 290–291). A similar scene emerges in Konstanz, which developed as an important town in international trade as early as in the twelfth century and where textile production became a major craft, especially based on flax and hemp (Storz-Schumm 1993). Judging by these cases, it may seem that the transition from vertical to the horizontal weaving was not altogether synchronic and the warp-weighted loom was used well into the High Middle Ages. The transition represents a longer process and period of overlap than often considered.

In Bergen, as in other Norwegian medieval towns, the upright warp-weighted loom was used even longer than on the Continent and was a common tool from the early twelfth century well into the fifteenth century but in very small quantities and evidently on a small scale after around 1400 (Øye 1988, 2014, 2015b). This was also the case in other excavated medieval towns, such as Oslo and Trondheim (Gjøl Hagen [1988] 1994, Rui 1991; Øye 2015b). Still, textiles in 2/1 twills and z/s spinning also became more frequent by the Early and High Middle Ages in these towns. Some of the archaeological textiles have, however, remains of starting borders, which indicates that 2/1 twills were also woven, and could be woven, on the upright loom. The presence of 2/1 twills is therefore no evidence or clear proof of the horizontal loom in itself – as earlier often suggested. Textiles moreover were to a large extent imported (Øye 2015b). In Swedish towns too, weaving on the warp-weighted loom lasted into the Late Middle Ages, such as in Malmö, where loomweights are found in layers as late as from the fifteenth century (Reisnert 2006, p. 562). In Norway, the upright loom has been used into the twentieth century in some rural areas, but mostly for weaving wall hangings (Hoffmann 1964), while in Iceland it has been used into the nineteenth century for producing *vaðmál*, 2/2 twill, of various qualities and on a larger scale. In the Middle Ages, weaving on the upright loom was also carried out on a commercial level for export (Þorláksson 1991).

Studies of textiles from a medieval graveyard from the Estonian countryside indicate that the development within textile production differed in urban and rural areas in the Baltic areas and show that old traditions were kept alive through the Middle Ages, from the eleventh to the seventeenth century, in spite of rapid social and political transformations in this period. The continuity in rural textile types also indicates a persistence of old technologies on the upright loom as well in contrast to the development in the new towns, and a spatial difference between traditions and transformations. In the Late Middle Ages, textiles were still obviously woven on a warp-weighted loom as indicated by the tubular selvages, 2/2 diagonal twill and 2/2 herringbone twill weaves and z-spun combed wool. This is probably evidence of a domestic handicraft and a textile culture well established centuries earlier and lasted with little change until the seventeenth century, at least in some areas in Estonia (Rammo 2014).

It has also been suggested that the reason why the two types of looms coexisted well into the High Middle Ages was due to the functional properties of the fibres used – where the upright loom was especially suitable for the elastic qualities of wool, while the treadle loom was better suited for the firm and rigid linen. Therefore, the two looms were used side by side (Grenander-Nyberg 1994b, pp. 75–76). The preserved textile remains and threads from Riga and Winterthur were also made of linen, the latter in a pit house, with a humidity especially suited for production of linen textiles. Early evidence of the two looms used side by side is also recognised in northern parts of Switzerland, where remains of a horizontal loom were found close to a vertical loom in a pit house dated to the twelfth century. Such coexistence seems to have lasted over a long period in this region. Also here, their concurrence has been explained by their different qualities for weaving linen and wool (Windler 2008, p. 215). A distinction between weaving in linen and wool is also expressed as different specialisations in later sources. In Germany and in other areas, literary sources distinguish between weavers of wool and flax, the former denoted *der Lakenmacher* and the latter expressed in the feminine *die Leinenweber*, which was allegedly less prestigious and also included women (Alper 2006, p. 170).

Who were the weavers?

