CA'LICO-PRINTING is that department of the art of dyeing which takes cognizance of the production of a coloured pattern on cloth. It appears to have been first practised at *Calicut* in India—hence the term *calico;* and the *pallampoors*, or large cotton chintz counterpanes, which have been manufactured in the East Indies for centuries, are evidence of the successful practice of the art in that country. From the East Indies, the art spread to Asia Minor and the Levant, thence to Augsburg in Bavaria; from whence, at the beginning of the 18th c., it spread to Alsace in France, to Switzerland, and ultimately to England and Scotland. The term is strictly applicable to the production of coloured patterns on cotton cloth or calico; but as now employed, it includes all the processes followed in the formation of a coloured pattern on cotton, linen, worsted, and silk goods, as also mixtures of two or more of these, such as the fabric called *de laine*, which is composed of cotton and worsted.

The first operation connected with the printing of cloth is the removal of the surface-hairs or minute threads which communicate a fibrous down or nap to the surface of the cloth, and if allowed to remain, would interfere with the uniform application of the colours. The surface down is got rid of by the process of singeing, during which the cloth is drawn over a red-hot iron or copper bar or plate, or through a series of gas jets. The apparatus generally used for *hot-plate singeing* consists of a furnace surmounted by a metal plate, which is sometimes ridged on the surface. The cloth having previously been joined at the ends, to make a long length, and been placed on a winch-roller, is first brought in contact with roller brushes, which raise the nap on the cloth, then passes over the white-hot metal cylindrical bar, and is wound on to a second winch-roller. The process is repeated twice on the face of the cloth, being the surface to be printed on, and once on the back. *Gas-singeing* is accomplished by drawing the cloth through brushes, and then over a horizontal pipe, perforated with rows of small holes, or slit from end to end, so that the gas issuing therefrom burns as a narrow sheet of flame. The cloth is not only allowed to come in contact with the burning gas, but the flame is transmitted through the cloth, and a suction-apparatus is often placed immediately above, so as to draw the flame through more effectually. When well singed, the cloth undergoes the process of bleaching (q. v.), and is thereafter calendered. See CALENDERING.

There are several modes of applying the colours to cloth, and these are respectively named—1. The Madder style; 2. The Padding style; 3. Topical style; 4. Resist or Reserve style; 5. Discharge style; and 6. China blue or pottery style. These various processes are at one in being intended to fix upon the cloth the different colours; but they differ from each other more or less in the several steps through which the cloth is passed, though occasionally there is little or no line of separation; and at times, the cloth is treated by one method, and subsequently by another style.

The *madder style* is that in which a certain fixing agent or mordant is printed on the cloth, which is then introduced into the colouring matter in a dye-vat, when the mordant, having an attraction alike for the fibre of the cloth and for the colouring matter, acts the part of glue or paste, and cements the colour to the cloth. Originally, madder was the only colouring substance employed in this style; but now-a-days, by far the greater number of dye-stuffs, vegetable and animal, including cochineal, logwood, &c., are attached to cloth in this manner. The fixing agents or mordants generally

