

Textile Weaving—

Primitive and Modern.

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Primitive Methods—

Fabrics of the early peoples.

Manufacture and tools used.

Progress made.

Invention of loom.

Modern Methods—

Silk Culture.

Date of origin.

Source of silk.

Early production.

Methods of manufacture:

reeling, throwing and dyeing.

"Man in his natural state has few wants to provide for, food and clothing being the principal ones; to provide the latter in a suitable form is a subject which occupies a considerable portion of time in civilized life. One writer observes that, 'though we find finery and external adornments common to every people, yet comfortable clothing is almost exclusively confined to the inhabitants of those portions of the globe which are far advanced in civilization.'"

Man's first article of clothing seems to have been fig leaves and immediately afterward the skin of beasts. Spinning and weaving were undoubtedly the earliest arts known to man and at the present day they are among those arts which form the main distinction between savage and civilized life.

At an early period manufacturers of goats' hair used to make tents similar to those the Arabs of the present day are in the habit of constructing. This fabric is supposed by some to have been spun and woven according to the worsted process, resembling to some extent the manufacture of mohair at the present day as distinguished from the making of woollen or felted goods.

The art of weaving is of great antiquity among the Chinese, Hindoos and Egyptians having been practiced by them for thousands of years. Pliny says the Egyptians were the inventors of

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weaving; "that they put a shuttle in the hands of their goddess, Isis, to signify that she was the inventress of weaving."

However as this is one of the arts of which, if Egypt was not "the mother" she was certainly "the nurse" as with the Egyptians, the Chinese and the Hindoos, spinning and weaving were carried to great proficiency and the productions of the distaff and the primitive loom would compare very favorably for fineness and delicacy - if they would not indeed surpass, the productions of the modern manufactures.

Not only in the civilized portions of the New World but among savages the practice of weaving is to be found. The Mound-builders clothed themselves in part at least, not in skins like the Indians, not like the Sandwich Islanders, in cloth made of the macerated bark of certain trees, nor like the dwellers of the Swiss Lakes, in matted sheets of vegetable fibre but in cloth spun with uniform threads of warp and woof.

From some mounds in Ohio were taken charred specimens of cloth which appeared to be composed of some material allied to hemp. The thread though coarse was uniform in size and regularly spun. Two modes of weaving were recognized: in one by the alternate intersection of the warp and woof; and in the other the weft is wound once around the warp - a process which could not be accomplished except by hand.

The art of spinning and weaving was also practiced by the Peruvians when their country was first invaded by the Spaniards; and the samples of cloth and the distaffs on which the thread was spun, are associated with the oldest monuments.

In the burial places are found numerous mummies in a sitting posture wrapped in many folds of cloth with an exterior covering of coarse matting. The cloth is woven with warp and woof, the thread being twisted or spun and often wrought into a variety of patterns. The fabric consists of the wool of the llama or alpaca and perhaps in some instances cotton, which there, is a native. In this connection it is not unusual to find spindles with the yarn upon them; these are sticks nine or ten inches long at one end of which is a button.

It is not necessary to suppose that complicated machinery is required to produce a good textile fabric. The Hindoo at this day, without much effort, manufactures a loom by employing two bamboo rollers, one for warp and one for the woven cloth, with a pair of treadles for parting the warp to permit the weft to be drawn across between the upper and under threads. The shuttle is a slender rod like a large netting needle rather longer than the web is broad and is made use of, as a batten or lay to condense each successive thread or weft against the closed fabric.

He carries this simple apparatus with his water

pitcher, rice pot and hooks to the foot of any tree which may afford him a comfortable shade. He then digs a large hole to receive his legs along with the treadles or lower part of the harness; he next extends his warp by fastening his two bamboo rollers at a proper distance from each other with pins, into the sword; he attaches the treadles to a convenient branch of the tree overhead, inserts his great toes into two loops under the gear to serve him for treadles; lastly he sheds the warp, draws through the weft and beats it close up to the web with his rod-shuttle or batten and thus makes a cloth which formerly found its way to the European markets.

