

# WEAVING and DESIGNING of TEXTILES.

## 1. Primitive Textiles.

### a. Materials.

#### 1. Linnen.

##### Vegetable Fibers.

##### Cotton.

##### Linen.

#### 2. Woollen.

##### Animal Fibers.

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## I. Primitive Textiles.

## A. Materials.

## 1. Leaves.

## Vegetable Fibers.

Cotton.

Linen.

## 2. Skins.

## Animal Fibers.

Wool.

Silk.

## II. Primitive Machinery.

## III. Progress of Textile Manufacture.

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Weaving and Designing of Textiles.

Cotton Spinning.

Personal Observations in the Woolen Mills.

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The earliest form of clothing used by man was leaves and coats of skin, and these rude garments form the basis for the textile fabrics of all future generations. They represent the two types of fibers used in the manufacture of textiles. The leaves represent our vegetable fibers used in the making of our cotton and linen cloth. While our woolens, formed from animal fiber, are direct descendants of the coats of skin. The fig leaves, used for clothing in primitive times also represents the food of the silk worm from which we obtain that form of animal fiber which gives us our silken tissues.

In Asia the keeping of sheep for the production of wool was carried to great extent at a very early time. In Egypt it seems to have been a part of the religion of the people not to wear sheeps wool and so they cultivated vegetable fiber, and from them we get our fine linen and broidery work. The Hindoos worked in cotton while the Chinese, at a very early period, brought the manufacture of silk to great perfection.

The art of spinning and weaving is of great antiquity among the Chinese, Hindoos and Egyptians. Egypt seems to have been the cradle of textile manufactures, "As she is of nearly all known arts." The machinery used in the manufacture of primitive textile was very rude. In spinning the coarsest yarns a large, clumsily constructed one thread wheel was used. For the fine yarns, the spindle, which had been in existance, from time inmemorial, was used. This spindle, in the earliest times, was composed of a piece of wood weighted at one end with a bit of clay. Later an iron spindle was substituted.



The Hindoos were very slow in regard to invention, and rarely improved on machinery after it left the inventor's hands. The distaff, spindle, and rude wheel continued to be, for ages, the only instruments by which yarns were produced. In 1530 the domestic hand spinning wheel was invented. In this the spinner took the thread with the finger and thumb of the left hand and drew it toward her, while with the right hand she turned the wheel. She extended and twisted repeated portions and as they were twisted wound them upon the spindle. Toward the close of the century the Saxony wheel was invented, and it was supplied with a "flyer" by means of which the twist was put in the yarn, and the yarn wound upon a bobbin. It was also provided with a tread. A later invention wound the yarn upon a barrel in even layers. Later a second spindle was added by means of which two threads could be spun at once. In 1678 a spinning machine was invented which lessened labor one-half.

Arkwright's invention revolutionized textile manufactures at about the same time Hargraves invented the spinning jenny. The next improvement was the combination of Arkwright's and Hargrave's inventions. From this time improvements in spinning machines have been made until it has been brought to the present efficiency.

The Egyptians claim to be the inventors of the loom - it was used by them at an early period - and was a very rude machine, consisting of a frame in which the warp was stretched, and a stick which served as healds, shuttle, and batten. The loom was held in either a perpendicular or horizontal position. Later the Romans invented a form of shuttle and used cones for separating the warp threads.

The next great step in weaving was the introduction of the



fly shuttle. It was followed by the changing shuttle by means of which the color of the woof could be changed without stopping the machinery. By Jaegsuard's invention the power of producing patterns was unlimited. The invention of the power loom, by Cartwright brought about a great change in weaving, and increased the production of textile manufactures. Many inventions have since been added until the loom has reached a high state of perfection.

Wool is a form of hair obtained from such animals as sheep and goats. Under the microscope it is found to be a small tube covered with scales. Sheep's wool is irregular and curly with marked tooth-like edges formed by the scales. This tendency to curl and the peculiar barbed condition of the fiber gives wool a commercial advantage for matted and felted fabrics. These are the carding wools. The combing wools are the long staples in which the fiber is straight and the barbs less marked. These wools are used in the making of the hard finished fabrics such as worsteds.

In obtaining the wool from its natural source the sheep are first thoroughly washed and dried before shearing. The animal is then caught, and with large shears the fleece is clipped at the center of the breast. First one side and then the other is clipped to the center of the back and the fleece slipped off like a loose overcoat. The fleeces are then baled and shipped to the factory. Here the bales are first sent to the sorting room, opened and the fleeces sorted. The wool is then put in a large tank of hot soap suds or mild alkali and thoroughly washed to dissolve out the oil. It is then rinsed, and passed between pressing rollers to remove the water. If the wool is not to be sent directly to the dyeing room it is thoroughly dried by means of the centrifugal drying machine which consists



of a wire netting through which hot air is passed by means of rotary fans revolving over hot air pipes. For those goods which are dyed in the wool the fiber is now ready to be sent to the dying room. Here the treatment varies with the color of cloth desired. The wool is then rinsed and exposed to the air.

