



Human History Through Fiber

How Fiber Changed the World

Howard Seltman and Kathy McIntyre-Seltman



MY DOCTOR SAID I
NEEDED MORE FIBER
SO I WENT TO THE
MARYLAND SHEEP & WOOL
FESTIVAL

WeeOnes
Miniature Stitch markers
Wooly Bags
Needles
y.com

MY DOCTOR
NEEDED MORE
SO I WENT TO
MARYLAND SHEEP
FESTIVAL

About us

1974



2024



Overview video (3:17) [Jillian Eve]

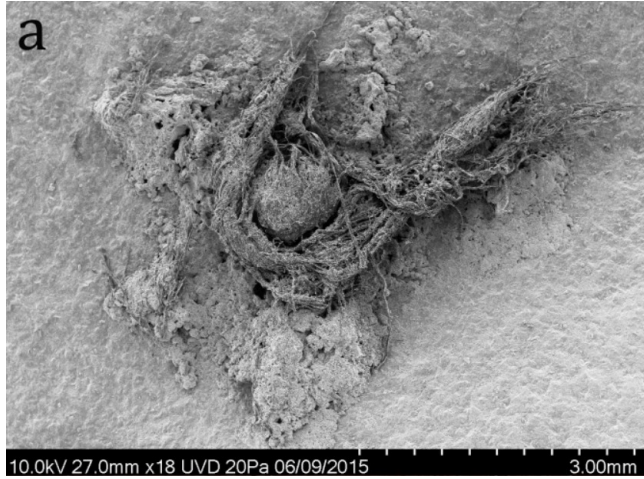
Course Overview

- **Week 1**
 - **Prehistory and early history**
 - **Process overviews of spinning and weaving**
- **Week 2**
 - Hemp and flax and other bast fibers
 - Cotton
- **Week 3: Silk**
- **Week 4: Woolly mammals**
- **Week 5**
 - Dyeing
 - Synthetics
 - Current fiber crafts

Some early uses for fiber

- Hafting
- Snares, bolos, harpoons
- Fishing line
- Fishing nets and hunting nets
- Bows and drills
- Collection and storage bags
- Lashing, incl. boats and looms
- Footwear
- Clothing
- Necklaces, bracelets, anklets
- Blankets
- Tents
- Baskets, mats, roofs
- Floor and wall coverings
- Sails
- An aid in working pottery

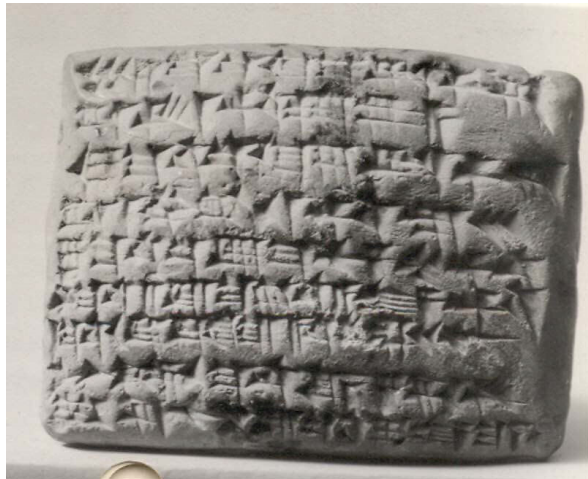
How we know about early uses of fiber



Trace remains



Related durable remains



Writing, art, impressions



Anthropology

Paleolithic beads from many places imply string

For example, “33 beads turned up during excavations ...near the mouth of Bizmoune Cave, about 10 miles inland from the coastal city of Essaouira [in Morocco].... Each bead had a hole drilled through it, presumably so the ornaments could be hung on strings or clothing, possibly worn as earrings or a necklace. Many have smoothed, polished edges, suggesting the intentional work of a craftsman.” --

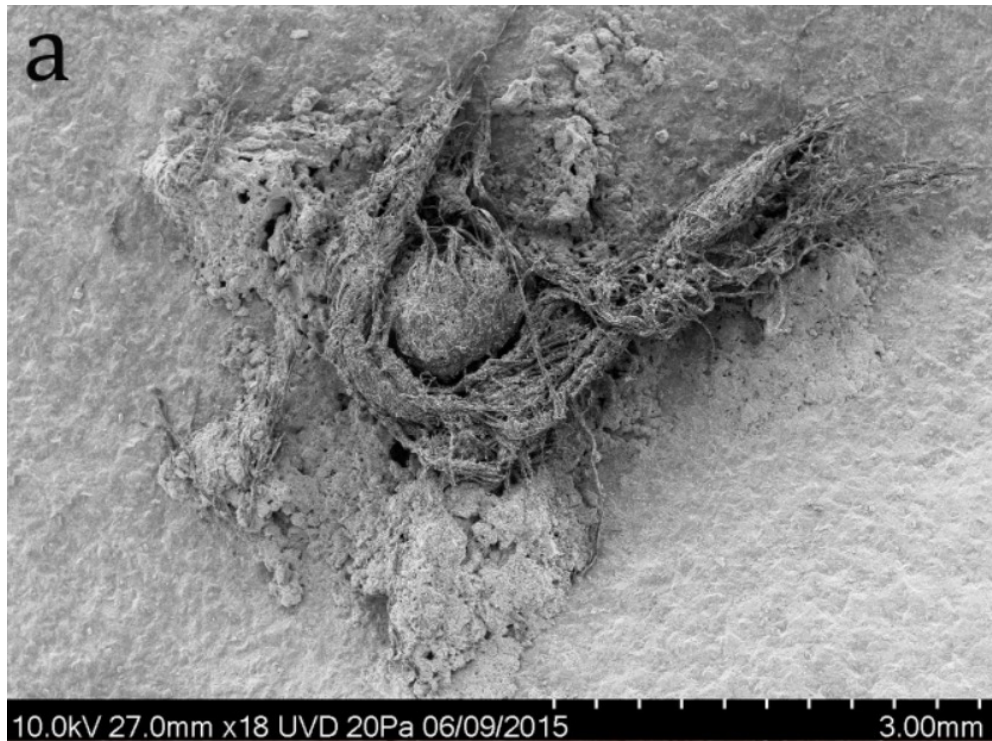
<https://news.artnet.com/art-world/worlds-oldest-jewelry-morocco-2037635>



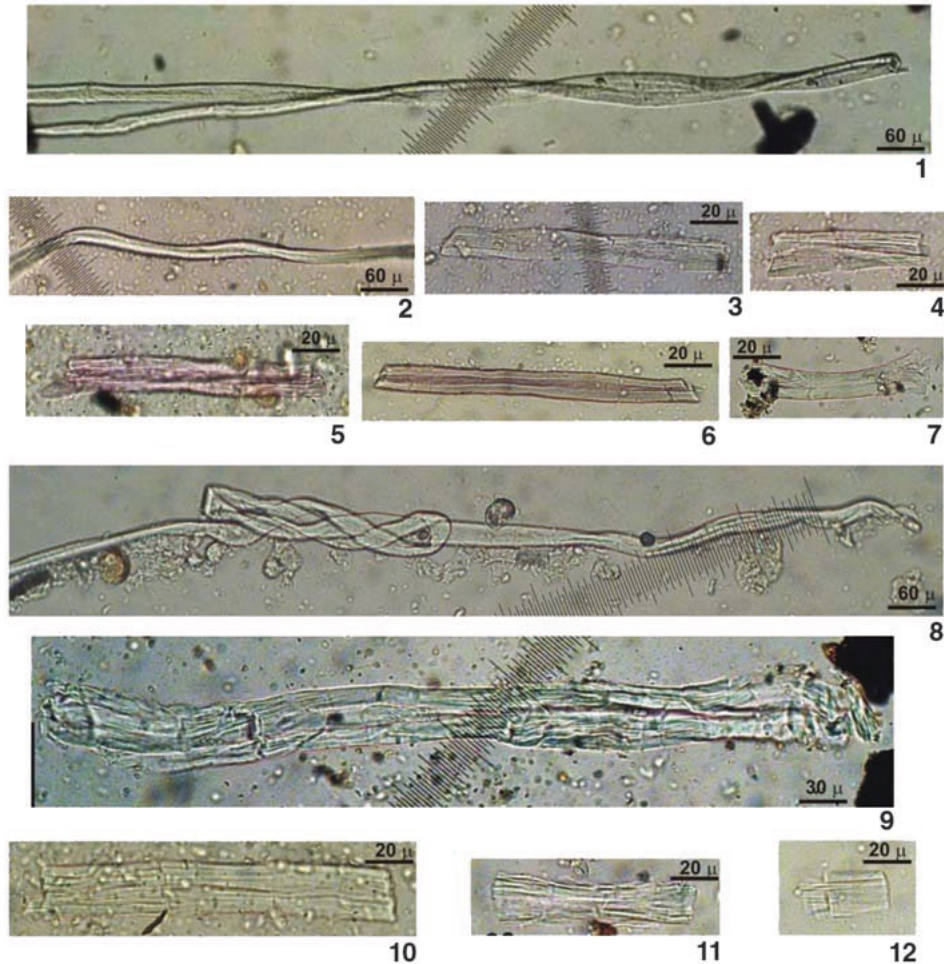
150,000 years old

Traces of Neanderthal fiber have been found

Some Neanderthals lived in a cave called Abri du Maras on the Ardèche River, a tributary of the Rhone, in the Middle Paleolithic between 52,000 and 47,000 years ago. On the surface of a stone flake, cordage was found showing three bundles of S-twist plied together with a Z-twist. The fibers come from conifer inner bark. The cord is 6.2 mm long and 0.5 mm wide.



Wild flax fibers were used 30,000 years ago

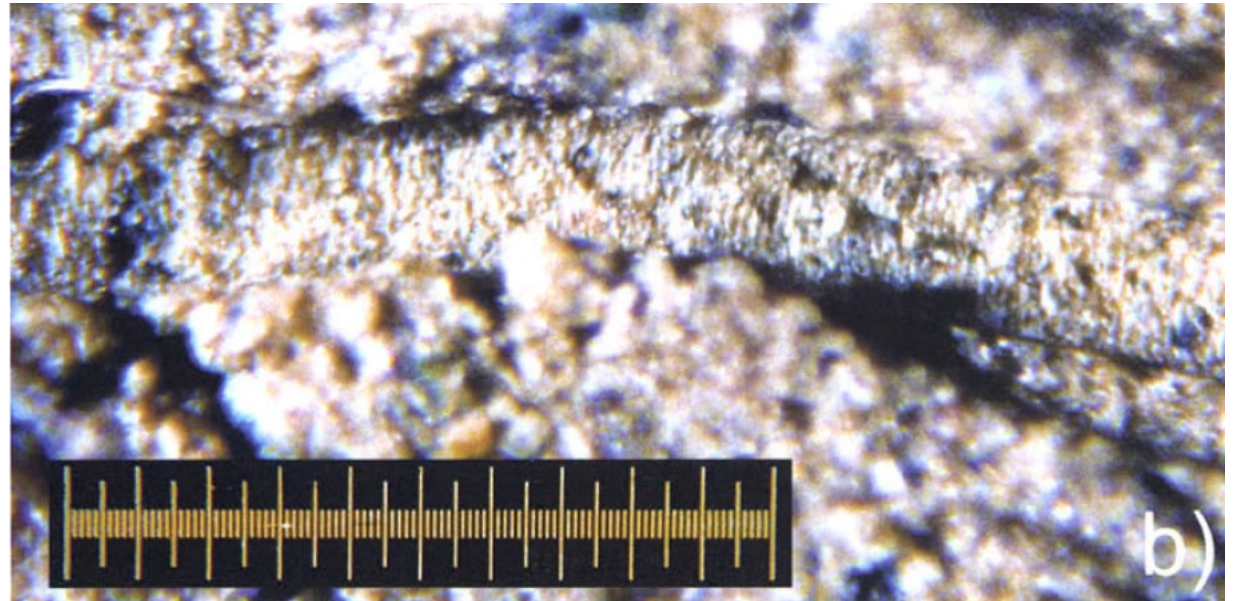


In Dzudzuana cave in Georgia frequented by hunter-gatherers from the Upper Paleolithic (32-26 thousand years ago), archaeologists found samples of flax showing twisting, tying, and dying.

