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Reviewed Article:

Recreating Historic European Spindle Spinning

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Spinning is a vital step in the production of textiles, whereby fibres are drawn out (drafted) and twisted together to make thread. In the present day, several culturally unique types of spinning are recognised, such as the thigh-rolling technique of traditional Navajo spinners who use unusually large spindles in a supported style (Wolf Creek, 2009). However, the default way of spinning with a spindle, particularly to Westerners, is usually considered to be "drop spinning". Both modern recreationists and academics carrying out experimental archaeology typically either a) simply practice "drop spinning" without critically appraising their technique or b) consider the type(s) of spindle spinning practiced in Europe historically to be variant(s) of "drop spinning". Additionally, they typically consider the distaff to be a flax-specific tool and often assert that wool was spun without a distaff.

In contrast, we feel strongly that imagery showing European spindle spinning between circa 1100 and 1800 AD does not support these assertions. Additionally, we find that reproduction historical European spindles and whorls are poorly adapted for use with the "drop spinning" technique. These points led us to explore an alternative interpretation of the pictorial evidence and assess the practicality of this interpretation.

> We have surveyed historic European imagery of spindle spinners and reconstructed a technique based on these with the help of ethnographic videos.

Reconstructing the technique

Looking at imagery

Various carvings, manuscript illuminations, woodcuts, sketches, drawings and paintings from throughout Europe and throughout the 1100-1800 AD period were analysed. A few images post-1800 AD were also included if they showed contemporary European spinners rather than historical, mythological, fictional, and/or non-European spinners. Features were noted that were common to many of these images. A small selection of the images that were analysed are listed in Table 1.

Key characteristics were noted (See Figure 1):

- Both left- and right-handed spinners are pictured However, this may relate to the artist's choice of composition rather than handedness of actual spinners, e.g., the distaff is almost always shown on the side of the spinner that faces away from the viewer when the spinner is pictured in profile or diagonally.
- A distaff is used in nearly every image, including those with wool-like fibre and images of shepherdesses. Of the hundreds of images we analysed, we have found only two that show a spindle used without a distaff, and one of these is unclear.
- Distaffs are long and are either tucked into the belt/under the arm or are free-standing; hand distaffs are not seen in the specified time period (though they are seen circa 950 AD and earlier, e.g. the hand distaff from York dated to between c. 930/5 and c. 975 (Walton Rogers, 1997)).
- Bast-like and wool-like fibre are both depicted on distaffs, as well as fibre which could represent either bast fibre or wool.
- The spindle is held on the opposite side of the body to the distaff rather than directly below it.
- The thread produced runs horizontally or diagonally down from the distaff to the spindle rather than vertically.
- The spindle is predominantly either held in-hand (in the fingers) or suspended a short distance from the hand.
- Whorls are sometimes present and, when present, are 'bottom' whorls (i.e., below the cop). Of the hundreds of images we analysed, only one appears to show a spindle with a 'top' whorl.
- Cops are wound in an oval/spindle shape.

Name and/or source	Date	Origin	Description	Spinning observations					
				Spinner	Distaff	Fibre	Right hand	Left hand	Spindle
North side of Tournai font, All Saints Church, East Meon, Hampshire, UK.	c. 1130-1140.	Tournai region, Belgium (stone). Hampshire, England, UK (carving).	"When Adam delved and Eve spun."	In profile, standing.	Long, in belt. Fibre dressed in beehive shape.	Unclear.	Near base of fibre on distaff, palm up.	Lower, on other side of body, palm down.	In left hand, very large oval cop, no visible whorl.
Adam and Eve medallion, H6, North Transept, Lincoln Cathedral, UK.	Early 13th Century.	Lincoln, England, UK.	"When Adam delved and Eve spun."	Face-on, seated.	Long, under left arm. Fibre dressed in spindle shape.	White.	Lower, on other side of body, palm down.	Near base of fibre on distaff, palm up.	Below right hand, white irregularly shaped cop, no visible whorl.

The Holkham Bible Picture book (British Library, Add MS 47682), f. 6r.	c. 1327-1335.	South-east England, UK.	Cain's descendants toiling.	Face-on, seated.	Long, under right arm. Fibre dressed in conical shape.	Wavy, white, wool-like.	Near base of fibre on distaff, palm up, finger extended.	Lower, on other side of body, palm down, finger extended.	Below left hand, large oval cop, round whorl below cop.
Speculum Humanae Salvationis (Kongelige Bibliotek, GKS 80 2°), f. 6r.	First half of 15th Century.	Germany.	"When Adam delved and Eve spun."	Face-on, seated.	Long, free-standing.	Fluffy, off-white, wool-like.	Lower, on other side of body, palm down.	Near base of fibre on distaff, palm up.	Below right hand, white oval cop, no visible whorl.
Roman de la Rose (Oxford, Bodleian Library, MS Douce 195), f. 60v.	Probably second half of 15th Century.	France.	Jalous berates his wife.	Face-on, seated.	Long, under left arm. Fibre dressed in conical shape.	Straight, white.	Lower, on other side of body, palm down, fingers extended.	Near base of fibre on distaff, palm up, pulling fibre from distaff.	Below or held by fingers of right hand, oval cop, round whorl below cop.
Netherlandish Proverbs by Pieter Bruegel the Elder.	1559.	Netherlands.	The proverb "one winds on the distaff whilst the other spins".	In profile, seated.	Long, between knees. Fibre dressed in straight chunks with pointed tips.	White, bast-like.	Lower, on other side of body, palm down.	Near base of fibre on distaff, palm up, pulling fibre from distaff with index finger and thumb.	Below right hand, slim grey oval cop, round black whorl below cop.
Print by Étienne Delaune, British Museum, UK. Museum number 1834,0804.197.	1569.	France.	Pastoral scene with animals, shepherd and shepherdess.	In profile, kneeling.	Long, under let arm. Fibre dressed in conical shape.	Unclear.	Lower, on other side of body, palm down.	Near base of fibre on distaff, palm up, pulling fibre from distaff.	Below right hand, oval cop, no visible whorl.
An Old Woman Spinning by Michiel Sweerts, The	1646-1648.	Netherlands.	Portrait of an old woman spinning.	Face-on, seated.	Long, under left arm. Fibre	Wavy, off-white, bast-like.	Lower, on other side of body,	Below fibre on distaff, pulling	In right hand, probably oval cop.

