insoluble pigments such as chrome yellow, the ochres, vermilion and ultramarine. Albumen is always dissolved in the cold, a pro­cess which takes several days when large quantities are required. The usual strength of the solution is 4 lb per gallon of water for blood albumen, and 6 lb per gallon for egg albumen. The latter is expensive and only used for the lightest shades. For most purposes one part of albumen solution is mixed with one part of tragacanth mucilage, this proportion of albumen being found amply sufficient for the fixation of all ordinary pigment colours. In special instances the blood albumen solution is made as strong as 50 per cent., but this is only in cases where very dark colours are required to be absolutely fast to washing. After printing, albumen- thickened colours are exposed to hot steam, which coagulates the albumen and effectually fixes the colours.

Formerly colours were always prepared for printing by boiling the thickening agent, the colouring matter and solvents, &c., to­gether, then cooling and adding the various fixing agents. At the present time, however, concentrated solutions of the colouring matters and other adjuncts are often simply added to the cold thickenings, of which large quantities are kept in stock.

Colours are reduced in shade by simply adding more starch or other paste. For example, a dark blue containing 4 oz. of methylene blue per gallon may readily be made into a pale shade by adding to it thirty times its bulk of starch paste or gum, as the case may be. Similarly with other colours.

Before printing it is very essential to strain or sieve all colours in order to free them from lumps, fine sand, &c., which would in­evitably damage the highly polished surface of the engraved rollers and result in bad printing. Every scratch on the surface of a roller prints a fine line in the cloth, and too much care, therefore, cannot be taken to remove, as far as possible, all grit and other hard par­ticles from every colour.

The straining is usually done by squeezing the colour through fine cotton or silk cloths. Mechanical means are also employed for colours that are used hot or are very strongly alkaline or acid.

Styles of Printing

The widely differing properties of the hundreds of colouring matters now on the market give rise to many different styles of textile-printing. Generally speaking, these fall into the following four great divisions :—

(1) Direct printing.

(2) The printing of a mordant upon which the colour is after­wards dyed.

(3) The discharge style.

(4) The resist or reserve style.

The fact that each of these divisions is further sub-divided into many smaller divisions renders it out of the question to give more than a few typical examples of the various styles they include.

(1) *Direct Printing.*—This style is capable of application to almost every class of colour known. Its essential feature is that the colouring matter and its fixing agent are both applied to the fabric simultaneously. In some instances the fabric requires to be pre­viously prepared for certain of the colours used along with those characteristic of the. process; but this is one of many cases where two styles are combined, and it must be classed with the one which it most resembles.

(a) *Application of Mordant Dye-Stuffs.—*Mordant colours include both artificial and natural dye-stuffs (see also under Dyeing), the most important of all being *alizarine,* an artificial preparation of the colouring-principle of the madder root. With different metallic oxides alizarine forms different colour-lakes all exceedingly fast to light and soap. Aluminium mordant gives red and pink lakes; iron mordant, purples and lavenders; chromium yields maroons; and uranium gives grey shades. Mixture of iron and aluminium produce various tones of chocolate and brown.

In addition to alizarine the following are a few of the more important mordant dye-stuffs employed in textile-printing:—

Alizarine orange with aluminium and chrome mordants for orange and warm brown shades respectively; alizarine bordeaux, with alumina, for violets; alizarine blue with chrome and zinc for quiet blue shades; coeruleine and alizarine viridine for greens and olives with chromium mordants; gallocyanine, chrome violet blue, alizarine cyanines, &c., with chromium for various shades of blue and violet; alizarine yellows and anthracene brown for yellows and fawn shades respectively with either alu­minium or chrome mordants. The natural dye-stuffs belonging to this series are chiefly: logwood, with chromium and iron mor­dants, for blacks; Persian berries and quercitron bark, with aluminium, tin and chromium mordants, for colours ranging from brilliant yellow to quiet old golds and browns; catechu, with chromium, for very fast dark browns; and, occasionally, in mix­tures, sapan-wood, peach-wood, Brazil-wood, and divi-divi extracts with any of the above-mentioned mordants.

The mordants are mostly in the form of acetates which are stable in the cold but decompose during the steaming process, and combine as hydroxides with the colours, forming and fixing on the fabric the insoluble lake.

