The Art of Dyeing.

The art of fixing coloring matters uniformly and permanently in the fibres of wool, silk, linen, cotton, and other substances. Dyeing is a chemical process, and the mode of its performance depends upon the substance operated on. Thus it is found that the process by which wool is dyed black, would only impart a rusty brown to linen. *Wool* unites with almost all coloring matters with great facility, *silk* in the next degree, *cotton* less easily than silk, and *linen* with even more difficulty. Preparatory to the operation of dyeing, each of these substances undergoes a species of preparation to free the fibres from adhering foreign matter, as dirt, grease, &c, which would prevent the absorption of the aqueous fluid to be afterwards applied, as well as impair the brilliancy of the dye. *Wool* is cleaned or scoured by means of a weak alkaline lye, soap and water, or putrid urine; the latter being very generally used for this purpose. *Silk* is cleaned from the natural varnish that covers it, by boiling with white soap and water. *Cotton* and *linen* are cleaned with alkaline lyes of more or less density. The substances so prepared are ready to undergo the various operations of dyeing.

Among the various coloring materials employed by dyers, some impart their tints to different substances by simple immersion in their infusions or decoctions, and have hence been called "*substantive colors;*" but by far the greater number only impart a fugitive dye, unless the fibres of the stuff have been previously filled with some substance which has a strong affinity for the latter on the one hand, and the coloring material on the other. The substances applied with this intention are called "*Mordants,*" and generally exercise the double property of "*fixing*" and "*striking*" the color. Thus, if cotton goods be dyed with a decoction of madder, it will only receive a fugitive and dirty red tinge, but if it be first run through a solution of acetate of alumina, dried at a high temperature, washed, and then run through a madder bath, it will come out a permanent and lively red. The principal mordants are the acetates of iron and alumina, sulphate of iron, alum, and some other chemical salts. A perfect knowledge of the effect of mordants on different coloring substances is of paramount importance to the dyer.

After having received the proper mordants, the goods are dried and rinsed, after which they are passed for a shorter or longer time through an infusion, decoction, or solution of the dyeing materials, which constitute the "*dye-bath*"; they are again dried and rinsed. In many cases, the immersion in the dye-bath is repeated, either with the same materials or with others to vary or modify the color. After the substances have been properly dyed, they are subjected to a thorough rinsing or washing in soft water, until the latter runs off uncolored.

94. Dye Woods, &c. Decoctions of the different woods are prepared for general use in the dye house as they are required. If the wood be in the chipped state, it must be boiled for an hour, in the proportion of 1 pound of wood to 1 gallon of water; a second

boiling is generally given with new water, and the liquor obtained used instead of water with more new wood. This second liquor is not good for dyeing alone, but when employed instead of water for new wood, ¾ pound of new wood is sufficient. The second liquor may, however, be used as an auxiliary in the dyeing of compound colors, such as browns, drabs and fawns. If the wood be ground the same quantity is taken—namely, 1 pound for each gallon of the decoction required, and is prepared as follows:—on a piece of coarse cloth stretched upon a frame, or laid into a basket, put the ground wood, and place it over a vessel, then pour boiling water over the wood until the liquor that runs through is nearly colorless. Barwood and Camwood are always used in the ground state, the wood being put into the boiler along with the goods; no decoctions of these woods are made. Decoctions of bark and weld are often formed by putting them into a coarse canvas bag, and then suspending it in boiling water.

The coloring principle of archil is highly soluble in hot water, and is useful in combination with other dyeing materials; but used alone, does not impart a permanent color.

95. To prepare Annotto. Into 2 gallons of water put 1 pound of Annotto, 4 ounces of pearlash, and 2 ounces of soft soap, and apply heat, stirring until the whole is dissolved. When convenient it is best to boil the solution.

96. To prepare Catechu. To 7 or 8 gallons of water put 1 pound of catechu, and boil till it is all dissolved; then add 2 ounces of sulphate of copper, stir, and it is ready for use. Nitrate of Copper may also be used, taking 1 wine-glassful of the solution made according to the next receipt.

97. To make Nitrate of Copper Solution. To 1 part by measure nitric acid, and 2 parts water, add metallic copper so long as the acid will dissolve it, then bottle the solution for use.

98. To make Sulphate of Indigo. Into 5 pounds of the most concentrated sulphuric acid, stir in by degrees 1 pound of the best indigo, finely ground; expose this mixture to a heat of about 160° Fahr. for 10 or 12 hours, stirring it occasionally; a little rubbed upon a window-pane should assume a purple-blue color.

99. To make Indigo Extract. This is prepared by proceeding exactly as stated for sulphate of indigo and then diluted with about 4 gallons hot water, and the whole put upon a thick woolen filter, over a large vessel, and hot water poured upon the filter, until it passes through nearly colorless; the blackish matter retained upon the filter is thrown away, and the filtered solution is transferred to a leaden vessel, and evaporated to about 3 gallons, to which is added about 4 pounds chloride of sodium (table salt) and well stirred; the whole is again put upon a wooden filter and allowed to drain. The extract remains as a thin pasty mass upon the filter, and is ready for use.

100. To make Red Liquor. Into 1 gallon hot water place 2 pounds alum; dissolve, in a separate vessel, 2 pounds acetate of lead in 1 gallon water; in a third vessel dissolve ½ pound crystallized soda; mix all the solutions together and stir well for some time, then allow to stand over night; decant the clear solution which is ready for use.

101. To make Caustic Potash. To 3 gallons water add 2 pounds either black or pearl ashes, and boil; when seething add newly-slaked lime, until a small quantity taken out does not effervesce when an acid is added to it. To test this, take a tumbler half filled with cold water, put a table-spoonful of the boiling lye into the tumbler, and add a few drops sulphuric acid; if the acid were added to the hot lye, it would spurt up and endanger the operator. When the addition of acid causes no effervescence, the boiling and adding of lime is stopped, and the whole allowed to settle; then remove the clear liquid into a vessel having a cover, to prevent it from taking carbonic acid from the air. This serves as a stock for general use. The lime sediment remaining may have some hot water added, which will give a strong lye, and may be used for first boils for yarn or heavy cloth.

102. To make Caustic Soda. For every gallon water add 1 pound soda ash, or 2 pounds crystallized soda (washing soda); boil and proceed by adding slaked lime, and testing as for potash; boiling for some time is essential in order to ensure perfect causticity.

103. To make Lime-water. Take some well and newly-burned limestone, and pour water over it as long as the stone seems to absorb it, and allow it to stand; if not breaking down freely, sprinkle a litttle more water over it. A small quantity is best done in a vessel, such as an old cask, so that it can be covered with a board or bag. After being slaked, add about 1 pound of it to every 10 gallons cold water, then stir and allow to settle; the clear liquor is what is used for dyeing. This should be made up just previous to using, as lime-water standing attracts carbonic acid from the air, which tends to weaken the solution.

104. To Make Bleaching Liquor. Take a quantity of bleaching powder (chloride of lime) and add to it as much water as will make it into a thin cream; take a flat piece of wood, and break all the small pieces by pressing them against the side of the vessel, then add 2 gallons cold water for every pound of powder; stir well, put a cover upon the vessel, and allow the whole to settle. This will form a sort of stock vat for bleaching operations.

105. To make a Sour. To every gallon of water add 1 gill of sulphuric acid, stir thoroughly; goods steeped in this should be covered with the liquor, as pieces exposed become dry, which deteriorates the fibre; if left under the liquor the cloth is not hurt by being long in the sour, but on being taken out, every care should be taken to wash out the liquor thoroughly, otherwise the goods will be made tender.