Fitzwilliam Museum, Cambridge, UK.					dressed in conical shape and covered.		palm facing body.	fibre from distaff with index finger and thumb.	Bottom half of spindle not pictured.
Femme de la Vallée de Campan (Hautes Pyrénées) by Marie-Alexandre Alophe, Bibliothèque Municipale de Toulouse, Toulouse, France.	Early 19th Century.	France.	Lithograph printed plate from a series about French costumes.	In profile, standing.	Long, under left arm, hoop top. Fibre folded through hoop.	Wavy, white, wool-like.	Lower, on other side of body, palm down.	Below fibre on distaff, pulling fibre from distaff with index finger and thumb.	In fingers of right hand, large white oval cop, no visible whorl.
Photograph of Mairead Mhòir by Walter Blaikie, SCRAN, Edinburgh, Scotland, UK.	September 1898.	Eriskay, Hebrides, Scotland, UK.	Photograph from a visit to the Hebrides.	Face-on, seated.	Long, under left arm. Fibre dressed in rounded shape.	Pale, described as wool.	Lower, on other side of body, palm down, fingers extended.	Beside fibre on distaff, pulling fibre from distaff with fingers and thumb.	In or just below fingers of right hand, large white irregularly shaped cop, no visible whorl.

TABLE 1. SELECTED IMAGES SHOWING HISTORICAL EUROPEAN SPINDLE SPINNING.

Comparing with other known spinning styles

This clearly represents a different style of spinning to other recognised spinning styles, particularly “drop spinning” (See Figure 1), whose key characteristics are:

- Distaffs are absent.
- Fibre is held in the non-dominant hand or around the arm of that hand.
- The dominant hand is held close to (beside or directly below) the non-dominant hand.
- Drafting is short-draw and occurs between the hands, often at eye height.
- The spindle hangs on a thread directly below the two hands.
- The thread produced runs vertically down from hands to the spindle.
- Whorls are almost always present but may be ‘bottom’ whorls (below the cop) or ‘top’ whorls (above the cop); they are permanently fixed to the spindle stick.
- Cops are wound in a conical shape.

Other types and subtypes of spinning have been previously recognised by fibre artists, ethnographers, and archaeologists. For example, classic texts by Mary Kissel and Grace Crowfoot identify four and six main types of

spinning without a wheel, respectively (Kissel, 1918; Crowfoot, 1931). Both of these classification systems include a 'grasped' style of spinning (Kissel's Type 2, Crowfoot's Type 4) as well as a 'supported' style (Kissel's Type 3, Crowfoot's Type 5). Crowfoot also identifies an additional style of spinning 'by rotation of the spindle in the hand' (Crowfoot's Type 3). These three types of spinning are distinct from each other as well as from the 'suspended' style spinning (Kissel's Type 4, Crowfoot's Type 6), of which "drop spinning" is one sub-type. Thus, it is clear that "drop spinning" or even suspended spinning is neither the only method of spinning without a wheel nor necessarily the predominant method, at least in a global and historical context.

Based on this evidence of variety in spinning methods, it seems unreasonable to conclude that the type of spinning shown in historical European imagery is simply the consequence of manuscript illuminators and artists just not being able to draw ("drop") spinning correctly. Instead, a more reasonable conclusion is that it is an accurate representation of a culturally unique method of spinning that remained consistent within a distinct geographic area for at least 800 years.

Using ethnographic evidence

Having demonstrated that the technique shown in historical European imagery is likely a genuine cultural variant of spinning, the next step was to attempt to reconstruct it. However, it is difficult to recreate a spinning method from static images alone. Thus, ethnographic video evidence was investigated.

A number of spinners, predominantly from Central and South-Eastern Europe, have been filmed since circa 2000 AD by ethnographers, tourists, family members, and friends. These spinners, predominantly elderly women, represent the last vestiges of long-standing, continuous 'living' traditions that are unique to their ethnic community and/or geographic region within Europe. These videos have been uploaded to the internet, particularly YouTube, where we accessed and analysed them. A selection of these videos is listed in Table 2. We did not consider videos from spinners who were not part of a living European tradition, such as spinners who had been spinning for a decade or more but learnt from books, the Internet or contemporary tutors. This was because their techniques were either demonstrably from other, non-European traditions, were blended/generalised or were from unknown chains of learning.

Title	User	Date uploaded	Date filmed	Origin	Fibre	Spindle held	Source
Old lady spinning wool with a distaff in Breb Romania	Basil Brooks	2 November 2011	Unknown	Breb, Maramures, Romania	Wool	In-hand (fist)	https://www.youtube.com/watch?v=ShSIOF0o5js
Prelo u selu Selanac-Obicaji Radjevine-Dobrivoje i Dobrila Pantelic	Obicaji Radjevine Dobrivoje i Dobrila Pantelic	11 February 2012	Unknown	Selanac, Ljubovija, Serbia	Wool	Suspended (short)	https://www.youtube.com/watch?v=YYdhME5mX_I
Prelo u Donjim Brezovicama-Obicaji Radjevine-Dobrivoje i Dobrila Pantelic	Obicaji Radjevine Dobrivoje i Dobrila Pantelic	31 May 2015	Unknown	Radjevska, Serbia	Wool	Suspended (short)	https://www.youtube.com/watch?v=ehdai72et_A
Traditional way of processing wool	lanadingarac	18 December 2007	Unknown	Rural Serbia	Flax, wool	In-hand (fist) for flax; in-hand	https://www.youtube.com/watch?v=V2iY4VFDiZI

						(fingers) for wool	
Preslica	kudgradina	25 February 2012	Unknown	Croatia (?)	Flax, wool	In-hand (fingers) for flax and wool	https://www.youtube.com/watch?v=r6B48-E8TEE
preslica.avi	BrNKA Izet	25 October 2011	Unknown	Croatia (?)	Wool	In-hand (fist)	https://www.youtube.com/watch?v=WFvNPgpiW2g
034TV - Predenje vune	034TV	30 June 2015	Unknown	Brodski Drenovac, Požega-Slavonia, Croatia	Wool	In-hand (fingers)	https://www.youtube.com/watch?v=R6BlJa0k-pI
Paganski obicaji iz istocne Srbije	Sladjana Miladinovic	6 January 2016	Unknown	Golo Brdo, near Tekija, Serbia	Wool	In-hand (fingers)	https://www.youtube.com/watch?v=6pEErRJeLUc
Romanian Peasant Wool Spinning	Peasantartcraft	7 April 2017	Unknown	Iaslovăț, Suceava, Romania	Wool	In-hand (fist)	https://www.youtube.com/watch?v=CtomLZ7n3-k
Hand Spinning Hemp.wmv	revelation7v9	23 June 2012	Unknown	Cheboksary, Chuvashia, Russia	Hemp	Suspended (short)	https://www.youtube.com/watch?v=pfBqpBEkhC8
Ramona Gavaldá i Joan Fuentes, la Sénia, juny 2001	ornitorrinc999	9 September 2018	June 2001	La Sénia, Catalonia, Spain	Wool	Suspended (short)	https://www.youtube.com/watch?v=f8s1o9CAyjg
Zanat koji umire / old craft dying	Nikola Vukmarković	21 March 2013	Unknown	Montenegro (?)	Wool	Suspended (short)	https://www.youtube.com/watch?v=a57gGGjWDdM

TABLE 2. SELECTED VIDEOS SHOWING TRADITIONAL SPINDLE SPINNING IN A EUROPEAN CONTEXT.