It is not known precisely in what manner the mound builders carried on the process of spinning and weaving, but numerous implements were used, some of which are square, oblong, oval, cruciform or lozenge shaped and most of which are highly finished.

It is almost certain that the textile manufactures received a great impetus in Egypt - the Cradle of nearly all known arts - from whence in course of time as a necessary consequence of war, revolution and increase of population in other parts of the globe they became extended throughout nearly the whole of Asia and from thence to Italy, Portugal and Gaul keeping steady pace with the march of civilisation.

The woollen manufacture in Europe appears to have been first established in Italy from whence most other countries of Europe were accustomed to obtain their best description of clothing. Among the Italian cities engaged in the manufacture or merchandise of woollen and worsted, Venice stands preeminent.

The textile fabrics of both the Greeks and Romans were almost entirely of woollen. For six years after the Romans retired from England, history is silent upon the subject of textile manufacture. But from the time of Alfred the Great even to the commencement of last century most of the spinning of wool was done by women and their industry was only equalled by their skill, it being the pride of a good spinster to make the first yarn and plenty of it.

For a considerable length of time the progress was steady: sometimes progressing rapidly then again declining until about 1597. From this time forward the manufactures of England made rapid growth and marvellous indeed was the increase of English trade. New branches of industry sprang up and developed themselves in quick succession and thus laid the foundation of a national prosperity, the like of which the world had never witnessed.

The introduction of the silk trade into this country appears to have taken place in the early part of the seventeenth century and progressed very rapidly. At the close of the seventeenth century the textile industries of England had grown to an enormous extent and competent authorities valued the wool shorn in England £ 2,000,000 sterling and the manufactures from it at £ 6,000,000.

We now arrive at a period which is noted in the history of the textile manufactures, both for the inventions and improvements that were made in the various processes and for the remarkable development which took place.

For thousands of years the hand of man had directly fashioned the material of his apparel but now for the first time automatic machines were brought into use; machines whose wonderful combinations, whose power of production, so infinite and various, so great in their operations and results; awakened in the mind the most profound feelings of wonder and astonishment.

The inventions of Kay, Hargreaves, Crompton, Arkwright, Watt, Cartwright and a host of others who sprang up almost at the same time, led the way to the production in abundance and at little cost, of beautiful and durable materials of apparel for the whole of the civilized world.

The distaff and spindle of the ancient

people were originally the only implements employed for converting wool into yarn. The one-thread wheel was next brought into use; the date of its origin here, however, seems to be lost in obscurity, but this and the rude teak wheel of Hindostan had evidently a common origin.

At the commencement of the eighteenth century there were three kinds of implements used for spinning all kinds of material. First the "Rock" as the ancient distaff and spindle were called in England. In the process of "Rock" spinning the spinners drew out the thread from the end of a shiver of combed wool and communicated the necessary motion to a rough kind of spindle by twirling it between the right hand and thigh, allowing the spindle to revolve when suspended by the thread which was gradually lengthened by the fingers. By this primitive process a yarn of the most delicate quality could be produced.

Next came the common one-thread wheel which up to the end of the eighteenth century was ordinarily used in spinning wool. This instrument was nothing more or less than the before mentioned loose spindle, mounted in a frame and turned by a cord passing over the rim of a large wheel, thus the spinners hands were left freer than by the loose spindle.

method to draw out the thread; consequently, it had a capability of production which was evidently its main advantage.

In this kind of spinning the operator took the wool with the finger and thumb of the left-hand, a few inches distant from the spindle and drew it toward her while with the right hand she turned a wheel; thus repeated portions were extended and twisted and as they were twisted, she wound them upon the spindle, guiding the thread with her left hand.

The third kind of machine was named the small or Saxon wheel. This, though a more perfect machine than the last mentioned, was only applicable, except in particular instances, to the spinning of flax.

