PAPER--ITS MATERIAL AND USES.

From the best authorities it would appear that cotton was the first material used in the manufacture of paper, after papyrus. The exact date is not known, but it is pretty well authenticated that paper from this material was made and used in the eleventh century. The Chinese, since the decadence of the papyrus manufacture in Alexandria, Egypt, may be considered the greatest manufacturers and users of paper. With them this material occupies a place of importance not equaled by any other one substance in use by us. They employ it for clothing, building, decorations, toys, and a hundred other necessities. They utilize linen rags, the inner bark of trees, the fibers of cane and bamboo, and for "rice paper" the stems of a wild leguminous plant. The soles of boots, umbrellas, hats, garments resembling in texture and durability woven fabrics, kitchen and table utensils, boxes, bowls, etc., this ingenious people fashion from paper. Even their pocket handkerchiefs are made of it; and some specimens of their paper are scarcely inferior in toughness and elasticity to the best textile fabrics.

We have scarcely reached their aptness in the quality of the paper, and are far behind them in adapting the material to our every day needs. We make paper water-pipes, row boats, paper hats, and bonnets, paper collars, cuffs, and shirt-fronts. We use it for twine to tie up paper packages; a specimen for machine belting is now on our table. It is doubtful if any other material is susceptible of a greater diversity of uses; yet we seem to lack the means of producing it cheaply enough to supersede other and more costly substances. It is hardly to be believed that knowledge of the manufacture, the various processes to adopt it to manifold uses, is lacking, but rather the difficulty of procuring the material from which it is made prevents us from making a more extended use of it.

For some years past paper "stock" has been very dear. Rags advanced in price, as cotton went up. Wood fibers and straw have been tested with a view of keeping down the continually increasing price of rags and furnishing a cheaper and equally valuable material. Yet these, especially the latter, are not new attempts. So long ago as 1756 the Germans used straw, and in 1776 a book was printed in France the paper of which was made of linden or basswood. In 1800 good white paper was made in England from straw and wood. It is certain that neither straw nor wood have yet been found equal to cotton and linen as a material for the production of paper.

Under these circumstances we have been much interested in the examination of specimens of paper made from the okra plant, which can be grown easily in every state of the union, yielding, even with the most careless cultivation, from four to eight tons of dried stalks per acre. As it can be grown in the immediate vicinity of the mills, and will yield to the cultivator from forty to eighty dollars per acre, exclusive of the market value of the seeds, there would seem to be some reason for looking to this as a proper substitute for the expensive stock now employed in the manufacture of paper. Certainly the specimens of okra paper before us, ranging from coarse brown wrappers to the finest printing, note, and bank paper, seem to offer good evidence of the value of this vegetable production as paper stock.

The subject is worthy the attention of paper manufacturers and others, as in addition to the low cost of the material, the expense of its preparation for pulp is much less than that demanded by the use of rags.

SILK AND ITS CULTURE.

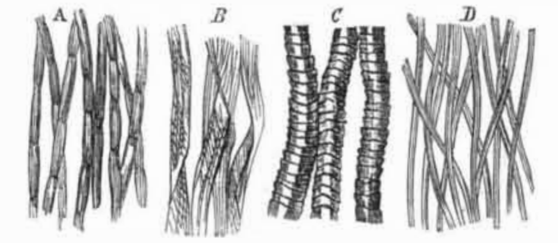
We have almost every variety of soil and climate, therefore there appears to be no good reason why the production of silk should not ultimately become one of the leading industries of our country. Already the subject is arresting some attention in California; but, like all other new branches of industry, it advances slowly. The workmen need experience, the capitalist needs confidence, and the markets need time. If there is haste there is danger, and there is not wisdom in attempting to do business without a thorough understanding of the conditions under which it can be made to pay. The *Alta California* expresses the belief that those who engage in it under favorable circumstances cannot fail of success. Among these circumstances are unincumbered ownership of the land, of soil favorable to the mulberry, a good knowledge of the method of taking care of the worms, eggs, and cocoons, and the facilities of getting labor cheap, such as that of women or children during the busy season.

The sale of cocoons raised last year in California numbered 200,000, of which half were killed under a misapprehension, so that 100,000 are supposed to remain for the production of butterflies this summer; and of these 50,000 are females, which should lay 300 sound eggs each. Let us suppose, however, that they lay 200 each, the number of cocoons this year would be 10,000,000; in 1869, 1,000,000,000; and in 1870, 100,000,000,000; that is if there were food and care for all. But neither can be obtained for such a multitude. It is doubtful whether more than 2,000,000 cocoons will be bred this year. There are great numbers of the mulberry trees in nursery, but very few in plantation, as they should stand, to produce leaves for the worms. Until there are extensive plantations of the mulberry, the production of silk must remain unimportant. In the mean time, however, the experience, the confidence, and the knowledge required for success are gradually establishing themselves, so that they will soon be urging the mulberry cultivation ahead instead of lagging behind.