Upon analysis of the videos of spinners operating in a continuous 'living' tradition, it was found that these spinners use a very similar method of spinning to that seen in historical European imagery. They spin in this manner when using wool, flax, or hemp – the only difference between fibres is that when spinning flax or hemp, they sometimes use a cage distaff. The only other notable differences compared with our observations from historical European imagery were:

1. Many of the Eastern European spinners use bat distaffs, which are known in this region since at least the high middle ages (Brisbane and Hather, 2007) but are not part of the spinning tradition in Central and Western Europe (ABT, 2016).
2. Some spinners in Romania, Serbia, and Croatia use an in-hand spinning method where the spindle is rotated in the fist, which we have not seen elsewhere in the imagery of historical European spindle spinning. However, the spindle hand's action resembles Crowfoot's spinning Type 3.

The presence of long distaffs (used for wool, flax, or hemp and tucked under the arm, tucked in the belt or free-standing), the holding of the spindle on the opposite side of the body to the distaff, the production of thread in a horizontal and/or diagonal direction, the use of spindles held in-hand and 'twiddled' by the fingers or suspended a very short distance from the hand, and the production of cops wound in an oval/spindle shape all directly correlate to what is seen in historical European imagery. This strongly suggests that the spinners in these videos represent the vestiges of a Europe-wide tradition of spinning.

The videos also provide evidence for one key aspect of the spinning method which could not conclusively be deduced from images alone: the location and type of drafting. As described above, "drop spinning" uses a short-draw between the hands. Most modern, Western wheel spinners also use this method and location of drafting. Long-draw spinning is predominantly known, at least to modern Western spinners and academics, in the context of the great wheel. Although since about five years ago, there has been a growing trend of combining long-draw spinning with a modern wheel.

From images alone, it was possible that either short- or long-draw was used in historical European spinning. However, the videos demonstrate that a short, not a long, draw is used. Additionally, drafting clearly occurs between the distaff-adjacent hand and the distaff, **not** between the two hands. The hand which turns the spindle is **not** observed engaging in drafting (except on the few occasions when a very bad tangle occurs in the fibre, and both hands are engaged to detangle it). Thus, the distaff plays an active role in the drafting process rather than simply being a passive holder of fibre. In contrast, the spindle-adjacent hand does not play an active process in drafting. This is very different from "drop spinning".

The videos also confirm that the spindles were used with both an in-hand ('twiddled' or 'finger turned') as well as a **short-suspension** (i.e., suspended, but only a short distance from the hand) method. A **long-suspension** method (i.e., suspended, but at times a long distance from the hand(s), as in "drop spinning") was not seen. The in-hand and short-suspension methods can be distinguished from each other in the videos by whether a half-hitch knot is put on the top of the spindle before turning it and taken off before winding the produced thread onto the spindle. A half-hitch knot is generally necessary for short-suspension spinning to prevent the spindle from unwinding and falling on the floor. However, the half-hitch is unnecessary for in-hand spinning – indeed, our experiments show this technique works better without one.

Putting theory into practice

Using the evidence and conclusions, we attempted to reproduce the spinning technique seen in the Central and South-Eastern European videos. Where necessary, we modified the technique shown in these videos to bring it closer to the key characteristics that are seen in historical European imagery and listed above, namely by avoiding the use of bat distaffs and the rotated-in-fist sub-type of in-hand spinning.

We experimented with both wool and flax. However, the traditional technique of dressing a distaff with flax and spinning flax is still widely known (e.g. Kennedy, 2012). Therefore, we will only discuss our experiments with wool in this paper.

Tools

We used reproduction medieval spindle sticks (sourced from Pallia, NiddyNoddyUK, and HersheyFiberArts) and both reproduction and extant medieval whorls (sourced from Pallia, NiddyNoddyUK, HersheyFibreArts, and Portable Antiquities Scheme (PAS)-reported metal detectorist finds). Pallia's spindle sticks are modelled after a 12th Century find from Bergen, Norway (Øye, 1988). They have a simple double taper with the fattest part of the stick approximately one-third of the distance from the end – a shape noted in other extant medieval and later spindle sticks from Europe (e.g., See Figure 2). The spindle sticks from NiddyNoddyUK and HersheyFiberArts are very similar to those from Pallia in length, diameter, taper, and mass.

It was important to use reproduction tools as the mass and dimensions (particularly diameter) of a spindle, and its whorl has a major impact on its rotational properties. Medieval spindles are quite distinct from modern "drop spindles" (See Figures 2 and 3). Notably, medieval whorls usually have a small diameter (typically under 40 mm) and often have a biconical, spherical, plano-convex, or conical cross-section (although sometimes a thick discoid cross-section is seen). In contrast, the whorls of "drop spindles" are typically between 45-90 mm in diameter and have thin discoid cross-sections that may be edge-weighted (See Figure 4). These differences result in markedly

different rotational properties and 'feel' when spinning, a fact which has previously been experimentally observed (Kania, 2015).

Our distaffs predominantly consisted of a very simple style – a stick, approximately 1 m in length (or longer if used free-standing rather than tucked in the belt), with a small notch approximately 2 cm from the tip. This notch was used to secure a band or ribbon for securing the fibre. This band is visible in the historical European imagery. Another variety of distaff we tried consisted of a stick of similar length with a knob of approximately 4 cm diameter at the top over which fibre could be folded. A third variant had a natural fork approximately 8-10 cm from the tip, around which fibre and/or ribbon could be wound. We did not use cage distaffs as we were predominantly experimenting with wool rather than bast fibres.