In making a desired color of cloth the exact proportion of each constituent color must be known. This is found by weighing out the different colors of wool and blending them together until the exact color is obtained. When the exact proportion is determined the wool is weighed out in large quantities and bedded in layers on the floor of the picking room, where it is sprayed with oil to replace the natural oil removed by washing.

The next process is teasing. The wool is taken from the edge of the layers and fed upon a large drum studded with teeth over which passes smaller cylinders with teeth which pull the wool apart. Revolving beaters force blasts of air through it which assist in the mixing. From this machine it is forced into a closed bin in a fine fleecy cloud.

The fiber is now ready to begin its way through the various machines by means of which it is brought to man, as the finished textile. The first process in textile manufacture is the "carding". Each set of cards consists of three machines, in which the product of one becomes the supply of the other. In each of the cards the important parts are one large cylinder with half a dozen small cylinders arranged about its upper part. Each cylinder is covered with wire cloth through which protrudes iron or steel bristles. The first card is provided with the "Bramwell feed" a device for weighing the wool and feeding the machine evenly. The wool passes between the cylinders,



the fibers are pulled and straightened and delivered from the machine into a tube which revolves slowly producing a loose rope, which is wound into loose balls or passed by means of pulleys to the next card. In the second card the work of the first machine is carried still farther. The wool is more finely divided and a more compact rope, or sliver, is produced. This enters the third card - or finisher - by means of a transverse feed which deposits the fiber criss cross and one layer upon another in the machine. This will cause the fiber to felt when the time comes. In passing through this machine the fibers are divided into two sets of strips, which in turn are formed into very loose threads of yarn by means of rollers. This yarn is wound upon long spools and is ready for spinning.

The Spinning machinery for wool is derived from that used for cotton spinning, with variations to suit the woolen fiber which is not strong enough to stand much of a strain. Spinning is the drawing out and twisting of the yarn to make it stronger and finer. The Spinning mule of today is an enlarged form of the old spinning jinny and consists of a frame one hundred feet in length, upon which the spools of "roving" are placed in rows. Opposite this moves the carriage or frame bearing the spindles. Upon each spindle is a bobbin to which is attached the end of the roving wool, which passes from the spool, between rollers on the frame. Each frame moves on a little track of its own, and receives its motion from the "head-stock". The rollers give out the thread, the spindles revolve and cause the bobbins to whirl and the thread is loosely twisted. The frame moves back one half of its distance, when the rollers cease giving out thread and the twisted thread is then drawn out one half its former length. By an automatic motion the twisted thread is wound upon the



bobbin. The frame moves back to its original position and the process is repeated until the bobbins are full. The amount of twisting required varies with the purpose for which the thread is to be used. The threads used for warp are much more twisted than those used for the woof. The warp thread is now taken, threaded in the "heck", and stretched in the loom. The woof bobbins are placed in the shuttle and we are ready for the process of weaving.

In weaving there are three primary movements of the loom. Shredding, picking and breaking up. Although breaking up is the last of the three motions, in describing the process of weaving we begin with it. When the beater is in contact with the cloth all parts of the loom are stationary. The lay begins to move back and all the parts begin to act. The first motion is shredding, or the separation of the warp threads to form a passage for the shuttle. The "tappets" open the shed and by the time the "lay" has reached the center of the stroke, have completed their action. The shed remains open until the "lay" reach<sup>es</sup> the same point in the return stroke. The second motion is picking, or the propelling of the shuttle from side to side of the loom. As soon as the shed is entirely open the shuttle leaves the box and passes to the box on the opposite side of the loom, leaving behind it the woof thread. The lay moves back and the beater beats the woof up to the cloth. As the cloth is woven it is wound upon a roller. After the cloth is taken from the loom it is "perched" and all imperfections marked. It then goes to the "burling" table where the imperfections are removed. It is then put in the "fulling mill", a large cylinder over which the cloth passes, as a belt, in rough folds. Another cylinder works over this and the cloth is thoroughly rubbed together. It is full<sup>ed</sup> in both length and width, the amount of full-



ing depending upon the cloth. The next process is "teasling", the rubbing up of the "nap". If the cloth is to be smooth the nap must be sheared. This is done by passing the cloth over a cylinder, which works against a series of stationary knife edges. After shearing the cloth is passed through a steaming and brushing machine, and if it is to be dyed in the piece, is then sent to the dyeing room where it is run through the "dye" in the same manner in which it is "fulled". It is subject to a final inspection and is then folded and pressed between heated rollers, wound upon thin boards, and is ready for market.