106. To make Cochineal Liquor or Paste. Put 8 ounces ground cochineal into a flask and add to it 8 fluid ounces ammonia and 8 ounces water; let the whole simmer together for a few hours, when the liquor is ready for use.

107. Acid Preparations of Tin. The acid preparations of tin used in dyeing are called *spirits*, with a term prefixed to each denoting their particular application, as red spirits, barwood spirits, &c. The tin employed for making these preparations has to undergo a process called *feathering*, and is as follows:—the tin is melted in an iron pot, and then poured from some height into a vessel filled with cold water; this granulates or feathers, the tin. (*See No.* 3319.)

108. Red Spirits are made by mixing together in a stoneware vessel, 3 parts by measure hydrochloric acid, 1 part nitric acid, and 1 part water, and adding to this feathered tin in small quantities at a time, until about 2 ounces tin to the pound of acid used are dissolved. In this operation the temperature should not be allowed to rise. (*See No.* 4124.)

109. Yellow Spirits are prepared in the same way, only substituting sulphuric acid for the nitric acid. This is used for the same purposes as red spirits, with the advantage of the economy of sulphuric over nitric acid.

110. Barwood Spirit is prepared by using 5 measures hydrochloric acid, 1 nitric acid and 1 water, dissolving in this 1 ounce feathered tin for every pound of the whole mixture. 1½ ounces tin may be used if the red dye is required to be very deep.

111. Plumb Spirit is made by using 6 to 7 measures hydrochloric acid to 1 nitric acid and 1 water, dissolving in it 1½ ounces tin for each pound of the acid mixture. This spirit is named from a preparation made with it and a decoction of logwood. A strong solution of logwood is made and allowed to cool, then to each gallon of the solution there is added from 1 to 1½ pints of the spirit; the whole is well stirred and set aside to settle. This preparation has a beautiful violet color, and silk and cotton are dyed of that shade by dipping them into this *plumb liquor* without any previous mordant. The depth of tint will depend on the strength of the solution.

112. Plumb Spirit for Woolen Dyeing. This is prepared by adding tin to nitric acid in which a quantity of chloride of ammonium (sal ammoniac) has been dissolved. Observe, that all these spirit preparations are varied by different operators, some preferring more or less of the two acids, and also of the tin; but the proportions given form good working spirits, and if care be taken in their preparation not to *fire* them, that is, not to allow the temperature to get so high as to convert the tin into a persalt, the operator will not fail in his processes as far as the quality of the spirit is concerned.

113. Tin Spirits. The following are among the best recommended preparations of tin spirits, used for dyeing scarlet:

1 pound nitric acid, 1 pound water; dissolve in this 1½ ounces sal ammoniac, and then add, by degrees, 2 ounces pure tin, beaten into ribbons.

Or: dissolve 1 part sal ammoniac in 8 parts nitric acid at 30° Baumé; add, by degrees, 1 part pure tin; and dilute the solution with one-fourth its weight of water.

Or: 4 parts hydrochloric acid at 17° Baumé, 1 part nitric acid at 30° Baumé; dissolve in this mixture 1 part pure tin.

Or: 8 parts nitric acid, 1 part sal ammoniac or common salt, and 1 part grain tin. This is the common spirit used by dyers.

114. Alum Plumb. Make a strong decoction of logwood, and then add to it 1 pound alum for every pound of logwood used.

115. To Test the Purity of Alum. The usual impurity which renders alum unfit for the uses of the dyer, is the ferro-sulphate of potassa, but if iron be present in any other shape it is equally injurious. Common alum frequently contains ammonia, from urine or the crude sulphate of the gas works having been employed in its manufacture. This may be detected by adding a little quicklime or caustic potassa. Pure alum should form a colorless solution with water, and give a white precipitate with pure potassa soluble in an excess of the latter. It should suffer no change on the addition of tincture of galls, prussiate of potash, or sulphureted hydrogen.

116. Nitrate of Iron is used in the dye-house for various purposes. Its principal use is for dyeing Prussian Blue, and is obtained as follows: Take 4 parts nitric acid and 1 part water in a glass or stoneware vessel; place it in a warm bath, and add clean iron so long as the acid continues to dissolve it with effervescence; take out any iron that remains undissolved, and, after settling for 1 hour, the clear solution is ready for use. The fumes given off during the operation should be guarded against, being deleterious to health and injurious to any metal or vegetal with which they come in contact. This solution should be kept in the dark, as it loses some of its strength by exposure to light.

117. Chloride of Iron is another salt used in the dye-house for dyeing silks and woolens a deep blue, and is preferred, for that purpose, to copperas. It is prepared for use thus: To 4 parts hydrochloric acid add 2 parts water, and apply a gentle heat; then add iron in pieces, or filings, so long as it continues to be dissolved; then pour off the clear liquid into a basin, and evaporate, when greenish colored crystals of chloride of iron will be obtained. This salt crystallizes with difficulty, deliquesces in the air, and should not be exposed. Instead of evaporating and crystallizing, the solution may be put in a bottle and reserved for use.

118. To make Iron Liquor. Into a large cast-iron boiler, or pot, a quantity of iron turnings, hoops or nails, are introduced, and acetic acid—the crude pyroligneous acid from the distillation of wood—is poured in upon them. The strength of the acid is generally of 5° Baumé, or specific gravity 1.035. A temperature of 150° Fahrenheit is maintained till the solution of protoacetate of iron is obtained. During the solution of the iron much tarry matter separates, which is skimmed off, and the solution frequently agitated, to free it, as much as possible, from the tar. As soon as a strength is gained of a specific gravity of 1.09, at 60° Fahrenheit, the solution is allowed to cool, for a further quantity of impurities to separate. When clean turnings are operated on, the process of solution is completed in 5 to 7 days.

119. To make up a Blue Vat. Take 1 pound indigo, and grind in water until no

grittiness can be felt between the fingers; put this into a deep vessel—casks are generally used—with about 12 gallons water; then add 2 pounds copperas, and 3 pounds newly-slaked lime, and stir for 15 minutes; stir again after 2 hours, and repeat every 2 hours for 5 or 6 times; towards the end, the liquor should be of a greenish yellow color, with blackish veins through it, and a rich froth of indigo on the surface. After standing 8 hours to settle, the vat is fit to use.

120. To make Blue Stone. Sulphate of copper is known in commerce as *Blue stone, Roman vitriol,* and *Blue vitriol,* and may be prepared by exposing pure copper in thin sheets to the joint action of dilute sulphuric acid and air; or by treating freshly precipitated oxide of copper with diluted pure oil of vitriol; or by boiling the metal with oil of vitriol, either in the concentrated state or diluted with an equal bulk of water. These are the simplest ways of obtaining this salt, which may be reduced to a crystalline form by evaporation. The crystals assume a well-defined rhomboidal form of a fine sapphire-blue color.

121. To make Solutions for Dyeing. In making solutions of copperas, blue stone, chrome, &c., there is no fixed rule to be followed. A quantity of the crystals are put into a vessel, and boiling water poured upon them and stirred until dissolved. Some salts require less water than others when saturated solutions are wanted; but in the dye-house saturation is not essential, and therefore there is always used ample water to dissolve the salt. In all cases, however, the proportions are known, so that the operator, when adding a gallon, or any other quantity of liquor to the dye-bath, knows how much salt that portion contains. From ½ to 1 pound per gallon is a common quantity.

122. To Prepare Cotton Yarn for Dyeing. Cotton yarn, when spun, is put up in *hanks,* a certain number of which combined constitute a *head;* the number of hanks ranging from 6 to 20, according as the fineness of the yarn varies from very coarse to very fine. Sufficient of these *heads* are tied together, or *banded* with stout twine into a bundle, to make 10 pounds.