Materials

A variety of wool types were spun to explore the technique more fully. The wool from many different breeds of sheep were used, representing a range of fibre lengths, fibre diameters, crimp and silkiness. The breeds included Blue-Face Leicester, Corriedale, Cotswold, Falkland, Gotland, Icelandic, Jacob, Kerry Hill, Lincoln Longwool, Manx Loaghtan, Merino, North Ronaldsay, Norwegian, Ouessant, Portland, Romney, Ryeland, Shetland, Soay, Southdown and Wensleydale. Both commercially prepared roving and hand-combed wool were used, the former due to convenience and the latter because it was closer to known medieval wool processing methods. All wool was washed before use.

Technique: dressing the distaff

The method of dressing the distaff is not always clear when viewing a fully dressed distaff, especially in historical European imagery. Additionally, very few of the ethnographic videos showed the distaff being dressed. Therefore, we experimented with three conjectural historical methods of dressing a distaff with wool. The shape of the dressed distaff produced with each of these methods was consistent with that seen in historical European imagery.

Our first method (de Alessandri, 2017) is described as follows. The fibres were combed by hand then drawn off the comb in a long sliver. The sliver was then broken into chunks approximately 40 cm long. These chunks were gently stretched and spread until approximately 25 cm wide. The stretched chunks were placed on top of each other to make a batt. Ribbon was tied to the tip of the distaff so that each end of the ribbon was of equal length. The distaff was then placed on one side of the batt, and the batt rolled around it fairly snugly. The distaff's ribbon was then tied over the fibre in a criss-cross fashion to secure the fibre. A variant of this method can also be done with hand-carded wool (Costigliolo, 2016a, 2016b), although we have not tried this variant.

Our second method (Aaradyn, 2017) also started with combing the wool by hand, drawing off a long sliver and breaking it into chunks. However, unlike the previous method, these chunks were not stretched/spread. Instead, several chunks were held together as one and a ribbon was tied in the middle of this bundle, leaving two long, equal-length ribbon ends. The bundle of fibre was then folded over the top of a distaff which had a knob at the top. The ribbon was wrapped criss-cross over the fibre as in the previous method.

Our third method (Griffiths, 2021) started like the previous two. However, the sliver was not broken into chunks. Instead, it was drafted gently at one end using the fingers, creating a dense twisted point approximately 3-5 cm long and approximately 5-7 mm wide at its tip. Ribbon was tied to the distaff so that one ribbon end was long and the other was only about 5-8 cm. The pointed tip of the sliver was tied firmly to the distaff using the ribbon. The sliver was then wound up and down the distaff in a spiralling motion, similar to that used when winding thread onto a spindle and ending near the bottom of the wound fibre. The long end of the ribbon was then wrapped over the fibre in a descending spiral and tied off near the bottom of the fibre. We also used a variant of this method,

which used commercially prepared roving. This variant is not historical. However, roving is more easily obtainable than hand-combed wool. Hence, it was used.

Other methods of dressing a distaff with wool, whose finished products are also consistent with historical European images, have been suggested by members of the distaff spinning community (Kania, 2014; Holmqvist, 2015). However, we have not tried these other methods.

Technique: spinning

Following the ethnographic videos, we used a short-draw draft between the distaff and the distaff-adjacent (i.e., non-dominant) hand. Wool was drawn from near the base of the fibre on the distaff, as shown in both ethnographic videos and historical European images. The spindle was turned by the dominant hand, either being rotated in-hand using the fingers or being flicked by the fingers and rotating whilst suspended (i.e., short-suspension spinning). In the latter case, a half-hitch knot was put on before starting spindle rotation to prevent the spindle from falling to the floor. Once an arm's-length of thread was produced, the half-hitch was removed if present and the thread was wound onto the spindle to create an ovoid/spindle-shaped cop that was just above, but did not touch, the whorl.

Videos of us practicing this technique can be found here: Aaradyn, 2013a, 2013b, 2016a, 2016b, 2016c; Griffiths, 2015, 2018a.

Observations

Learning the technique

Historical European spindle spinning took a bit of getting used to. Often, the in-hand method was better to learn with as it is more controllable and cannot 'run away' with you. Initially, a 'park and draft' method can be used, whereby you draft a little, stop drafting, turn the spindle a little, stop turning it and then repeat. Medium-length, moderately crimped wool fibres that were not too fine or sleek were best for learning, e.g., Shetland.

For all of us, the biggest learning hurdle was re-training our brains, arms, hands, and fingers to draft between distaff and non-dominant hand rather than between the hands. We had all learnt and become proficient with "drop spinning" before attempting to learn this technique. Obviously, a historical European would not have had this issue.

Ergonomics of the technique

People frequently ask whether the fingers get tired with this technique, particularly with the in-hand method. However, except when the cop is over-large (and thus the spindle is very heavy), the fingers do not get noticeably tired. One of us tried to make the largest cop possible. We only stopped once the cop and spindle stick together weighed just over 115 grams (the whorl had been removed earlier, see below). Whilst this was tiring to twirl with the fingers, it was at least 50 % heavier than most cops we made and was also far larger than the 'full' cops seen in historical European imagery. A more typically-sized cop does not result in significant finger fatigue.

Some of us noticed the bicep of our distaff-arm becoming tired after prolonged spinning sessions when learning. However, after gaining experience (and presumably better posture and/or stronger muscles), this ceased to be a problem, and we can now spin for several hours, or even most of a day, without any aches or pains.

The technique worked well standing, sitting on a chair, or sitting/kneeling on the floor with very little modification required to arm or hand motions and little effect on product or speed. We found we preferred a shorter (approximately 1m long) distaff for holding in the belt, either for standing or sitting. A longer distaff was necessary for mounting in a stand or for holding between the knees, as seen in some imagery, but could still conveniently be used in the belt when standing.

A noticeable benefit of the technique was the ease with which spinning can be combined with walking. Even after only a few days' practice, and when still far from proficient at the technique, we found that spinning could be easily combined with walking. This occurred regardless of the fineness of the thread being produced. In contrast, "drop spinning" was comparatively difficult to combine with walking, even for the experienced spinner and especially when spinning fine threads. This is due to the tendency for the long-suspension to allow the spindle to act like a pendulum with the consequent breaking of the thread.

Details of the technique

Our practical experimentation allowed us to answer some key technical questions we had raised when simply looking at the imagery and the archaeological finds.