employed are different strengths of *red liquor* (acetate of alumina), *iron liquor* (acetate of iron), and mixtures of these. These are thickened with wheat-starch, potato-flour, roasted starch or dextrine, and gum-arabic, so that the mordant may not run when it is placed on the cloth by the pattern-block or by the printing-machine. After the mordant has been imprinted on the cloth, the latter is hung in a warm airy room, where it can easily dry, but where it is at the same time surrounded by a moist atmosphere. The result is, that the mordant is decomposed, the acetic acid is evolved, and the alumina or iron is left attached to the fibre of the cloth in the state of an insoluble sub-salt, which cannot be dissolved by water. As some of the mordant is still left in its original soluble condition, it is necessary to wash the cloth free from this, else, during the dyeing operation, the soluble part of the mordant would run on to those parts of the cloth not intended to be coloured, and thus produce a blotted appearance. To obviate this, the cloth, having undergone the process of *drying and ageing*, is then introduced into a vat containing water, through which is diffused some cow-dung, dung substitute—a preparation of bone ash, sulphuric acid, carbonate of soda, and glue—or bran. The result of this process of *dunging* is the removal of the soluble part of the mordant, as also the starch or thickening agent, leaving the decomposed or insoluble mordant adhering to the fibre. The terms *dung*-fixing, *substitute*-fixing, and *bran*-fixing, have reference to the employment of one or other of these agents at this stage of the operation. When the cloth has been well washed from the dunging, it is introduced into the vat or dye beck containing the colouring matter. The whole is heated by steam-pipes, and the cloth being placed on a sparred reel kept in motion, is repeatedly wound out of the vat, and returned thereto. The result is, that wherever the mordant adhered to the cloth, the colouring matter is attached thereto, and little or no trace of colour adheres to the unmordanted parts. The last operation is the *clearing* or *brightening*, during which the coloured cloth is introduced into warm baths of water containing soda, soap, or, for the more delicate tints, bran, and is thereafter acted on by weak acid solutions. The object is to clear the colours, and at the same time to confer upon them the property of resisting the fading action of the air and sun for a much longer time. The different shades of colour which can be obtained from the same madder beck or vat, with different mordants, are very numerous, and include reds, lilacs, purples, chocolates, and blacks. Thus, when a weak solution of red liquor (acetate of alumina) is employed as the mordant, a light red tint is procured; with a stronger aluminous mordant, a deep red is formed on the cloth; with a more or less dilute solution of iron liquor (acetate of iron), the cloth is coloured lilac, violet, or purple; with a strong solution of iron liquor, black is obtained. Indeed, the same piece of cloth stamped in different places with the various strengths of aluminous and iron mordants, and mixtures of these, and immersed in the madder-bath, will be obtained dyed with all the shades mentioned; and in this manner, many of the beautiful variegated coloured dresses and handkerchiefs are prepared for market.

The *padding style* in C. is intended mainly for the impregnation of cloth, in whole or in part, with mineral colouring substances. When the cloth is to be entirely coloured, it is immersed wholly in a vat containing the mordant. When the colour is to appear as a pattern on the fabric, the mordant is applied by a pattern block, or by the printing-machine. In either case, the cloth is thereafter thoroughly dried, and washed in various solutions, and then introduced into a vat containing the substance to form the colour. Thus, if a piece of cloth is to be entirely impregnated with *chrome yellow*, it is first treated or *padded* in a solution of 8 parts of bichromate of potash ($KO,2CrO_3$) to a gallon of water dried, and then placed in a vat containing a solution of 6 or 8 ounces of acetate or nitrate of lead ($PbOA$, or $PbONO_5$) to the gallon of water. The result is that the chromate of lead ($PbOCrO_3$) is formed in the tissue of the cloth; and when the latter is washed and dried, the yellow colour still adheres to the cloth firm and fast. To print a yellow pattern on cloth, 7 to 9 ounces of acetate of lead, and the same quantity of nitrate of lead, are dissolved in a gallon of water, thickened with starch, and placed upon the cloth according to pattern. After drying, the cloth is first immersed in water containing a little carbonate of soda, and ultimately in a solution of bichromate of potash, when the pattern becomes fixed in bright yellow, insoluble in water. To produce *Prussian blue* on cloth, it is treated with acetate and sulphate of iron, dried, washed with warm chalk-water, and immersed in a very weak solution of yellow prussiate of potash. A pattern in Prussian blue is produced by printing a pattern in the cloth with the iron solutions thickened with gum, and thereafter proceeding as above. Chrome green is produced in a similar way, by using sulphate and acetate of copper, thickened with glue, and thereafter arsenious acid with potash; and so also other colours, such as iron buff or chamois, manganese bronze, &c.

The *topical style* in C. is the process whereby certain colouring matters which are insoluble in water, and cannot therefore be applied to cloth by the modes suggested under the madder and padding styles, are treated at once with the mordant, and the mixture by one operation transferred by block, or otherwise, directly on the surface or *top* of the cloth, and hence the term *topical*. Indigo, safflower, and arnotto are instances of such insoluble colouring substances; and when these and other dye-stuffs, such as logwood and Brazil wood, are treated with water, thickened with starch and nitro-muriate of tin (known as *spirits*) added, with occasionally a little of other salts, such as nitrate of copper, the result is the formation of *spirit-colours*, which can be printed on the surface of cloth, and possess a certain degree of fixity. The permanency of these *spirit-colours*, however, is very much increased, and the general appearance improved, by afterwards subjecting the goods to the action of steam in a wooden chest or box, when the term *steam-colours* is applied.