In this machine evidently lay the germs of Arkwright's invention. The spindle in the Saxon wheel had on it a bobbin on which was wound the thread; round the bobbin a flyer revolved at a greater speed than the bobbin itself, which gave the thread the necessary twist. The wheel being very small received its motion from a treadle. Spinning by this wheel seems to have formed a favorite occupation of lady spinsters during the seventeenth and eighteenth centuries.

We now come to the loom. It is claimed for the Egyptians that - they, as has al-

ready been said, were the first inventors of weaving and certainly the earliest looms of which we have any evidence are those of the Egyptians.

The Greek and Roman nations in the first period of their history appear to have used looms similar to those of the Egyptians. Later the Romans used a loom approaching somewhat the loom of modern days.

A great many inventions of various styles were made but the great invention of Pierre Jacquard outstripped them all and placed a power of producing patterns, which is practically without limit, in the hands of the weaver, thus enabling the productions of the loom to become what they more frequently ought to be - works of art.

Let us now take up the subject of silk, its culture and manufacture. The exact date when the use of silk was discovered is uncertain. The Chinese in their records claim that it was about 2700 B.C. and point to the calculations of eclipses made by Jesuit missionaries for the emperors and fitted to each event as their proof. But the record of the length of the reign of the early emperors and the incidents which occurred during their reigns offer a much safer means of calculation.

From these the conclusion may be drawn that Hoang-ti the third of the Chinese emperors and the first of the silk culturists-commenced his reign about 1703 B.C. This would give to China over 3600 years of silk culture and production.

The legend is that Hoang-ti charged his wife and Queen Si-Sung-Chi to examine the silk worms and test the practicability of using the thread from the cocoons. In her zeal she collected large numbers of the worms, fed them herself and discovered how to reel the silk and to make it into garments. This was about 1700 B.C. and for her discovery she was deified so the Chinese records say and has ever since been known as the "Goddess of Silk worms."

The wild silkworms or allied species were found in southern or eastern Asia inhabiting the jungles of India, Siam and Cochin China, but the cocoons were used only for carding and spinning, very much as spun silk is now produced. Meanwhile the Chinese kept their method of obtaining silk a profound secret for nearly two thousand years. They gave the silk to the Persians who for one thousand years, without knowing how or from what it was made, carried it to the Western States.

Aristotle, as the result of the observations of some of the more intelligent of the scholars who accompanied Alexander the Great in his expedition to India, gave a very accurate description of the silkworm, speaking of it as a horned insect which passed through successive transformations and produced "bombykia" as he called the silk.

For twelve or fifteen hundred years after silk fabrics had become known in Western Asia and Eastern Europe, the prevalent opinion was that it was either a fleece which grew upon a tree (thus confusing it with cotton), or the fibre obtained from the inner bark of some tree or shrub, while some, deceived by the glossy and silky fibres of the seed vessels of our common milkweed and the still longer and more beautiful product of the silk-cotton tree (*Bombax*), believed that it was the product of some plant or flower of the *Bombax* family. A few had come so near the truth as to think that it was spun by a spider or beetle.

So carefully did the Orientals keep their secret that it was not exposed until the sixth Century after Christ, when two monks who had been engaged in missionary work in China solved the mystery by bringing

to Constantinople a small quantity of silk-worm eggs concealed in the hollow of their palmer staves.

Thus made public this knowledge soon spread over the world and though the vast-production of silk by the Chinese was not diminished, that of Europe and western Asia was greatly developed in the centuries that followed.

It may be well here to give the nature of silk. It is a liquid, gummy substance secreted by certain insects from their food at different stages of their growth; it is contained in cells or tubes on each side of their bodies and whenever they wish to, they can draw it out through the minute openings of the organs called spinnerets. From two to six of these threads being united which as they are drawn out harden and strengthen to form a fine but remarkably strong thread. This thread is used by the insects themselves for a variety of purposes.