The first question was: how do the whorls stay on? Historical European spindle sticks are tapered, as seen in both the imagery and the archaeological finds. If you hold these sticks so the widest point is one-third of the way from the bottom and firmly push the whorl on from the bottom up, the whorl will stay in place at a height that matches the imagery. The friction between whorl and spindle stick was sufficient to keep it in place in all but two instances. The first is when the spindle is dropped and hits a hard surface. The second is described in the following paragraph. In the nine years we have been experimenting and teaching this technique, we have never experienced a whorl falling off for any reason except these two. They certainly do not just slip off in general use.

The second question was: why are the cops on spindles in historical European imagery wound in an ovoid/spindle shape, not in the conical shape used on "drop spindles" (See Figure 5)? As explained above, whorls are held onto historical European spindles by friction alone. This is in contrast to a "drop spindle", where the whorl is permanently attached to the rest of the spindle, e.g., with glue. If the cop is wound in a conical shape on a historic European spindle, it tends to press on the whorl and can cause the whorl to be pushed down, loosen and fall off. Also, if you wish to remove the whorl (see next paragraph), the base of the cop stops being supported and tends to partially unwind and tangle, ruining this section of the thread. Hence, a spindle-shaped cop is a necessary part of the technique.

The third question was: why do so many historical European images show spindles without whorls? One theory previously raised was that the whorl was inside the cop. However, this was discounted as some images do show whorls, and they are clearly below the cop. In trying the technique, we found that as the cop grew it became sufficient to act as a whorl on its own. The whorl could then be removed, bringing the total mass (i.e., spindle stick plus cop) closer to the starting mass (i.e., spindle stick plus whorl). This made it easier to keep the thread thickness consistent, especially with short-suspension spinning (where the mass of the spindle can 'pull' on the drafting zone and thus affect the thread thickness). It also allowed a larger cop to be made before the combined mass of spindle and yarn started affecting the ergonomics of the spinning. This is important as a larger cop means a longer continuous thread. Longer threads are more useful for downstream processes, especially weaving.

The fourth question was: why do most of the extant medieval European spindle sticks have no notch at the tip, unlike "drop spindles"? Most modern "drop spinners" consider the notch at the tip of the "drop spindle" essential for holding the half-hitch knot in place. However, our experience shows that a half-hitch or a notch prevents the twist from properly entering the growing thread when using in-hand spinning. Therefore, a notch is highly undesirable in this situation. However, a half-hitch is needed for short suspension spinning. Our experience shows that the combination of an ovoid cop and putting several wraps of thread between the base of the cop and tying the half-hitch prevents the half-hitch from slipping off the tip of the spindle, even in the absence of a notch (Griffiths, 2018b). Thus, the various parts of the technique (cop shape, winding technique) work seamlessly together, enabling the same spindle stick to be used for both in-hand and short-suspension spinning.

Advantages of the technique

A final key question is expansive; therefore, we will address it separately. Why did historic Europeans use this technique? Our experiments allow us to come up with several suggestions to answer this question.

Firstly, it is a very low-tech technique. It involves the use of two sticks (the distaff and the spindle stick, both of which can be crudely carved), a whorl (which could be made from clay or other locally available materials) and a ribbon, cord or string (which could be as simple as the thread you made). This is important, as (depending on the exact date and geographical location) spinning was a technique needed by all households for home-production of textiles and clothing (e.g. Østergård, 2004) and/or a very poorly paid job (e.g. McIntosh, 2005). The lack of even moderately expensive tools meant that this technique was accessible to the very poor and those far from market centres.

Secondly, it is a very compact technique. The distaff, when not in use, could be leant against a wall or put on a shelf or other surface where it would take up very little space. This is in particular contrast to the early spinning wheel (i.e., the great wheel), which would take up a considerable percentage of the floor space in many historic European houses.

Thirdly, it is a very portable technique. Not only can the distaff and spindle be taken with you, but it is also very easy to concurrently walk and spin, even when still learning. This allows spinning to be done in short spurts of 'downtime' that occur in-between tasks as well as during 'dead' time when little else can be done (e.g., whilst walking or riding to market or whilst tending sheep at pasture). Again, this is in direct contrast to spinning wheels, which cannot be used on the move and are often not portable. For poor women, in particular, being able to spin all the time was likely to have been a major advantage.

Conclusions

We have surveyed historic European imagery of spindle spinners and reconstructed a technique based on these with the help of ethnographic videos. We conclude that the historic European imagery is an accurate representation of a culturally unique method of spinning, not simply the result of an inability of artists to draw spinning correctly. We provide several explanations for features of this technique seen in the imagery and suggest why the technique may have been so popular among women for such a long period in European history.

We make a plea to academics carrying out experimental archaeology, as well as modern recreationists who attempt to demonstrate historic spinning, e.g., at museums and re-enactment events. You would not consider, for example, Navajo spinning (with its jumbo-sized supported spindle and seated spinner) to be equivalent to historic European spinning. It would, we suspect, never occur to you to use it to represent historic European spinning in experimental archaeology or during historic recreations. However, contrary to popular opinion, "drop spinning" is just as anachronistic in these contexts. Without recognition of this fact, your experiments are likely to be flawed, your recreations are likely to be incorrect, and your demonstrations will teach false knowledge. With recognition of this, you can avoid these issues and gain a deeper understanding of history and of the practicalities of spinning in the historic European context. We challenge you to do the latter.

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About Authors and their Attributions

Cathelina di Alessandri initiated and led the pictorial and ethnographic research and first developed the recreated spinning technique. Mary Ann Megan Cleaton, Alice Rose Evans, Jane Hunt and Cathelina di Alessandri refined and further developed the recreated spinning technique, found additional pictorial evidence, and theorised about the advantages of the technique. Mary Ann Megan Cleaton wrote the manuscript and made the figures. Mary Ann

Megan Cleaton, Alice Rose Evans, Jane Hunt and Cathelina di Alessandri edited the manuscript. All authors approved the final copy of the manuscript.

Keywords spinning

Glossary

Bast: Fibre from the inner bark of certain plants including flax, hemp, and nettle.

Bat distaff: A type of distaff with a broad, flat head to which fibre is tied. Culturally unique to parts of Eastern Europe and Western Russia since at least the medieval period (Brisbane and Hather, 2007).

Cage distaff: A type of distaff with an openwork head over which fibre is spread and tied. The head may be ovoid, cylindrical or conical. Traditionally used for bast fibres.

Cop: The thread wound onto a spindle.

Distaff: A tool used to hold fibre during spinning. Various lengths and forms have been used by different cultures, at different points during history and for different fibres.