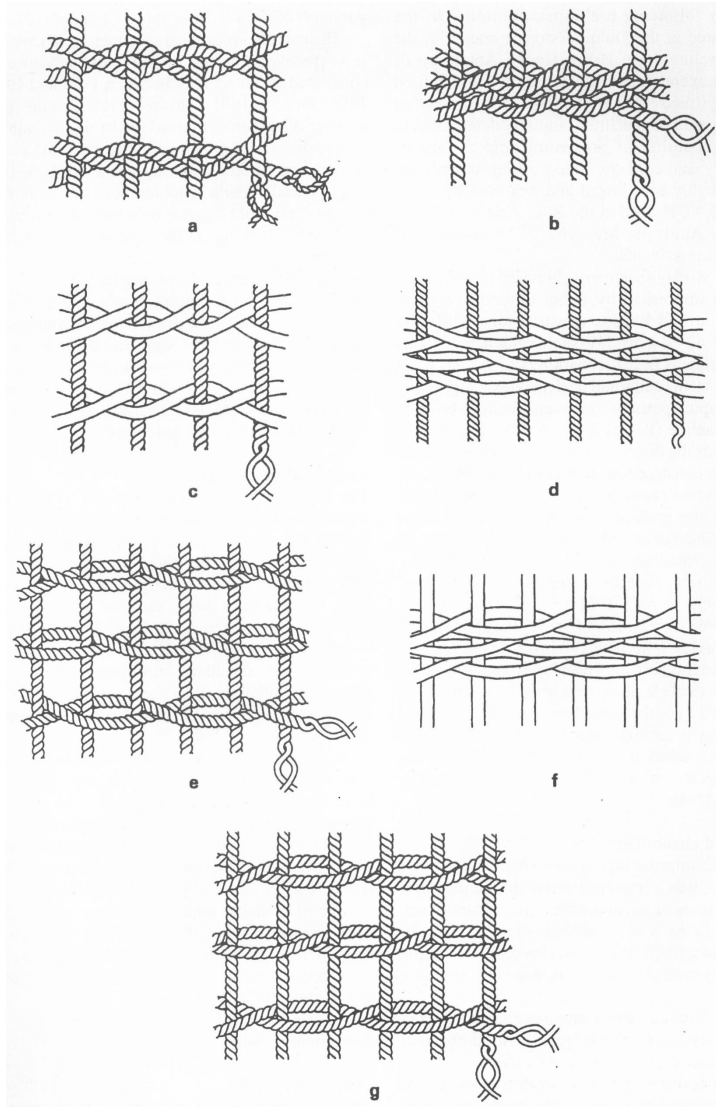
-- Eliso Kvavadze et al., *Science* Vol 325 11 September 2009, p. 1359 (DOI: 10.1126/science.1175404)

The earliest known plant fiber impressions in clay are 26,000 years old

- Pavlov VI is an archaeological site in Moravia (southwest Czech Republic) -- *Antiquity*, 83: 282-295, 2009
- It has thousands of animal bones, stone tools, shells, and 12 fired ceramic pieces formed to make animal shapes
- There is clear evidence of impressions of a fibrous net structure



Many methods were used to combine cordage into netting 26,000 years ago



Adding Dolni Vestonice (also in Moravia) to Pavlov gives 90 impressions, showing many twining types. -- *Anthropologie*, 1998, 36:1, pp. 43-68

A few Paleolithic Venus figurines have string skirts

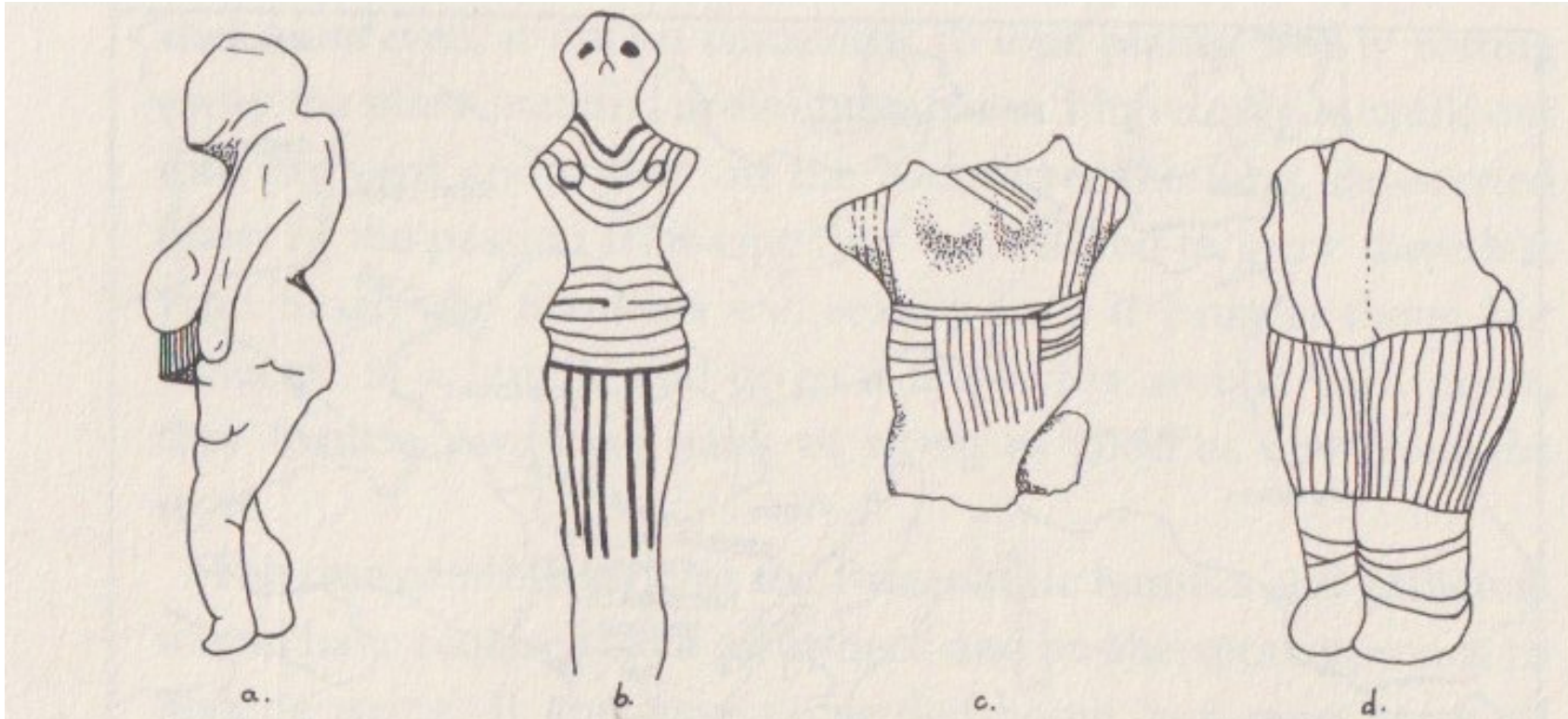
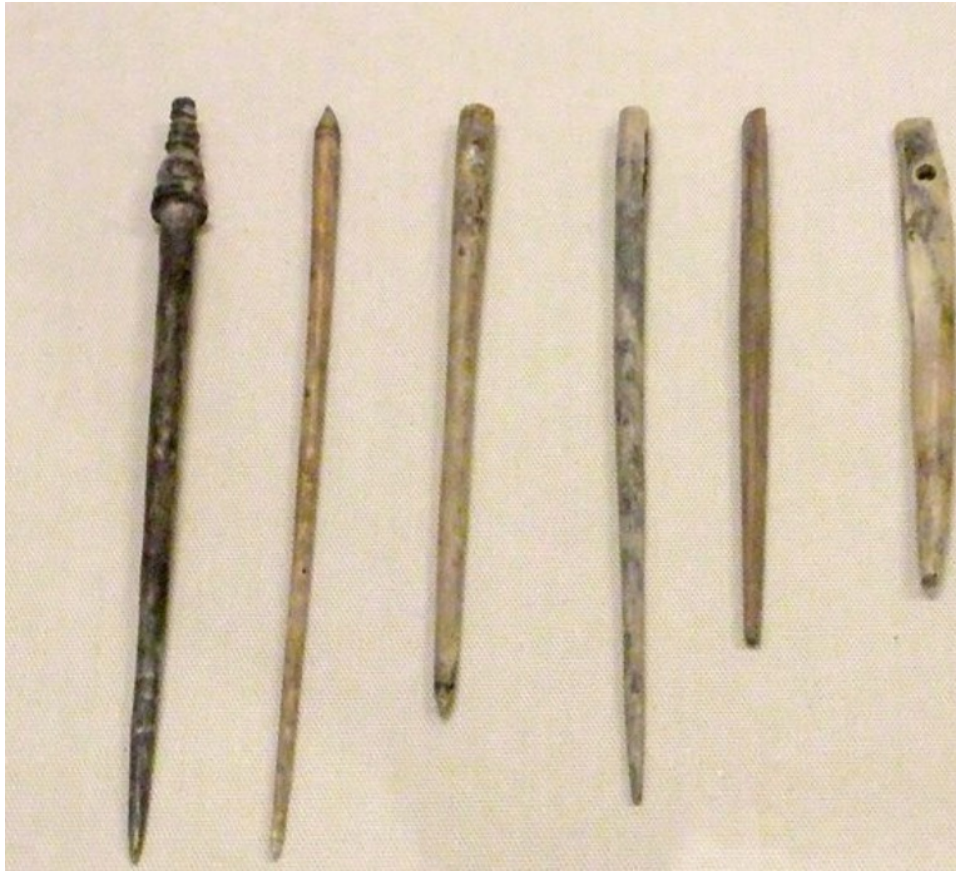


Figure 2.5. Stone Age figurines of women wearing string skirts: from (a) Gagarino, Russia (ca. 20,000 B.C.); (b) Šipintsi, western Ukraine (ca. 3500 B.C.); (c) Vinča, Serbia (4500 B.C.); (d) Crnokalačka Bara, Yugoslav Macedonia (ca. 3000 B.C.). Compare figs. 2.6–2.8. The bindings on the feet of (d) look very much like the crude bast shoes with cloth leg bindings used by Russian and Ukrainian peasants into this century.