The larvae of the Bombycidae or silkworm family and of some others, do not attempt to spin until they are ready to pass into the chrysalis condition and then enshroud themselves in silken cocoon of their own spinning. In all the cases, however, the product is the same - silk, which requires to be reeled, carded,

spun, doubled and redoubled, cleaned, twisted and otherwise handled before it is fit for use.

The best silk worms are those of the genus *Bombyx*, most of which feed on the leaves of the white mulberry, though some of them may be reared on the leaves of other species of mulberry. One or two species of *Bombyx* as well as some of the other genera feed on the leaves of the ailanthus and of the Castor-oil plant but these make an inferior quality of silk.

This insect like all its analogous species, is subject to four metamorphoses. It is first an egg which the warmth of spring brings forth in the form of a caterpillar and this as it enlarges progressively casts its skin three or four times according to the variety of insect.

The moth, milder or perfect insect which after a longer or shorter time, according to the genus, the climate and the temperature, works its way out of the cocoon, has but a brief life, not exceeding a week in any case and usually only two or three days.

In this time the female moth lays about 400 or 500 whitish or yellowish eggs and about the size of a mustard seed. These usually though not always adhere by a gum or sticky substance to the leaves, paper or other surface on which

they are laid. The egg has a small spot on one end called the micropyle and when the worm hatches, which in our climate is about the first of June, it gnaws a hole through this spot.

If their food is not yet ready for them they may be kept from hatching seven or eight months by keeping them in a cool place; they are then hatched. At first the worm does not exceed one-twelfth of an inch in length. Under favorable circumstances of food, warmth, etc. they go through their various changes in from twenty to fifty six days, moulting or casting their skins four times.

When they have attained their full growth they are about three inches in length. At this time they seek a place to spin their cocoon which are generally finished in from three to six days. The color of the worm's pro-legs before spinning indicates the color the cocoon will be. This varies in different species and may be a silvery white, cream yellow, lemon or green. When the cocoons are ten days old all those not intended for future use are placed under steam heat to kill the chrysalis as the moth when coming out breaks so many threads that they are ruined.

The various processes which silk undergoes in its transformation from the fine, thin, filaments of the cocoon to the heavy texture of substantial dress silks or to the wondrous fabrics wrought by the Jacquard loom involve an enormous amount of labor, the cost of which is chiefly represented in the price of silk goods, the mere cocoons being comparatively inexpensive.

The first process is reeling, an art which seems very simple but which really requires much skill, patience and watchfulness. One of the obstacles to be overcome is the variable length of the silk in the cocoons; no two of the same breed of worms will spin just the same amount; and between cocoons from different breeds or those spun under different circumstances, the length varies from 300 to 1300 yards. This variable length necessitates joining the filaments of which usually from six to ten are reeled together to form a single thread of silk. The reeling must not be done too close to the chrysalis as that portion of the silk is inferior and not generally of good color.

The cocoons are first assorted and those of the same color and those of fine and coarse

texture being placed by themselves. The outside loose silk is then removed as this cannot be reeled, after which the cocoons are plunged into warm water to soften the "gum" which sticks the threads together. In five or ten minutes the water is pressed out and the gum sufficiently softened to permit of easy winding. It is wound first on a spool about three and a half inches in length.

If it is Chinese silk, it is cleaned by being passed through the cleaning machine; each thread usually but not always passing between two sharp-edged metal plates which remove any unevenness leaving the filament smooth clean and even. The silk on the second spool is next passed to a doubling machine where, if it is intended for tram or organize, two or more threads are joined together and drawn upon a third spool.

If it is intended for sewing-silk or twist, four, five, six or more filaments are doubled together. The silk in this state is put in the spinning machine and spun a certain number of turns per inch, the twisting being looser for tram, filling or weft than for warp or organize. For the latter,

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two of these threads are doubled and spun upon a fourth spool, the twist being reversed to make the thread stronger.