Draft/draw: The process of pulling out and attenuating fibres during spinning.

Drop spinning: A term unique to the English language, coined sometime in the early 20th Century (Griffiths, 2020a, 2020b, 2020c). In most modern texts and speech, this term is used in one of two ways: a) uncritically as a synonym for "spinning with a spindle" and b) to refer to the specific style of spinning shown in Fig 1. In this article we use it in the latter sense only.

Grasped spinning: A style of spinning characterised by both Kissel (as Type 2) and Crowfoot (as Type 4) (Kissel, 1918; Crowfoot, 1931). Key characteristics are the use of a large spindle held ('grasped') in two hands and a tension ring, forked stick or other support to help draft. This style was first described among the Salish tribes of North America (Kissel, 1916).

Hand distaff: A short type of distaff that is held in the hand. Used by various cultures, including Ancient Rome.

In-hand spinning: A term coined by the authors. A style of spinning that includes a subtype where the spindle is turned/twiddled in the fingers (previously undescribed) and a subtype where the spindle is rotated in a fisted hand (Crowfoot's Type 3; Crowfoot, 1931). We also argue that grasped spinning (Kissel's Type 2, Crowfoot's Type 4; Kissel, 1918; Crowfoot, 1931) represents a third subtype of in-hand spinning. The key characteristic of all three of these subtypes is that the spindle is held in the hand(s), rather than being supported by a surface or suspended from its thread.

Long-suspension spinning: A term coined by the authors. A subtype of suspended spinning where, as a length of thread is made, both hands remain in place while the spindle moves away from the hands. Therefore, just before winding thread on the distance between hands and spindle is long.

Long-draw: A type of drafting. A section of fibre is pinched off. Twist is then allowed into it whilst it is simultaneously drafted by being stretched out. Twist concentrates in the thinner areas, preventing them from being stretched further, allowing the thicker sections to be automatically thinned by the spinner pulling on the thread and stretching until it is even. The result is a long length of fibre made in one extended ('long') draft/draw.

Roving: A type of prepared wool fibre. A long, thin (approximately 80 mm wide) strip of commercially prepared, compacted, carded fibre.

Short-suspension spinning: A term coined by the authors. A subtype of suspended spinning where, as a length of thread is made, one hand moves with the spindle away from the other hand. Therefore, just before winding thread on the distance between the dominant hand and spindle remains short.

Short-draw: A type of drafting. A small section of fibre is drafted, with the drafting area kept small and no twist allowed to enter into it. The hand(s) then move to allow twist into the drafted fibre without stretching out the section of fibre. This is repeated, using multiple, sequential 'short' drafts/draws in an 'inchworm' fashion.

Spindle: A small hand tool used to spin thread. The term generally refers to the whole tool (i.e., 'stick' and whorl combined), although not all spindles have whorls and, of those with whorls, some have detachable whorls.

Supported spinning: A style of spinning characterised by both Kissel (as Type 3) and Crowfoot (as Type 5) (Kissel, 1918; Crowfoot, 1931). The key characteristic is that the spindle is supported by being placed on a surface. There are two major subtypes: where the spindle is supported by being placed on the floor/ground and where the spindle is supported by being placed in a small bowl, shell or cup.

Suspended spinning: A style of spinning characterised by both Kissel (as Type 4) and Crowfoot (as Type 6) (Kissel, 1918; Crowfoot, 1931). The key characteristic is that the spindle is freely suspended from its thread without any support from a surface or the hand(s). "Drop spinning" is a subtype of suspended spinning.

Thread: A length of twisted fibres, longer than the length of an individual fibre.

Whorl: A weight used on many but not all spindles to provide added momentum during the spin. May be integral or detachable.

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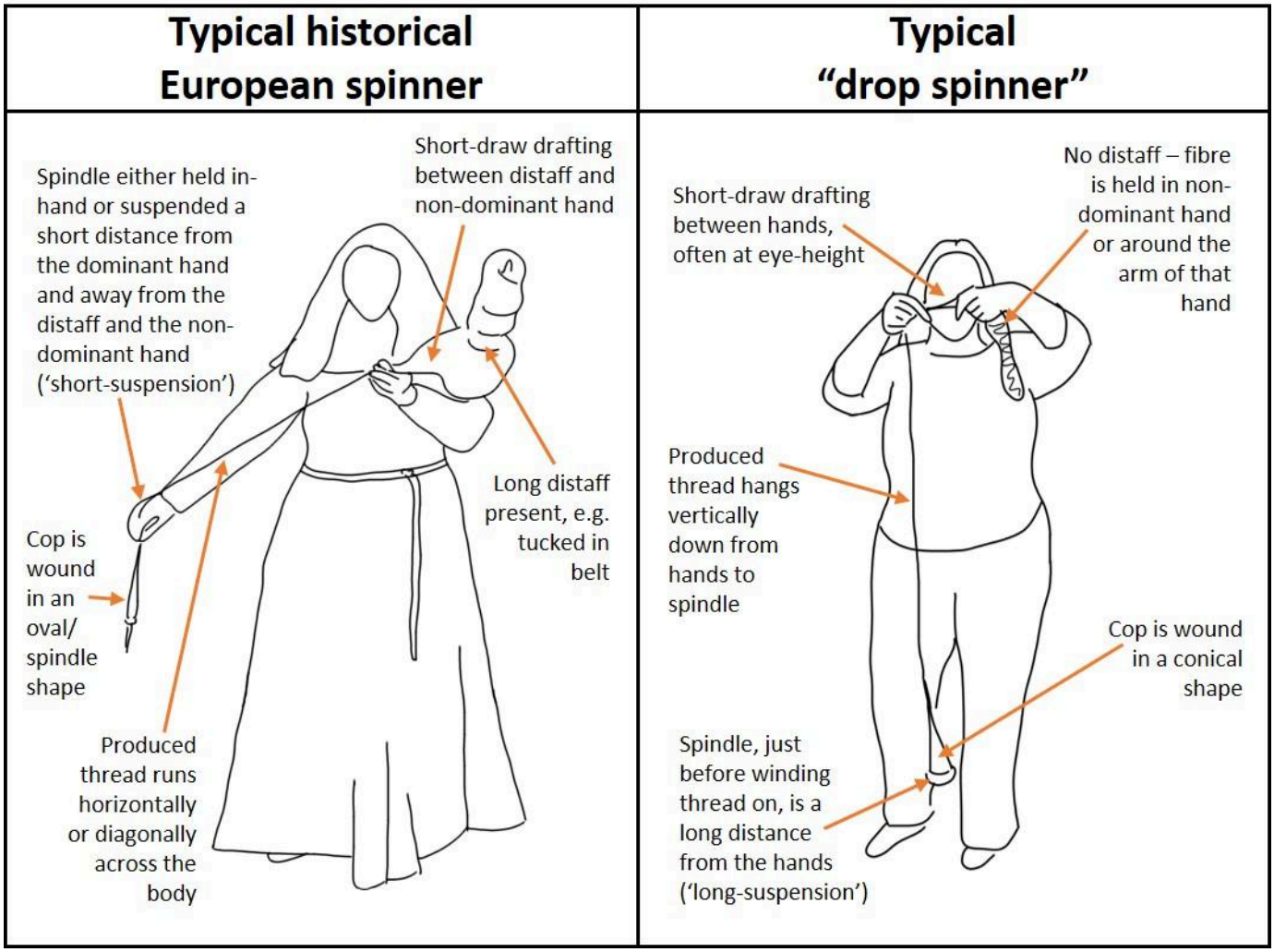