After banding, the cotton is boiled in water for 2 or 3 hours until thoroughly wet. The bundles are then loosed, and each roll of yarn is put on a wooden pin, about 3 feet long and 1½ inches thick, 4 or 6 pins making a bundle. The yarn is now ready for dyeing dark colors; but for light shades, it must be bleached previous to dyeing. The bleaching is performed thus:

123. To Bleach Cotton Yarn. A vessel sufficiently large to allow of the yarn being worked in it freely without pressing, is to be two-thirds filled with boiling water; add 1 pint bleaching liquor (*see No.* 104) to every gallon of water in the vessel, and work the yarn in this for half an hour. Into another vessel of similar size, two-thirds filled with cold water, add one wine-glassful sulphuric acid for every 2 gallons water; stir well, and then put the yarn from the bleaching solution into this, and work for 10 minutes; then wash out until all the acid is removed. This will bleach the yarn for dyeing any light shade.

124. To Prepare Cotton Cloth for Dyeing. The cloth is taken out of the fold, and hanked up by the hand, taking the end through the hank and tying it loosely, technically termed *kinching;* it is then steeped over night in old alkaline lye, which loosens and removes the oil, grease and dressing which it has obtained in weaving; it is then thoroughly rinsed in clean water. Where there is a dash-wheel, it should be used for this washing. In consequence of the liquor often fermenting with the paste in the cloth, this process has been technically termed the *rot steep.*

If the cloth is to be dyed a dark color, no further preparation is needed; but if light, the cloth has to be bleached as follows:

125. To Bleach Cotton Cloth. After undergoing the *rot steep,* boil for 3 hours in caustic lye, of the strength of 1 gill of stock lye (*see No.* 101) to the gallon of water; wash out, and steep for 6 hours in a solution of 1 pint of bleaching liquor (*see No.* 104) to the gallon of water; wash, and steep 1 hour in a strong sour of 1 wine-glassful sulphuric acid to 1 gallon water; wash well from this before drying or dyeing.

If the cloth be very heavy, it may be necessary to repeat in their proper order the boiling in lye, the steeping in bleaching liquor, and in the sour, finishing, as before, with thorough washing or drying.

In bleaching cloth for dyeing, care has to be taken that it is all equally white, otherwise it will show in the color.

The quantity of water used should be sufficient to cover the cloth easily without pressure.

If the goods be old, and have previously been dyed, and if the shade required be a deep shade, and the color of the goods light, in that case nothing is generally required but steeping in alkaline lye to remove any grease or starch; but if the color of the cloth is dark, the best method is to bleach as if they were gray goods.

126. To Remove Oil Stains. When there are oil spots upon goods, and so fixed or dried in, that steeping in an alkaline lye will not remove them, rub a little soft soap upon the stain, and let it remain for an hour, then rub gently with the hand in a lather of soap, slightly warmed, and wash in water; for cotton, a little caustic lye will do equally well, but the soap is preferable, and seldom fails. It is essential that all oil or grease be removed before dyeing.

127. To Remove Iron Stains. Take a little hydrochloric acid in a basin or saucer, and make it slightly warm, then dip the iron stain into the acid for about 1 minute, which will dissolve the oxide of iron; the cloth must be well washed from this, first in water, then in a little soda and water, so as to remove all trace of acid. A little oxalic acid may be used instead of hydrochloric, but more time is required, and with old fixed spots is not so effective. The same precautions are necessary in washing out the acid, as oxalic acid dried in the cloth injures it.

128. To Remove Mildew from Cotton. Proceed with the stains by rubbing in soap or steeping in a little soda, washing, and then steeping in bleaching liquor (*see No.* 104), or by putting a wine-glassful of the stock

liquor (*see No.* 101) in 1 pint of water; afterwards wash, pass through a sour (*see No.* 105), and wash again.

129. To Remove Indelible-Ink Marks. Steep in a little chlorine water or a weak solution of bleaching liquor (*see No.* 104), for about half an hour, then wash in ammonia water, which will obliterate the stain; then wash in clear water. They may also be removed by spreading the cloth with the ink marks over a basin filled with hot water; then moisten the ink marks with tincture of iodine, and immediately after take a feather and moisten the parts stained by the iodine with a solution of hyposulphate of soda, or caustic potassa or soda, until the color is removed; then let the cloth dip in the hot water; after a while wash well and dry.

130. Indigo Blue Dye for Yarn. The vats used for dyeing indigo blue are usually wine pipes or other large casks, sunk in the ground to a depth convenient for the operators to work at. Five of these constitute a set, and are worked together and kept of the same strength. The yarn being worked in quantities of 100 pounds, 20 pounds are passed through each vat.

Each vat is filled about three-fourths with cold water; there are then added 8 pounds of indigo, 16 pounds of sulphate of iron (copperas), and 24 pounds newly-slaked lime. The whole is well stirred with a rake for half an hour, and this stirring is repeated every 1½ hours for the first day.

The time to stop the stirring is known by the solution becoming a rich oak yellow, having large blue veins running through it and a fine indigo froth on the surface. When these signs are all favorable, the solution is allowed to stand for several hours till all the solid matter settles, when it is ready for use.

The mode of dyeing consists in simply immersing the goods, and working them in the solution for 15 minutes, taking out and wringing or pressing, and then exposing to the air; repeating this operation until the desired depth of color is obtained. The yarn is then washed in cold water and dried. When the shade required is very deep, the yarn may, previous to washing, be passed through a tub of water acidulated with vitriol till it tastes acid, and then washed; this adds brilliancy to the color.

131. Sky Blue Dye for Cotton Goods. To dye 10 pounds of cotton, first bleach the cotton (*see No.* 125); then, to a tub of cold water sufficient to work the goods easily, add ½ pint nitrate of iron, and work in this for 20 minutes; wring out, and pass through a tub of clean water. Into another tub of cold water add 4 ounces ferrocyanide of potassium in solution, and about a wine-glassful of sulphuric acid; work the goods in this for 15 minutes; wring out and wash through cold water, in which is dissolved 1 ounce of alum; wring out and dry. For lighter or darker shades of blue, use less or more of the iron and ferrocyanide; or, should the color be too light after passing through the process described, add 1 ounce more ferrocyanide, repeat the operation through the same tubs, and the shade will be deepened nearly double.

132. Napoleon Blue. For 10 pounds cotton goods, the cotton must be first bleached. Into a tub of cold water put 1 imperial pint of nitrate of iron and 2 gills hydrochloric acid, then add 3 ounces crystals of tin (or 1 pint chloride of tin); stir well and immediately work the goods in it for 30 minutes; wring out and put directly into the *prussiate tub*, made up with water into which is put a solution of 12 ounces ferrocyanide, and one wine-glassful of hydrochloric acid; work in this for 15 minutes, then wash out in clean water in which is dissolved 2 ounces of alum. If a deeper shade of blue is required, wash them in clean water without the alum, pass them again through the two tubs; and, lastly, wash them in water with the alum.

133. Royal Blue. This is dyed in the same manner as *Napoleon Blue*, but the liquors are stronger—using 2 pints iron solution, 2 gills hydrochloric acid, and 4 ounces tin crystals. The Prussiate tub is made up by dissolving in it 1 pound ferrocyanide of potassium, and adding 1 wine-glassful of sulphuric acid, and 1 of hydrochloric acid. If not dark enough with putting through once, repeat.

