# A Short Description of Silk and Silk Manufacture

CHENEY SILKS

Manufactured by

CHENEY BROTHERS

MILLS:

South Manchester, Connecticut.

SALESROOMS:

New York, Boston, Philadelphia, Chicago, San Francisco.

# SILK AND SILK MANUFACTURE.

**HISTORY.** The raising and manufacture of silk are very ancient arts, said to have first originated in China. In 2650 B. C. the Empress Si-ling-Chi is said to have invented the industry and was placed among the Chinese divinities as "Sien-Thsan," that is, "The first promoter of Silk Industry."

From thence the arts are said to have found their way through India and Persia to Europe, arriving there about 550 A. D., though they do not seem to have become well established in Europe before the Twelfth century. Mezerin in his chronicles says, "Silk became so common that in the year 1347, as many as a thousand citizens of Genoa appeared clothed in silk in a public procession."

Our ancestors were in this country only a short time before they began to attempt to plant the industry in America. In 1624, we find in the colony of Virginia, numbers of skilled men imported from France to start the raising of silk worms. In the year 1649, there was published in London a pamphlet called, "A Perfect Description of Virginia," in which it said, "It surely would be better to grow silk here where mulberry trees are so plenty, than to fetch it as we do from Persia and China, with great charge and expense and hazard, thereby enriching heathen and Mahumetans."

Connecticut was very early in the field and in 1747, Governor Law appeared in silk coat and stockings, the silk for which is said to have been raised on his own place. From that time to the present day, there have been countless efforts to start the raising of silk in this country, sometimes by the aid of government bounties, sometimes without.

They have extended from Maine to Florida, to California, and all have failed from various reasons, chiefly on account of the cost of labor, which in Europe is paid from twelve to thirty cents per day, while in Asia as low even as two cents per day.

Between the years 1837 and 1840, there was the wildest of speculation in mulberry trees throughout the country. Just previous to this time of speculation the Cheney Brothers first became interested in the raising of silk worms and later in the sale of mulberry trees. Both failed, but in 1838, one of them started a small plant to make sewing silk, at South Manchester, Conn., in which he was afterwards joined by his brothers. This was the beginning of the first really successful silk factory in this country; a business which has grown until today the firm employs about 4,000 operatives and occupies 29 acres of floor space.

The raising of silk in this country has been a failure, but the manufacture has increased with great rapidity during the years since 1850, thanks to the tariff, without which it could not exist. Of recent years, competition in the United States has become very close and fierce.

**PRODUCTION AND CONSUMPTION.** In the year 1902, Chabriéres, Morel & Company, of Lyons, published the following estimates of the world's production and consumption of raw silk (revised where possible on later information to 1909):

| | Production | Consumption |
|---|---|---|
| **EUROPE.** | | |
| France | 700,000 kl. | 4,327,000 kl. |
| Italy | 4,412,000 | 1,000,000 |
| Switzerland | 50,000 | 1,550,000 |
| Spain | 82,000 | 200,000 |
| Austria | 166,000 | 725,000 |
| Hungary | 147,000 | |
| Russia and Caucasus | 400,000 | 1,400,000 |
| Bulgaria, Servia, Romania | 156,000 | 17,000 |
| Greece and Crete | 60,000 | 20,000 |
| Salonica, Adrianople | 261,000 | 30,000 |
| Germany | | 2,850,000 |
| England | | 800,000 |
| **AMERICA.** | | |
| *United States | | 7,600,000 |

*Average imports 1904 to 1908 inc.



| | | |
|---|---|---|
| **ASIA.** | | |
| Bruitia | 400,000kl. | 50,000 |
| Syria | 450,000 | 110,000 |
| Persia | 330,000 | 165,000 |
| Turkestan | 820,000 | 700,000 |
| China | 11,280,000 | 6,435,000 |
| do. Canton | 4,000,000 | 2,000,000 |
| Japan | 9,800,000 | 3,000,000 |
| India | 1,200,000 | 1,400,000 |
| Tonquin and Annam | 1,000,000 | 900,000 |
| **AFRICA.** | | |
| Egypt | | 200,000 |
| Tripoli and Morocco | | 70,000 |
| Algeria and Tunis | | 65,000 |
| Other Countries | | 100,000 |
| | 35,714,000 | 35,714,000 |

Kilo is 2.2 pounds.

From this it will be seen that China, Japan and Italy are the greatest producers of raw silk in the order named, and that China, including Canton, United States, France, Japan and Germany are the great manufacturers or consumers of raw silk also in the order named, or the United States is now the second silk manufacturing country in the world, and is greater even than France, Italy and Switzerland combined.

