



### CALICO-PRINTING.

DERIVATION OF THE WORD "CALICO." — THE ANTIQUITY OF CALICO-PRINTING. — PLINY'S DESCRIPTION OF THE EGYPTIAN PROCESS. — THE PROCESS USED IN INDIA. — ITS INTRODUCTION INTO EUROPE. — RESTRICTIONS IN ENGLAND ON THE USE OF CALICO. — CALICO-PRINTING IN THE UNITED STATES. — DESCRIPTION OF THE VARIOUS PROCESSES NEEDED. — MORDANTS. — SOURS. — IMPROVEMENTS IN CALICO-PRINTING. — THE DIFFERENT STYLES REQUIRED BY THE DIFFERENT MARKETS OF THE WORLD.

THERE is a town in India, in the province of Malabar, the territory of which was given, centuries ago, by the first monarch of that province, to one of his chiefs. He gave to that chief his sword, with all the land in the limits of which a cock crowing at a small temple could be heard. This formed the original dominion of the Tamuri, to whose ancestor it was given, and was called *Colicoda*, or the cock-crowing. It came afterwards to be called *Calicut*, where large quantities of cotton goods were manufactured, and were imported into England under the name of *Calico*. This word is applied to white cotton cloth in England; but in the United States it is given to all colored or printed cotton cloth. In France it is called *Indienne*; in Italy, *Indiana* (tela), indicating the country from which the art of calico-printing was received by Europeans.

Calico-printing is the art of impressing colored patterns or designs on white cotton cloth. Doubtless before any printing, properly so called, was done, cloth was painted by hand, and also woven in colored designs. Herodotus speaks of a people on the shores of the Caspian Sea who painted the forms of animals on their garments with vegetable dye. "They have trees whose leaves possess a peculiar property; they reduce them to powder, and then steep them in water; this forms a dye or coloring matter, with which they paint on their garments the figures of ani-

mals. The impression is such that it cannot be washed out; it appears, indeed, to be woven into the cloth, and wears as long as the garment itself."

In an earlier age, it was said, "Now Israel loved Joseph more than all his children, because he was the son of his old age, and he made him a coat of *many colors*." Whether this coat was woven or painted cannot be determined. The king's daughters, who were virgins, were apparelled in garments of divers colors. It is said to be a custom in India to clothe a favorite child in a coat of many colors, because it is believed that neither tongue nor evil spirit will injure him, the attention being taken from the beauty of the person to the brilliant colors of the garment. The "glowing purple of the Tyrian dye" was greatly esteemed in very early times, and was often appropriated as the color of royalty. The kings of the Midianites, defeated by Gideon, were clothed in purple raiment. The pagan nations were sometimes accustomed to array the images of their gods in robes of purple. When the prophet Ezekiel took up a lamentation for Tyre, he spoke of the "blue and purple from the Isles of Elishah," in which the people were clothed. This reference is doubtless to the islands of the Ægean Sea, from whence the Tyrians obtained the shell-fish,—the murex and the purpura,—which produced the dark-blue and bright-scarlet coloring material, the use of which contributed so much to the fame of ancient Tyre.

From an account given by Pliny of the nature and process of coloring cloth practised by the ancient Egyptians, it may be inferred that they had attained great skill in what is now called the art of calico-printing. "An extraordinary method of staining cloths is practised in Egypt, being first imbued, not with dyes, but with dye-absorbing drugs, by which they appear to be unaltered, but when plunged for a little in a caldron of the boiling dye-stuff, they are found to be painted. Since there is only one color in the caldron, it is marvellous to see many colors imparted to the robe in consequence of the modifying agency of the dye-absorbing drugs. Nor can the dye be washed out. Thus the caldron, which would of itself undoubtedly confuse the colors of cloth previously dyed, is made to impart several dyes from a single one, painting while it boils."

Calico-printing or calico-painting has been one of the industries of India for centuries, and is practised with an extraordinary skill. In the town of Muhlhausen, greatly celebrated for calico-printing,

are exhibited specimens of modern Indian calico in the preparation state, topically covered with wax, to serve as a resist to the indigo dye ; and also ancient styles of pencilled cloth covered with most complex figures, the execution of which must have required the highest degree of intelligence and skill. Among other curiosities, the counterpane of a state bed is shown, six yards long and three broad, which must have taken a lifetime to execute, on their plan of applying the melted wax with a pencil. Modes of printing similar to those practised in India have been long known in Asia Minor and in the Levant, also in China. The cottons and nankeens of the Chinese are renowned all over the world. They excel also in making flowered satins, and other silk stuffs, which from time immemorial have attracted the merchants of Asia.