FIG 1. A TYPICAL HISTORICAL EUROPEAN SPINNER AND A TYPICAL "DROP SPINNER". IMAGE BY MARY CLEATON.

FIG 2. AN EXAMPLE OF EXTANT MEDIEVAL EUROPEAN SPINDLE STICKS AND WHORLS FROM THE MUSEUM OF LÖDÖSE, SWEDEN. PHOTO BY ANDREA HÅKANSSON, WITH PERMISSION.

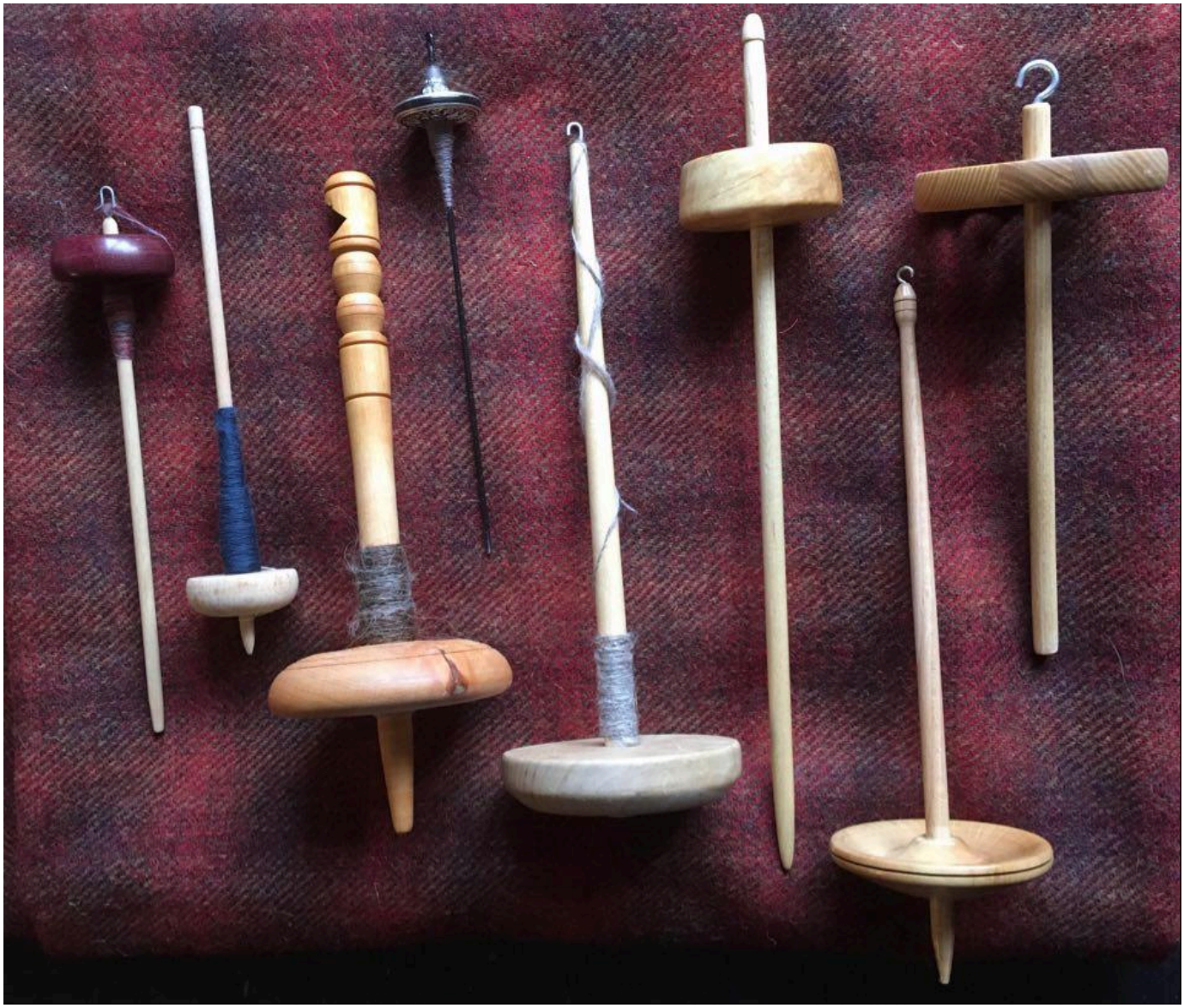

FIG 3. A SELECTION OF THE MODERN “DROP SPINDLES”, INCLUDING BOTH BOTTOM-WHORL AND TOP-WHORL STYLES. PHOTO BY ANNA LINDEMARK, WITH PERMISSION.