For the year 1910, the imports of raw silk into this country reached 21,563,782 pounds, valued at $68,102,732. The imports of manufactured silk were $32,370,115. The value of the raw silks imported into the United States in 1904, when manufactured, would be over $170,000,000 showing that the largest part of the manufactured silk used in the United States was made here or 84%.

There are in the United States, by the census of 1910:

| | |
|---|---|
| Total number of looms | 75,000 |
| Total number of spindles | 2,405,527 |
| Value of output finished goods | $171,559,000 |

It is estimated that 3,000 looms have been added during the year 1910.

The states most largely engaged in the manufacture are New Jersey, Pennsylvania, New York and Connecticut, but there are factories in many other parts of the country. In recent years a number have been started in the southern and western states. These factories employ nearly 100,000 people. There are 843 silk factories not including cotton and woolen factories which make silk mixtures.

**MOTH EGGS, WORMS, COCOONS, ETC.** Silk is the product of cocoons made by the silk worm, which is found in the countries enumerated in the list of silk producers given. The food of silk worms is the leaf of the mulberry tree, though there are certain coarse wild silks, such as tussahs, found in China, Korea, Japan and India, the worms producing which live on the leaves of certain species of oak and chestnut.

The color of the cocoons varies greatly. Most of the Europeans are bright yellow, though some are white. The Eastern cocoons on the other hand are mostly white, while a very few are yellow. The wild silks are for the most part ecru color, though some are pale green. This color, except in the wild silks, is derived from the gum secreted by the worm, with which the fibres are stuck together. It comprises from 15 to 30% of the weight, and is removed by boiling in soap and water before the silk is dyed. All silks except the wild silks, after the gum is removed, are from white to cream in color. The tussahs, or wild silks, remain an ecru color.

The greatest care has to be exercised throughout in the care of the moths, eggs, worms and cocoons, such being the succession of changes. That is, the moth lays eggs which are collected and kept cool till the proper season for incubation, when they are kept warm during the time occupied in hatching, sometimes about the person of the raiser. After a time these eggs hatch out worms, little tiny things hardly bigger than a pin-head. After the worms are hatched, they require constant care and feeding with chopped mulberry



leaves till they reach maturity, about 32 days after hatching, during which period they moult or change the skin three times. When grown they are about three inches in length, and spin their cocoons from a fibre and gum which they secrete. When the cocoons are spun, the worms become chrysalides inside of them. The cocoons are then collected and the chrysalides killed, generally by heat, before they can again become moths.

**RAW SILK.** The cocoons are then sent to the reelers or filatures. A number of cocoons, greater or less, according to the size of thread desired, are placed in a basin of hot water, which softens the gum. After the outside fibres are removed so that the ends run free, just as you would unwind a thread from a ball, the ends are collected together through a guide and wound up on a reel. As the silk cools and dries, the gum hardens, sticking the fibres from the different cocoons together in one smooth thread, varying in size according to the number of cocoons used. The finest sizes reeled are but little coarser than a spider-web. An 8-10 denier silk runs 491,000 yards per pound, or a pound would stretch 297 miles. It is seldom reeled coarser than 28-30 denier, which runs about 150,000 yards per pound. The silk in this state is known as raw or reeled silk; practically none is produced in the United States. The size is denoted by the denier. The hank, or skein, is 400 French ells — 476 metres — 520 yards. 533⅓ deniers make one ounce avoirdupois. The number of deniers that one such hank, or skein, weighs is the count of the yarn. In the English system, but little used, the number is denoted by the drams per 1,000 yards.

**THROWING.** From this point, raw silk, the manufacture in the United States begins. We import our raw silk chiefly from Italy, China and Japan. It is handled here first by the throwster, who winds it from the skein and makes various kinds of thread for different purposes.

Raw silk wound on spools in a single thread and called singles is often used to make warps (that is, the threads running lengthwise of a piece of cloth), for piece dyed goods, or cloth which is woven with the gum in the silk and after-

ward boiled out and dyed. Singles are also sometimes used for filling, (that is, the cross threads), in very thin fabrics.

Organzine is usually used for the warps of yarn-dyed goods; that is, goods the threads of which are dyed before weaving. To make Organzine, the raw silk is wound, then twisted in the singles, two or three or more threads put together twisted in the reverse direction, then reeled into skeins for dyeing.

Tram is used for filling of either yarn or piece-dyed goods, also sometimes for the warps of piece-dyed goods. To make tram, the raw silk is wound; two, three or more threads are put together and twisted, generally rather slack twist.

