

TEXTILES: BEFORE THE MACHINE AGE

1. Textiles in antiquity

Definition A textile is a woven fabric, generally formed by twisted or spun threads.

Baskets and mats are also a form of weaving, and made from strands which may be twisted, although generally they are not.

All these woven products were made in antiquity, the earliest definite evidence being from Neolithic cultures of around 5000 BC.

Before weaving, clothing must have been made from skins, sewn with fine leather thongs or strands of sinew. This is most certain from Northern Europe. In warmer climates, e.g. the Mediterranean, plant fibres may have been used for sewing.

The idea of interlacing threads to make e.g. a fishing net, comes from Mesolithic times. Plant fibres were so used in Finland in that era.

In Neolithic times, communities settled in villages, produced food instead of hunting or gathering it, and so had the opportunity to develop crafts. Agriculture, pottery and weaving thus developed contemporaneously.

With the interlacing of threads by hand, basketry and fabric weaving are essentially the same process. But whereas basketry has stayed that way, weaving quickly developed to the use of some sort of loom. This may be defined as any arrangement in which one set of threads - the WARP - is stretched as a parallel system, while the other - the WEFT is passed through it at right angles, and interwoven so that the two sets of threads are held by each other.

As basketry has largely remained a craft and has not become a technology in the modern sense, we shall not consider it further, but proceed with the development of textiles woven on a loom.

Early textiles.

Earliest known are from Egypt around 5000 BC - linen, around 25 threads per inch in both warp and weft. Around 3000 BC the linen was quite fine, 88 x 50 threads per inch (warp figure first, then weft). Other specimens from Iraq and Iran and India date from this period. Looped techniques as in modern Turkish towels date from c 2160 BC in Egypt.

First European evidence is from Swiss lake-villages, c 2500 BC, - again linen. Around 30-50 threads per inch.

From Spain is evidence of tunics of esparto-grass fibre c 2000 BC.

Cotton textiles dating from around 2000 BC found in Peru. - probably also from 3000 BC in India.

Very fine linen, 280 x 80 threads per inch, was found in Tutankhamen's tomb, c 1350 BC, in Egypt. A wonderful collection of textiles (among other things) was found there.

Silk textiles originated in China many centuries before Christ, and were being exported to the west under the Han Dynasty, 202 BC - AD 220. First known in the west only as a sort of mystery fabric; the Romans thought silk was a fine down on certain leaves of flowers or trees.

Silk first made in Europe in Constantinople AD 530, starting from eggs of silkworms brought from China (or so legend has it). But until 12th century, most silk still came from Far East. Wool was widely used by Greeks and Romans, and in good fine quality textiles - but elsewhere at that period, wool textiles were coarse

Cotton also was known in Europe to the Greeks and Romans, certainly soon after 400 BC, and Pliny (AD 23-79) distinguished Egyptian and Indian cotton-plants.

"Fustian" cloth was made in Egypt from 2nd century AD with linen warp and cotton weft.

2. The basic materials.

Wool The breeding of sheep for improved wool was done by the Greeks and Romans. Grading of wool for quality was done from this time onwards, and both regions of the Continent and the area of the animal were recognized as bases for grading. E.g. English wool was highly valued in the Middle Ages and was exported to the large manufacturing cities of Flanders and Italy. English wool was further subdivided; the best grades came from Shropshire, Herefordshire and the Cotswolds: the cheapest from Cumberland, Westmorland and Durham. English wool was also further graded as "mother-wool" from the back and neck, tail and leg wool, and breast and belly wool.

In other regions of Europe, other gradings were used. Wool was removed from the sheep with shears from Roman times onwards; previously it was plucked.

By the Middle Ages there was a careful preliminary treatment of the wool, which essentially forms the basis of the present day process.

- (a) remove damaged portions; sort rest into fine, medium and coarse.
- (b) wash and degrease; for this ~~rye~~ was often used - it is water in which ashes have been soaked with lime or an alkaline solution of soda and/or potash; or urine diluted with water (1 urine : 3 water) also used. Then rinse and dry.
- (c) beat on a hurdle or cord framework with sticks to remove foreign matter and open out and loosen the fibres.
- (d) oil (with olive oil or butter): 1 part oil to 5 of wool for weft,
1 " " " 9 " " " warp.