134. Blue. Copperas (sulphate of iron) is used as a mordant for dyeing blue by ferrocyanide of potassium (prussiate of potassium). The copperas best suited for the blue vat should be of a dark rusty green color, and free from copper, zinc, or alumina. Thus, 10 pounds cotton may be dyed a good rich blue by working it for 15 minutes in a solution of 4 pounds copperas; wring out; and then work through a solution of 4 ounces of the ferrocyanide; finally, wash in cold water containing 1 ounce alum in solution.

Copperas is also used as a dye by the oxidation of the iron within the fibre. Thus:

135. Iron Buff or Nankeen. Take 2 pounds copperas, and dissolve in warm water, then add the requisite quantity of water for working the goods; work in this for 20 minutes; wring out, and put immediately into another vessel filled with lime-water, and work in this for 15 minutes; wring out and expose to the air for half an hour, when the goods will assume a buff color. If the color is not sufficiently deep, the operation may be repeated, working through the same copperas solution, but using fresh lime-water each time. The goods should be finally washed through clean warm water and dried.

136. Nankeen or Buff Dye for Cotton Goods. To a tub of hot water add 1 pint nitrate of iron, and work in this for half an hour 10 pounds cotton previously bleached (*see No.* 125); wash out in water, and dry. This process is simple and easy, and produces a permanent dye.

137. General Receipts for Dyeing Cotton. In the following receipts, the quantities are given for 10 pounds cotton, whether yarn or cloth. For more or less cotton, the quantities can be increased or diminished in proportion; but when small articles are to be dyed—such as ribbons, gloves, &c.—a little more of the materials may be used in proportion to advantage. Where washing is referred to, it is always in cold water, unless otherwise specified.

138. Common Black. Steep the goods in a decoction of 3 pounds sumach while it is hot, and let them lie over night; wring out

and work them for 10 minutes through lime-water, then work for half an hour in a solution of 2 pounds copperas. They may either be washed from this, or worked again through lime-water for 10 minutes; then work them for half an hour in a warm decoction of 3 pounds logwood, adding ½ pint chamber lye; before entering the goods, lift and raise with 2 ounces copperas in solution; work 10 minutes, then wash and dry.

139. Jet Black. The goods are dyed in the same manner as the last receipt; but along with the logwood is added 1 pound fustic.

In both the above receipts if 3 pints iron liquor (*see No.* 118) be used instead of the copperas, or in part mixed with the copperas, it makes a richer shade of black, but copperas is generally used; if mixed, use half the quantity of each.

140. Blue Black. Dye the goods first a good shade of blue by the vat (*see No.* 130), and then proceed as for common black. If the blue be very deep, then half the quantity of the materials for dyeing black will suffice.

141. Spirit Yellow. Work through a solution of protochloride of tin, of the specific gravity of 1° Baumé, for 30 minutes; wash out, and work for 15 minutes in a decoction of 3 pounds bark kept at a boiling heat; lift out the goods and add to the bark solution ½ pint single chloride of tin; work the goods for 20 minutes in this, and then wash well in cold water. This gives a rich yellow.

142. Spirit Brown. First dye the goods a spirit yellow, according to the last receipt; after washing, work for ½ hour in a decoction of 2 pounds lima or peachwood and 1 pound logwood; lift the goods out and add 3 ounces alum in solution, and work the goods in it 15 minutes; wash and dry. By varying the proportions of logwood and limawood, a variety of shades may be produced.

143. Mordant Brown. Steep the goods for six hours in a decoction of sumach, next dye a spirit yellow, according to the receipt given above. Then work for half an hour through a decoction of 2 pounds limawood and 8 ounces logwood; lift the goods, and add 2 ounces alum in solution; work for 15 minutes, wash and dry. This method is well adapted for cotton goods, is better than the spirits, and more easily performed by the non-practical man. The spirit brown is best for yarn.

144. Cinnamon Brown. Dye a dark spirit yellow (*see No.* 141), and work for 30 minutes in 3½ pounds limawood and ½ pound logwood; lift the goods and add 2 ounces alum in solution; wash and dry.

145. Uvanterin Brown. Dye a spirit yellow (*see No.* 141), then work for 20 minutes in a decoction of 1 pound limawood and 1 pound fustic; lift, and add ½ pint red liquor (*see No.* 100); work 10 minutes in this; wash and dry.

146. Fawn Brown. Take 1 part annotto liquor (*see No.* 95), and 1 part boiling water; stir well, and work the goods in it for 10 minutes; wring out and wash in two waters; then work for 20 minutes in a decoction of 2 pounds fustic and 1 pound sumach; lift, and add 3 ounces copperas in solution; stir well, and work for 20 minutes longer; then work for 20 minutes in a decoction of 8 ounces limawood, 8 ounces fustic, and 4 ounces logwood; lift, and add 1 ounce alum; work in this for 10 minutes; wring out and dry.

147. Catechu Brown. Work the goods at a boiling heat for 2 hours in 2 pounds of catechu prepared according to No. 96; wring out, and then work for half an hour in a hot solution of 6 ounces bichromate of potassa; wash from this in hot water. If a little soap be added to the wash water, the color is improved. Deeper shades of brown may be dyed by repeating the operation.

148. Catechu Chocolates. Dye brown according to the last receipt, then work for 15 minutes in a decoction of 1½ pounds logwood; lift, and add 3 ounces alum in solution; work 10 minutes longer; wash out and dry. Different shades of brown and chocolate can be produced, by varying the proportion of logwood, and the strength of the brown dye.

149. Chocolate, or French Brown. Dye a spirit yellow according to receipt No. 141; then work for half an hour in a decoction of 3 pounds logwood; lift, and add ½ pint of red liquor (*see No.* 100), and work 10 minutes longer; wash and dry. A deeper shade may be obtained by adding 1 pound fustic to the logwood.

150. Catechu Fawns. Work the goods 15 minutes in hot water containing 2 pints catechu, prepared as in receipt No. 96; wring out, and work 15 minutes in hot water containing 1 ounce bichromate of potassa in solution; wash and dry.

151. Catechu Fawns—Another Method. Work in the catechu the same as in the last receipt; wring out, and work for 15 minutes in warm water containing 2 ounces acetate of lead in solution; wash in cold water and dry.

152. Catechu Fawns—Another Method. Work in warm water containing 4 pints catechu (*see No.* 96), lift, and add 2 ounces copperas in solution, and work for 15 minutes; wash in water, and then in another tub of warm water in which sufficient soap has been dissolved to raise a lather, and then dry.

153. Common Red. Make a decoction of 3 pounds sumach, and put the goods in at once; let them steep over night; wring out and work for an hour in a mixture of 1 gill red spirits (*see No.* 108), to every gallon water; wring out and wash well; then work for half an hour in a decoction of 3 pounds limawood and 1 pound fustic, using this decoction as hot as the hand can bear it; lift, and add 1 gill red spirits, then work for 15 minutes more; wash out and dry.

154. Barwood Red. To a decoction of 2 pounds sumach, add a wine-glassful of vitriol, and steep the goods in it for 6 hours; wring out and work for an hour in red spirit (*see No.* 108), diluted to 2° Baumé; wring out and wash, then pass through a tub of warm water; put 10 pounds barwood into a boiler with water and bring it near to the boil, then put in the goods and work among the wood grains for ¼ hour; lift out, wash, wring and dry. Deeper shades may be dyed by using larger quantities of the materials in each operation.

155. Scarlet. For 1 pound of goods, boil 1¼ ounces cream of tartar in water in a

block-tin vessel; add 1¼ ounces tin spirits, made according to the first receipt in No. 113; boil for 3 minutes, then boil the goods in it for 2 hours; drain and let the goods cool. Next boil ½ ounce cream of tartar for a few minutes in some water; add to it 1 ounce powdered cochineal, boil for 5 minutes, adding gradually 1 ounce tin spirits, stirring well all the time; then put in the goods and dye immediately.