Crepe yarn is used in making crepe, in chiffon, and for other uses. It is very hard twisted thread, generally tram, from 40 to 80 turns per inch.

Floss Silk. Not used for weaving. A very slack twisted tram, generally composed of a large number of threads of singles.

Embroidery silk is made by winding the raw silk, putting a large number of ends together, giving them a slack twist, doubling and twisting in the reverse direction with a slack twist.

Sewing silk is made by winding and doubling the raw, twisting into tram, hard twisted, doubling and twisting in the reverse direction, drawing under tension at the same time it is twisted. Machine twist is similar, but 3 ply.

**SPUN SILK.** There is another class of threads made from silk other than those made from raw or reeled silk, namely, those produced from waste silk by spinning and known as spun silks. Waste silks are the pierced cocoon, that is, those from which the moth has come out by making a hole and breaking the fibres in one end of the cocoons; also the waste made in the filatures in producing raw or reeled silk, chiefly the outside fibre of the cocoon and the inside next the chrysalis, and the waste made in manufacture.

Spun silks are made by several manufacturers in the United States, Cheney Brothers being the largest producers. The waste silk is ungummed; that is, the gum is removed



from the fibres by boiling with soap, by maceration or rotting, or by chemical re-agents.

After the gum is removed from the cocoons and other waste silk they are opened and combed, most of the chrysalis shell being removed. The remainder, with other foreign matter, is picked out by hand from the combed silk, which is then lapped, put through a number of drawing frames to get the fibres even, on the roving frames, where it first takes the form of thread then on the spinning frames where it is twisted. If it is to be used as singles, the manufacture ends here. If two or three-ply yarns, the singles are doubled, twisted again, singed by running through gas flame, cleaned by friction controlled, that is, the knots and lumps are taken out, and then reeled into skeins for dyeing or put on spools.

**SPUN NUMBERS.** There are two methods in general use for numbering spun silk. In the French system, the number is based on the singles, by the meters per kilogramme; two and three cord yarns have 1-2, 1-3, etc., the length the numbers indicate. Thus:

No. 100 singles has 100,000 meters per kilogramme.
No. 2-100 has 50,000 meters per kilogramme.
No. 3-100 has 33,333 meters per kilogramme.

The other and more generally used system in this country is the English system. The hank is 840 yards and the number of hanks in one pound avoirdupois is the count of the yarn. It is based on the finished yarn, and singles, two and three cord yarns of the same number all have the same yards per pouud. Thus:

No. 50 singles has 42,000 yards per pound.
No. 50-2 has 42,000 yards per pound.
No. 50-3 has 42,000 yards per pound.

**DYEING YARNS.** Generally speaking, there are two large classes into which silk goods may be divided, those in which the threads are colored before weaving and called yarn-dyed goods, and those dyed or printed after weaving and called piece-dyed or printed goods. In dyeing yarns,

the silk is first ungummed and cleaned by boiling in soap and water, then washed in cold water. If the thread is to be weighted, as is very freguently done, tin salts, iron or other heavy material is deposited on the fibre. If carried far, this is very injurious, making the silk tender and weak. Sometimes there is more weighting than silk. Yarns are usually dyed in hot liquors, aniline colors being the ones in most common use today, though other dyes are used for special purposes. Some yarns are dyed in the gum, and some, called suples, with a part of the gum left in. After dyeing, they are washed in cold water, dried and wound on spools.

**WARPING.** The threads that run lengthwise in cloth are called warp. The warp is usually made by placing a large number of bobbins on a rack or creel and running the threads from this on a reel, winding off as many yards as required for the length of the warp; this is called a section. Enough sections are put on the reel to produce the desired number of ends or threads in the warp. The whole number of threads is then wound from the reel to a roll or loom beam.

**HARNESS.** The threads or ends of the warp are next drawn through the harness and reed. The harness is made up of a number of shafts or leaves; each shaft or leaf is a series of cords or wires with a loop or eye in the centre, which are strung between two pieces of wood or a frame. A thread from the warp is drawn through each eye by means of a small hook, beginning with the first thread of the warp, through the first eye on the first shaft of the harness, the second thread through the first eye on the second shaft, the third through the first eye on the third shaft, and so on through the harness. When one thread has been drawn on each shaft, the next thread is drawn through the second eye on the first shaft and so through the harness again. This is called a straight draft; for special work other drafts are at times used. The number of shafts in the harness vary according to the character of the weave to be made, from two to thirty in number. In the case of harness for making brocades each eye is on an independent cord.