Silk is the produce of a member of the animal kingdom, and occupies the highest position among all the tissues as regards resistance and durability, the average length of each single thread afforded by our worm being about three hundred yards. It has been ascertained that bundles of fibers of equal size, of silk and flax gave the following unequal powers of resistance:—

Silk supported without breaking a weight of	34 lbs.
New Zealand flax	$23\frac{1}{5}$ lbs.
Hemp	$16\frac{1}{2}$ lbs.
Ordinary flax	$11\frac{3}{4}$ lbs.
Cotton, less than	7 lbs.

In order to better appreciate the character of these textile materials, single fibers of each have been selected and placed side by side; and to these have been added fibers of wool.

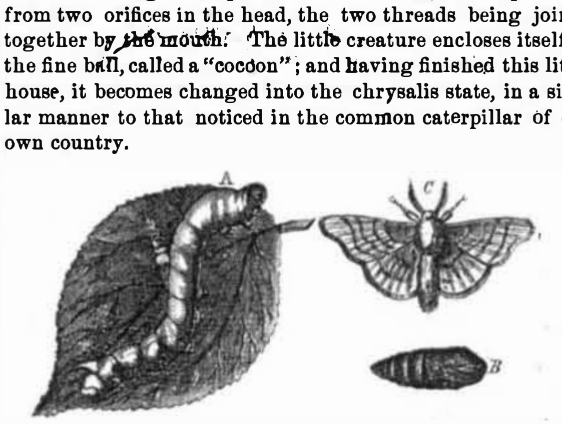


Fiber of flax, A; of cotton, B; of wool, C; of silk, D; placed so that their relative size and markings may be readily contrasted. The fiber or cells of cotton are manifestly much thinner and less resisting than those of the other substances.

The manufacture of silk appears to have been first known and practiced by the Chinese nearly three thousand years before the Christian era, but it was not until the sixth century that the western world received the great boon of a supply of silkworm eggs. The manufacture of silk began to be successful in France in 1521, during the reign of Francis I., and that country now furnishes the world with the finest quality of dress silk.

It will be interesting to consider some of the methods adopted for rearing the worm, and the processes through which the silk passes before it can be used for sewing or clothing purposes. The eggs of the worm are about the size of a pin's head, and are obtained from the moth of the previous year, being deposited on sheets of paper. The Chinese are careful to keep back the hatching of the worm until its food, the mulberry leaf, is sufficiently grown; and to effect which a variety of ingenious methods are employed.

The worm, when hatched, resembles a black thread, and is about a tenth of an inch long. If plentifully supplied with food, it soon increases in size, shedding its external skin as that becomes too narrow for the comfort of its owner—an operation repeated four times during its brief existence of little more than a month. The worm at last becomes sickly, ceases to feed, and begins to spin a delicate thread, which proceeds from two orifices in the head, the two threads being joined together by the mouth. The little creature encloses itself in the fine ball, called a "cocoon"; and having finished this little house, it becomes changed into the chrysalis state, in a similar manner to that noticed in the common caterpillar of our own country.



In the annexed engraving the silk worm is represented. A, the worm feeding, and near its spinning time. B, the chrysalis, as taken from the cocoon. C, the moth, as produced from the chrysalis.

The domestic treatment of the silkworm has been brought to great perfection in Italy. Formerly the eggs were hatched at uncertain periods, depending on the natural warmth of the season, or they were put in manure beds, or were worn in little bags about the person next the skin. They are now hatched in an apartment heated to the proper degree by a stove, but they are first washed in water, and afterward in wine, to separate light eggs, as well as dirt, and the gummy envelope which surrounds the heavy ones.

The temperature of the hatching room is at first 64°, but is gradually raised one or two degrees daily, until, it reaches 82°, which it is not to exceed. Pieces of coarse muslin, or of white paper pierced with holes, are placed over the eggs when they are about to be hatched. Through these the worms creep to the upper surface, and are removed as soon as possible to a cooler place. Young leaves and sprigs of mulberry are laid upon the muslin or paper, when the worms eagerly settle on the leaves, and can thus be transferred to trays, and removed to the nursery. This is a dry room of regulated warmth, with windows on both sides, so that free ventilation may be attainable. Chloride of lime should be in use to purify the air, and a thermometer and hygrometer to regulate the heat and moisture; the latter is apt to abound where silkworms are kept, and is very prejudicial to them, moist exhalations arise from the leaves and from their bodies; fermentation also soon takes place if litter and dung be not speedily removed from their trays; these are fertile sources of disease among the worms, and may carry off thousands in a day.