Awls and needles *may* indicate use with textiles



Sibudu Cave, South Africa, 61,000 years ago



Eyed needles, China, 40,000 years ago

Summary of fiber use in the Paleolithic

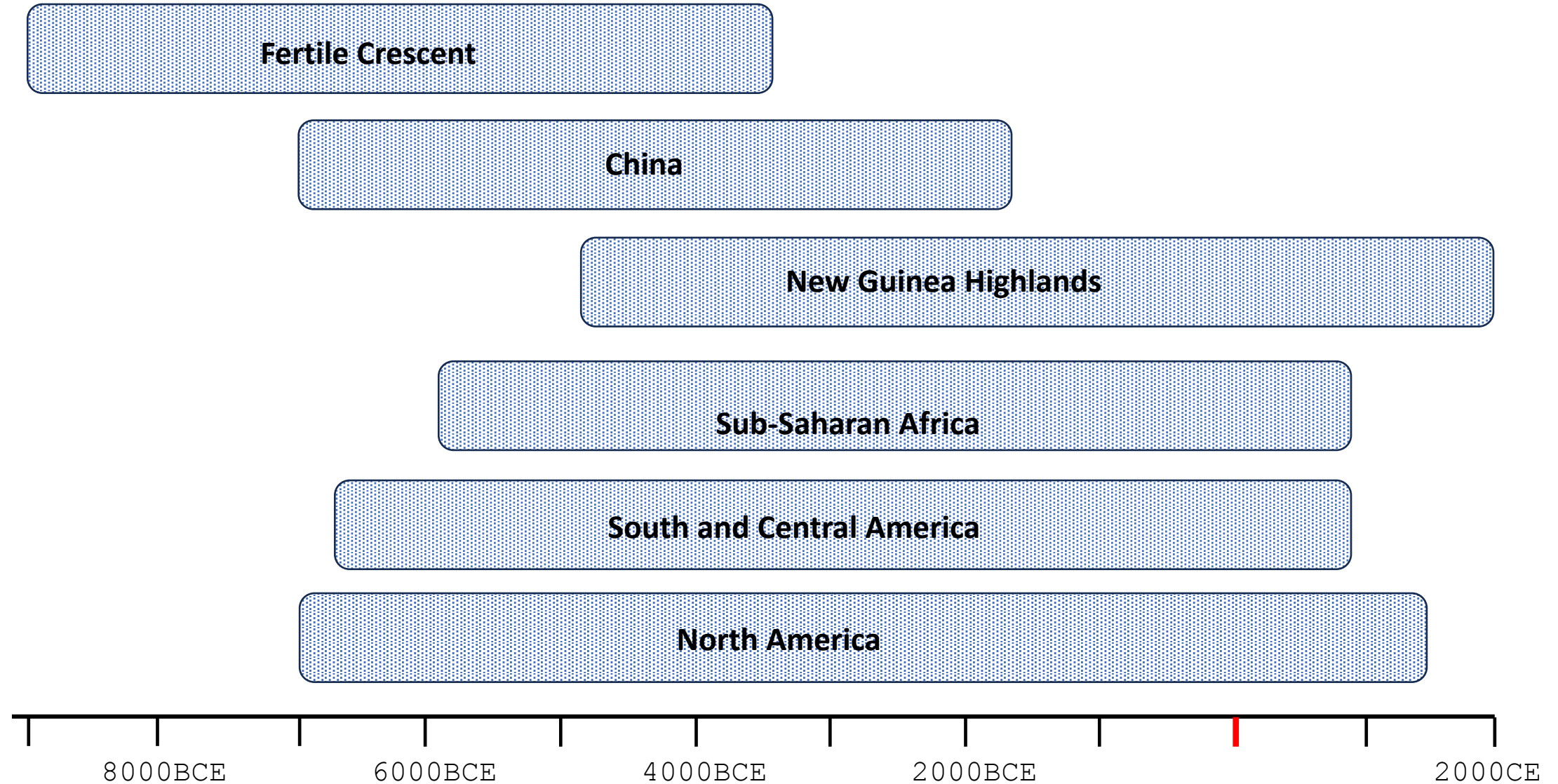
- Roughly 50,000 to 11,000 years ago
- Alder and yew bark; milkweed, flax and nettle
- Mats, baskets, knotted nets, blankets, and bags, as well as a wide array of apparel
- Bone and ivory awls and hooks
- Eyed needles and impressions of whip stitching
- Nets suggest how women, children and the elderly contributed to food production
- Fiber technologies probably consumed large amounts of time, especially for women

Key Point: The term “Stone Age” is misleading

- "This privileging of Paleolithic durables—specifically of stone—is at odds with the ethnographic record, which universally documents that it is the more perishable plant-based technologies that form the bulk of hunter-gatherer material culture—even in arctic and subarctic environments. The same has been noted by archaeologists working at sites with ideal preservation (e.g., permafrost, dry caves, wet sites). They have documented that artifacts made of plant remains—cordage, nets, baskets, cloth, footwear, etc.—outnumber those made of stone by a factor of 20:1.”
- “Simply put, then, by looking only at stone tools we focus on male technologies—especially those used by prime aged males—and ignore tools and implements used by the rest of the people, those making up the ‘invisible majority’ during the Paleolithic.”

-- *The Roles of Perishable Technologies in Upper Paleolithic Lives*, by Olga Soffer and James M. Adovasio, SUNY Press 2010

The time of the Neolithic period varies by place



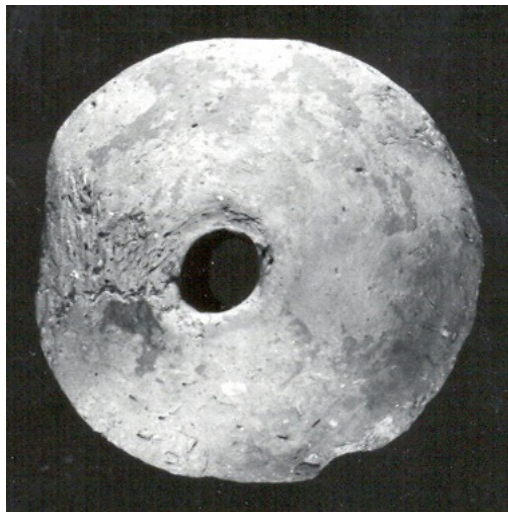
Spindle whorls are found in many archaeological sites



Monjukle Depe (Turkmenistan) 6000 BCE



A Neolithic Spindle whorl found in Worcestershire County, England



Hajji Firuz Tepe (Iran) 6000 BCE

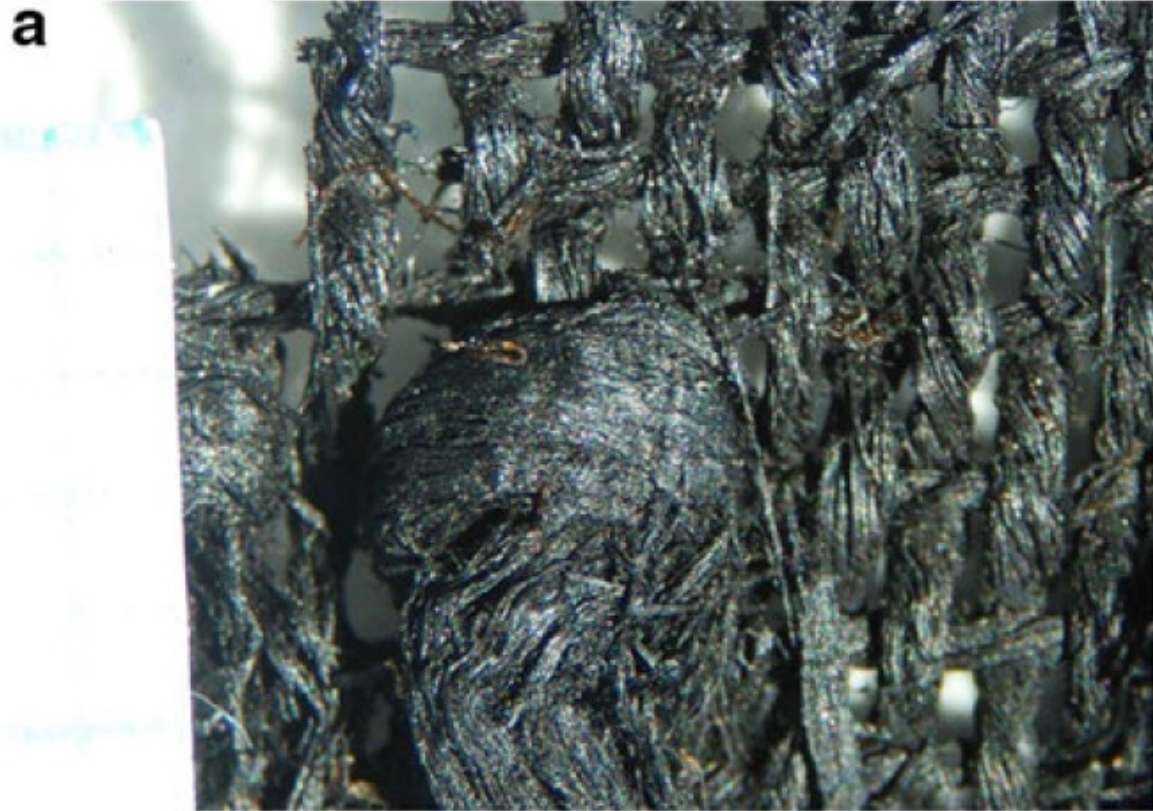


Macedonia 6500 BCE

Huaca Prieta in Peru reveals cotton cloth with indigo dye from about 6000 years ago



Swiss bogs preserved nearly 5000-year-old fabric



a: Textile from 2680 BCE

b: Linen thread from 2700 to 2600 BCE

Loom weights are common after the Neolithic



Viking 800-1000 CE



Bronze Age Britain



A selection of loom weights found in Karabournaki (phot.: Dr. Joanne Cutler†)

Greece 600 BCE



Fig 3. Clay weight with unique marks on upper and lateral sides. Copyright: T. Karavidović

Croatia 200 BCE

Archaeological Finds from Iron Age Turkey

“As the fiery destruction meted out by the Kimmerians overtook the citadel of Gordion early in the 7th century B.C.[E.], a group of 21 weights fell to a house floor in a row 1.59 meters long. The loom had been set up in the anteroom of the women’s working quarters TB7. This porch contained over 150 loom weights and 90 spindle whorls, while in the main room of TB7 more than 450 more loom weights and 46 spindle whorls were available.... But all of these numbers were dwarfed by the contents of the royal storehouses TB 1 and 2, which together produced more than 1100 of these donut-shaped loom weights....

[W]e can calculate that King Midas of Gordion could have kept over 100 women weaving for him, which makes him more than twice as rich as Homer’s fabulous King Alkinoos, who had fifty (*Odyssey* 7.103).”

-- *Prehistoric Textiles* by E.J.W. Barber

Thousands of Sumerian cylinder seals depict life around 3000 BCE

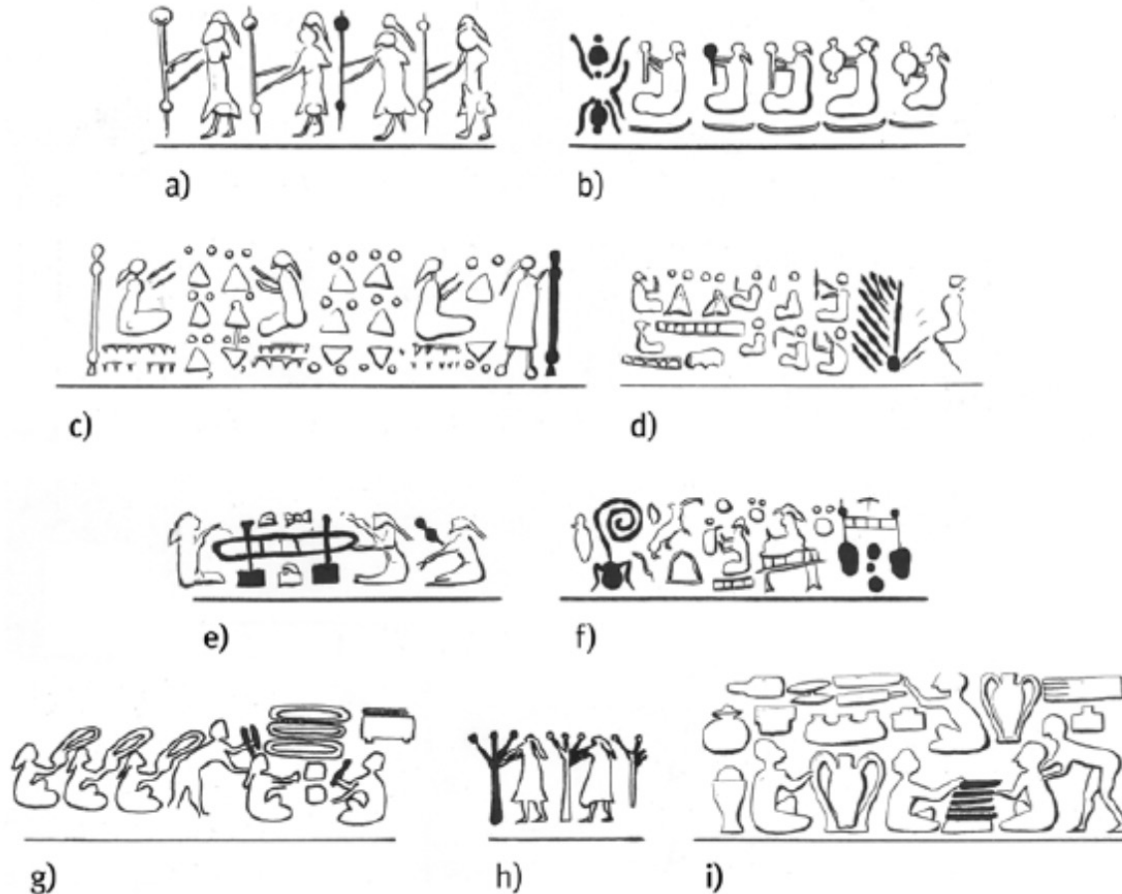


Fig. 5: Textile work: weaving and other tasks. a) Jemdet-Nasr. Spinning. After Amiet 1981: no. 306; b) Susa. Spinning. After Rova 1994: no. 430; c) Susa. Weaving on vertical loom? After Amiet 1981: no. 330; d) Tell Brak. Weaving? After Rova 1994: no. 905; e) Choga Mish. Weaving on horizontal loom. After Amiet 1981: no. 319; f) Ur. Weaving. After Rova 1994: no. 891; g) Ur. Weaving. After Rova 1994: no. 320; h) Susa. Flax processing? After Rova 1994: no. 419; i) Susa. Airing the wool with sticks? After Rova 1994: no. 337.