**REED.** Next the warp threads are entered or drawn through the reed or comb — which is similar to an ordinary comb but closed top and bottom — one, two, three, or more threads in one dent or space between two teeth of the reed.

**WEAVING.** The warp with harness and reed is placed in proper position in the loom, the warp beam at the back next the harness, then the reed placed on the lathe or batten, and then the cloth, which is rolled up on another beam. When weaving is commenced, a certain number of the shafts of the harness are raised up; thereby lifting some of the threads of the warp above the others. Next the shuttle is thrown through the space between them. The shuttle contains a bobbin or quill of thread which is unwound as it passes through, supplying the cross threads or filling for the cloth. Then the reed is brought forward, pushing the filling into its proper place. The process is repeated, different shafts of harness being lifted at such time as to produce the desired weave. For instance, if a plain weave is desired, every other shaft is lifted, which in turn lifts every other thread; the next time the remaining shafts are lifted, while those lifted on the first pick stay down, and so on. An almost endless variety of weaves may be produced in this way, by the use of shafts, and almost all plain fabrics, such as Satins, Twills, Pongees, Taffetas, Armures, Crepes, Peau de Soies and Foulards, also a great variety of stripes and small figures are so woven. At the present time practically all figured or brocaded goods are woven by the use of the Jacquard machine, invented by Joseph Marie Jacquard, of Lyons, France, about the year 1800. In this machine each thread of the warp passes through an eye which is attached to a cord, in its turn attached to a hook. These hooks are controlled by paper cards with holes punched in them which either push the hooks back, or if holes are punched, allow them to be lifted by means of blades which rise and fall between the hooks. By the use of such machines very large patterns with great variety of weaves may be produced.

**RIBBONS.** Ribbons are woven several pieces in one loom, with a separate shuttle for each piece, which is carried

through the shed or warp by a rack and pinion, instead of being thrown through as in broad goods; otherwise the weaving is the same.

**VELVETS.** Velvets and other pile fabrics are woven in two pieces, one over the other with the pile threads woven back and forth between them. A knife travels between the two pieces cutting the pile threads so as to leave the ends standing up straight. Velvets used to be woven over wires and cut by hand, but this method is practically obsolete.

**PIECE DYEING.** If the goods are woven with the gum still in the silk, it must be taken out afterward and the goods either dyed in the piece or prepared for printing.

**PRINTING.** The most primitive method of printing is by the use of stencils. It is the method employed by the Japanese and Chinese. Next came block printing, which is still extensively employed in Europe. The pattern is raised in felt on wooden blocks, the color taken up from pads, one block for each color. The results are good, but the work is very slow. Most silk goods are today machine printed. The design is engraved or etched on copper cylinders, one cylinder for each color; the color thickened with gum, is supplied by rolls running against the cylinders and the surplus is scraped off by a knife blade, leaving only that in the engraving, which is taken up by the cloth. After printing, the cloth is steamed, to set the colors, and then washed, in order to remove the gum used to thicken the colors for printing.

**FINISHING.** All silk goods, whether yarn dyed, piece dyed or printed, are given some kind of finish; sometimes it is no more than is necessary to smooth out the wrinkles. But there are a great many such processes by which goods may be treated. They are run through gas flames to singe off loose fibre, over steam cylinders to dry and straighten them, over a great variety of sizing machines to stiffen them with starch or glue, calenders or heavy rolls to smooth and iron them, steam presses of great power to press them out, breaking and rubbing machines to soften them, tentering machines to stretch them to uniform width. There



are also moiréing, or watering, embossing and various other machines for special purposes.

**WATER PROOFING.** One of the worst difficulties with which the manufacturer of piece-dyed and printed silk goods has had to contend has been the ease with which they become spotted with water, and for a number of years many people have tried to prevent this by various processes, as is evidenced by the fact that there are no less than two hundred such processes patented. None of them have met with much success, as they injured the feel or strength of the goods. Cheney Brothers have recently solved this difficult problem, and are now treating such goods with a process invented in their own works, which prevents the spotting of silks with ordinary rain water. They call such goods SHOWER-PROOF.

After goods are finished they are carefully inspected for imperfections, measured and wrapped in paper and packed in cases for shipment.

How complicated and numerous are the processes for treating silk goods, may be realized when a piece of goods, piece-dyed or printed, is handled its entire length between fifty and one hundred times after it comes from the loom, sometimes even more.

The foregoing is the barest kind of a sketch of the silk processes; at the same time it is probable that it is too long to teach to little children, and is intended more for the information of teachers. Those wishing more detailed information, we refer to the library of books on textile manufacture, published by E. A. Posselt, of Philadelphia.