156. Common Crimson. Steep over night in a decoction of 3 pounds sumach; work in spirits diluted 2° Baumé, wash and then work for 30 minutes in a decoction of 3 pounds limawood and 1 pound logwood; lift, and add a gill of red spirits (*see No.* 108); work for 15 minutes; wash and dry. A beautiful red crimson is obtained by omitting the logwood; and a diversity of tints dyed by varying the proportions of the limawood and logwood.

157. Light Straw. To a tub of cold water add 4 ounces acetate of lead in solution, work the goods in this for 15 minutes, and wring out; then work for 10 minutes in another tub of water containing 2 ounces bichromate of potassa; wring out, and work again in the lead solution for 10 minutes; wash and dry.

158. Leghorn. This tint is dyed in the same manner as the last, but adding ½ pint of annotto liquor (*see No.* 95) to the chrome solution. Different shades may be obtained by using more or less of these stuffs, without varying the mode of working.

159. Annotto Orange. Heat the annotto solution (*see No.* 95) to about 140° Fahr.; work the goods in it for 20 minutes; wring out thoroughly in order to economize the liquor, wash in a couple of waters and dry. If the goods are then passed through water with sufficient acid to taste sour, a very red orange, almost scarlet, is obtained, but the tint fades quickly.

160. Logwood Blue. Dye first a light blue with the vat (*see No.* 130), then soak the goods for several hours in a hot decoction of 2 pounds sumach; then work for 15 minutes in water containing 1 pint red liquor (*see No.* 100) and 1 pint iron liquor (*see No.* 118); wash in two waters, hot; then work for 20 minutes in a decoction of 2 pounds logwood; lift, and add ½ pint red liquor, and work again for 10 minutes; wash and dry.

161. Fustic Green on Yarn. Dye a blue with the vat (*see No.* 130), wash and wring, and then pass through red liquor (*see No.* 100) diluted to 4° Baumé; wash through a tub of hot water, and then work for 20 minutes in a decoction of 4 pounds fustic; lift, and add 2 ounces alum in solution; work for 15 minutes, wash and dry.

162. Fustic Green on Cloth. Work the goods in red liquor (*see No.* 100) diluted to 4° Baumé, and dry in a hot chamber; then wet in hot water and work for 20 minutes in a decoction of 3 pounds fustic; lift, and add 2 ounces alum in solution; work again for 15 minutes; wring out and work in *chemic* (a solution of sulphate of indigo whose acid has been neutralized with carbonate of soda); wring out and dry.

163. Dark Green on Cloth. After the goods have been cleaned, work them for 10 minutes in red liquor (*see No.* 100) at 5° Baumé; wring out, and pass through a tub of hot water; then work for half an hour in a decoction of 3 pounds bark; lift, and add ½ pint red liquor (*see No.* 100); work 10 minutes longer, then lift and drain; work next for 20 minutes in a tub of cold water containing 5 gallons chemic (*see last receipt*); wring out and dry. The depth of shade can be varied by increasing or diminishing the quantities of material in proportion.

164. Green with Prussian Blue. Dye a good Prussian blue (*see No.* 131) according to the depth of green required; then work 10 minutes in red liquor (*see No.* 100) at 4° Baumé; wash in warm water, and work for half an hour in a decoction of 3 pounds fustic; lift, and add 2 ounces alum in solution; work again for 10 minutes, wash and dry. A finer tint can be obtained by using bark instead of fustic, but it must not be worked too warm.

165. Sage Green. Dye a Prussian blue (*see No.* 131), and work 10 minutes in a solution of 2 pounds of alum; wring out, and work 15 minutes in a decoction of 1 pound fustic; lift, and add a pint of the alum solution already used; work 10 minutes; wash and dry.

166. Olive or Bottle Green. Dye a good shade of Prussian blue (*see No.* 131); then mordant 10 minutes in red liquor (*see No.* 100) at 5° Baumé; wring out and wash in hot water; then work half an hour in a decoction of 3 pounds fustic and 1 pound sumach, then add ½ pint of iron liquor (*see No.* 118), and work 15 minutes; wash in a tub containing 2 ounces alum, and dry.

167. Olive or Bottle Green—Another Method. Work the goods in red liquor (*see No.* 100) at 5° Baumé, wash out in warm water; then work for half an hour in a decoction of 3 pounds bark and 1 pound sumach; lift, and add ½ pint iron liquor (*see No.* 118), and work 15 minutes; wring out and work 15 minutes in the chemic (*see No.* 162); wring out and dry.

168. Olive Green. Dye a Prussian blue (*see No.* 131); then work for 10 minutes in red liquor (*see No.* 100) at 4° Baumé; wash in hot water, and work in a decoction of 3 pounds bark and 1 pound logwood; lift, and add ½ pint red liquor, and work 10 minutes; wash and dry. By varying the proportions of bark and logwood, different shades of green may be obtained.

If the goods be yarn, a light blue may be dyed by the vat (*see No.* 130) instead of the Prussian blue, and proceeded with as above.

169. Lilac or Puce. Work for an hour in red spirits (*see No.* 108) at 1½° Baumé; wring out and wash; then work half an hour in a decoction of 3 pounds logwood at about 140° Fahr.; lift, and add 1 gill red spirits, and work 20 minutes; wash and dry. Half a pint red liquor (*see No.* 100) or 2 ounces alum, may be added to the logwood after lifting, instead of the red spirit.

170. Lilac or Puce. Work for 15 minutes in red liquor (*see No.* 100) at 5° Baumé; wring out and wash in a tub of warm water; then work half an hour in a decoction of 2 pounds logwood at 140° Fahr.; lift, and add ½ pint red liquor, or 2 ounces alum; work 10 minutes, and wash in clean warm water; wring out and dry.

171. Light Purple or Adelaide. Steep the goods in a decoction of 2 pounds sumach; wring out, and work half an hour in plumb spirit (*see No.* 111); wring out, and wash in clean cold water until no taste of acid is left on the goods, and dry.

When working with the plumb spirit, it is advisable to put a sufficiency of it into a separate vessel for working the goods, returning the liquor afterwards to the plumb tub.

172. Light Purple. Steep in a decoction of 2 pounds sumach; wring out and work for 20 minutes in red spirits (*see No.* 108) at 1½° Baumé; wash well and then work in plumb spirit, and finish the same as the last receipt.

173. Purple. Steep in a decoction of 2 pounds sumach until cool; work in red spirits (*see No.* 108) at 1½° Baumé for an hour, and wash in cold water; then work for half an hour in a decoction of 3 pounds logwood at 140° Fahr.; lift, and add 1 gill red spirits, and work 10 minutes more; wash in cold water and dry.

If a browner tint is required, use a little more sumach; for a bluer tint, use less sumach and more logwood; and add, after lifting, ½ pint red liquor (*see No.* 100), or 2 ounces alum, instead of red spirits.

174. Lavender or Peach. Work for 20 minutes in plumb spirit (*see No.* 111); wring out, and wash in clean cold water till free from acid taste, and dry.

175. Logwood, Lilac or Puce. Dye a good shade of Prussian blue (*see No.* 131); then work 15 minutes in a decoction of 1 pound logwood at 140° Fahr.; lift, and add 4 ounces alum; work 10 minutes, then wash in cold water and dry.

176. Logwood Lilac. Dye a sky blue (*see No.* 131); then work for 15 minutes in a tub of warm water containing 1 gallon alum plumb (*see No.* 114); wring out and dry.