Weavers, Tomb of Khnumhotep

Middle Kingdom

Norman de Garis Davies

ca. 1897–1878 B.C.

📍 Not on view

This facsimile painting copies part of a scene in the tomb of Khnumhotep (tomb 3) at Beni Hasan. The scene depicts a group of weavers. The women at the right are plying linen thread and the two at the left are weaving cloth on a ground loom. The facsimile was painted at the tomb in 1931 by Norman de Garis Davies who was director of the Graphic Expedition of the Museum's Egyptian Expedition.



The Bronze Age Minoans wove linen and dyed wool to trade with the Egyptians



Fresco from about 1400 BCE

Some Greek pottery depicts fiber production



Oil jar (550-530 BCE) showing weighing wool, weaving on an upright loom, and folding cloth and spinning

Loom weights are used with vertical looms

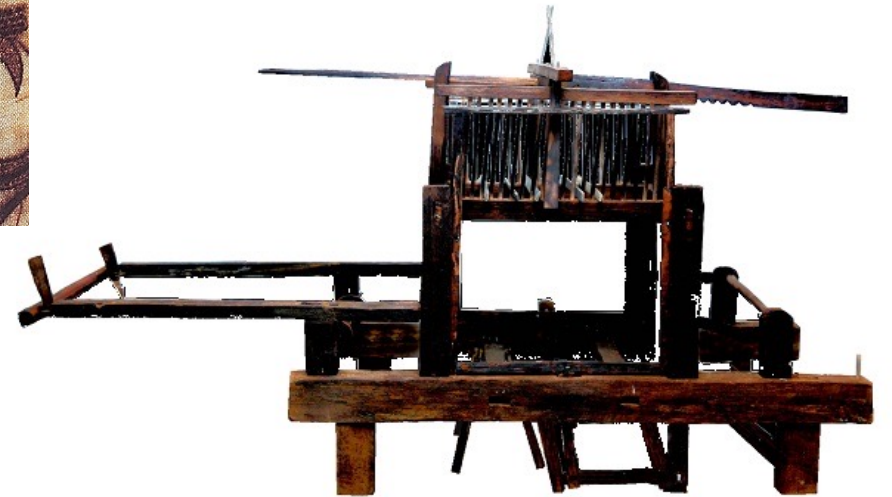


Grecian Urn 550-530 BCE

Weaving with silk is very old in China



Ritual silk garment, Zhou dynasty, 4th century BCE



Model of a loom from a Chengdu tomb, Han dynasty, 206 BCE to 220 CE

Wooden loom tools from Tianluoshan,
4500 BCE

Chinese silk work is depicted as early as 700 BCE



A lacquerware painting from the Jingmen Tomb (704–223 BC), depicting men wearing traditional silk dress



Painting of court ladies preparing silk,
Song dynasty, early 12th century CE



Inspecting the silk

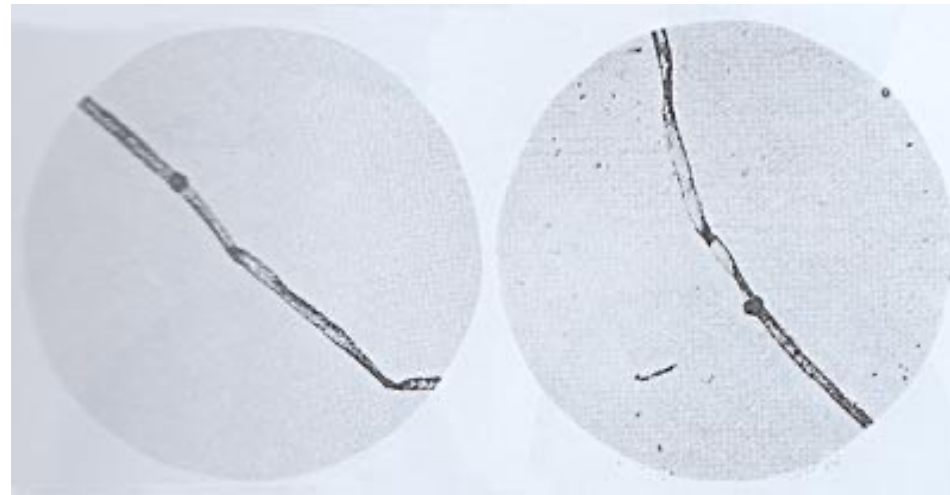
Cotton in India goes back thousands of years

"Farmers in the Indus valley were the first to spin and weave cotton. In 1929 archaeologists recovered fragments of cotton textiles at Mohenjo-Daro, in what is now Pakistan, dating to between 3250 and 2750 BCE. Cottonseeds founds at nearby Mehrgarh have been dated to 5000 BCE. Literary references further point to the ancient nature of the subcontinent's cotton industry. The Vedic scriptures, composed between 1500 and 1200 BCE allude to cotton spinning and weaving..."

-- Empire of Cotton A Global History (2015) by Sven Beckert



Fabric impression



Microscopic identification of cotton

Peruvian women in the 1970s in the area of Huaca Preita weave like in Neolithic times



A lot of the earliest writing is about fiber

- 5000 years ago, the Sumerians developed cuneiform writing
- A large portion of extant writing is about the wool and linen economy



4000-year-old example (wife to husband):
Say to Pūsu-kēn, thus says Lamassī

Kulumāya is bringing you nine textiles. Iddin-Sîn is bringing you three textiles. Ela refused to take any textiles and Iddin-Sîn refused to take another five textiles.

Why do you always write to me, "The textiles that you send me each time aren't good!" Who is this person living in your house and denigrating the cloth that I send to you? For my part, I do my best to make and send you textiles so that for every trip at least ten shekels of silver can reach your house.

Fiber in the Old Testament (? ~1250 BCE)

- Exodus 35:4 “Moses said to the whole Israelite community, ‘... Everyone who is willing is to bring to the Lord an offering of gold, silver and bronze; blue, purple and scarlet yarn and fine linen; goat hair;’ ...”
- Exodus 35:10 “All who are skilled among you are to come and make everything the Lord has commanded: ...the curtain for the doorway at the entrance to the tabernacle; ... the woven garments worn for ministering in the sanctuary—both the sacred garments for Aaron the priest and the garments for his sons when they serve as priests.”
- Proverbs 31: “A wife of noble character who can find? She is worth far more than rubies... She selects wool and flax and works with eager hands.”

Some fiber myth

- Greece: Athena and Arachne; Penelope
- Egypt: Tayet
- Navaho: Spider Woman
- Japan: Amaterasu
- China: Zhī Nǚ

The Fates (Moirai)

- Clotho "the spinner"
- Lachesis "the Allotter"
- Atropos "the Inevitable"



Some fiber etymology

- Chinese **biānzhi**: to weave or compile or put together (e.g., a plan)
- The Egyptian root for *weaving* and *being* are the same: **nnt**
- English **loom**: early 13c. shortening of Old English *geloma* "utensil, tool"
- English **clue**: 1590s, a special use of a revised spelling of *clew* "a ball of thread or yarn", originally in reference to the *clew* of thread given by Ariadne to Theseus to use as a guide out of the Labyrinth in Greek mythology
- *Flaxen* hair, *tow*-headed, *distaff* side of the family, getting *fleeced*
- Ride a **shuttle** back and forth like that used to hold the weft

Fiber is poorly preserved, but its production and use are key early human technologies



Questions and Comments?

How do we get the Fiber?

Wool: shearing, plucking

Silk: boiling cocoons and unwinding

Cotton: picking seed pods

Flax: cutting



How do we process the fiber for use?

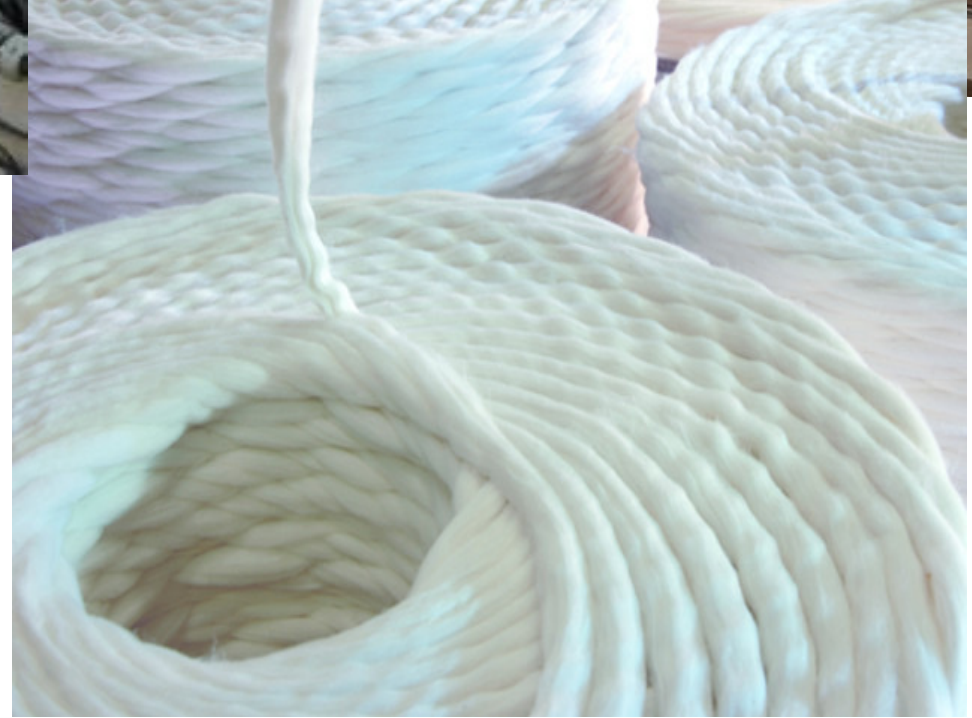
SCOURING

- **Wool:** dirt, poop, sweat, lanolin
- **Silk:** degumming
- **Cotton:** seeds
- **Flax:** fermenting, breaking up fibers

CARDING, COMBING, REELING

- Removes vegetable matter
- Fluffs and aligns fibers
- Reeling unwinds silk cocoons





How do we turn fluff into string?

Individual fibers are too short to turn to textile, so they must be attached together

- Twisting fibers together makes a cohesive strong thread
- Pulling “drafting” fibers against each other allows individual fibers to overlap and so they can be twisted together, allowing length

Drafting



Staple length



Twist



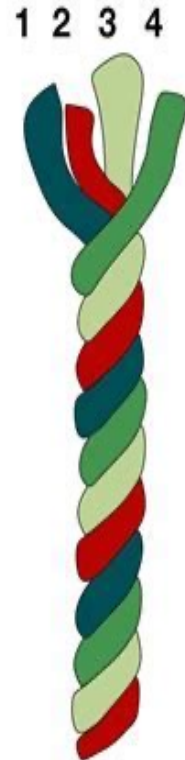
Multiple threads twisted together are stronger



ply two



ply three



ply four



How do we put twist into fiber?

