Adding Twist

The Progression of Direct Drive Spinning Wheels in the Middle Ages

 [1]

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[1] *Sleeping Beauty*, by Alexander Zick (1845–1907)

Thank you to Vastie for the research help. This document and I would be lost without you.

Thank you to the Fiber Equipment: Great Wheels, Winders, Walking Wheels, and Spindle Wheels Facebook Group for encouraging me to get my first Great Wheel. Special thanks to Val Gaddis and Pat Bringham for the work you do.

Thank you to my Editors.

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Preface

It started with a curse, a cautionary tale. The princess would prick her finger on the spindle of a spinning wheel. She would fall into a deep slumber only to be awakened by the kiss of a prince—or, in some versions of the story, the pain of her inbred infant nursing at her finger (Basile). The moral of the story is lost on me. Was it to not piss off the fairies? Was it that spinning wheels should be gotten rid of altogether because spindles are so damn sharp? Was the moral that all art is phallic, or was the story about the dangers of womanhood communicated through the tools of gendered work? It's amazing to me that the art of spinning survived in light of this tale. Who would want to risk suffering the princess's fate? Maybe the king was on to something when he burned every spinning wheel in the lands on a pyre (Disney). Or maybe it was just another way to inform the women using these tools what their value really was (Bottigheimer, p.142).

There is something special about direct drive wheels. They survived opposition in Europe during the early Middle Ages and evolved from structures similar to charkha spinning wheels into what we know today as great wheels.

This document is split into two parts. In part one, I focus on the history of direct drive spinning wheels in the Middle Ages in order to shed light on how the direct drive endured as a spinning tool. In part two, I document my experiences with a great wheel, the challenges I faced learning how to spin, and the rewards this method of spinning has given me.

Part One

History of the Direct Drive Spinning Wheel in the Middle Ages

The origins of the first spinning wheel are debatable. Iain Morley and Colin Renfrew, theorized that the Indus Valley Civilization, which occupied a region of south Asia more than 4000 years ago, had the technology of the spinning wheel. Their theory that a spinning wheel was used during this time was based on the existence of "finer and more uniform threads, which were being woven into plain textiles". Morley and Renfrew used works from Archeologist J.M Kenover, who wrote about clay impressions of fabric that were made in Harappa during the Ravi Phase, 3500-2500 BCE, to justify their theory of spinning wheels existing during this time (Morley) (Kenover).

I would have left this statement where I found it, moved on with my project, and would have been perfectly happy to do so, but the more I thought about Morley and Renfrews take on wheels being used to produce a somehow more uniform thread (compared to drop spindles) equating to wheels being used for the purposes of turning fiber into cordage must exist at this time, the more it troubled me. So I went back on my false start and combed over the Jonathan Mark Kenoyers, 2004 writings entitled Ancient Textiles of the Indus Valley Region that were sourced for Morley and Renfrews writings. Nowhere in the document does it mention the use of a spinning wheel to produce thread, only spindle whorls (used on drops spindles) were discussed (Kenover).

Other than Morley and Renfrews improperly sourced statements, I find the hypothesis, by itself, implausible, given that drop spindle spinning can produce fine and even yarn (Farnquemont). Given the many terracotta spindle whorls both Kenover, Morley and Renfrew, and other sources, we speak about later in the text, reflect that drop spindles or equivalent hand spindles were used heavily up until the renaissance time periods to make cordage for textiles and that Bette Hochberg, in her book *Handspindles,* theorizes that the rotation of hand spindles

and drop spindles may have influenced early civilizations to experiment with spinning on larger wheels (Hochberg), but doesn't go as far to define its existence in an early time period leaves me with the feeling that It is questionable to claim the use of a spinning wheel as early as 3500 BCE, solely because fine threads exist.

I do not see this as just an error, or misinformed quoting, but rather an assumption that many, including myself, sometimes hold. That from prehistory to present day there is this slow and steady march toward more productive means of manufacturing, with very little backtrack or deviation from the path forward. It is logical in some ways to assume that inorder to achieve a better product, in this case a finer thread, a more advanced / current technology, in this case a direct drive spinning wheel, would be needed. But, for the direct drive spinning wheel this was, and was not the case. As this document will explore, the direct drive spinning wheels employment depended on the methods of spinning, region of use and materials used with this type of tool, with the early Islamic world (modern day Iraq and Iran), India, and China being credited with the invention of the spinning wheel.

The standing for this being that images exist of spinning wheels being used. For instance, in the image created by Yahya ibn Mahmud al-Wasiti in 1237 CE clearly shows an early direct drive wheel similar to a charkha spinning wheel[2]. An image by Wang Juzheng, dated circa 1270 CE, appears to show a spinning wheel that is directly driven[3]. In both images the wheels are without

[2] Image of a woman using a spinning wheel in: Al-Hariri, Al-Maqamat (les Séances). by Yahya ibn Mahmud al-Wasiti, Baghdad, (c.1237)