That the shift of looms also represented a shift of gender roles tends to have become a common

conception, often with reference to the previously mentioned citation of Rashi of Troyes in the late eleventh century as well as later guilds and guild regulations – rules that often were laid down in the later Middle Ages by organisation of master craftsmen (Rosser 1997, p. 16). Although the role of guilds has been much debated, the issue of gender has largely been a non-issue for most historians as male dominance has been taken as a precondition. However, historians of women and gender have questioned the previous assumptions of the guilds as an all-male terrain, especially related to the rise and early period of the guild system. Underlining its emphasis on household production especially in the early phase meant that women could play crucial roles as wives, daughters and widows as participants in the family business (Crowston 2008, pp. 20–22). Although guilds prevented women from getting status as craftspeople, it still happened but often without a juridical and fiscal identity. It has therefore been warned against a too simplistic reading of craft rules, also because guilds were not one single hierarchical structure. They could also entail a complex collaboration between craftsmen and women which has not been sufficiently acknowledged (Rosser 1997, p. 14). Taking into account the long-established competence and know-how within textile production transmitted over generations predominantly within the female sphere, where gender identities in the archaeological record most prominently are expressed through burial rites[8] and in various early medieval written accounts conveyed both explicitly and symbolically (e.g. Herlihy 1990, Jesch 1991, Þorláksson 1991, Walton Rogers 1997, pp. 1821–1822, Henry 2005, pp. 51–54), the issue of gender should be looked into more closely.

In many regions, guilds were established rather late in the High Middle Ages, but some are also relatively early. In England, guilds for weavers were already established during the twelfth century, such as in York, Lincoln, Winchester, Oxford, Huntingdon and Nottingham (Oldman 2012, p. 252 with references). In 1165, the weavers' guild in York was second only to the London weavers for the fees paid to the crown (Evans 2006, p. 71, Hall 2006, p. 95). The earliest specific mention of weavers themselves comes from Beverly and York in 1163 and 1164. Here, the notion weaver needs not even be an exclusive male indicator. In Norwich, a certain Elizabeth Baret was enrolled as a *freeman* of the city in 1445/6 because she was a worsted weaver, and in 1511, a riot occurred when the weavers here complained that women were taking over their work (Ayers 2006, p. 32). That women even in the Late Middle Ages could play an important role within guilds of weavers as family members and employed staff is documented in guild and borough ordinances both directly and indirectly through rights and restrictions. An ordinance from Shrewsbury, 1448, for example, indirectly tells that women could occupy the craft of weavers within guilds by proclaiming that on the death of their husbands, wives from then on should be ruled and governed by wardens and stewards of the guilds. Another ordinance from Bristol 13 years later forbade master weavers to engage wives, daughters and maids who wove on their own looms as weavers but made an exception for wives already active before this act. This restriction was explained by male unemployment at the time (Goldberg 1995, pp. 204–205, citing the documents). Indirectly these restrictions demonstrate that female weavers within guilds were far from uncommon.

In Germany, guilds of weavers seem to appear later than in England. In Göttingen, for example, a guild for wool weavers was established in the first half of the fourteenth century (Arndt 2006, pp. 187–189). This is about the same time as a guild for weavers of linen was established in Braunschweig – again underlining the differences in textile production. In Bremen, several professional male weavers are recorded in the early fourteenth century, but evidently alongside female weavers, who are documented even later, in 1440 (Rech 2004, pp. 290–291).

In Scandinavia, guilds for weavers are only known from medieval Danish areas with the highest urbanisation. They appear, however, rather late. In 1432–36, a female weaver, *Mette Weuersk*, is referred to as a member of the Gertrud's guild in Flensburg, presently Germany. The first reference of a male weaver comes 50 years later, from 1483, referred to as a member of a guild in Roskilde. From the 1500s onwards, weavers appear in sources from Copenhagen, Odense and Malmö (Søgaard, 1975, p. 680 with references). The guild of weavers that was established in Copenhagen in 1500 also accepted female weavers as independent members and the rules were recorded in the guild's statutes. Similar rules also appear in the statutes of the Malmö guild later in the century (Jacobsen 1995, p. 230 with references).