The silkwork is liable to many diseases which can only be guarded against by careful experience and watching. The improved means, first employed in Italy, for preserving the health of these valuable insects, are due to Count Dandolo, who gave particular and scientific attention to the subject, and superseded many an absurd custom in the rearing of silkworms. According to his method wicker shelves are arranged in a room at convenient distances, and are lined with paper, on which the worms are placed. Such worms only are placed together as have been hatched at the same time, the space allowed them being, for each ounce of eggs, 8 square feet during the first age, 15 feet for the second age, 35 feet for the third age, $82\frac{1}{2}$ feet for the fourth, and about 200 feet for the fifth age. The mulberry leaves are chopped in order to present a large number of fresh-cut edges to the young insect. Four meals a day, as a regular rule, and luncheons between when the worms are particularly voracious, are the liberal allowance for their subsistence. The temperature at which silkworms are healthiest appears to be from 68° to 75°, though they are able to bear a much higher temperature. Alternations of heat and cold are exceedingly injurious to them.

When the silkworms are about to spin they are provided with little bushes of broom, heath, or other flexible substance, arranged upright between the shelves, their tops being bent into an arched form by the shelf above. The bushes are spread out like fans, to allow plenty of space for the cocoons; for if crowded, the worms are apt to form double cocoons, two working together, and these are worth only half the price of single cocoons.

When the time arrives for reeling off the silk, the cocoons are thrown into a vessel containing hot water, the latter serving to dissolve the gummy matter surrounding the true thread. By means of a small wisp the end of this thread is found, and a number of these are wound on to a reel; the fineness of each of the filaments being too great to permit of its being used in the single state. In thus winding the silk, the threads are gradually spread apart, so that they may not adhere together while moist, which they would otherwise be liable to do, owing to the gum remaining on the surface. The color of the silk varies from a beautiful and brilliant yellow to a light grey, or "French white"; and in this state it is exported for the use of the silk throwsters, whose business it is to convert the reeled silk into a thread capable of bearing the wear of subsequent manufacturing operations.

HOW TO ASCERTAIN THE AMOUNT OF IMPURITIES IN WATER.

On page 366 we explained in a short article how to test the purity of water, and mentioned seven different tests relating to the most commonly occurring impurities. We will now show how in the most simple manner the amount of each of these foreign ingredients, dissolved or suspended in water may be ascertained.

QUANTITY OF SOLID MATTER.

The total amount of all kinds of solid matter can only be ascertained by the help of a balance. A certain quantity of water, say a gallon or a pint, is slowly evaporated by a gentle heat—boiling may cause loss of the solid matter also—and after being concentrated to one or two ounces, it is placed in a small porcelain or platinum dish or cup, in which it is finally evaporated to dryness. The weight of the solid matter remaining will tell how many grains there were present to the gallon or pint. To obtain the most correct result, it is best to subtract the weight of the dish when clean, from its weight when coated with the deposit obtained after evaporation.

Fortunately for most of the other tests the use of the balance may be dispensed with in case of necessity, as the amount of impurity may be very correctly arrived at by the amount of the test found necessary to cause a complete precipitation.

QUANTITY OF COMMON SALT, CHLORINE, AND HYDROCHLORIC ACID.

By the assay of silver a solution of the nitrate is made and then a solution of common salt of certain strength is employed to precipitate all the silver, and the amount of silver is arrived at by the amount of the standard salt solution employed for this purpose. This method may be inverted, and for ascertaining the amount of common salt or other chlorides in impure water, we may employ a standard solution of nitrate of silver of certain strength, and watch how much of it is required to precipitate all these chlorides. It is of the utmost importance to use chemically pure nitrate of silver, and as the commercial article is often adulterated with nitrate of potash to such an extent as to contain only about half the proper amount of silver, it may be well to make it by dissolving pure silver in nitric acid, and evaporating to dryness in a clean dish.

It takes very nearly seventeen grains of nitrate of silver to precipitate six grains of chloride of sodium (common salt,) the precipitate consisting of chloride of silver, nitrate of soda remaining in solution. The reason why these relations of quantities exist in these particular substances, depends on the so-called atomic weights of which they are composed, and may be learned from any good text book on chemistry. If now we dissolve 8x17 or 136 grains of nitrate of silver in an ounce (480 grains) of pure water, it will precipitate 8x6 or 48 grains of common salt, that is, 480 grains of this water will precipitate this amount or every drop the tenth part of one grain of common salt; as a drop is very nearly the 480th part of the quantity of one ounce. This is our standard solution by which we may test all chlorides. If now we take one ounce of the water to be analysed, and drop carefully this standard solution in it, every ten drops required to form a precipitate will indicate one grain of common salt, and a single drop the tenth part of one grain of common salt in an ounce of the impure water.

As four grains of nitrate of silver precipitate very nearly one grain of chlorine or free hydrochloric acid each drop will indicate one fortieth part of a grain of these substances