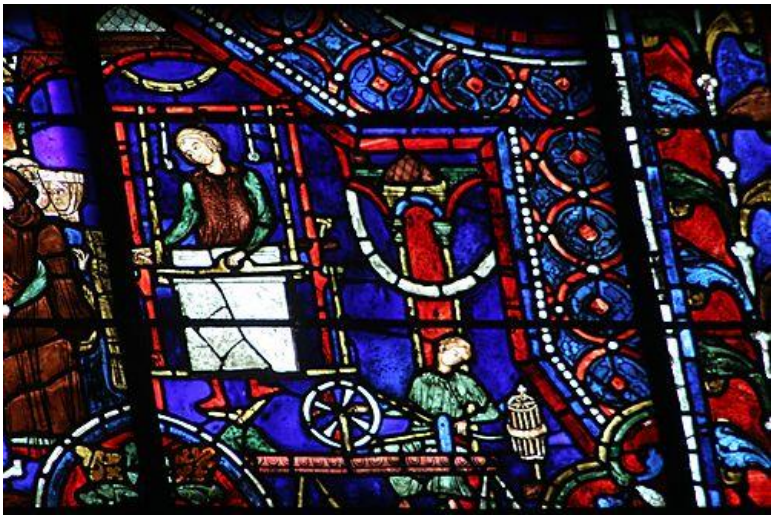
[3] Detail of The Spinning Wheel, by Wang Juzheng, Northern Song Dynasty (c. 1270)

wooden rims. The charkha wheel supports its drive band with a string that is criss-crossed over the spokes, while the wheel from china supports its drive band by its spokes. There is evidence of these types of wheels in Slavic countries, Greece, Italy, and Switzerland (Baines). There is also reference to spinning wheels in a 12th-century Indian poem written by Kadire Remmavve (Ramaswamy, p.210). Remmavve's poem, originally written in the Kannada language, talks about specific parts of a spinning wheel that do not correlate with drop spindles.

Fast turning Spinning Wheel
Listen to the caste and lineage (kula Jati)
Of the spinning wheel I turn.
The plank below is brahma
The torana is Vishnue
The wooden idol (bobbin winder) Aaha Rudra.
The two threads the pass through constitute intellect.
Awareness is the spindle.
You turn the wheel by the handle called devotion
The threads turn and the bobbin is lifter
I cannot turn the spinning wheel
Because my husband has beaten me
What can be done, Lord Gummisvara (fearful aspect of Siva)

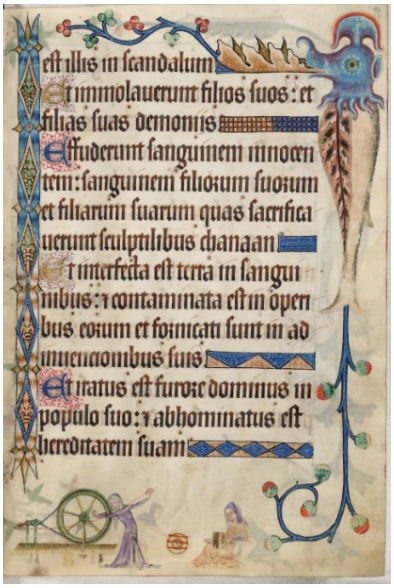
The spinning wheel appeared in Europe in the 13th century. In *Medieval Technology and Social Change*, author Lynn White notes that the wheel was mentioned in regulation documentation in Speyer, Germany, around 1280 CE. Specifically, the regulation only allowed wheel-spun yarn to be used in the weft of weaving and not the warp. White also notes that in 1288 CE, the use of wheel spun fiber was prohibited in all weaving in Abbeville, France (White,

p.119). For the majority of the Middle Ages, the drop spindle was the popular tool of choice for spinning fiber. In Lady Siobhan nic Dhuinnshleibhe's research, she states that "they...(machine spun yarn)... cannot rival handspun yarns in delicacy and versatility... In handspinning, you can design the exact kind of yarn you desire with any variations in texture or color or thickness that you wish – your only limitation is your own skill level in spinning." This gives an explanation for why even later in the middle ages, drop spindles remained popular (Dhuinnshleibhe). For example, we can see a nude Eve spinning with a distaff and spindle in *The Good Samaritan/ Creation Window Panel 21: Adam and Eve labor*[4]. The window, which is located in Chartres Cathedral of Notre Dame, is dated 1205-15 CE,. In the same chapel we see *The Savinian, Potentian and Modesta Window* [5] dated 1215-25 CE. This window features a weaver working to the left and a spinner on a direct drive wheel to the lower right. The worker is seated while working at a charkha-style wheel.



[4] Adam and Eve labor. (c. 1205-15) France, Chartres: Cathedral of Notre-Dame, The Good Samaritan/ Creation Window Panel 21: Adam and Eve labor. Genesis 3:16-7.
[5] Donors- Weavers, (c.1215-25) France, Chartres: Cathedral of Notre-Dame, Savinian, Potentian and Modesta Window Delaporte no. 43, Deremble-Manhes no. 17 Panel 01: Donors- Weavers.