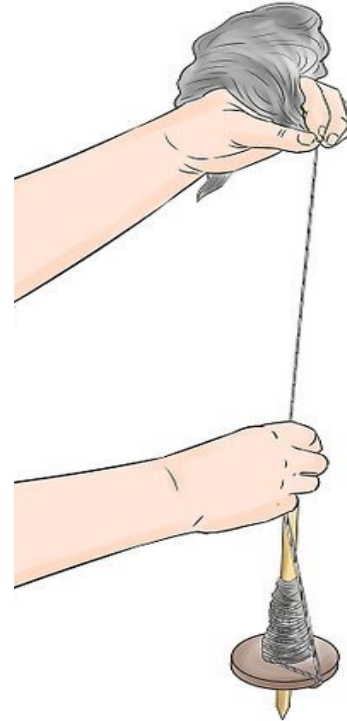
Spindle

Twist applied to a stick by hand, then transmitted to fiber

Spinning wheel

Twist applied much more quickly by turning a larger wheel coupled with a smaller whorl

Fibers drafted or pulled past each other longitudinally while twist is applied



Spinning : Spindles

Drop-spindle or free-spindle

- Spindle hangs and is flicked or rolled
- Twist into yarn as it is hanging
- Spinner can stand or walk while spinning
- Top or bottom whorl



Drop Spindle Video

Spinning: Spindles

Supported or stationary spindle

- Spinner is seated and the spindle is supported in a bowl or other container
- Spindle is flicked or rolled
- Fiber spun off tip
- Low or mid whorl



Supported Spindle Video

Drop spindles



Supported spindles



Spinning: Spindles

Thigh spindle

- Spinner is seated and the spindle is rolled between the thigh and the palm of the hand
- Fiber spun off tip
- Supported style



Navaho Spindle Video



Spinning: Spindles

Kick spindle

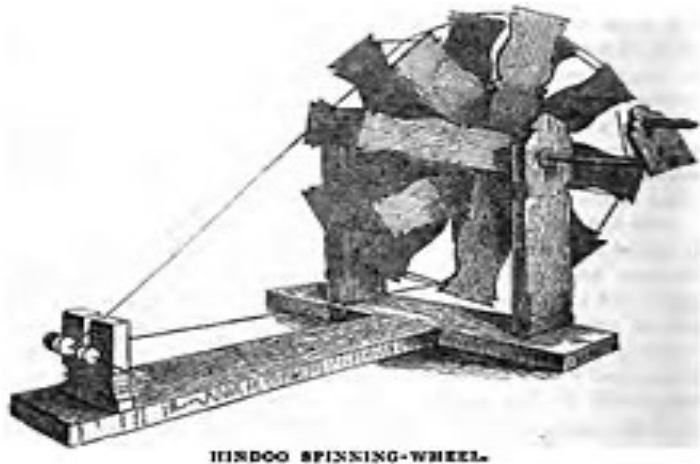
- Spinner is seated, spindle is rolled with foot
- Usually supported style

Spinning Wheel

Origin unclear

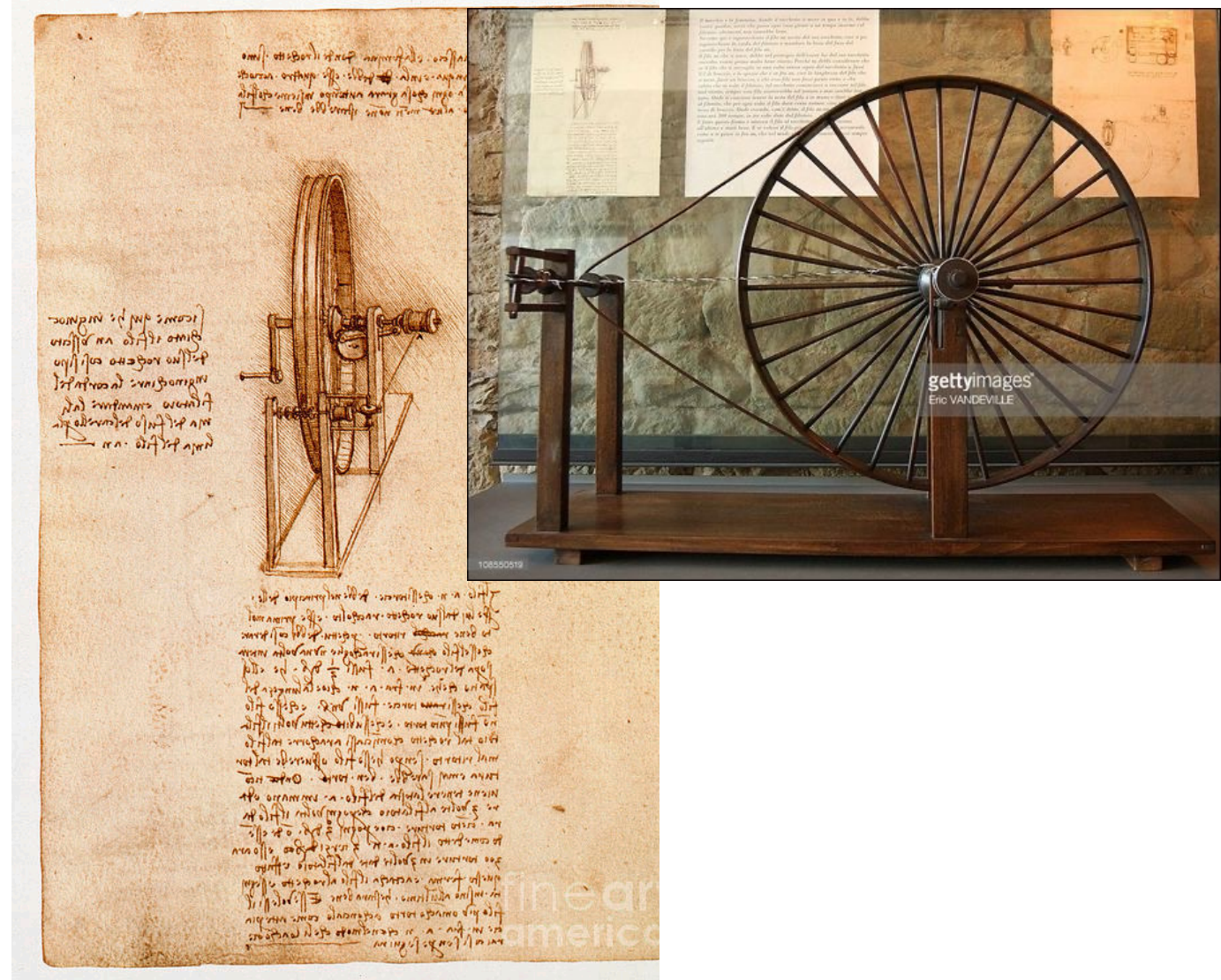
- 1000 BCE in the Levant
- 500 CE India
- 1100 CE China

Widespread use in Asia, Persia and Europe by 1100-1200



Spinning Wheel

- Leonardo DaVinci design
- Thicker band drive by 1500 in Low Countries
- Treadle added 17th C in Germany



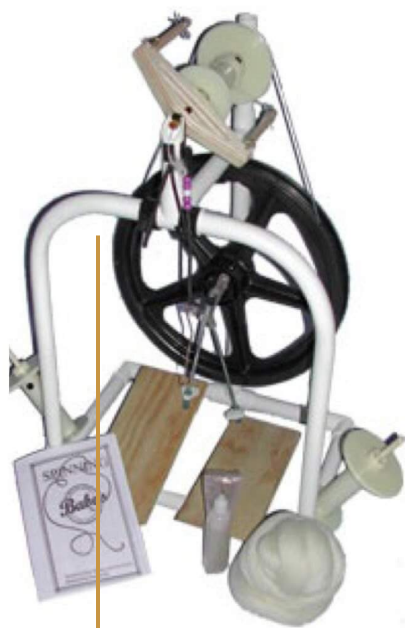




Great Wheel Video



Short Forward Draw video







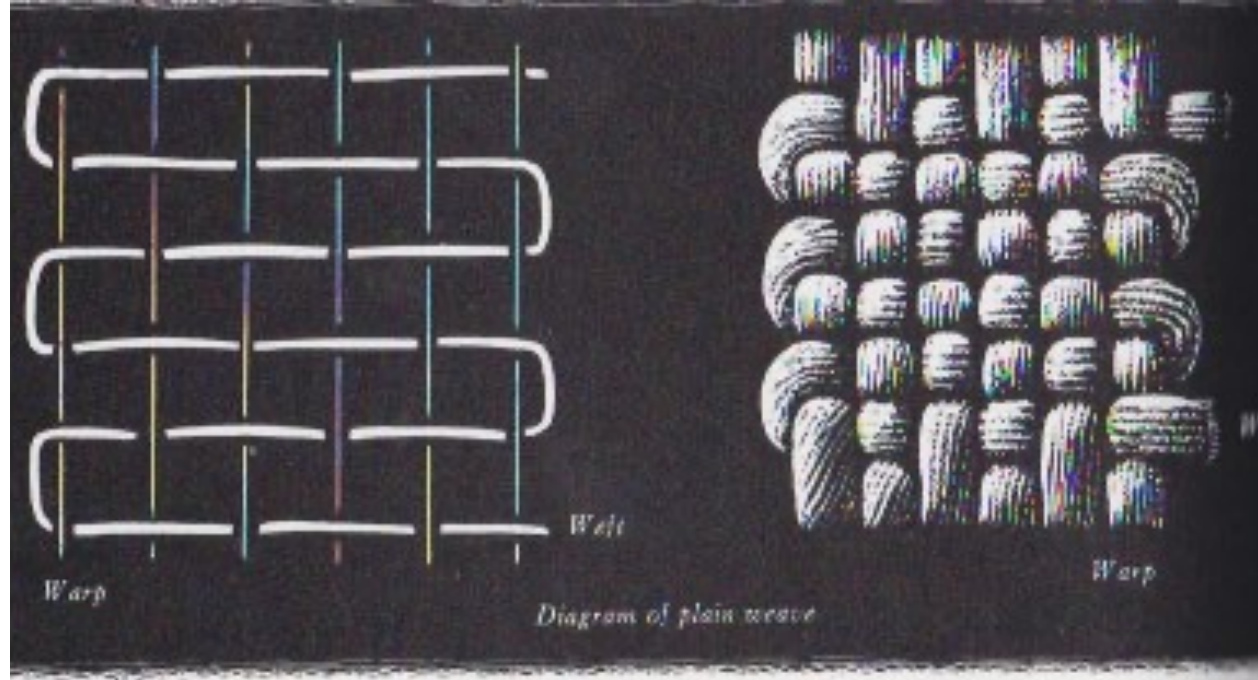
Questions and Comments?

So – now we have the string, what do we do with it?



A brief overview of weaving

- Preceded by basketry, but weaving uses continuous materials, and the product is more flexible
- **Warp**: parallel threads under tension that are longitudinal
- **Weft** (or **woof**): threads perpendicular to the warp and interlacing it; these automatically form the **selvage**



Early problems in search of new technology

- Keeping the warp threads taut
 - Warp onto some kind of loom
- Avoiding the tedium of going over and under, back and forth
 - Use a flat stick separating the even and odd warp threads to create a **shed** for pulling the weft quickly through
- Since you can't also use a stick for the **countershed** something new is needed
 - Tie loose string **heddles** around the warp threads that need to be raised to create the countershed, use a heddle stick to raise them when needed
- Keep the warp threads parallel and untangled with a **reed**
- Keep it all tight with a **beater**
- Wind the weft threads onto a **shuttle**
- Allow greater warp length and a fixed working position with weft and cloth **rollers**
- Allow greater warp width