Then the real preparation starts:

Carding:

Loosening of the tangled wool until fibres are free.

(N.B. word comes from "carduus", latin for thistle, since thistle heads were often used. Teasel more frequently used for carding.)

Metal "cards" used from 13th century, comprising a pair of wooden boards about 9 x 6 inches, with wooden handle, one side of each being covered with leather through which inclined wire teeth protrude.

Small piece of wool put on one card and pulled apart by teeth of the other. When the wool is evenly distributed over all the teeth, one card is moved the other way and collects a roll of the spongy wool. The fibres, although drawn out suitably for spinning, are crossed in all directions, so that the resultant yarn is spongy, giving the woven cloth a soft texture.

If worsted cloth is required, which is a hard cloth, the fibres must be parallel, and this is obtained by combing rather than carding. This too was done by the Romans and Greeks. Not done in medieval times until the 12th century. The wool was combed out with heated combs, and the wool which could be pulled off the combs had long parallel fibres.

Curiously, a vibrating string on a bow could also be used for untangling the fibres.

The wool is then spun and wound: we shall discuss this later.

Flax and some other vegetable fibres (e.g. Hemp, jute, sisal)

Flax is a plant, *Linum usitatissimum*, whose seeds are also well-known as the source of linseedoil. Originally the best flax was grown in Egypt, imported by Greeks and Romans. But by 216 BC, Spain was famous for its flax and linen. Grown also in Gaul and the Low Countries. In recent times, Ireland famous for it. In Middle Ages, cultivated throughout Europe. The basic treatment applies to this day. N.B. Jute is a grass, treated practically the same as flax except fibres are longer, necessitating larger machines; used for sacking, etc.

(a) remove seed - capsules by hand or by combing

(b) "retting" process now set up; this is a bacteriological or fermentative process in which sheaves (or "beets") of flax are laid in water. The fibres on the outside of the stem become loosened from the woody stem. Gas is produced during retting and makes the flax tend to float. So when done in the old days, or even now in some places in N. Ireland, in ditches and ponds, it is held down by stones. In modern factories, retting is done in concrete tanks with controlled temperature and rate of water flow, with flax held down by cross-bars.

(c) straw then dried by laying out in fields.

(d) it is then beaten or hammered against a stone or wood bench to separate and drive off the woody material loosened by retting. This process, known as "scutching", and now done by machine, has to avoid breaking the fibres.

(e) fibres then combed - and the kind of comb used changed little from ancient Egypt to very recent times. Called "hackling".

Hemp was used by Thracians 5th century BC.

For these vegetable fibres, the subsequent processing is spinning, etc. much as for wool.

Cotton

Originally grown in Egypt and India. In medieval times, grown also in Macedonia, Thessaly, Black Sea shores, and China, as well as Syria etc.,

The cotton industry was introduced into Spain by the Moors in 8th century AD, then spread to Italy and France by 12th century, to Flanders by 13th century, to Germany by 14th century, and to England by 15th century. Main supplies were from Syria and Cyprus.

For transport the cotton, which comprises the seed hairs, was pressed into bales. On preparation for weaving, this material was spread out on wickerwork or wire frames and beaten. Seeds, sand and soil passed through the mesh, and the fibres opened up. It was then carded as for wool, and spun into yarn. It was boiled in lye after this (not before).

Silk

This is the filament of the cocoon of moths of the family Bombycidae. The silkworms are the caterpillars (usually of the species Bombyx mori L.) and are best reared on the leaves of the white mulberry Morus alba.

Silk-culture did spread to Europe, and flourished in Spain in 10th century and in Sicily and Italy in 12th century. A little even reached England before the end of the Middle Ages.

The caterpillars were dormant for a long period after hatching. After the "awakening" they feed voraciously. They then envelope themselves in cocoons of silk filaments formed from a liquid secreted by special glands. The cocoons were plunged into boiling water to soften the gummy material binding them, and stirred with rods. Threads of silk adhered to the ends of these rods, and were drawn out as long filaments and wound on large open reels on which they dried. Several filaments were wound together for strength. Spinning is not necessary for silk.

1lb of caterpillars surviving the awakening gave about 12lb of silk.