The oldest documentation of a male weaver (OS *vävare*) in medieval Sweden, mentioning a *Hans weffar* in Stockholm, is from 1517. From Finland, a special term for a male weaver, denoted in German as *Wandmacher* or pl. *Wandtmakari*, also appears rather late, and where some Finnish and other German weavers worked at Åbo castle (Turku) employed by the King. Here, canvas was primarily woven. From the same time, female weavers are also mentioned, denoted in Swedish as *wäfwerska* (Kaukonen, 1975, p. 680 with references). At this time, weaving still seems to be regarded as an unmanly profession in Sweden, and according to the Swedish Bishop, Peder Månsson, weavers and other artisans of mainly female crafts could and should not be used as soldiers (Granlund, 1975, p. 680 with references).

In Norway, weavers in plural (ON *vefarar*, pl.) are first mentioned together with other artisans in the Urban Code of 1276, specially designed for Bergen and related to the urban taxation (levy) (*NgL* II, p. 204) but without further specification. This is about the same time as the archaeological remains of the horizontal loom from Bergen are dated. The first mention of a named weaver in Norway turns up in the 1570s, also in Bergen, and according to the name, evidently an immigrant male craftsperson (Hoffmann, 1975b, p. 679).

In Iceland without any towns in the Middle Ages, a large-scale textile production of *vadmál* also for export was based solely on the use of the upright warp-weighted loom, but still on a professional, specialised basis. Here it was organised within a rural household structure and carried out by female weavers of subordinate status, denoted as a *vefkonur*, pl. (Þorláksson 1991). The scanty documentary evidence of weaving and weavers from the Nordic countries, then, indicates that weaving had still not become an exclusive male sphere in urban contexts by the end of the Middle Ages.

The iconographical evidence of weaving scenes further substantiates the same trend, although it is rather scanty and dates mainly to the Late Middle Ages. In spite of often alluding to biblical or mythological persons, such as Eve, Mary, Penelope and Arachne, they also seem indirectly to reflect contemporary well-known work and gender domains. The earliest illustration of a broadloom from the Ordinance book of Ypres, the so-called *Keurboek*, from 1366 (cf. Figure 3) shows two weavers at the loom, a man and woman, and another woman warping. Together with a child at the spinning wheel, it may also signify a workshop within a household setting. Altogether, medieval illustrations from both England and the Continent, mostly dated to the Late Middle Ages, show both men and women at the loom. The many depictions of weaving scenes that appear in European manuscripts, on glass windows and in other contexts from the middle of the thirteenth century onwards in England, France, the Netherlands, Belgium and Germany clearly display that not only men but also women participated in the weaving on the horizontal loom (Figure 9). They also represent different types of looms – broad and narrow – and show that the horizontal treadle loom could be more or less advanced and that female weavers could operate the loom and not only male weavers. Such illustrations are relatively common in the High and Late Middle Ages but scarcer from the sixteenth century onwards.

Figure 9. Woman at a two-treadle loom *c.* 1360 (Egerton Genesis Picture Book, British Library, Egerton 1894, fol. 2v, with permission).

In the Middle Ages, extensive production was connected to the households, both rural and urban, in different ways. Regardless of status, women generally were legally and economically subjected to the head of the household, normally a man. This also explains why the written sources are usually quite tacit about the women in economic and juridical matters.

This was also the case for workshops connected to guilds, where women could also participate and have a role as craftspeople (Kowaleski and Bennett 1989, p. 479; Epstein 2008, p. 162). However, reassessments of women's role in the guilds have shown that even here women could play an important role by working with master weavers as wives and children. Although their training was informal, they benefitted from a long-acquired competence and know-how transmitted as tacit and embodied knowledge (Epstein 2008, p. 162). In the household-based guilds, they could play crucial roles as wives and daughters of the master and even be regarded as partners, and there were opportunities available for women to be employed as paid workers (Kowaleski and Bennett 1989, pp. 477–480). Women also then appear as producers within guilds and the masters largely as organisers and entrepreneurs within the urban textile trade (Soly 2008). Widows could also inherit privileges (Crowston 2008, p. 19). Even as late as in the Early Modern period, widows could have inheritance rights to workshops and do guild work under the guild licences of their fathers and masters. They could also hire non-guild female labourers (Ogilvie 2004, pp. 339–341). Pure female-dominated guilds also existed in major textile-producing towns, such as in Paris, Rouen, London, Cologne and others. These were rather rare and also specialised in skills of luxury-oriented production, mostly related to silk (Kowaleski and Bennett 1989, p. 475). It is, then, noteworthy, that the most specialised and demanding branch was organised as female guilds.