From India the art of calico-printing was introduced into Europe ; some towns in France particularly became celebrated, and are so still, for printed cottons of brilliant and fast colors. The art was introduced into England in the year 1696. But it was not till after the middle of the last century, about 1768, that calico-printing was commenced in Lancashire, where it now constitutes one of the most interesting and productive branches of English industry. The introduction of calico into England encountered great opposition from the silk-weavers, who often assailed in a riotous manner the East India House, because the company imported the chintzes of Malabar. The government yielded to the remonstrances of the silk trade, and imposed heavy duties on Indian calico, and afterwards prohibited the importation altogether.

In the year 1720 the wearing of all printed calico whatsoever was prohibited by a new law, passed in order to quiet the clamor of the woollen and silk manufacturers. Ten years later Parliament permitted the manufacture and wearing of printed cloth made of cotton weft and linen warp, imposing on it a duty of sixpence the square yard. In 1774, after a most expensive application to Parliament, cloth made entirely of cotton was allowed to be printed under certain burdensome restrictions, though cotton cloth was much better suited for printing than mixed webs of cotton and linen, which received the colors unequally, owing to the unequal attraction of these two fabrics for dyes. Calico-printing in England continued to be the subject of oppressive laws till the year 1831, when they were all repealed ; and the business, left to its natural development, under the taste, skill, and capital of the coun-

try, had a great increase ; so that in a brief period a single manufacturer in Manchester produced a million of pieces in one year.

Large establishments for calico-printing are found in the New England and in some of the Middle States. The quantity produced in the United States nearly equals the production of England, though the quality of both English and French calico is superior. The consumption of calico in the United States is greater, in proportion to the population, than that of any other country in the world. Calico-printing in our country is more remarkable for mechanical power and speed than for taste. The mode of business, forced in many instances by large capitals on the joint-stock system, differs entirely from that of Great Britain. The cost of production is also much higher, from high-priced labor, coal, and drugs. As early as the year 1824, the product of printed cottons in the New England States amounted to sixty thousand yards per week. In the year 1860, the product of printed cloths in the same States amounted to two hundred and seventy-one million eight hundred and fifty-seven yards, or an average of five million two hundred and twenty-eight thousand yards a week.

Cotton cloth intended for printing must be subjected at the outset to the operation of singeing, for the purpose of removing the fibrous down or nap. There are two methods of accomplishing this. One, the old method, consists in passing the cloth rapidly over a semi-cylindrical bar of copper or iron, kept at a bright-red heat, placed horizontally over the flue of a fireplace situated immediately at one end of the bar. The new method consists of a horizontal range of gas-jet flames, over which cloth is drawn by rollers, with a continuous rapid motion ; a line of suction-tubes is placed over the extended web, to draw the flame up through the interstices of the cloth, which effectually clears the thread of down. The apparatus used for this method of calendaring is the invention of Mr. Samuel Hall, of Basford, England ; and when it is so arranged as to allow the passage of two pieces of cloth at the same time over two gas flames, is capable of singeing fifty pieces of cloth per hour.

After singeing off the loose, downy threads, the cloth must be well bleached. Bleaching means the whitening of cloth by the removal or destruction of substances which color it. The term, however, has a more extended meaning, and besides whitening, bleaching is understood as a process which prepares the cloth for

dyeing. The whiter cloth is, the more light it will reflect from its surface, and the more brilliant will be the color of its dyes. Though for dyeing purposes whiteness is not always an essential point; what is essential is the removal of certain substances which exist in the fibre, and are inimical to the entrance of the dye. If light and bright shades are required, it is necessary also that the fabric should be free from the dull-gray color naturally belonging to it; but for dark and heavy colors this is not necessary. In any kind of dyeing, where part of the fabric is intended to remain white, as in dyeing after printing, both points must have careful attention; the cloth must be a good white, and free from all foreign matters, because otherwise the white parts would become tinged with the dye, and it would not be possible to restore the white to its original brilliancy without at the same time injuring the colored parts of the design. So that bleaching for printing is a most difficult part of the art, and requires the greatest care and skill to accomplish it in a satisfactory manner.

The first operation in bleaching cotton cloth is *steeping* or *wetting out*. It is placed for a number of hours in cold or tepid water; this is sometimes called the *rot steep*, and very heavy goods are wetted out with boiling water. The object of this steeping is to remove the dirt and greasy matters and metallic particles, which have accumulated upon it in the course of gathering, packing, and storing the cotton, and manufacturing it. The goods are then thoroughly washed from this steep in the dash-wheel, or tramped in water, and then washed by rinsing them through water with the hands: they are then ready for the boiler.