Alizarine reds and pinks are the most complicated of the mor­dant colours, requiring for their proper production the addition of brightening agents, such as oxalate of tin, oils, tartaric acid, and also acetate of lime. This also applies to alizarine orange, but all the other colours are very simple to compound and are stable for a long time after making. Reds, pinks and oranges are best prepared freshly each day; their constituents are liable to combine if the colour stands twenty-four hours before printing.

The following types of recipes will give some idea of the way in which colours are mixed :—

|  |  |
| --- | --- |
| *Red.* 6½ gallons thick starch and tragacanth paste. | |
| 1¼ , | , alizarine (20 per cent. commercial paste). |
| 1 | , nitrate of alumina, 18° Tw. |
| i , | , acetate of lime, 28° Tw. |
| i . | , oxalate of tin, 10° Tw. |
| ½ , | , 10 per cent. solution of tartaric acid. |
| *Pink.* 6½ gallons starch-tragacanth paste. | |
| I , | , blue shade alizarine (20 per cent, paste). |
| 1∣ , | , sulphocyanide of alumina, 180 Tw.  , acetate of lime, 280 Tw. |
| i : | , oxalate of tin. |
| i , | , citrate of alumina, 400 Tw. |

For reds and pinks the nitrate, sulphocyanide and citrate of alumina are generally preferred in practice to the acetate though the latter is also largely used. Oranges from .alizarine orange are made similarly.

|  |  |
| --- | --- |
| *Purple.* 9∣ gallons starch paste.  ; „ blue shade alizarine, 20 per cent. | |
| j : | , acetic acid.  , acetate of lime, 280 Tw.  , acetate of iron, 240 Tw. |
| *Maroon.* 5i gallons paste. | |
| I , | , alizarine, 20 per cent. |
| í . | , acetate of chrome, 32® Tw. |
| i . | , acetate of lime, 280 Tw. |

Blues and the other colours are made by leaving out the lime in the last recipe and replacing the alizarine with another colour.

|  |  |
| --- | --- |
| *Alizarine Blue,* J lb | alizarine blue shade (powd.). |
| *(Light Shade.)* ι gallon water. | |
| 31 | ,, thick paste. |
| ιl | „ acetate of chrome, 40o Tw. |
| Logwood and other natural colours are specially boiled. | |
| *Logwood Black.* | '15 lb starch.  10 „ British gum. |
| - | 4i gallons water.  J „ acetic acid.  ij » logwood extract, 48β Tw.  - j „ quercitron extract, 480 Tw. |
| Boil, cool and add :— | |
| ( J lb red prussiate of potash. | |
| ) gallon water. | |
| 2 | „ acetate of chrome, 40o Tw. |
| 2 | oz. chlorate of potash. |
| *Quercitron Yellow,* ι⅜ | gallons quercitron extract, 48β Tw. |
| 6i | ,, water. |
| II | lb starch. |
| Boil, cool and add :— | |
| 2  **4** | gallon acetate of chrome, 30o Tw. |

The proportions here given are liable to variations according to circumstances. Indeed, no two works employ quite the same recipes, although the proportion of mordant to dye-stuff is pretty generally known and observed.

After printing, the goods are dried, steamed for one hour, and then washed and finished.

*(ft) Application of Basic Aniline Dye-Stuffs.*—These colours all form insoluble lakes with tannic acid; hence tannic acid is the common fixing agent of the group. Arsenic in combination with alumina also gives basic-colour lakes, but their poisonous char­acter and their inferior fastness to most reagents considerably limit their application.

The more important basic dye-stuffs are: methylene blue, methyl violet, rhodamine, auramine yellow, safranine emerald green and indoine blue. Most of them are fairly fast to soaping, but towards the action of light they vary’ a good deal, methylene blue being perhaps as good as any, and the malachite greens the least stable.

Their application is simple. A solution of the colouring matter is added to the requisite quantity of starch paste or gum, and, when well mixed in, the tannin is added in the form of a solution also. If desired they may’ be boiled up like the extract dye-stuffs (logwood, &c.), but this is not necessary unless large quantities are required, when it would be more convenient to boil the whole at once than to mix small batches by hand.