Women also seem to have been able to carry out their crafts more independently outside guilds and also transgressing the household sphere more independently when they appear in the sources more or less accidentally in matters needing records caused by disputes. Such was the case when in 1278 a Felicity is denoted as weaver at Halesowen manor in Lincolnshire, and again in 1388 when Cecily de Malberthorp is referred to as linen weaver working on commission appears at court. Others act on the public scene when breaking agreements and norms. This was, for instance, the case in 1361 when Beatrix de Bedford, also a weaver in Lincolnshire, was recorded for not being willing to serve her neighbours, and when the two weavers, Matillas Swan and Alice de Skerne, were charged for taking too high prices for their weaves (Goldberg 1995, pp. 172, 177, 178 with citations). These women, however, seem to have operated on a smaller scale. The sources reveal though that 'weaver' did not necessarily stand for a man.

Concluding remarks

Altogether, the long-established dichotomy between male professional craftsmen and weavers and women as homework producers of textiles should be modified, not only as for the first phases of the introduction of the horizontal loom and prior to the establishment of guilds but also later. Here, various source categories – documentary, iconographic and archaeological evidence – substantiate that the conception of the medieval weaver as a male craftsman should be adjusted.

The change from a domestic household-based production to a more commercially based industry took place at different times and scales in various areas of Europe and did not only involve men. The presence and coexistence of the vertical and horizontal looms for many generations in many cases indicate a longer transitional phase where women played an important role in textile production not only in rural households by weaving on the warp-weighted loom but also in towns on the horizontal loom. The faster horizontal broadloom, able to produce broader and longer textiles, must clearly have ousted the vertical loom in the larger textile-producing centres, making textile production and weaving into a major urban industry. Reorganisation of manufacture and marketing within guilds were central elements in the medieval economy, where new and more advanced tools such as the horizontal loom played a central role. As Bray (2007) has pointed out, new technologies may promote processes of boundary work and renegotiations of which is considered masculine and feminine. This also seems to be the case with the establishment of urban crafts such as weaving. Still, the production

continued to rely on a large female workforce throughout the Middle Ages – based on a long-achieved embodied technological expertise, know-how and constituted an important economic impact – a contribution that has largely been neglected and disregarded in the shadow of formal male apprenticeship within male-dominated guilds.

Notes

1. I am indebted to Professor Einar Thomassen, specialist on ancient religions, for this contextualisation.
2. The textile researcher G. Crawfoot thought, for example, that the Talmud here refers to the Middle East (Hoffmann 1964, p. 260).
3. For more information and discussion about its origins, see Broudy (1979).
4. Heddle horses have also been denoted as heddle cradles (Walton Rogers 1997) but basically have the same function as balances for strings connecting pulleys, heddle bars and treadles when making a shed. Some have only notches to fasten the string, others holes.
5. The original manuscript was lost in 1914 during the World War I, but photos had been taken earlier and reproduced in paper, being published in 1904 as illustrations in an article. An accurate reproduction the original *Keurboek* of the same scene was made in 1861 as a diploma showing the original colours (photos and information: Kenniscentrum, Musea Ieper and Stad Ieper, Stadsarchief). In many publications, this weaving scene has been redrawn without the same precision as in the original and seems to present the weavers as males.
6. Edwine Psalter, Trinity College, Cambridge MS R 17.1.
7. Cf. Mårtensson *et al.* (2009) underlining the importance of loomweights as sources to textile production.
8. Textile tools, including loomweights and weaving beaters, are common finds in prehistoric female burials expressing an almost hegemonic femininity. In Norway, textile tools may also occur in male burials from the Viking period in small numbers (Petersen 1951, pp. 293, 296) but find conditions and contexts are often uncertain due to early and imprecise recorded finds, and not being excavated professionally. A possible connection with production of sails has been suggested (Rabben 2002). This is an issue the present author looks closer into in a wider project related to tools and textile production in West Norse environments.

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