The next step in the bleaching process is called *bowking* or *liming*. The bowking apparatus is a large, egg-shaped caldron, with a false, flat bottom, placed a little above the rounded true one, to protect the cloth from all danger of being scorched by the fire. Through the centre of this false bottom a pipe rises from near the real bottom to a short distance above the top of the caldron. The boiler being filled with goods, and supplied with a proper quantity of the detergent liquid, is securely covered with a dome-shaped lid. When the boiling becomes active, the steam forces a constant stream of liquid up the central pipe, causing its constant overflow, whereby the goods are constantly wetted and soaked with the boiling-hot ley of lime. The action of the lime in bleaching is simply a preparatory one; it prepares the way for the soda-ash, softening the matters to be removed; but it actually

removes very little more than a similar boiling in hot water would. The goods are then washed from the boil, and allowed to drain, the draining being facilitated by pouring hot water upon them; they are then hanked up, taking out all the twists, and laid into vats of bleaching liquor as loosely as possible. When the cloth has been allowed to steep in the bleaching liquor for some hours, it is again washed out, and subjected to the *souring* process. The passing of the goods through the *sours* takes out any lime that may have become fixed upon the cloth, either chemically or mechanically. It decomposes the lime soaps by taking the lime from the fatty matter, the fatty matter yet adhering to the cloth, but in an altered or acidified state, in which it is easily acted on and dissolved by soda-ash.

After washing out of the *sours*, the cloth is subjected to boiling heat for several hours in alkaline ley made of crude soda. The goods are again rinsed, and finished by a steep for an hour in vitriol and water. By these means all oily and resinous matters, particles of iron or iron rust, all foreign substances usually found in good cotton, are removed.

“There are very few dye-stuffs capable by themselves of imparting to cotton colors of sufficient lustre and durability combined. They are rendered fast as well as brilliant by the intervention of certain substances, which, in consequence of their attraction for the cloth and the coloring matters, form a bond of union between the two, and are on that account sometimes called bases, and at other times mordants, from their taking firm hold of or biting the dyes. These intermediate substances, though colorless themselves, possess the power of modifying the color of the dye, or of producing from the same dye-stuff different tints; so that a piece of white cloth, after being imbued with various mordants, will assume various colors in a single dye vat. Thus, if white cotton be impressed with the mordant of acetate of alumina in one set of lines, with that of acetate of iron in a second, and with a mixture of these two mordants in a third, on being exposed to the madder bath for a proper time, it will become permanently printed in red, black, and chocolate stripes.”

In calico-printing it is necessary that the mordant should be applied only to certain parts of the cloth, the remaining part either being left white, or occupied by some other mordant or color. If, however, a drop of mordant in its fluid state be applied to a piece of cloth, it spreads in a circular form far beyond the size of the

drop, but not in an equable manner. This inclination of liquids to spread beyond the limits of their first application, is overcome by thickening them with various substances, such as gum, flour, sugar, molasses, glue, starch of potatoes, of rice, and of sage. These thickeners constitute a great item of expense in calico-printing; as the large quantities of these substances, which are derived for the most part from articles of human food, after having accomplished their purpose, are a complete loss. The thickening of mordants and colors is one of the important operations in calico-printing; on this so much depends in the way of obtaining good results that it may be considered as the most important part of color-mixing; and that a color-mixer will be good, bad, or indifferent, as he instinctively perceives the importance of this branch of his art, and is successful in carrying it out. While most of the other substances employed in this work leave some traces of themselves on the finished product, the gum, starch, flour, etc., used as thickeners, are only temporary in their application, and have to be all removed before the colors are finished.

When the cotton goods are properly prepared by calendering and bleaching, and the mordants thickened and mixed with colors, they are ready for printing. There are several mechanical modes of printing calico. (1.) The old method of printing by blocks is still in use. The blocks are generally made of sycamore wood, about ten inches long and five inches wide, with an arched handle on the back. The face is either cut in relief into the design required, or the same object is obtained by means of slips of copper inserted edgewise, filed down and polished, to secure equality of impression in the several lines. This renders them more durable, as frequent applications diminish the distinctness of outline of their designs or figures. Calico-printing by hand is performed by applying the face of the block first to the coloring material and then to the cotton cloth spread on a smooth table covered with a blanket; the impression is transferred to it by striking the block with a light mallet. A second and third color is applied to the cloth by using a second or third block, so engraved as to fill in the vacancies left by the preceding. This method involves great cost of labor, and is attended with irregularities in the execution of the work.

(2.) The usual block-printing method was to a great extent superseded by the Perrotine, a machine of most novel and elegant description, the invention of M. Perrot, of Rouen. "Three thin

wooden blocks, engraved in relief, about three feet long and from two to five inches broad, are successively brought to bear on three of the four faces of a prismatic roller of iron, round which the cloth is successively wound. Each block rests on springs, which enable it to press with the delicacy of a skilful arm, and each receives its peculiar colored paste from a woollen surface, imbued by a mechanical brush in rapid alternation." This machine operates with great speed and precision; so that one man, and three boys to superintend the three colors, could do the work of twenty men and as many boys in ordinary block-printing.