The *resist style* in C. is that in which certain materials are placed on the surface of cloth, to protect it from the adherence of the mordants, and, consequently, to keep that part of the cloth from being attacked by the colouring matter. These materials are termed resists, reserves, or resist-pastes, and they are divisible into mechanical and chemical. The *mechanical resists* are such substances as fats, resins, oils, wax, and pipe-clay. A common resist for silk and woollen goods is a mixture of 2½ of resin and 1 of suet; and it is principally in the colour-printing of silk and woollen dresses and handkerchiefs that mechanical resists are employed, though they are occasionally used for the printing of cottons. The chemical resists may act on the mordant or on the colour. Thus, if it be desirable to remove the mordant, and thus leave certain parts of the cloth unable to attach colour, the printing of a pattern with some acid substance on the cloth will form with the mordant a soluble salt, which can be readily removed by

washing, whilst the parts which have not been so acted on by acid are not dissolved away by the washing, and still retain the full power in the colour-vats to cause the adhesion of the colour. For this purpose, where an iron or aluminous mordant has been employed, it is customary to print thereon in the requisite pattern, lemon-juice or lime-juice (containing citric acid), tartaric or oxalic acid, and bisulphate of potassa, or a mixture of two or more of these, thickened with pipe-clay, China-clay, gum-arabic, dextrine (British gum), gum-Senegal, or a mixture of these; occasionally, chloride of tin is employed. Sulphate of zinc, sulphate and acetate of copper, and the chloride of mercury, are used to resist the adherence of indigo blue.

The *discharge style* in C. comprehends the employment of similar materials to those used in the resist style, but *after* the cloth has been coloured or dyed, and for the purpose of discharging the colour, or bleaching the cloth at certain parts, according to pattern. The dischargers for organic colouring matters are chlorine and chromic acid. The chlorine is employed in the form of bleaching-powder (q. v.), and the cloth already dyed is printed with a solution of tartaric acid (or other acid), thickened with pipe-clay and gum, then dried, and passed through a solution of bleaching-powder, when the decoloration occurs, as already explained under BLEACHING. The chlorine is also applied by placing a number of folds of coloured cloth between perforated pattern-plates, and subjecting the whole to great pressure; a solution of chlorine (obtained by adding an acid to a weak solution of bleaching-powder) is allowed to percolate down through the perforations of the plates, and the cloth immediately underneath, so that only those spots are bleached, while the rest of the cloth is so highly compressed as to keep the liquid from coming in contact therewith. The well-known Turkey-red handkerchiefs are *patterned* in this way. The chromic acid is generally employed in discharging indigo colour. The cloth, already entirely blue, is soaked or padded in bichromate of potash, and then an acid discharger printed thereon; and wherever the acid discharger (tartaric, oxalic, citric, or hydrochloric acid) comes in contact with the blue cloth containing the bichromate of potash, chromic acid is liberated, and destroys the colour. Instead of acting upon the coloured cloth, the discharger may be employed to carry off the mordant. Thus, cloth treated wholly with a mordant, and thereafter printed with a pattern in acid, has the mordant removed at those parts where the pattern block has placed the acid. Mineral colours can also be discharged in a similar way.

The *China blue or pottery style* in C. is a modification of the topical style, where indigo is deposited on cloth in the insoluble state, and is thereafter manipulated with, so as to impregnate the cloth with the indigo more or less strongly, and thus produce different shades of blue.

The above descriptions of the various operations in C. have special reference to cotton cloth; and though many steps of the manipulative processes apply equally well to linen, silk, worsted, and de laines (worsted and cotton), yet considerable modifications in mode of treatment and material employed are required in the successful colour-printing of all texture containing animal fibre, such as silk and wool. Where the printing of such fabrics differs essentially from the processes already indicated, special reference will be made under SILK and WOOL. The different colouring matters employed in C. being identical with those used in dyeing, will be considered under the general popular title DYE-STUFFS; and the mode of compounding these into the various colours and shades, will be more appropriately introduced under DYEING.