Spinning wheels underwent some physical changes from their predecessors. Some wheels were table-supported or had taller legs with smaller drive wheels. This image from *An amorous encounter,* [6] located in the Smithfield Decretals and dated between 1275-1325 CE, shows a spinner being interrupted by a man (Fulford, p.1). The wheel shown has a larger drive wheel and base, with taller legs than a charkha style wheel. It is operated with the spinner standing, unlike charkha spinning where the spinner is seated near the floor. Later images shown in the *Luttrel Psalter,* [7] dated between 1325-1340 CE, depicts a larger, self-supported wheel similar to a more modern great wheel or walking wheel. This wheel has a much larger drive wheel with shorter legs. Additionally, the spindle looks to have some sort of accelerator. What appears to

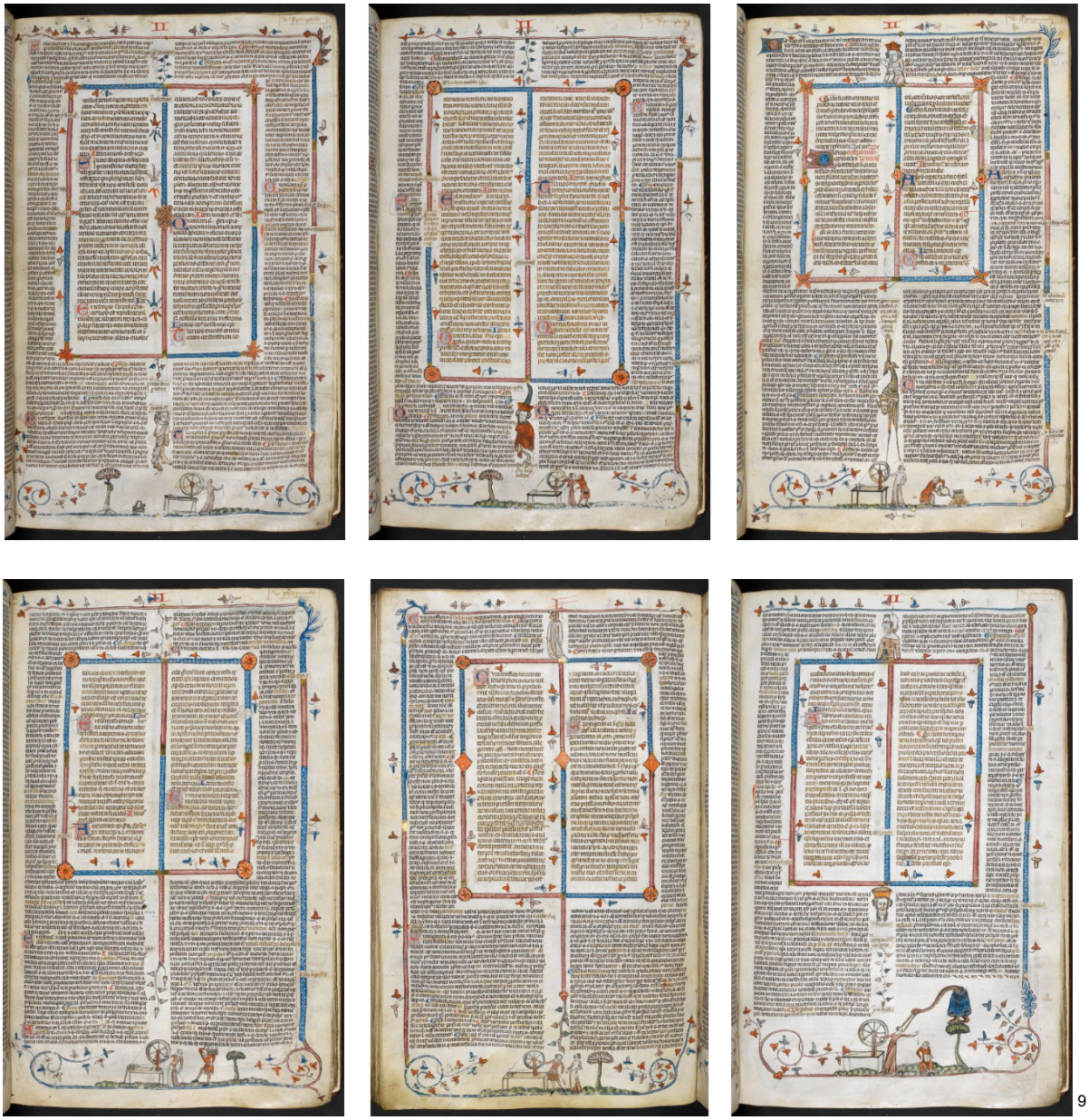


[6] *An amorous encounter*, The Smithfield Decretals, (c. 1275–1325). British Library
[7] *The Luttrell Psalter,* (c. 1325–40), Northern England, British Library

be an accelerator could instead be how the illustrator understood the wheel's construction, showing the spindle in its front and back states at the same time. The drive wheels appear to have a solid rim, most likely made of wood (Baines).

In Patricia Baines book *Spinning Wheels, Spinners and Spinning,* the author makes a few interesting points regarding wheels in the middle ages. Baines states that the first medieval wheels in France may have been first used as a winder for finished yarn, referring back to the image on the *Savinian, Potentian and Modesta Window* (Baines). However, the image *Making Snares and Feeding Dogs* created in 1410 CE for Gaston Phebus work *Livre de la chasse,* [8] depicts a distaff, implying that the wheels are used to make cordiage.