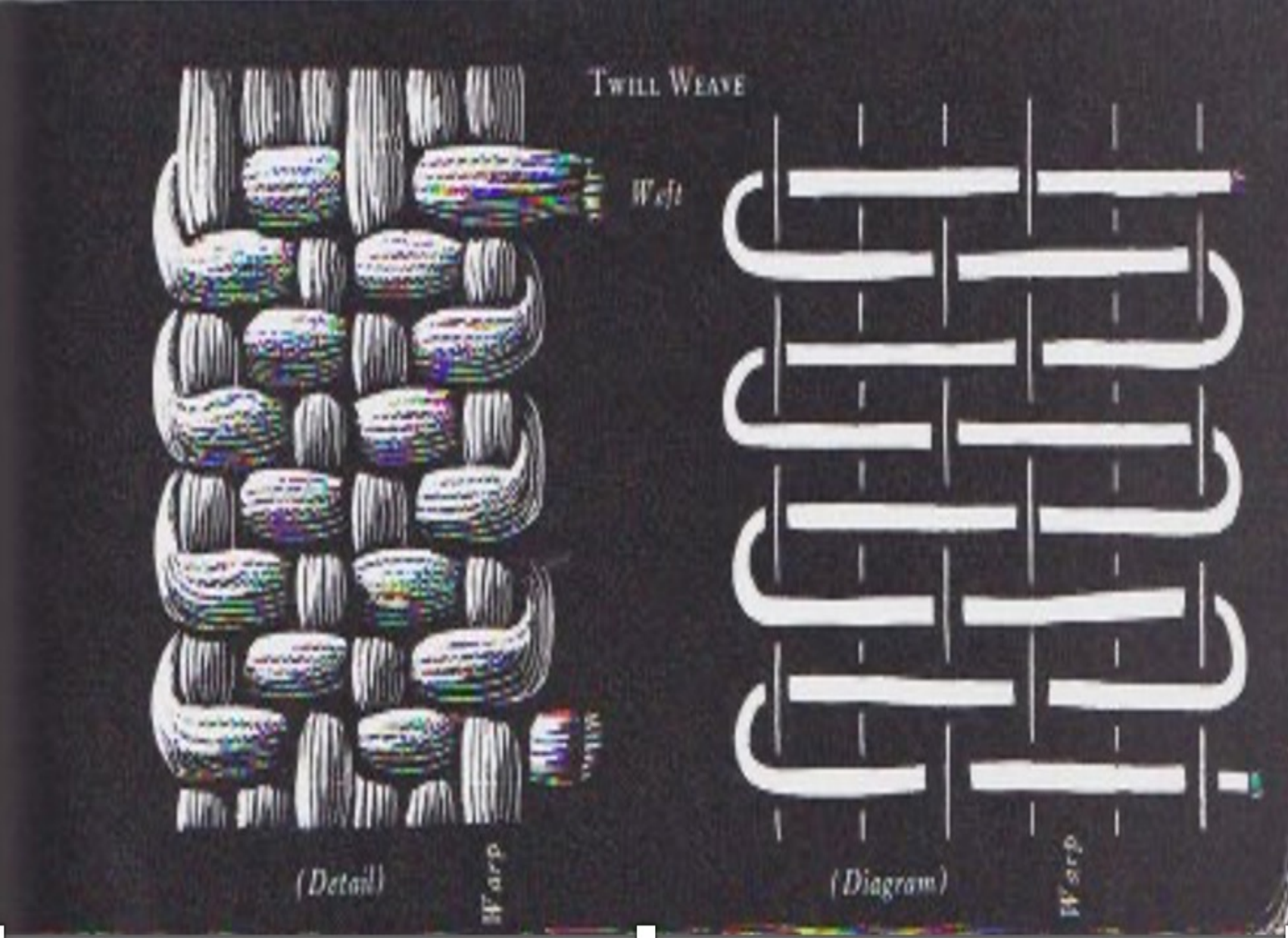
Backstrap loom (1:03) [nico 14850]

Example from Guatemala (shed: right to left, countershed: left to right)

Variations for aesthetic and/or practical reasons

- Use different types of thread for warp vs. weft
- Double up on some warp or weft threads
- Change the spacing of warp and/or weft threads
- Change the color of the threads
- Make some threads thicker or thinner
- Add additional non-structural weft threads to create **brocade**
- Use **floats**, where the weft goes over or under multiple warp threads
- Create complex patterns using multiple heddles
 - Straight over/under is **plain weave** or **tabby**
 - Alternate singles and floats (with shifts) to create **twill**
 - 4 heddles allow 14 warp shed patterns, 8 heddles allow 254

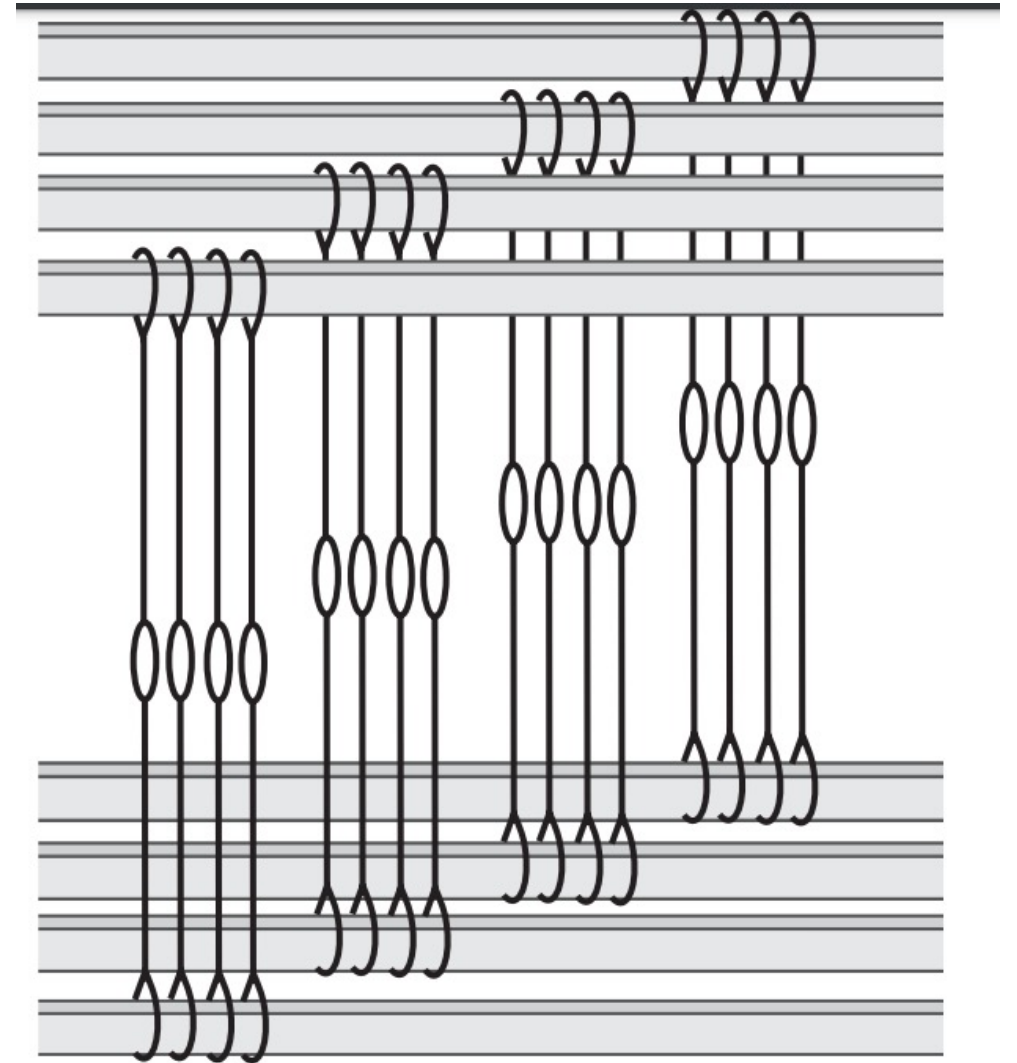
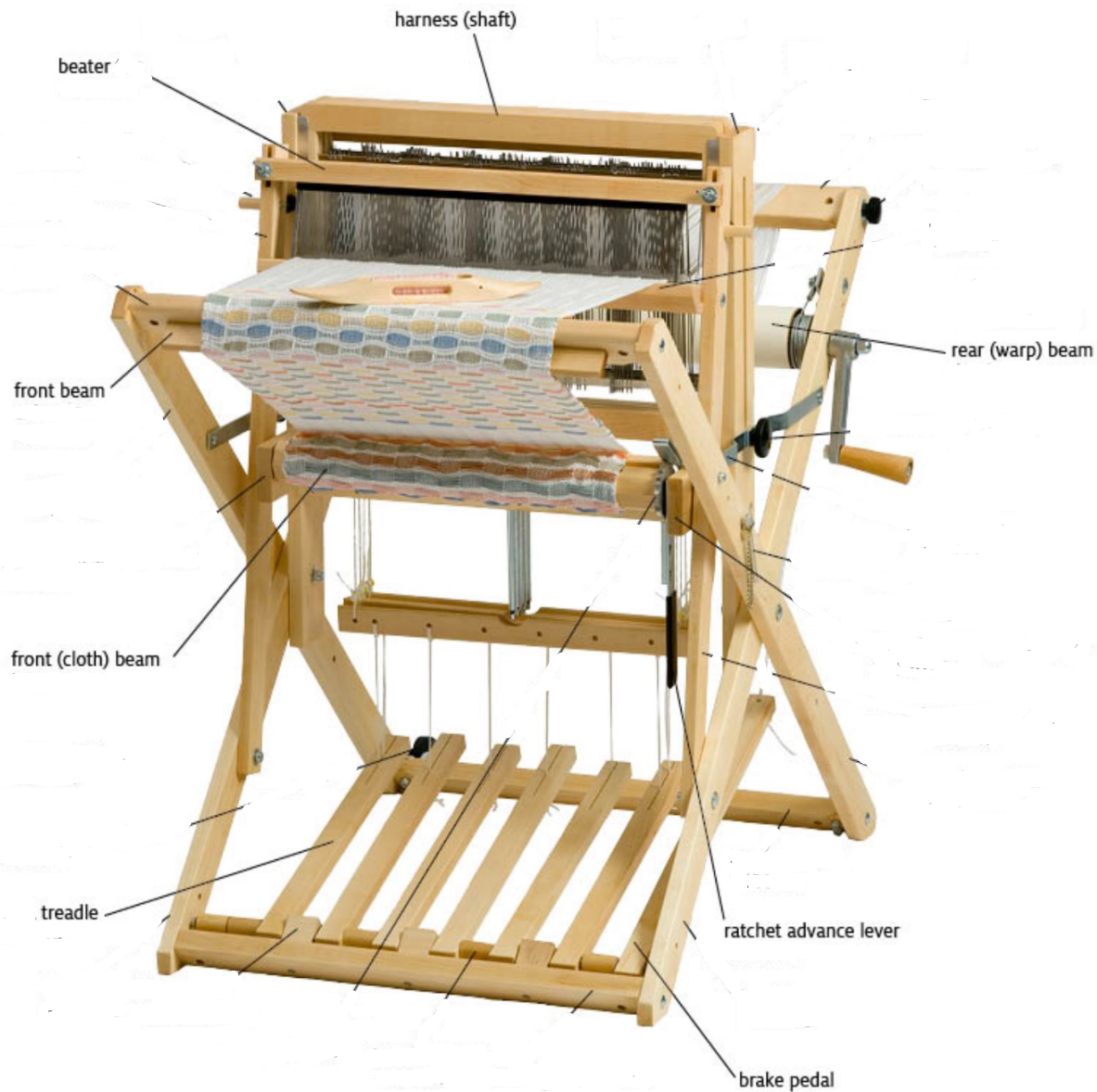
Twill weave detail



Vertical warp-weighted looms (3:47) [Intuitive
Artificer]

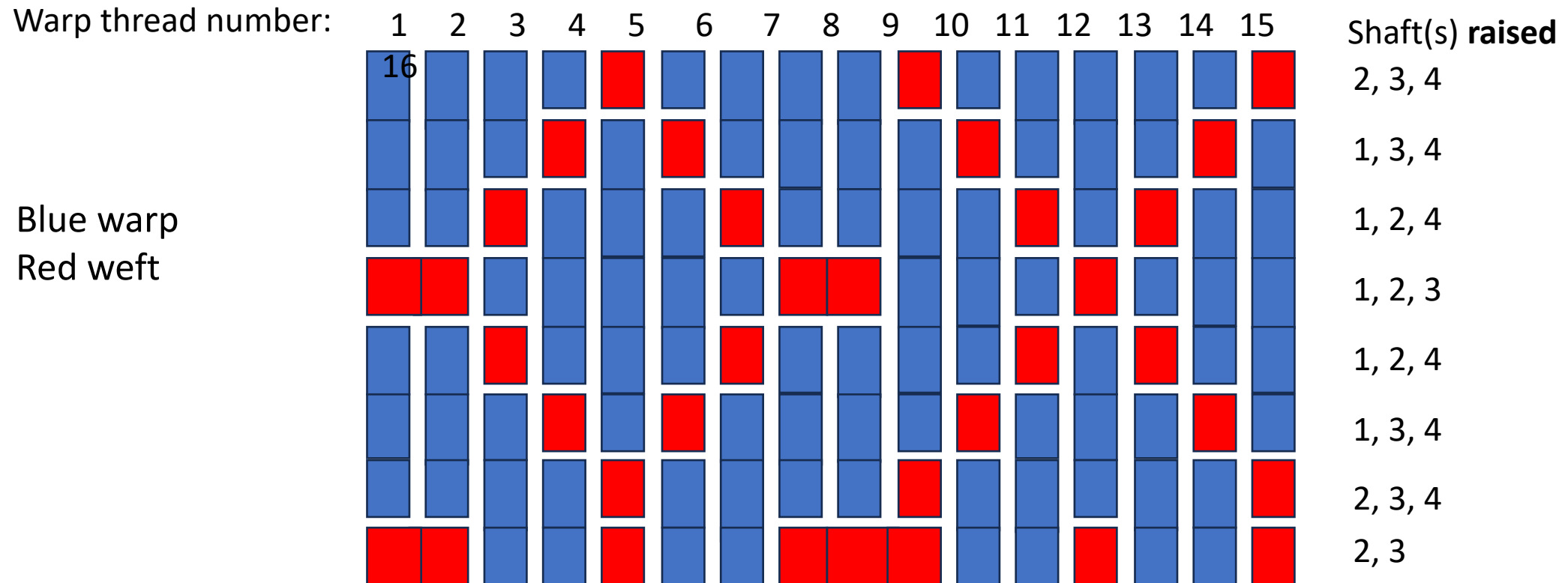
Rigid heddle loom (0:28) [Ashford]