3. Spinning and Winding

Spinning is the forming of threads by drawing out and twisting fibres. Drawing consists in pulling out the fibres lengthwise, which arranges them in a more or less parallel alignment. It is the twisting which gives elasticity and strength to the spun yarn, because all fibres have microscopic irregularities which cause one fibre to adhere to another when pressed by twisting.

Spinning among primitive peoples was and is done without any implement. The fibres are rolled between the palms of the hands, for example.

A simple spinning device used in ancient times is the suspended spindle. A length of fibres is drawn out, twisted by hand, fastened to the spindle and then caught under the hook. The fibres are then paid out regularly while the spindle is rotated by hand, dropped, and allowed to swing. The whorl acts as a flywheel to maintain the spin.

N.B. The length of fibres bunched together after pulling but before twisting is called a "rove" or the "roving".

N.B. A "distaff" is a larger affair which seems to have been used for holding fibres or rovings.

Spinning has always and almost invariably been women's work. Hence an unmarried woman is a spinster, and the female side of a family is called the distaff side.

The spindle wheel introduced in medieval Europe was a simple mechanization of the spindle, 13th century. "In spinning with the wheel, the right hand keeps it revolving while the left holds the prepared fibres. The unspun yarn extends from the fibres to the spindle, being held at an angle of about 45° to its axis. With each revolution of the spindle the last turn of yarn slips off the end of the spindle, imparting one twist. The fibres are drawn out as this twisting proceeds until the left arm is fully outstretched. The yarn is then brought at right angles to the spindle and the latter reversed for a few turns, to bring the yarn from the tip to the winding position, before the spun yarn is wound onto the spindle. Thus the operation is intermittent and comprises two distinct actions - spinning and winding - on. The sequence is identical with that of the spindle and whorl."

(Description from Hist. Tech III, p 203)

Later the "flyer" was introduced. Certainly well-developed by 1480; Leonardo da Vinci (1452-1519) also designed one. This was a device for imparting the twist automatically so that simultaneous spinning and winding takes place.

Silk had special machinery devised in the East, but in principle spinning and winding was the same as for wool, cotton and flax.

4. Weaving: The Loom

- A. The horizontal ground loom dates from about 3000 BC in Egypt
- B. The vertical framed loom with two beams used in Egypt by 1400 BC
- C. The warp-weighted loom dates from Troy, around 2500 BC. It is the only one of the three to be now extinct.

Referring to A, odd warp threads are lashed to a stick called the rod-heddle. When this is raised it makes a space called the "shed" through which the weft is passed. Then the rod-heddle is lowered, and the flat piece of wood called the "shed-rod" is turned up to raise the even warp threads, and the weft passed through the shed (called the "countershed" this time). This is not much different to a modern loom.

Types of Weave

The Fig. is reasonably self-explanatory.

Fulling

To felt and thicken the cloth, obliterate gaps, etc. Cloth soaked in a fluid-detergent of some kind: alkali or urine with fuller's earth (hydrated Al silicate very finely divided in nature), and then trampled. Finally rinsed. Trampling with human feet was replaced by hammering in fulling mills driven by waterwheel during the Middle Ages, but dates not known.

Process mainly for woollen cloth, but also used for others.

KNITTING

Origin unknown

Definition: fabric built up from series of loops (N.B. weaving is defined by its warp-and-weft basis).

Knitting probably originated because in early times it could give a fabric of greater elasticity and more easily fitted to human body. Early form was sprang (a Nordic term) found between 1500 and 1000 BC in Egypt as well as Scandinavia. Sprang was made on a frame of parallel threads which were later removed; and another version used rods to form a plaited sprang.

There was also a development in Peru about the same time, and this was a bit nearer true knitting.

The above were needle-knitting forms.

Frame knitting also evolved in antiquity, e.g. in Arabia perhaps in the 7th century BC. Sandal socks were known there.

Lace

Developed as a form of knitting, and reached a great height in Florence in the 16th and 17th centuries AD.

The first knitting machine was devised by Wm Lee in the reign of Elizabeth I - he died in 1610 or thereabouts.

Nowadays, needle-knitting at home competes with sophisticated knitting-machines in factories.

Reference

"A note on knitting and knitted fabrics" by J. Norbury,
Hist. of Tech, Vol. III, pp 184-186.

Other References at end of Textiles II.