[8] Making snares and feeding dogs, *Livre de la chasse* (PML 1044, fol. 45),(c. 1410)



[9]

[9] Spinning wheels on fols. 137r, 139r, 142r, 146r, 147r, 147v, the Smithfield Decretals, The British Library, (c 1300-c 1340),

The Decretals of Gregory IX, edited by Raymund of Penyafort (or Peñafort); with the glossa ordinaria of Bernard of Parma in the margin. The text is dedicated to the University of Paris (f. 4r), but both the text and gloss were written in Southern France, probably in Toulouse, and include a characteristic southern feature of lemmata underlined in yellow. The Calendarium or table of contents at the beginning (ff. 1v-3v) was added on a separate quire in England.Decoration:The manuscript's decoration was executed in two phases. Phase 1 (Toulouse) includes 5 historiated initials in colours and gold at the beginning of rubrics to each book. Initials in red with pen-flourished decoration in purple, or in blue with pen-flourished decoration in red.

Textile Work in the Middle Ages

Early in the middle ages, textile production largely remained in townships (Duby). Men, women, and, in some cases, children were employed in the many processes of harvesting, preparing, and manufacturing textiles, with spinning seen largely as women's work [10] (Gies).

The economy of the European textile trade was pitted against workers. Families and peasants specializing in specific processes of preparing cloth were scattered across the townships and segregated. Workers had restrictions placed on them that did not allow for them to work for more than one merchant or master. Production was controlled by entrepreneurs who had ties to the government, as well as ties to other businessmen who oversaw the different steps of textile production. This made it easy for the entrepreneurs to back out of deals at any moment, sticking the workers with the materials and no options for selling. In other words, the spinners were prohibited from selling to the weavers and the weavers were prohibited from going to the dyers. Everything went through the entrepreneurs with whom the workers were contracted. Needless to say, this caused problems. In 1245 CE in Italy and in the city of Flanders, Belgium, weavers and proletarian protesters bloodied the streets. Later, in 1378 CE Florence, groups of wool washers and carders

[10] Giovanni Boccaccio / Talbot Master, De claris mulieribus in an anonymous French translation (Le livre de femmes nobles et renomées), France, N. (Rouen), c. 1440, British Library, Royal 16 G V, f. 56, Gaia Caecilia, Detail of a miniature of Gaia Caecilia or Tanaquil, with a loom, and women spinning.

known as ciompi, spinners, weavers, and winders took power, but were quickly subdued. In 1322 CE in the city of Douai, France, a conflict occurred and two working women were punished by having their tongues cut out in public and then being exiled (Gies).

The Boinebroke proceedings (1286 CE) show the divisions between worker and master. Agnes li Patiniere of Douai, a Flemish cloth maker defending her mother and herself, was one of forty-five plaintiffs filing suit against Jean Boinebroke of Douai who would force his workers into unfair contracts. Agnes describes Boinebrok's behavior as being particularly cruel. The class division between workers and entrepreneurs was illustrated by one woman's testimony in which she stated she took her wool to Lord Jean and lost money because she had no other option than to sell to him because of his contracts. Boinebroks even went as far as leveraging the church to threaten workers with censures and excommunications on grounds of being wasteful or careless. It was not until his death that workers were freed from employment under him (Gies).

Fleece, Textiles and Trade in Medieval England and its Importance to Means of Production

It is impossible to talk about spinning in medieval europe without talking about wool, and it is impossible to talk about wool in medieval europe without talking about the economic impact of wool as a profitable commodity. J.P. Bischoff in their work *"I cannot do't without counters" Fleece Weights and Sheep Breeds in late thirteenth and early fourteenth century England* quotes Shakespeare's play *The Winter's Tale* to highlight the importance of wool production in medieval estates (Bischoff)(Shakespeare).

Shepherd / Clown: Let me see: every 'leven wether tods; every tod
yields pound and odd shilling; fifteen hundred
shorn. What comes the wool to?

Autolycus *[Aside]:* If the springe hold, the cock's mine.

Shepherd / Clown: I cannot do't without counters. Let me see; what am
I to buy for our sheep-shearing feast? Three pound
of sugar, five pound of currants, rice,—what will
this sister of mine do with rice? But my father
hath made her mistress of the feast, and she lays it
on. She hath made me four and twenty nose-gays for
the shearers, three-man-song-men all, and very good
ones; but they are most of them means and bases; but
one puritan amongst them, and he sings psalms to
horn-pipes. I must have saffron to colour the warden
pies; mace; dates?—none, that's out of my note;

nutmegs, seven; a race or two of ginger, but that I
may beg; four pound of prunes, and as many of
raisins o' the sun.

Autolycus: O that ever I was born!

J.P. Bischoff goes on to write how the recordkeeping of estate managers in 13th and 14th century England give us insight to the economics of wool. The records Bischoff sources, also reveal fleece weight and in some cases the weight differences show breed differences that equate to staple length differences (Bischoff). This rabbit hole is important to my Hypothesis, I feel that direct drive wheels lasted/evolved as a tool in medieval Europe because of its ability to spin shorter staple length fibers. However, this may have been the wheel's downfall when it was introduced to the European textile industry. In Ella Gordon's video produced for Jamieson & Smith, she explains the difference between woolen and worsted spun yarns. Woolen spun yarn is created by carding the fibers. This process will fluff the fibers while keeping the shorter and longer fibers together. The fibers are not strictly parallel to one another, which creates a sometimes bulkier/fluffier yarn. In worsted spinning, yarn is combed. The fibers lay parallel to one another and the shorter fibers are removed, or separated, through the process of combing. This will create a flater, more defined yarn capable of being very fine (Jamieson & Smith).