The preliminary processes of winding and cleaning are followed by that of doubling which simply consists in placing two threads - singles - side by side and winding them together without twist. The so called spinning of silk consists - merely in twisting the threads either before or after doubling.

The "trame" already mentioned is the product of the union of two or more single untwisted threads which are then doubled and slightly twisted. "Organize" is produced by the union of two or more single threads separately twisted in the same direction which are doubled and then retwisted in the opposite direction.

The processes of winding, cleaning, doubling, twisting, rewinding and reeling the silk, together constitute what is called "throwing". When the silk is thus brought into the condition of thrown silk it is usually transferred to a reel and made up into skeins thus preparing them for dyeing.

The silk being ready for the dyer is delivered to him in skeins. He first-boils it in soap and water to free it from any remaining

gum and to give it a more lustrous appearance. When dried it is next put into dye vats and then there is an opportunity for deception either on the part of the dyer or the manufacturer.

By the boiling process the silk if pure should lose about twenty four per cent of its weight from gum, sugar, waste, etc. If it loses more, the silk has been tampered with or not properly thrown; if less it must be of remarkably good quality or has not been boiled long enough. A pound of silk delivered to the dyer will thus after boiling weigh a fraction over twelve ounces. But by secrets known to his art, the dyer can so fill the spaces of the silk with dye-stuffs as to make it appear more solid, thicker and stronger than it naturally would be although in fact its texture is injured.

When dyed the silk is wound on spools, a process requiring much skill and care as it is now in the condition known as soft silk. It is now ready either for sewing silks, twists, dress trimmings or fringes, or to be prepared for weaving into braids, ribbons, laces, sashes, handkerchieves or broad goods.

For sewing silk and twist, the processes of throwing and dyeing complete the manu-

facture, except for these a larger number of threads are twisted together than for tram, organize or singles. In twist, the twisting is done in the opposite direction from that for sewing silk.

The manufacture of laces, braids, upholstery and dress trimmings is an important department of the silk manufacture. In a few of these goods, as in cords, some of the tassels and much of the military and upholstery trimmings, a part of the filling or some of the material is wool or cotton usually covered with silk. Part of the silk is made into sewing silk of varying degrees of fineness for fringe; part is made into twist or quimp from which are woven headings for fringe. Some fringes are woven on looms and either cut apart in the middle, if the fringe is to be short, or divided at the end and so made thicker and heavier if it is to be made long. Silk buttons are partly woven and partly wrought by hand.

We next come to the weaving of ribbons and broad goods. There are many varieties of these, each requiring a different method of treatment. Gauze, veiling and the thinnest silk tissues form a class by themselves; hand kerchieves, foulards, India silks and

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the lighter and thinner ribbons another; while millinery silks, ties, scarfs and fancy silks constitute still a third.

Figured and embroidered ribbons and silks brocades are woven on the improved Jacquard looms; while bonnet, belt and velvet ribbons are woven on gang looms, weaving from six to forty pieces at the same time. Gros-grain and heavy silks whether black or colored are woven on power looms. In the practical manufacture of ribbons and broad goods in this country the handloom is very little used as it is too slow in its action to be profitable and in most descriptions of goods better results can be effected by the power looms.

The problems originally to be solved in the invention of power looms were: to obtain tenuity in the warp; to effect its gradual unrolling and the rolling up of the woven goods; to drive the shuttle back and forth at the proper time; to beat up the tissue properly; to effect the stopping of the machinery for the substitution of a new filled bobbin when the one in the shuttle was exhausted; to accomplish ten or more times the work of the weaver

within a given period.

The improvements which have since been added permit the weaving of satins and velvets and of most goods of regular figure on the power loom and there is yet room for great improvement in the weaving of plain goods.

Thus the silk manufacturers of America share a common hope that is the basis of all their endeavors - the hope that the products of their textile art may meet the ordinary needs as well as the highest-tastes of their Country men and Country women.