The description of woollen manufacture will serve to illustrate the manufacture of other textiles, such as silk, cotton, and linen. The process is practically the same in all cases. The treatment varying only in detail.

Silk is a form of animal and vegetable fiber and under the microscope is an even double filament of gum which is exuded by the silk worm. In the manufacture of silken textile there are two distinct industries involved. That of agriculture - in raising the mulberry trees and the silk worms - and that of the silk manufacture. The silk worm is a tiny manufacturer himself, and obtains the material from which he spins his "cocoon" from mulberry leaves. This material he stores as a gummy secretion in large glands on either side of his body. These glands end in a spinner in the mouth. The worm spins about himself a silken shell of this gummy secretion, spinning from the outside toward the center and the nearer the center the finer the thread. The cocoon is a white or yellowish fuzzy ball, containing a long continuous thread of silk. The cocoons are gathered and if the silk is to be reeled, are dropped into a vessel of hot water to dissolve the gum. They are gently stirred and the ends of the threads are detached. The thread from a number of cocoons, the number



varying with the size of thread required, are reeled off together. For machine silk two threads are used. In spun silk, the cocoons are treated the same as wool and cotton fiber, are baled and sent to market. When the bales are opened they are cleared of dirt, and then emptied into large vats of boiling soap water, where they are kept constantly stirred by means of machinery. They are then rinsed in clear water and dried in the centrifugal drier, and are then spread in a drying room for one week. They are now ready to be beaten and combed into sheets. This is done by means of the "lapper". The next process is carding. The material is carded several times, and the loose fluffy silk of the card passes to the "spreader", the product of which is a thick loose tape of fiber. The tape then passes to a "drawing frame" which evens the laps and reduces them to a sliver. This is repeated through several machines until the sliver is very fine and is ready for the "roving frame" in which it is made into yarn. The yarn is spun, reeled into skeins, and sent to the dye house. In silk dyeing the work is all done by hand. After dyeing the yarn is washed and dried and is then ready for weaving. The weaving of silk is very similar to that of wool. After the cloth is woven it is taken from the loom and finished. The first processes are "gassing" and "burning". In "gassing" the cloth is passed quickly over a gas flame to singe off the stray filaments. It is then treated with a steam spray of gum and shellac. Is pressed and is ready for market.

Cotton is the vegetable wool of commerce, and furnishes a large per cent of the textiles used by man. The cotton plant is a shrubby bush about the height of a man. The blossoms are nearly yellow, though they vary in color. The pod constitutes the center of the flower, and is divided into three seed vessels. In these vessels



the seeds are surrounded by a lock of cotton. The seeds grow by depositing layers on the inner surface of the outer covering. In the center of the seed is a milky fluid. This disappears as the seed matures. The fibers appear as cells upon the surface of the seed, these cells become elongated, and finally fill the seed pod with a tangled mass of young cotton fiber. When the seed pod breaks we have a white, fluffy ball of cotton. Under the microscope the cotton fiber is seen as a twisted ribbon, with corded edges. The corded edges adapt it for lapping and forming a strong thread.

Cotton is best raised upon light sandy loam. The soil is prepared during the winter months and the seed planted in the early spring. The picking season begins about the last of July, and ends with frost. After picking the cotton is stored until it can be "ginned" - this is the process of removing the seeds. It is then baled and sent to market. At the mills the bales are opened and the cotton thoroughly cleaned and mixed. It is then "scutched" to form a "lap" or "sheet" which is then wound on a roller. The next process is carding which is very similar to woolen carding. "Combing", "drawing", "slubbing" and "roving" are processes by means of which the sliver is attenuated and twisted before it is ready for the spinning.

The processes of spinning and weaving in cotton are closely allied to that of wool, and need not be described here. From the loom, the cloth is taken to the cleaning room where it is thoroughly washed and dried. If it is to be dyed it is now sent to the dyeing room, or if to be printed, as in the case of calico, to the printing-press. After dyeing and printing the cloth goes to the finishing room where it is treated with a finishing mixture and is then pressed and ready for market. There are a large number of methods for finishing cotton fabrics. The finishing varies with the material.



In designing all textiles the pattern to be woven in the fabric is first made upon paper in colors. Then it is reproduced in a small piece in the experimental weaving room. If the pattern works out alright a design of the pattern is made on a large scale and all materials necessary to produce the result is estimated. The kind of weave, the variety of yarns used for the woof and warp, the color required, the number of times the pattern is repeated in the width and in the length of the cloth, and the amount of material, all are determined by the designer.

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