It is my prediction that worsted spun yarn was made on dropspindels, and the direct drive wheels, if used for spinning, may have been used for woolen style spinning. Therefore there would be cause for preference. It is possible to spin both worsted and woolen on dropspindels and direct drive wheels. However, for anyone who has ever used these tools, the drop spindle lends itself to worsted-style spinning and the larger direct drive wheels lend themselves to woolen-style spinning.

This may explain why the direct drive wheel stuck around in areas where wool was the fiber of choice, but was not as popular as other styles of spinning, such as spinning by drop

spindle. Armed with this theory and the meticulous records of trade in medieval households we take a deeper look into wool as an industry to see if evidence was kept for woolen style spun yarn that was made into textiles.

As the European middle ages advanced into the 13th century, the textile industry began to boom economically. Even though textiles were beginning to be produced more and more in urban areas, production continued in rural areas as well. This setup provided workers in rural areas continuous work in the winters, and some saw spinning and other textile work as part-time labor (Oldland).

The Great Pestilence, or Black Plague as we know it, put a kink in the cog of textiles. Aproximately 25 million people died in Europe from 1347 to 1352 CE. Amazingly, textile demand, particularly for wool, bounced back fast. According to John Oldland in his work *The Economic Impact of Cloth Making on Rural Society, 1300-1550,* from 1475 CE onward, textile production in Europe "was a catalyst for economic growth in what otherwise remained a somewhat stagnant agricultural economy" (Oldland).

There was a difference in the wool cloth produced in the early part of the middle ages compared to the later part of the middle ages. Early on, wool had a medium staple length and was cultivated locally. Cloth was made from fiber spun from a distaff and drop spindle, and the wool would have retained some of its natural oils. The wool would have mostly been "woven by one person on a narrow loom, and most of the cloth was around a foot in width, and woven in lengths of ten feet or less. The cloth did not need to be fulled, or finished" (Oldland, 230). By the later middle ages (after 1500 CE) woolen cloth that was fulled became the popular means of production. "The wool used was shorter and curlier and therefore may have had to be purchased from wool broggers. The wool was sorted, washed and then greased with oil. The warp was combed and rock-spun, the weft carded and wheel-spun" (Oldland, 230).

It was my intention to continue this research in depth for this project. Sadly real life happened and I will have to pick this subject up at a later date.

A Different Driven Wheel

Lady Siobhan nic Dhuinnshleibhe in her work "A Brief History and Evolution of Spinning" sheds light on the transition of wheels with direct drives to a flyer wheel style. She found through her research that the "silk reeling and throwing mills of 13th century Italy may have inspired the development of these wheels (flyer style wheels), as flyers were used to load spun yarn onto bobbins. The thread was twisted as it left the bobbin, rather than being twisted and then loaded onto the bobbin as seen in modern flyer wheels. The first published discussion of these machines doesn't appear until 1607 CE, yet there is documentation that the technology for these reeling machines was brought" (Dhuinnshleibhe). This wheel style is shown in the images *La femme au rouet* (The lady at the spinning wheel) by Lucas van Leyden, 1494-1533 CE (top)[11] and *Portrait of a Lady spinning,* 1531 CE (bottom).[12] In both images, women are spinning with flyer wheels on which the drive wheel is turned by hand instead of by a treadle or foot pedal. Past the 1500s, flyer wheels gained in popularity, but the direct drive wheel remained.

[11] La femme au rouet (The lady at the spinning wheel) by Lucas van Leyden, Paris, 1494,1533
[12] Portrait of a Lady spinning ca. 1531, Oil on panel, Museo Nacional Thyssen-Bornemisza, Madrid

Part Two

My Experiences Spinning on a Great Wheel

I had been eyeing a wheel in an architecture salvage shop off of Saint Francis and Douglas in Wichita, Kansas for months[13]. It was overpriced but complete, so I did the only logical thing: I bought it. At that time, I was not thinking much about the history of spinning. Instead, I knew from my experiences working with a Navajo spindle, and one crazy summer growing cotton in my parents' backyard, that I might enjoy working with the great wheel for its method of working with fiber. It was not until later that I reached back into history to see how the great wheel evolved in America. The size and aesthetics of the great wheel compared to a charkha wheel are vastly different, but both wheels are accomplished at spinning short staple lengths of fiber, like cotton. Little did I know about how finicky this type of wheel could be when it came to the fibers and techniques used to spin, or how much fun I would have with this handsome tool.

[13] Original Image, Grate wheel in the antequestore I purchased it from

Getting the Wheel Ready

When I purchased the wheel, I looked for maker's marks but found none. It wasn't until I began to oil the wheel that I noticed it may be a Frankenstein wheel. The maidens, spindle, and mother-of-all looked to be from a different style wheel. The wheel post looked damaged or cut from a different wood type than the base. The base, legs, and tension post looked like they belonged together. The wheel post was missing a dowel to brace it, and the mother-of-all was damaged, carved roughly in one spot to fit one of the maidens deeper into its seat. The drive wheel looked like it belonged to the base, however the axle appeared to have been modified [14] [15] [16]. Valerie Gaddis and the Facebook group *Fiber Equipment: Great Wheels, Winders, Walking Wheels, and Spindle Wheels,* informed me that some wheels don't have a pin or threads to hold the drive wheel in place. Gaddis and this group helped me in the first steps of making the decision to purchase this wheel. Without them, I would not have started this journey.