177. Common Drab. Work for 15 minutes in a decoction of ½ a pound sumach; lift, and add 1 ounce copperas in solution, and work 15 minutes more; wash out in a tub of cold water, then work 15 minutes in a decoction of 4 ounces fustic, 2 ounces limawood, and 1 ounce logwood; lift, and add 1 ounce alum in solution; work 10 minutes, then wring out and dry.

A great variety of different tints can be produced by varying the proportion of the limawood, fustic, and logwood; and lighter or darker shades by diminishing or increasing the quantities of sumach and copperas.

178. Olive Drab. Work for 15 minutes in ½ pound sumach; lift, and add 1 ounce copperas, and work 15 minutes more; wash in water, then work for 20 minutes in water with ½ pound fustic; lift, and add 1 ounce alum, and work for 10 minutes and dry.

179. Drab. To a tub of hot water add 1 pint annotto preparation (*see No.* 95), which gives a light salmon color; then proceed as for *olive drab* in last receipt. By varying the quantities a great variety of tints may be obtained.

180. Stone Color. Work the goods 20 minutes in a decoction of 1 pound sumach; lift, and add 1 ounce copperas in solution; work for 15 minutes, and wash in cold water; then work 10 minutes in warm water containing ½ pint alum plumb (*see No.* 114); wring out and dry. This gives a reddish tint, which may be avoided by using a solution of ½ ounce of alum instead of the alum plumb.

181. Catechu Stone Drab. Work the goods 15 minutes in hot water containing 2 pints prepared catechu (*see No.* 96); lift, and add 2 ounces copperas in solution; work for 15 minutes, and wash in water, then work for 10 minutes in a tub of warm water containing a decoction of 2 ounces logwood; lift, and add ½ ounce alum; work 10 minutes more, wring out and dry.

182. Catechu Drab. Work for 15 minutes in hot water containing 1 pint prepared catechu (*see No.* 96); lift, and add 1 ounce copperas; work 10 minutes; wash out and dry. A variety of tints may be obtained by finishing in a weak decoction of one or other of the different dye-woods.

183. Chrome Dyes for Cotton Goods. The following recipes will serve to illustrate the use and value of chrome (bichromate of potassa) as a dyeing agent. The quantities given are for dyeing 10 pounds weight of cotton, and may be increased or diminished in proportion, according to the quantity of goods to be dyed.

184. Light Straw. To a tub of cold water add 4 ounces acetate of lead, previously dissolved; work the goods through this for 15 minutes, and wring out; into another tub of water add 2 ounces bichromate of potassa; work the goods through this 10 minutes, wring out and pass again through the lead solution for 10 minutes; wash and dry.

185. Lemon Color. Into a tub of cold water put 1 pound acetate of lead, previously dissolved; work the goods in this for 15 minutes, and wring out; into another tub of cold water put 6 ounces bichromate of potassa in solution; work the goods for 15 minutes through this, and wring out; then work it 10 minutes in the lead solution; wring out, wash, and dry.

186. Deep Yellow. To a tub of cold water add 1 pound acetate of lead, and 1 pound nitrate of lead in solution; work the goods in this for 30 minutes, and wring out; then to a tub of warm water add 12 ounces bichromate of potassa, and work the goods in it for 15 minutes; expose to the air for half an hour, then pass again through both solutions, working them the same time in each as before, and expose to the air for one hour; then pass them through the lead solution; wring out, wash and dry. If the color is not deep enough they may be passed through the solutions again, observing the same rules.

187. Deep Amber Yellow. Put into a tub of water 1 pound acetate of lead, and to this add gradually caustic potassa or soda, until the precipitate formed be re-dissolved, taking care not to add more alkali than is required for this solution; work the goods in this for 30 minutes; wring out, and work for 15 minutes in another tub of water to which 8 ounces bichromate of potassa has been added in solution; wring out, wash and dry. 2 or 3 ounces sulphate of zinc may be added to the chrome solution with good effect. If a deep red amber be required, add to the chrome solution ½ pint muriatic acid.

188. Chrome Green. Dye a blue by

the process described in No. 131; then dye a yellow according to the last receipt. The depth of the blue and yellow will regulate the tint of green.

The principal difficulty is when a particular depth or shade of green is wanted, to ascertain the exact shade of blue to be given, as blue cannot be added upon the yellow. This is a matter which can only be learned by practice.

189. French Process for Dyeing Turkey-Red. The following process for dyeing turkey-red, is the one in general use in France at present.

The quantities of materials, &c., given, are for dyeing 2200 pounds of cotton, which has already, it is assumed, been subjected to thorough washing and scouring in soap.

Dissolve 20 to 22 pounds carbonate of potassa in about 330 gallons of water, and provide for future use 1300 to 1400 pounds of fat oil; next divide the goods to be dyed into three equal portions.

The first step in the process is *oiling* the goods; mix together one-third part of the fat oil and of the solution of potassa, stirring by degrees into the oil sufficient solution to produce an emulsion; this makes the *white liquor*.

One-third of the goods are padded, that is, drawn through evenly backwards and forwards, in this white liquor; then take them out and lay together in a heap in a fresh cool place for 10 or 12 hours, and dry in an atmosphere heated to 140° Fahr.

While the first portion of the goods is drying, prepare a second portion of white liquor, and subject a second portion of the goods to the same operation as the first; the remaining portion of the goods is in turn subjected to the same treatment, using the remainder of the fat oil for a third tub of white liquor; by this means the process proceeds without intermission, each portion being under different stages of treatment simultaneously.

This routine is repeated several times (generally seven or eight) on each portion, each always in its own tub, according to the quantity of oil which it is desired to fix on the goods. If the bath begins to fail, either a little tepid water is added, or a certain quantity of *old white liquor* proceeding from the washings.

The next stage is to remove superfluous oil; this is done by macerating the goods twice, successively, for 24 hours each time, in a solution of carbonate of potassa at 1° Baumé. The liquid which is wrung or pressed out of them constitutes the *old white liquor*, which may be employed again for filling up in the oiling operation. The goods are then carefully rinsed.

The third process is *galling* or *mordanting*. Bruise 22 pounds gall-nuts, and boil repeatedly until thoroughly drawn; add sufficient water to make up to 66 gallons; dissolve in this 35 pounds alum with the assistance of heat. This is sufficient for working one-half, that is, 1100 pounds of the cotton, which must be padded in the liquid at a temperature of about 160° Fahr.; it is next suspended for 2 days in a drying-room heated to 112° Fahr., and then passed into a hot concentrated bath of chalk. Care must be taken to work the goods very equally in this bath, in order to avoid streaking. The goods are then washed, and present a fawn-colored appearance.

The fourth step is *the first dyeing*. This is performed on 10 pieces at a time, the proportions of madder varying according to the breadth and length of the pieces, from 13, 15, 17 to 20 pounds madder for each piece. As in the preceding process, the madder is divided into two equal portions, one portion being used for the first dyeing, and the other portion reserved for the second dyeing. The one portion is mixed with the requisite quantity of water, from 300 to 400 gallons; the 10 pieces are introduced into this bath at a tepid heat, and kept in it 3 hours, the temperature being gradually increased, until, at the end of 2¾ hours, boiling point is reached; and this heat is sustained for the remaining ¼ hour. The goods must then be washed, thoroughly cleansed, rinsed and dried.

The fifth stage is the *second galling;* which is prepared in the same gall liquid, and in the same manner as the *first galling*, finishing with the chalk bath, washing and drying.

The sixth operation is the *second dyeing*, an exact repetition of the *first dyeing*, using the remaining half of the madder reserved for this purpose.