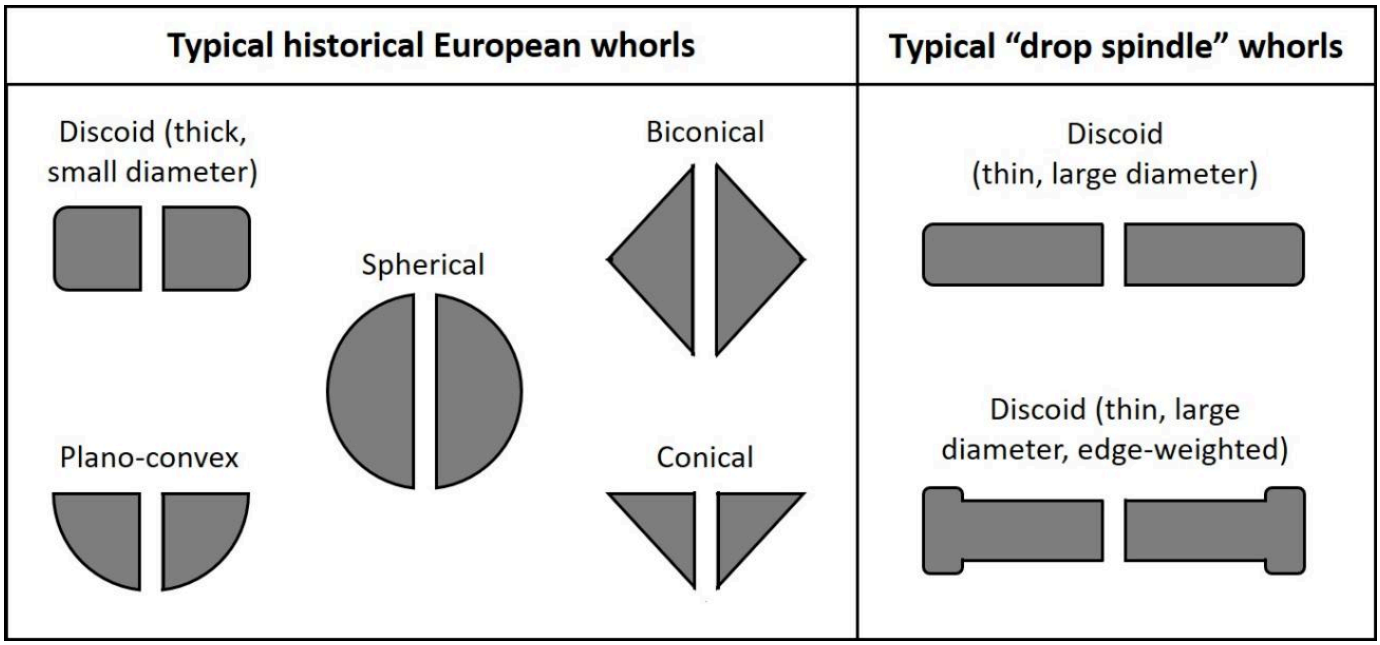

FIG 4. TYPICAL HISTORICAL EUROPEAN AND “DROP SPINDLE” WHORL SHAPES IN CROSS-SECTION. IMAGE BY MARY CLEATON.

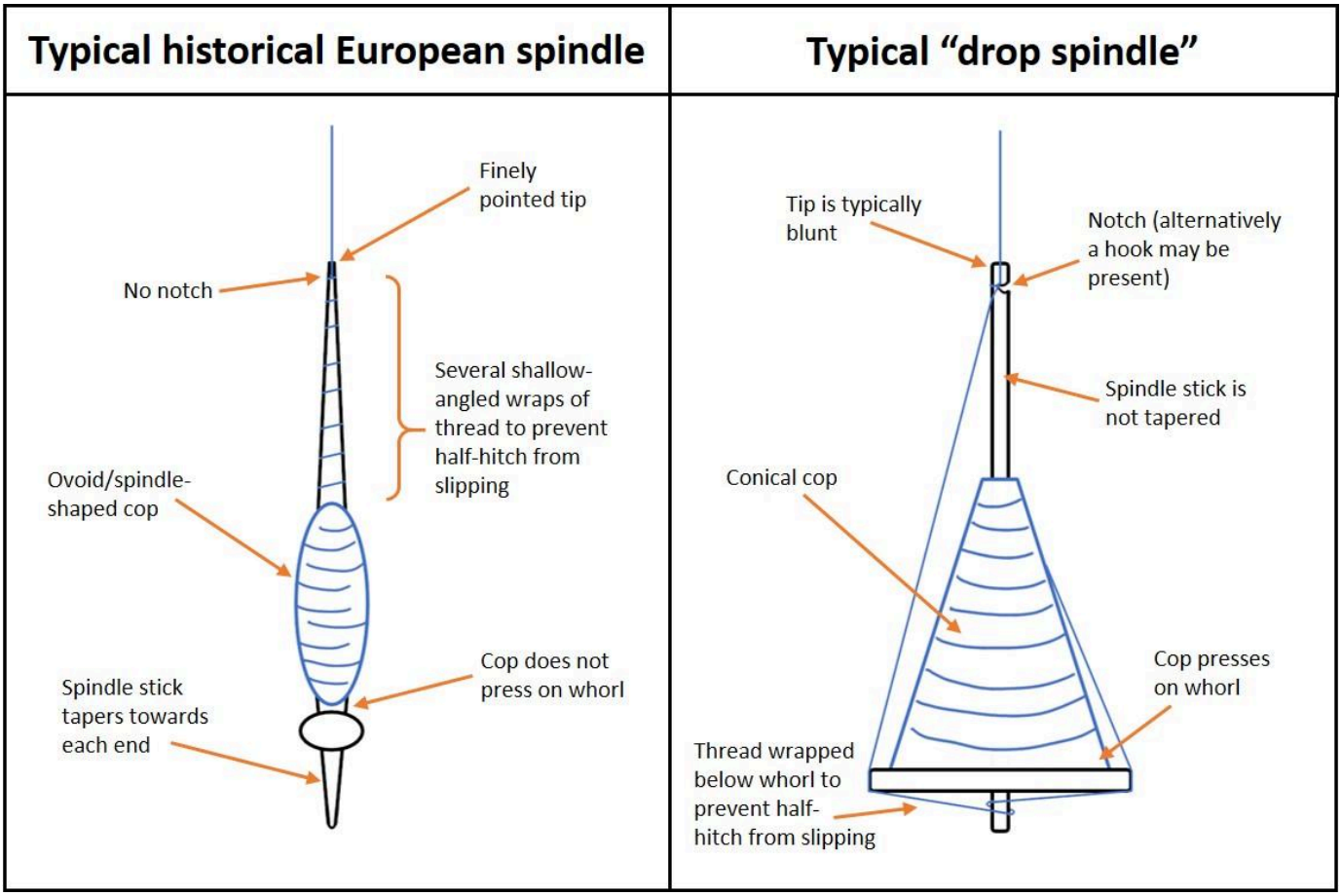

FIG 5. A TYPICAL HISTORICAL EUROPEAN SPINDLE AND A TYPICAL "DROP SPINDLE", EACH WITH A COP OF YARN. IMAGE BY MARY CLEATON, INSPIRED BY ROBERTSON, 2004, FIG 5.