4-shaft horizontal loom

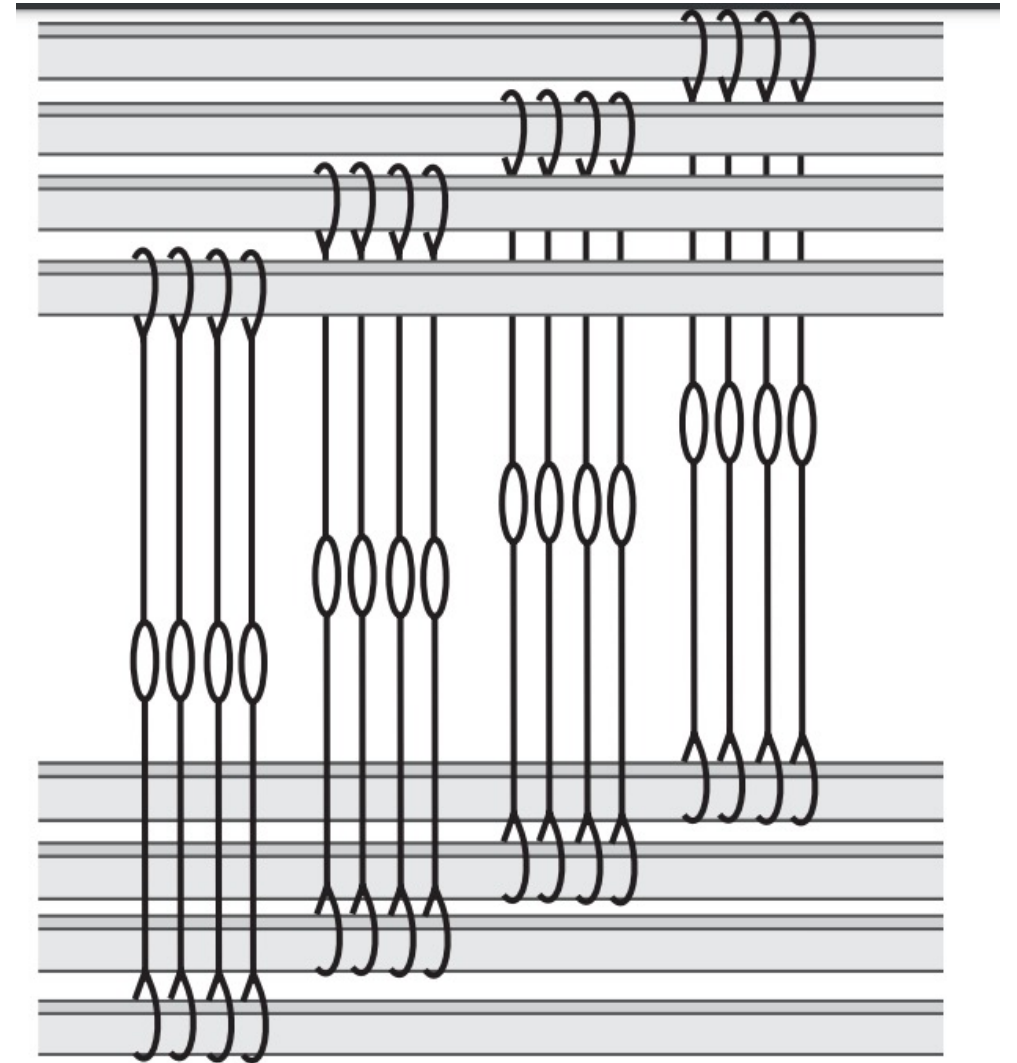
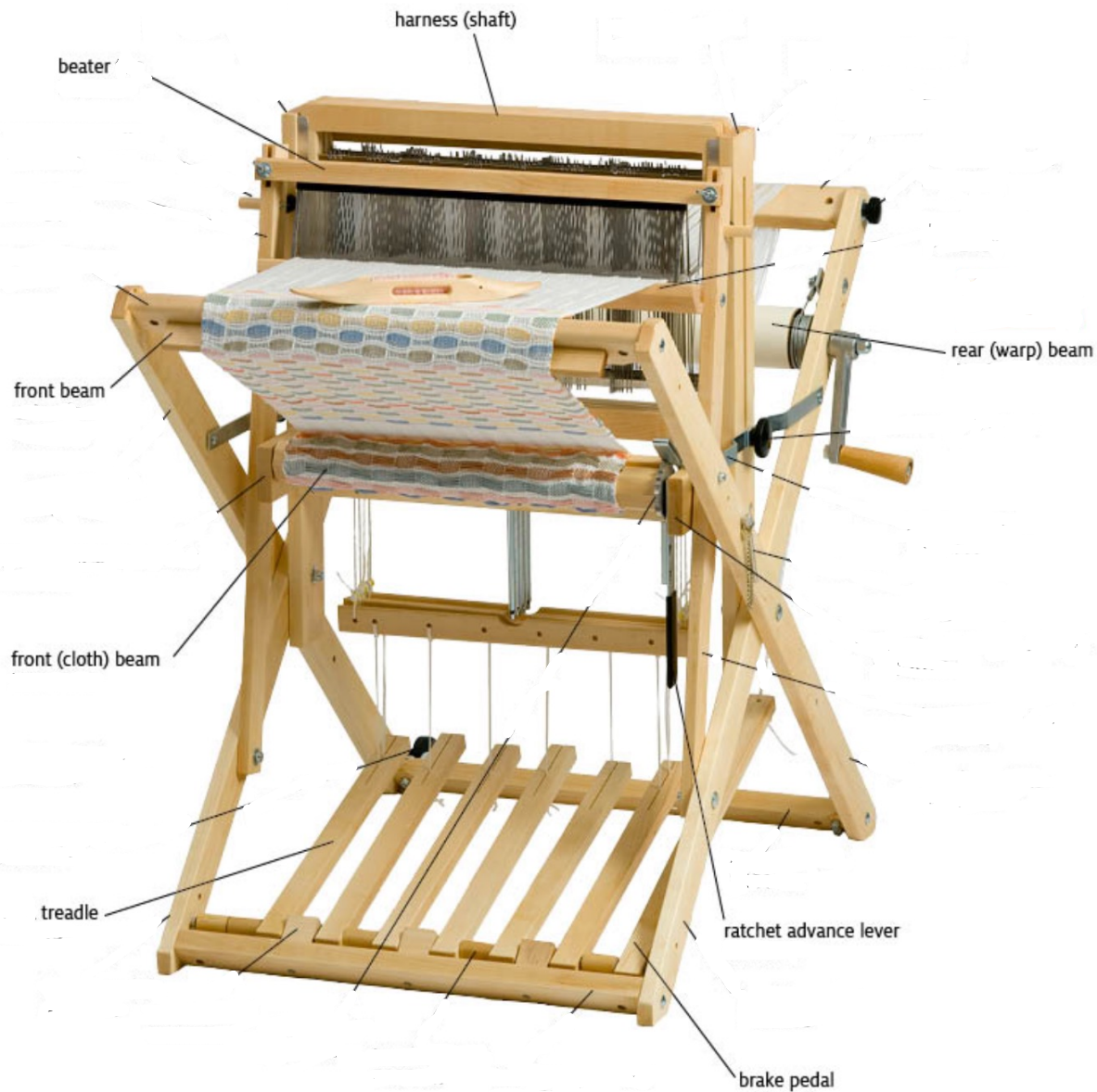


Weaving Patterns

Shaft number 4	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Shaft number 3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Shaft number 2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Shaft number 1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16



4-shaft horizontal loom



Brocade is produced using supplementary weft



Tapestry uses manual placement of multiple, colored wefts (0:26) [Rebecca Mezoff]

"The advantage of this book is that it lays out all the details and techniques in an almost circular way, so that the readers feel as though they are taking a class taught by a master."

--Booklist



Patterns can be added after weaving



Embroidery



Silk painting



Block printing

Questions and Comments?

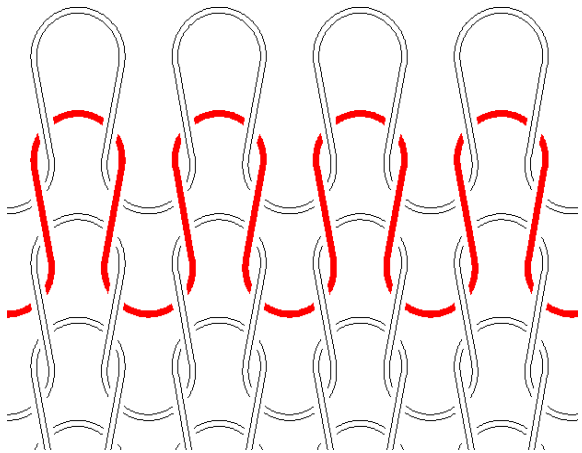
Nålebinding 6500 BCE



Egypt 300 CE

Knitting 1000-1500 CE

- Egyptian, Islamic world
- Medieval times – widely practiced
- 1500's – first knit stockings
- 1524 – first patterns published



Crochet 1800's

- “shepherd’s knitting”
- 1837 first published patterns
- Has never been successfully mechanized
- Suited to 3D



Questions and Comments?

Extra slides

Neanderthal fiber technology has cognitive and behavioral implications

- “While it is clear that the cord from Abri du Maras demonstrates Neanderthals’ ability to manufacture cordage, it hints at a much larger fibre technology. Once the production of a twisted, plied cord has been accomplished, it is possible to manufacture bags, mats, nets, fabric, baskets, structures, snares, and even watercraft.”
- Implies knowledge of seasons and processing and “requires an understanding of mathematical concepts and general numeracy in the creation of sets of elements and pairs of numbers to create a structure”
- Hardy, et al, Scientific Reports (2020), 10:4889 (<https://doi.org/10.1038/s41598-020-61839-w>)

Some fiber myth

- Athena is the goddess of weaving and wisdom
- Arachne was turned into a spider after besting Athena at weaving
- Penelope fended off her suitors by unwinding her weaving at night
- Tayet is the Egyptian goddess of spinning and weaving, and the patroness of weavers involved in mummification
- The Navaho Spider Woman taught the people the arts of weaving and agriculture
- Amaterasu, the goddess who spins and weaves sunbeams, is the supreme deity and divine ancestor of the Japanese Imperial Family
- Zhī Nǚ, goddess of weaving, is the daughter of the Chinese Jade Emperor, and spends all her time spinning beautiful silk robes and lacey garments for the Heavenly Host

The Fates (Moirai)