The seventh step, *first clearing*, is performed in a close boiler, two-thirds filled with water containing in solution 13 pounds soap, and 3½ pounds carbonate of potassa; the goods are boiled in this for 8 hours.

The eighth process is a *second clearing*, conducted in the same manner as the *first clearing*, but dissolving in the water 14½ pounds soap, and 14 ounces chloride of tin instead of the potassa solution.

For only very lively reds a *third clearing*, similar to the second, is required. The goods, after clearing, are exposed for some time in the air; then worked through a bran bath, which adds to the brightness of the color.

The process here described is slightly modified by some French dyers; thus, experience proves that the oil is better fixed in the stuff when the drying is not performed too rapidly; and there are some who, when the season does not admit of exposure to the air, heap the pieces together, after oiling, in a drying-room heated to 95° Fahr., turning them over from time to time to prevent injury from overheating. Some use ox-blood in the proportion of 40 pounds blood to 100 pounds madder.

190. Violet. Dye a turkey red (*see No.* 189), and then pass through the blue vat. (*See No.* 130.)

191. Preparation and Dyeing of Woolens. To prepare new woolen goods for dyeing, the cloth or yarn (if the latter, it is first banded with twine into spindles, *see No.* 122,) is steeped over night in soap lye, and then scoured through clean soap to remove all oil or grease that may be upon the wool. Instead of soap, a scouring mixture may be prepared with 1 pound soft soap and 1 pound common soda (or ½ pound soda-ash), in 10 gallons water.

Goods to be re-dyed must first be steeped and scoured in soap and soda. If the remaining color be unequal or dark, the goods must be worked for a short time in a sour,

made by dissolving 2 ounces bisulphate of potassa in each gallon of water used. Woolen goods are always dyed hot, as near boiling point as possible; this necessitates the use of boilers, which should be of copper, or copper and tin, as iron will not answer the purpose. The dye-stuffs are generally put in the boiler, and the goods worked with it, but it is cleaner to make decoctions (*see No.* 94), and use the clear liquor. All washings are to be in cold water unless otherwise specified. The quantities given in the following receipts are for dyeing 10 pounds of woolen goods, either cloth or yarn, unless otherwise specified.

192. Black. Work for 20 minutes in a bath with 8 ounces camwood; lift, and add 8 ounces copperas; work 20 minutes more, then withdraw the fire from the boiler, and submerge the goods in the liquor over night, then wash out. Work for an hour in another bath containing a decoction of 5 pounds logwood and 1 pint chamber lye; lift, and add 4 ounces copperas; work for 30 minutes longer, wash and dry.

193. Brown. Work for an hour in a bath made up with 2 pounds fustic, 2 pounds madder, 1 pound peachwood, and 4 ounces of logwood; lift, and add 2 ounces copperas; work for 30 minutes, wash and dry.

194. Brown Dye. The different shades of this dye vary from pale yellow and reddish brown up to very dark brown, almost black, every shade of which, however, may be produced, as the taste of the workman may dictate, by mixtures of reds and yellows with blues and blacks, or by simple dyes, which at once impart a brown,—as catechu, walnut rinds, or oxide of manganese.

Boil the cloth in a mordant of alum and common salt dissolved in water, then dye it in a bath of logwood, to which a little green copperas has been added. The proportion of alum should be 2 ounces, and of salt 1 ounce, to every pound of cloth.

Or boil the goods in a mordant of alum and sulphate of iron, then rinse them through a bath of madder. The tint depends on the relative proportions of the alum and copperas; the more of the latter, the darker will be the dye. The joint weight of the two should not exceed ⅛ of the weight of the wool. The best proportions are 2 parts of alum and 3 of copperas.

For other receipts for dyeing black and brown see Index.

195. Crimson. Work in a bath for one hour with 1 pound cochineal paste, 6 ounces dry cochineal, 1 pound tartar, and 1 pint protochloride (single chloride) of tin; wash out and dry.

196. Scarlet. Work for an hour in a bath with 1 pound tartar, 2 ounces dry cochineal, 8 ounces sumach and 8 ounces fustic; wash out and dry.

197. Red. Work for 30 minutes in a bath made up with 1 ounce chrome and 1 ounce alum; wash in cold water; then work for 30 minutes in another bath with three pounds peachwood or limawood; lift, and add 1 ounce alum; work for 20 minutes; wash and dry.

198. Claret Red. Work for an hour in 5 ounces camwood; lift, and expose the goods until well drained and cold; meanwhile, add to the camwood bath 4 ounces copperas, 2 ounces alum, and 8 ounces logwood; work the goods for 30 minutes, wash and dry.

199. Scarlet. For every 100 pounds of fabric, boil, in a suitable kettle, 11 pounds ground Honduras cochineal, 5 pounds half-refined tartar or 3 pounds tartaric acid, 2 pounds oxalic acid, 1 pound tin crystals, 1½ pounds flavine, 10 pounds scarlet spirit (*see below*). After it has boiled for about fifteen minutes, cool the dye to 180° Fah., enter the goods, handle them quickly at first, and let them boil slowly for 1 hour, when they will be a good scarlet. Take them out, cool, and rinse in cold water. If it should happen that the wool or flannel shows some white hair, which is generally the case when new wool is used, then add 5 pounds of raw muriatic acid to the dye. This powerful agent will work wonders in scarlets, oranges, and pinks, as it tans the wool, which is perhaps a little greasy, and prevents the tin crystals from fastening too quickly to it, and thereby evener colors are obtained. This latter fact is very valuable, and not generally known.

Scarlet spirit is thus prepared: Take 16 pounds muriatic acid 22° Baumé, 1 pound feathered tin, 2 pounds water. The acid should be put in a stoneware pot, and the tin added, and allowed to dissolve; the mixture should be kept a few days before using.

200. Lac Scarlet. Work for 30 minutes in a bath with 1 pound tartar, 8 ounces sumach, and 2 pounds lac; lift, and add about a gill of bichloride of tin; work for 30 minutes, wash and dry.

201. Pink. Work for an hour in a bath made up with 1 pound tartar, 8 ounces alum, 1 pound cochineal paste, and 1 gill red spirits (*see No.* 108); wash in cold water and dry.

202. Yellow. Work for 20 minutes in a bath of water containing 8 ounces tartar and 8 ounces alum; lift, and add 2 pounds bark, 8 ounces sumach, 8 ounces fustic, and 1 pint red spirits (*see No.* 108); work in this for 40 minutes, wash out and dry.

203. Orange. Work for 40 minutes in 2 pounds sumach, 3 ounces dry cochineal, 1 pound fustic, 8 ounces tartar, and 1 pint red spirits (*see No.* 108); wash and dry.

204. Sky Blue. Work for 30 minutes in a bath containing 8 ounces argol, 1 pound alum, and 1 gill indigo extract (*see No.* 99); wash out and dry. The shade of blue will depend on the quantity of indigo extract used.

For other shades of blue see Index.

205. Pigeon Blue. Work for 40 minutes in 2 ounces chrome (bichromate of potash), 4 ounces alum, and 1 ounce tartar; wash out in cold water, and then work for 30 minutes in another bath made up with 3 pounds logwood; lift, and add 1 ounce verdigris; work for 15 minutes, wash and dry.

206. Apple Green. Work for 30 minutes in a bath with one ounce chrome and 1 ounce alum; wash through cold water, then work for 30 minutes in another bath with 2 pounds fustic and 8 ounces logwood; wash and dry. Different proportions of the materials used will produce different shades.

207. Green. Work for 15 minutes in 5 pounds fustic, 2 ounces argol, and 5 ounces alum; lift, and add ½ gill of indigo extract (*see No.* 99); work for 30 minutes and dry.