Youtube and Facebook were my salvation when it came to the first steps of bringing this wheel back to life from the dust and its stationary existence. I cleaned the wheel using minimal soap and water to get off the years of grime. In order to avoid water soaking into the wood, I used just enough moisture to pick up the dust and dirt on the wheel's surface. Once the wheel

[14] Original image, Cleaning Parts of the Wheel
[15] Original image, Cleaning Parts of the Wheel
[16] Original image, Cleaning Parts of the Wheel

was dry, I used lemon oil on the wood. It was extremely dry, and it took almost half a bottle before the wood stopped absorbing the oil the instant it touched its surface. Next, I put an orange oil and beeswax-based sealer on the wood, let it sit, then wiped off any excess (Farmhouse). I didn't apply sealer to the wheel post because of its texture. I then oiled and scrubbed the surface of the axle with 3-in-1 oil and steel wool. I then lubricated the axle and the leathers with Crisco and placed a pin and brass washer on the axle to prevent the drive wheel from falling off, even though it spun in one spot without moving (Gaddis). Eventually the brass washer should be replaced with leather to prevent friction that could damage other parts of the wheel. I waxed a cotton string with beeswax to create a drive band. To my surprise, the drive wheel was balanced (without any wobble) when it turned. After a bit of fiddling with the tension post, it spun surprisingly well. Regardless of its appearance it worked brilliantly.

The whole process of cleaning took about two hours. Once done, the surface of the wheel was completely different[17]. The wood had taken on a rich, dark color, looking more like a piece of modern furniture than an old dusty antique. The cleaning alone had given me great joy and was every bit worth my money simply because of how handsome the wheel turned out.

[17] Original image, Clean and Complete Great Wheel

Preparing and Cleaning the Wool

After putting a drive band on the wheel and trying out some beautiful Cheviot roving, I realized that spinning on the great wheel was going to be a little bit harder than I thought. Having no beginner's luck with drafting from the fold or worsted spinning, I backtracked and looked for other methods (Frazzlehead). Lois Swales stated that the staple length of fiber and the way in which the fiber is combed can affect how the wheel spends yarn. She recommended a shorter staple length fiber (3 inches in length rather than the 6 inches I had with the Cheviot) that was combed using wool carders (Swales). Back to the Internet I went and quickly bought a set of wool carders and some Jacob fleece that was in the appropriate staple length. By the next weekend I had my carders and wool.

The wool I received was wonderful. I received almost 4 pounds of wool, but I did not realize it was raw fleece until it was on my doorstep. It was in good condition: it smelled like sheep, not like mildew, and there were no breaks in the fiber, with very minimal second cuts and very few pieces that needed to be skirted. Some of the pieces were a bit longer in staple length than I needed, and a small portion of the wool had coarse outer coat hairs. The process of skirting and sorting the fleece took a bit longer than expected because of this.

After sorting the fleece by staple length, I placed a portion of the wool in a lingerie bag and began the process of washing. I had done this before with my Mistress, her Excellency Genevieve de Chambery, on a fleece from a sheep that was raised for meat. The meat fleece took forever to clean; I was relieved when I received the Jacob fleece in good condition and knew it would take much less effort to get clean. My parents' house had extremely hot tap water, so I used that for the cleaning process. Some sources we're very picky about the temperature at which wool is cleaned. For me, the hot tap water was enough, because I couldn't hold my hand under the water for very long at its hottest temperature.

I filled a plastic tub with hot tap water and Myers dish soap and began to wash the fleece. I gently placed the Jacob sheep wool in a lingerie bag in the water without josling or stirring the

wool. Again, there are at least 1,000 different sources with information on how to wash wool, and each of them is different. Some artists insist on moving the wool as little as possible in order to avoid felting, but I have found that an up-and-down motion will not disturb most wool as much as stirring the wool will. It is important when washing wool to do your own research and maybe even a test batch on your specific wool. In addition, I wasn't afraid of using dish soap to clean my wool. There are products available specifically for cleaning wool, but the dish soap did fine for me. There is one caveat to this: when dyeing wool, be very picky about what soap is used, because some soaps can leave a residue that may impede how the dye takes to the fiber.

I soaked the wool in the soapy water for about 20 minutes and then poured off the first batch of wash water outside so the lanolin and dirt did not get into the pipes. After that I filled the plastic tub back up with just hot water and put the wool back into the tub to soak. I made sure not to transfer the wool from cold to hot or hot to cold water, as I was afraid it would surely felt. Also, I did not add water to the tub with the wool in it and instead let the tub fill up before I placed the wool back into the water to avoid agitation. The wool took three rinses for the water to run clear.

I was happy that my parents had a brand-new washing machine that was able to be placed on a spin cycle only. I placed the lingerie bag filled with wet wool into the washing machine and let it run on spin only for about 8 minutes. This removed some of the water and allowed the fleece to dry faster after the spin cycle was done. I took the wool out of its lingerie bag and spread it out gently on a window screen to dry. A day after its wash, the wool was ready to be carded. I may have scratched up my hands a few times not respecting the sharpness of the

carders [18] [19]. The teeth of the carders were set at 75 teeth which is suitable for most wools (woolery).