(3.) The introduction of cylinder printing has been the greatest improvement in this art. It is a machine which, with one man, can do the work of a hundred men and as many assistants by any other mode of calico-printing. The copper cylinders now generally used are hollow, or bored through the axis, about three feet long and from three to six inches in diameter. The surface of these cylinders is engraved, not by the ordinary methods of hand-engraving, but by the mechanical pressure of a steel roller, which transfers the figures engraved on it to the relatively softer copper. Sometimes the cylinders are covered with various figures by the process of etching. These cylinders, corresponding with the different colors to be used, are mounted on a strong iron frame, so as to pass against a larger central cylinder covered with felt, between which and the copper-engraved cylinder the cloth is printed as it passes. The engraved cylinder revolves in contact with an attendant roller, which dips into an oblong trough containing the mordants and the coloring matter properly thickened. It is cleared of superfluous coloring matter by the edge of a flat ruler made of bronze, called vulgarly the "doctor" (ductor), which is applied to it obliquely, leaving the depressions of the engraved cylinder filled with coloring, while the excess falls back into the trough. The cylinder thus charged with impressible color acts on the cloth, and rolls it onward with its own revolution, imparting its figured design with great precision. At one of the print works in Manchester, England, is a machine of this kind, capable of printing twenty colors. So rapidly do these machines operate that they print a piece of twenty-eight yards in a minute, or the length of nearly one mile of well-colored designs of exquisite beauty is printed in an hour. Such is the combined result of skill in machinery and art, and of chemical science, carried to a high state of perfection.



All goods after being printed must be placed in a hot-air chamber before having their colors brought up in the dye-house. But as more of the thickened mordants have been applied to the cloth than can be absorbed and retained, it must be subjected to a process of cleansing. This cleansing cannot be accomplished by a mere washing with water, as the excess of mordant liberated from one part of the cloth would be absorbed by another, where the design required a white or colorless part, or in the case of different mordants being on the same piece of cloth, they would intermix, and spoil one another. It became necessary, therefore, to find some fluid in which the cloth could be washed from the excess of mordant and the useless thickening matter, which at the same time should prevent the loose mordant from fixing itself on any part of the fabric. Such a fluid was found in a mixture of hot water and cow-dung. The dunging of printed goods has been regarded as one of the very important, though mysterious, processes in calico-printing. The heat of the cleansing liquor and its strength must vary with the styles of work, and be skilfully adapted to them. Too high a temperature and too much dung are injurious to delicate colors, such as the pinks and the yellows; colors thickened with starch require a higher temperature than those thickened with gum. The cloth should never be allowed to stop for a moment in its progress through the dung-bath, for the part in contact with the surface of the water would run, and cause a line mark across the cloth.

The goods must then be washed in the dash-wheel, or passed through a rinsing trough; then winched through a fresh dung-cistern at a lower degree of temperature; then washed again. They are then ready for the dye-bath.

There are several different styles of work in the process of calico-printing, each of which requires a different method of manipulation.

(1.) *The madder style*, to which the best chintzes belong, in which the mordants are applied to the white cloth, the colors being afterwards brought up in the dye-bath. On those portions of the cloth on which the mordant is applied the coloring attaches itself in a durable manner; but on the unmordanted portions the color is feebly attached, so that it may be wholly removed by washing, either in soap and water, in a mixture of bran and water, or in a dilute solution of chloride of lime.

(2.) *The padding style*, in which the whole surface of the calico is imbued with a mordant, on which afterwards different colored figures may be raised by the topical application of other mordants, joined to the action of the dye-bath.

(3.) *The resist style*, where the white cloth is impressed with figures in resist paste, which will protect the parts it covers from receiving any color, and afterwards subjected to a cold dye, as the indigo vat, and then to a hot dye-bath, with the effect of producing white or colored spots on a blue ground.

(4.) *The discharge style*. The object of this style of work is the production of a white or colored figure on a colored ground. This is accomplished by printing on the cloth already dyed or mordanted a substance called the *discharger*, which has the property of decomposing either the coloring matter or the mordant.

(5.) *The China-blue style*, which requires very peculiar treatment, and is practised with one coloring matter only, namely, indigo. The different shades of blue are secured by first printing with indigo in its insoluble state, and then reducing this to the soluble state, and dissolving it on the cloth by immersing it in certain chemical preparations.

All these different styles require a complicated process peculiar to each. The art of calico-printing has been carried towards perfection by the exercise of the highest mechanical ingenuity, the cultivated taste of the best artists, and the talent of the most distinguished chemists. "It is curious to consider the great variety of taste the calico-printer is obliged to consult. As articles of dress, his goods are to be worn by the half-clothed savage, fond of a display of gaudy colors; they are to please the refined tastes of civilized nations, of the women of Eastern harems, and the wives of African kings. Almost every country is a customer for these goods, and each demands peculiar styles, patterns, and colors."