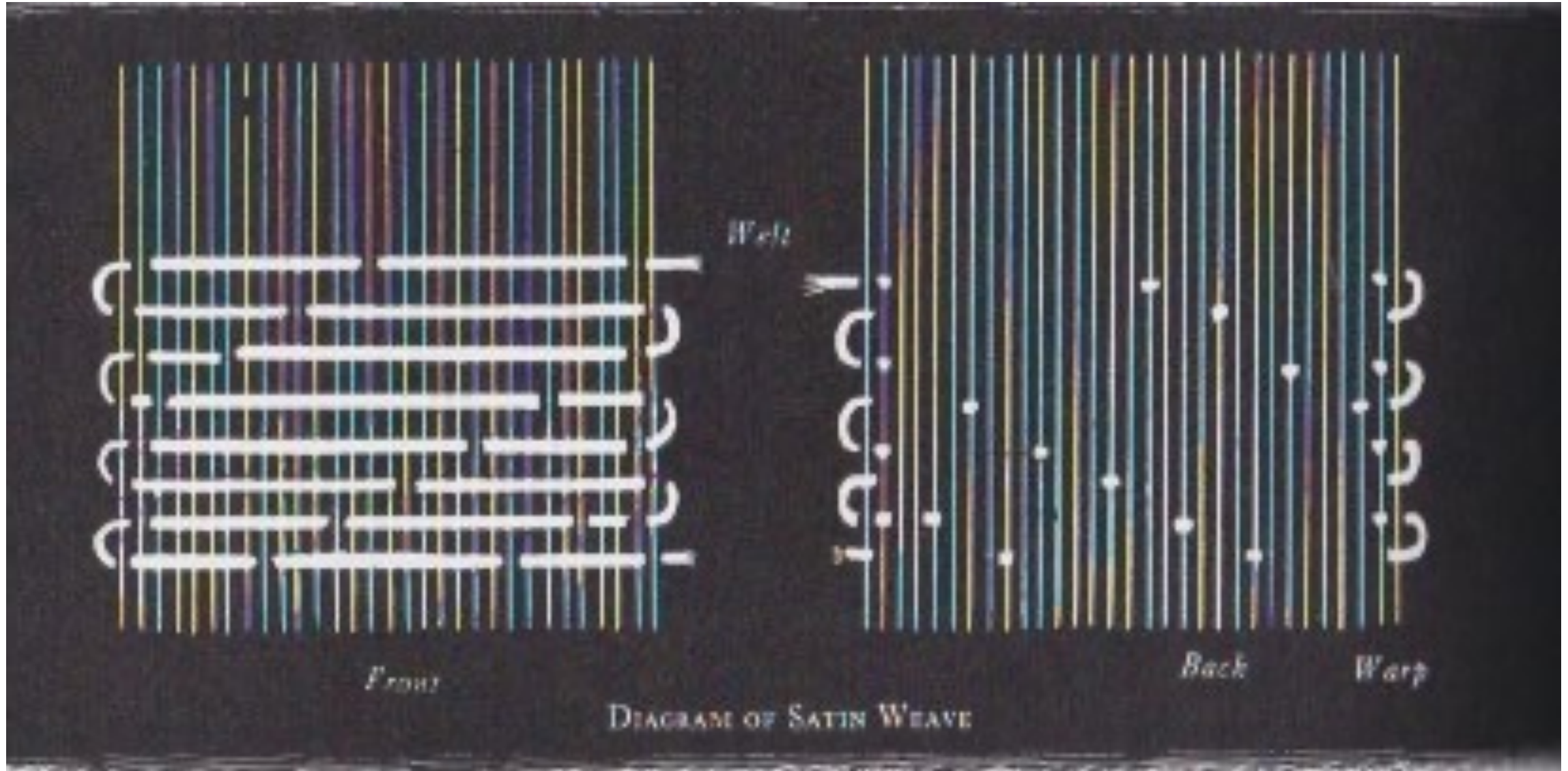
- Clotho "the spinner" wove the threads of human life while in the womb
- Lachesis "the Allotter" determines how much mortal life is assigned to the soul of each individual
- Atropos "the Inevitable" is expected to cut off the thread of life, completing the cycle and determining when a human will die. She is typically seen hand in hand with death and the Underworld. Once Atropos cuts the thread, each soul is sent to the Underworld where they receive judgement.



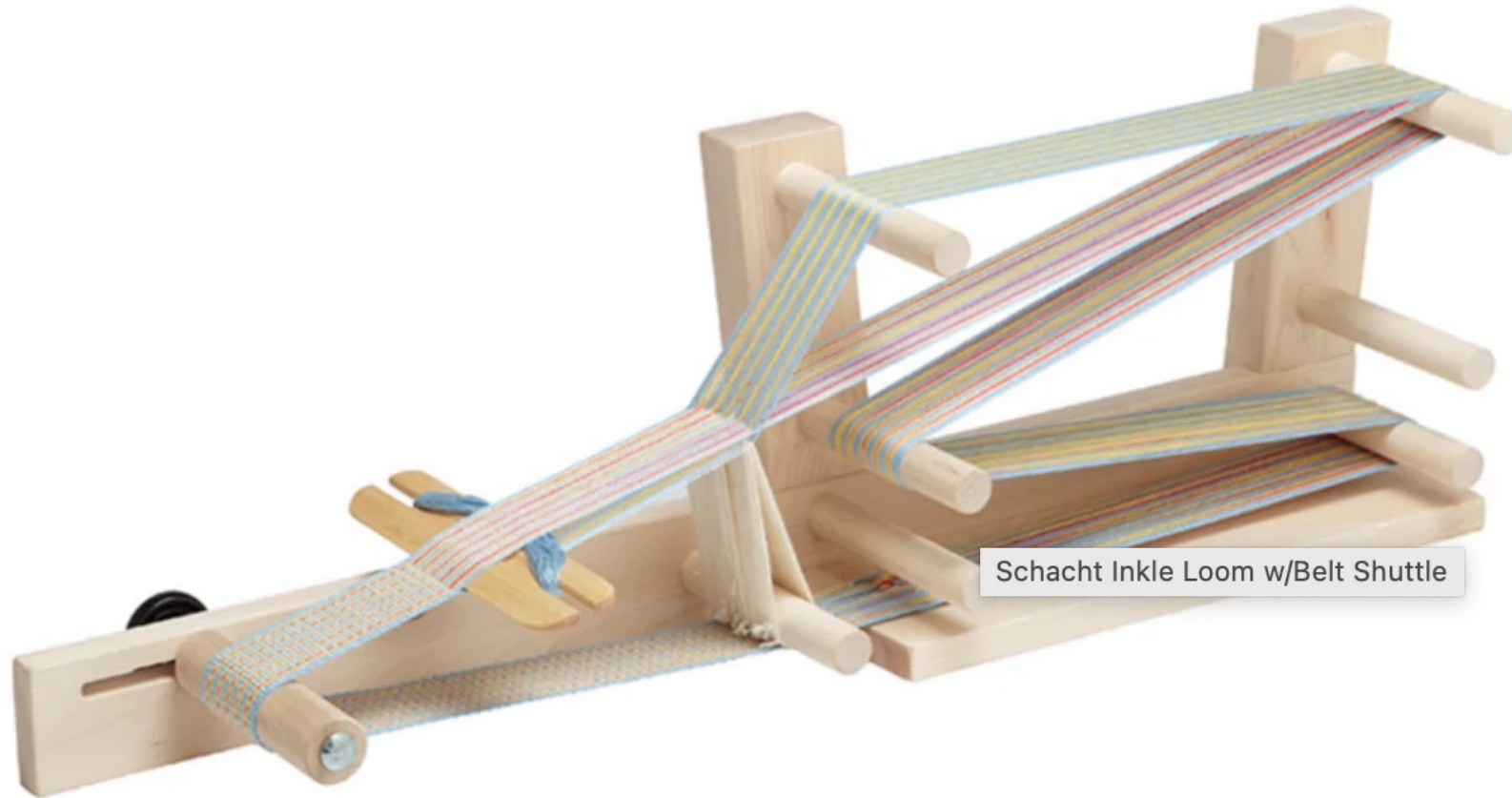
A few weeks of my reading novels

- *The Maid* by Nita Prose: “I weave my way through the throng of guests, push past the revolving door and into the lobby.”
- *The Big Sleep* by Raymond Chandler: “[His story] seemed a little too pat. It had the austere simplicity of fiction rather than the tangled woof of fact.”
- *The Last Story of Mina Lee* by Joyce Kim: “But she and her mother were now both free yet forever woven into each other. They could be both: separate and inseparable. They were not a rotten net but something more deliberate like threads of color, variations of blue, plaited, one after the other. Her mother’s death was not a knot but a temporary undoing.”

Satin weave detail



Inkle looms are a few hundred years old and weave narrow bands on a continuous warp loop with a fixed heddle



Schacht Inkle Loom w/Belt Shuttle

Tablet (card) weaving is a simple, ancient technique for sheds on narrow looms with simple tools



Figure 1: Several examples of bone tablets found at Jarlshof in Shetland, at the Broch of Burrian on North Ronaldsay in Orkney, at Harbour Broch at Keiss in Caithness, at Keil Cave in Argyll and at Tain in Ross-shire. They are dated between 200 B.C and 400 A.D. Their sizes range from 3.2 cm for the smaller round tablets to 4.4 x 5.0 cm for the largest triangular tablet.

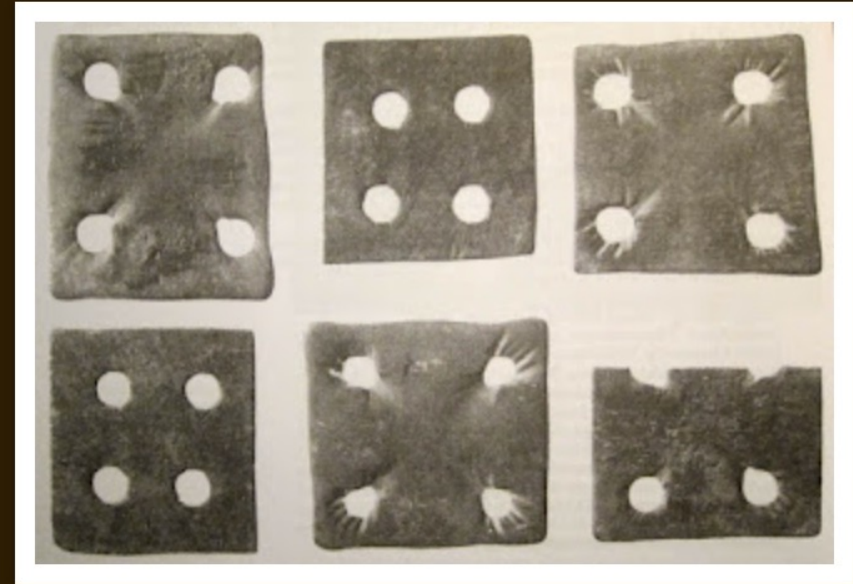


Figure 2: Wooden tablets from Antinoë, Egypt dated to the 4th to 5th century A.D.

Tablet weaving on an inkle loom (5:10) [Elewys]



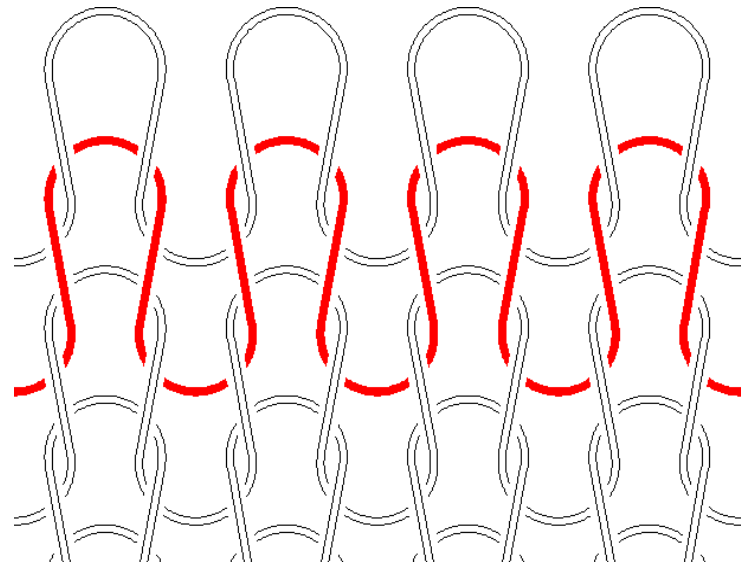
Weaving vs knitting

Weaving

- At least 12,000 years old
- 2-dimensional
- Warp and weft on a loom
- Straight yarns crisscross
- More easily mechanized

Knitting

- About 1500 years old
- 2-dimensional
- Single yarn with 2 needles
- Rows with a meandering course
- More stretch



Knitting vs Crochet

Knitting

- Two needles
- Interlaced yarn
- One row active at a time
- 1500 years old
- Basically 2-dimensional

Crochet

- One hook
- Knotted yarn
- One stitch active at a time
- 1000 (200) years old
- Freeform version is 3-d