Again, I went to YouTube and watched Lois Swales's video "Carding Wool Like a Ghost," on repeat until I was able to produce a rolag similar to hers. I was not completely successful the first time I carded my wool[20]. I took small portions of the cleaned wool and placed it on one carder, then holding the carders opposite of one another I began to card the wool by lightly brushing the teeth of the carders over the wool. Then to transfer the wool from one carder to another, I held the carders in the same direction as one another and lightly skimmed one carder over the other's teeth to remove one side of the wool from the carder. Then, I started the process over again. It took some practice, and I am still not good at this, but over time I learned that the amount of wool placed on the carders affects how hard it is to run the carders through the fiber. Less is more. Once the fiber is even and fluffy, it may be removed from the carders by skimming the fiber off when the carders are facing the same direction as one another. Once both sides of the fiber was free from the carders, I gently rolled the soft, cloud-like wool into a rolag. Some spinners use their cards to do this. I just use my hands for more control. (Swales)

[18] Original image, Combing Wool
[19] Original image, Combing Wool
[20] Original Image, carded wool rolags

Spinning the Fiber

Once I cleaned and carded enough fiber, I began to spin. I taped a piece of wax paper to the spindle to make it easier to remove the yarn cop (Rehash Fiber). I used a scrap of wool yarn as a leader, and I had to play with the tension and the placement of the drive band. I noticed that my spindle knocked around a little bit. This is due to the worn-out leathers that are holding the spindle in place. Gaddis mentions in her videos that this is not good. I will either have to replace the worn-out leathers with new ones or with corn husks, as most American great wheels would have used (Gaddis).

The processing of the fiber greatly affected how easy (or difficult) it was to spin with. I was able to draw my fiber out long and produce an even yarn. Much like practicing with the wool carders, I found that I needed practice walking with the wheel. I am tempted to bend over to get closer to the spindle instead of walking back and forth like the tool was intended to be used.

Judging the amount of twist that needed to be in the yarn was a whole different story. I'd watched many YouTube videos of people spinning on their great wheels and noticed a large discrepancy and how much twist different spinners put into their fiber. This could be due to the type and thickness of yarn being produced, if the yarn will be plied later, what fiber the spinner is working with, and the ratios of different wheel types. A lot of what I did in the beginning was trial and error in regard to the amount of twist that I felt I needed to allow for.

I tried plying the fiber in stages using a cardboard box with knitting needles strung through it to secure my cops in place. At first I plied a 3-ply yarn[21] spinning the wheel in the

[21] Original image, 3-ply yarn hank

opposite direction (Rehash Fiber). When I ran out of one of the cops, I continued to make a 2-ply yarn, and when another ran out I saved the single. I was not worried about the integrity of the finished yarn because this was my test to see if I could do it. I then knitted in the stockinette style as an example for show. The yarn I produced with my very first attempt with a great wheel has mistakes and uneven spots with over and under twisting, but given how much it took to get to the point of producing something that resembles yarn, I am extremely proud of myself. I am also appreciative of the research I have found and the knowledge obtained.

Making the Medieval Test Wheel

"I could see this turning into a champion's entry at some point, where I would construct a wheel closer in style to what is seen in the middle age manuscripts." This was going to be my conclusion, but I had some time, so I had to make it. Again, I went back to the spinning wheels in the Smithfield Decretals, The British Library, (1300-1340 CE), for inspiration[22]. The images shown are the clearest I have seen that depict the parts of the direct drive wheel in action. In the image of a woman spinning with a person seated carding fiber, I could clearly see the

construction of the wheel. It is basic with a short, table-like base that is elevated to about the spinster's knees. The legs are a count of four, unlike in the American-style great wheels with three legs. The drive wheel itself has a large band of what appears to be bent wood. Some American-style great wheels have a very wide band around the drive wheel. The drive wheel is supported by two arms that hold the axle on both sides. In another image from the same document shown earlier in this research, there is a clear view of the spindle that is supported by two maidens attached directly to the base/table. The top of the wheel reaches over the spinster's

[22] Spinning wheels on fols. 147r, the Smithfield Decretals, The British Library, (c 1300-c 1340)

head, and the support for the axel stopps at her chest (even though ergonomically the axle on the drive wheel should be at the spinner's elbow). This gave me construction ideas and proportions to keep in mind.

I had purchased another American-style wheel that has seen better days. Somewhere in its life, a new base had been constructed and the parts were fitted to one another so that it would not come apart. I decided for sake of time and convenience that I would use the most complicated parts of the American wheel (the drive wheel, maidens, and spindle) combined with a newly constructed base. The goals for this construction were many. The wheel needed to look like it was from the Middle Ages, the parts original to the American wheel could not be altered to keep their integrity, the wheel needed to be transportable, and it should function as a large direct drive wheel should.

I have access to a full woodshop at my place of employment[23] so I had minimal need for tools. Given the price of lumber, I went with premium pine. For the construction I used a 1' x 12" x 8' board to construct the base. The board was cut in half and sandwiched together to create the 2' x 12" x 4' base. It is a bit on the light side. I would like to have more weight in the base next time. I then plotted out the holes for the legs on the bottom panel and the slots for the upright arms supporting the drive wheel.

I made the legs from a 1 ¼" pine closet hanger rod cut into 16" pieces. The drive wheel supports were made out of a 1" x 3" x 6" board I cut into 27" lengths and adjusted after dry fitting. I cut 1 ½" x ½" notches out of the tops of the supports to accommodate a ½" steel rod to

[23] Original Image, Wood shop and wood

act as the axle for the wheel[24]. On the inside cavity of the drive wheel I placed a neoprene spacer to balance out the wheel with the axle adjacent to the original horn spacer. I glued caps to the sides of the support arms so that the axle would not slip and could only be removed from the top. I rounded the portions out to make it look more like the original image. Something about the images in the manuscript leads me to believe that the drive wheels or supports may have been fixed to the axles because of the circular holes that appear at that junction. After testing that the wheel spun straight and the appendages fit the cuts, I glued and clamped everything together overnight.

The next day, I sanded the base. I cut the steel rod was cut and polished it to size (about 5 ½" long). Then, I waxed the base for a light protective seal[25]. This left the task of placing the holes for the maidens in the appropriate spot. I left this for last because the placement of the maidens and spindle depended on the placement of the drive wheel. Using a string (on the drive band) and a square, I plotted where the rough center of the spindle should sit. Then using the original mother-of-all, I measured how far apart the maidens should be and drilled the appropriate-sized holes. I did not glue the maidens in place, so I could remove them. Because of this, the holes were a tight fit. I considered putting multiple sets of holes in the base so the maidens could be moved for tensioning purposes, but decided against it.

[24] Original Image, wheel test fit
[25] Original Image, wheel base ready for wax coat

Spinning on this wheel was different from the American-style wheel.[26] When I used the same fleece as before, this wheel made thicker yarn. This could have been due to multiple things, such as user error, differences in wheel ratio, or the staple lengths of the fleece I was working with (I am beginning to regret not oiling the fleece after washing). It could have been how I spun the fiber (woolen vs. worsted), it could have been the drive band tension. All of this can be troubleshot. Regardless, it spun, and I look forward to working on the next set of plans for another wheel soon.

[26] Original Image, wheel being used at a weekend event

In Conclusion and in the Future

I feel that direct drive wheels lasted as a tool because of their ability to spin shorter staple length fibers. However, this may have been the wheel's downfall when it was introduced to the European textile industry. I found little evidence on the preparation of fiber during the Middle Ages but given the resistance to wheel spinning when it was first introduced, it is my prediction that worsted spun yarn was made on dropspindels, and the direct drive wheels, if used for spinning, may have been used for woolen style spinning. Therefore, there would be cause for preference. It is possible to spin both worsted and woolen on dropspindels and direct drive wheels. However, for anyone who has ever used these tools, the drop spindle lends itself to worsted-style spinning, and the larger direct drive wheels lend themselves to woolen-style spinning. This may explain why the direct drive wheel stuck around but was not as popular as other styles of spinning.

I am very much in love with my great wheel. In the future I hope to build a wheel like this from the ground up, exploring woodworking techniques from the time in which it would have been used. I hope this document contributed to our society's understanding of wheels from the Middle Ages as it did mine.

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2. Al-Hariri, *Al-Maqamat* (les Séances). By Yahya ibn Mahmud al-Wasiti, Baghdad, (c. 1237)
3. Detail of *The Spinning Wheel*, by Wang Juzheng, Northern Song Dynasty (c. 1270)
4. Adam and Eve labor. (c. 1205-15) France, Chartres: Cathedral of Notre-Dame, The Good Samaritan/ Creation Window Panel 21: Adam and Eve labor. Genesis 3:16-7.
5. Donors- Weavers. (c.1215-25) France, Chartres: Cathedral of Notre-Dame, Savinian, Potentian and Modesta Window Delaporte no. 43, Deremble-Manhes no. 17 Panel 01: Donors- Weavers.
6. *An amorous encounter*, The Smithfield Decretals, (c. 1275–1325). British Library
7. Spinning wheels on fols. 137r, 139r, 142r, 146r, 147r, 147v, the Smithfield Decretals, The British Library, (c 1300-c 1340)
8. *The Luttrell Psalter,* (c. 1325–40), Northern England, British Library
9. Making snares and feeding dogs, *Livre de la chasse* (PML 1044, fol. 45),(c. 1410)
10. Giovanni Boccaccio / Talbot Master, De claris mulieribus in an anonymous French translation (Le livre de femmes nobles et renomées), France, N. (Rouen), c. 1440, British Library, Royal 16 G V, f. 56, Gaia Caecilia, Detail of a miniature of Gaia Caecilia or Tanaquil, with a loom, and women spinning.
11. La femme au rouet (The lady at the spinning wheel) by Lucas van Leyden, Paris, (1494-1533)
12. Portrait of a Lady spinning (ca. 1531), Oil on panel, Museo Nacional Thyssen-Bornemisza, Madrid
13. Original Image, Grate wheel in the antequestore I purchased it from
14. Original image, Cleaning Parts of the Wheel

15. Original image, Cleaning Parts of the Wheel
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