More or less indigo extract will make the green bluer or yellower, as required.

208. Fast Green. First dye a blue in the indigo vat (*see No.* 130) according to the depth of the green required; then work for an hour in a bath with 4 pounds fustic and 2 pounds alum; dry out.

209. Olive. Work for an hour in a bath made up with 10 ounces fustic, 8 ounces logwood, 4 ounces madder, and 2 ounces peachwood; lift, and add 4 ounces copperas in solution; work for 30 minutes and dry.

210. Wine Color. Work for an hour in a bath with 4 pounds cudbear, and dry. For a darker shade use more cudbear. If the tint be desired bluer, add, after 30 minutes working, 1 gill ammonia; if a redder tint is wanted, add a wine-glassful of hydrochloric acid; but if this last be used, the goods must be washed out before drying.

211. Light Violet. Work for an hour in a bath with 4 ounces cudbear, 4 ounces logwood, 2 ounces barwood or camwood, and 2 ounces peachwood; lift, and add 2 ounces alum in solution, work for 30 minutes and dry.

212. Lilac or Puce. Work in a bath for one hour with 10 ounces logwood, 1 ounce camwood and 8 pounds cudbear; lift, and add 2 ounces copperas in solution; work for half an hour and dry.

213. Brown Drab. Work for 30 minutes in a bath with 2 ounces ground madder, 1 ounce peachwood, 2 ounces logwood, and 6 ounces fustic; lift, and add 3 ounces copperas in solution; mix well and work the goods for 30 minutes more; then wash and dry. The shade can be adjusted to suit, varying the quantities and proportions of the dye-woods.

214. Properties of Dye-woods. Peachwood reddens, madder gives the drab tint, fustic supplies yellowness, and logwood induces a slate hue.

215. Stone Drab. Work the goods for 20 minutes in a bath containing 1 ounce peachwood or limawood, 2 ounces logwood and ½ ounce fustic; lift, and add 1 ounce copperas in solution; stir well and work in this for 30 minutes; lift out and expose to the air for a short time; wash and dry. Different shades are made by varying the quantities of the dye-woods. (*See last receipt.*)

216. Slate. Work for half an hour in a bath with 8 ounces logwood and 1 ounce fustic; lift, and add 1 ounce alum and ½ ounce copperas in solution; work for half an hour; wash and dry. For a bluer tint, use less alum and more copperas; for more purple, use less fustic and more alum, &c.

217. Blue. Dyeing woolens blue is performed by dipping in the blue vat (*see No.* 130), and then exposing to the air, repeating the operation till the desired depth of color is obtained.

218. Blue Purple. 100 pounds wool are first dipped a light blue in the vat, and well rinsed. Then take a stone pot, put in 3 pounds tartar, 3 pounds feathered tin, 5 pounds blue vitriol, and 20 pounds muriatic acid; heat all in a sand bath until dissolved.

From this mordant take 10 pounds in a suitable kettle; add 5 pounds tartar to it, stir it well, and enter the wool at 170° Fahr.; let it boil for 1 hour; take it out, cool, and let it lay for 24 hours. Then boil out 20 pounds good logwood for ¾ hour in fresh water; cool off the kettle to 150° Fahr., enter the wool, and handle it well for an hour, then heat it up to 185° Fahr., but do not let it boil; let it go for 1 hour more, when it will be a dark purple. This color stands the sun remarkably well, perhaps owing to the fact that there is not any alum or sulphuric acid used, except that contained in the blue vitriol.

219. Blue Purple, Fast Color. 100 pounds of wool are first dipped in the blue vat to a light shade, then boiled in a solution of 15 pounds alum, and 3 pounds half-refined tartar, for 1½ hours; the wool taken out, cooled, and let stand 24 hours. Then boil in fresh water 8 pounds powdered cochineal for a few minutes; cool the kettle to 170° Fahr.; handle the prepared wool in this for 1 hour, in which time let it boil for ¾ hour, when it is ready to cool, rinse, and dry. By coloring first with cochineal, as above, and finishing in the blue vat, the fast purple, or dahlia, so much admired in German broadcloths, will be produced.

220. Royal Blue Dye for Woolen Goods. Woolens may be dyed different shades of blue with nitrate of iron, observing the general rule that woolens must be worked at a boiling heat.

To dye 5 pounds of woolen goods—work for 20 minutes in a bath with 1 pound ferrocyanide of potassium, and lift; then take ½ pint nitrate of iron and add to it 1 ounce crystals of tin (or 1 pint chloride of tin); stir well for a few minutes and then add this mixture to the bath, and work the goods in this for 30 minutes; wash out and dry. For various shades of color, increase or diminish the quantities in proportion.

221. Chrome Dyes for Woolen Goods. The quantities given in the following receipts are for dyeing 5 pounds of woolen goods, unless otherwise stated. It must be understood that the goods must be cleaned before dyeing, and the dyeing must always be performed at a boiling heat.

222. Black. Work for 1 hour in a bath with 8 ounces bichromate of potassa, 6 ounces alum, and 4 ounces fustic; lift, and expose to the air for a short time; wash well, and then work for 1 hour in another bath with 4 pounds logwood, 4 ounces barwood, and 4 ounces fustic; lift, and add 4 ounces copperas in solution; work half an hour in this, and then wash and dry. In order to dye a blue black, the goods must be first dyed blue by the vat (*see No.* 130) or otherwise, and then proceeded with as for black, only using less materials.

223. Brown. Work for half an hour in 8 ounces of bichromate of potassa; lift, and expose till cold; then work an hour in 2 pounds fustic, 4 ounces madder, 3 ounces cudbear, 4 ounces tartar, 2 ounces logwood; lift out and dry; or it may be washed before drying

224. Rich Yellow Brown. Work for an hour in the following bath: 2 ounces bichromate of potassa, 2 ounces argol, 2 ounces alum; wash from this bath; then work about 40 minutes in another bath made up with 2 pounds fustic, 1 pound madder, 8 ounces

peachwood, and 4 ounces logwood; wash out and dry. This gives a very beautiful brown; and a great variety of tints and shades may be made by varying the quantities of the last bath, the first bath remaining the same.

225. Rich Yellow. Work for half an hour in a bath with 3 ounces bichromate of potassa and 2 ounces alum; lift, and expose till well cooled and drained; then work for ½ hour in another bath with 5 pounds fustic; wash out and dry.

226. Bottle Green. Work for an hour in a bath with 2 ounces bichromate of potassa and 4 ounces alum; lift out and expose to the air till cold; then work for an hour in a second bath with 3 pounds fustic, 1½ pounds logwood; wash out and dry.

227. Invisible Green. Work for an hour in a bath with 3 ounces bichromate of potassa, 4 ounces alum; lift, and expose to the air for some time; then work for an hour in a second bath with 2 pounds fustic, 3½ pounds logwood; wash out and dry. By comparing these last two receipts it will be seen that the different shades are produced by varying the proportions of the same dye-stuffs, and will serve as a guide for other shades of dark green.

228. Olive. Work for an hour in a bath with 4 ounces chrome, 2 ounces alum; lift and expose to the air; then work for an hour in a bath with 3 pounds fustic, 1½ pounds camwood, 1 pound logwood; lift out and dry.

229. Purple. Work the goods half an hour in a bath with 1 ounce bichromate of potassa, 1 ounce alum; lift out and wash in cold water; and then work half an hour in a bath with 2 pounds logwood, 1 pound peachwood; lift, and add 1 ounce alum in solution; work in this for 20 minutes; wash and dry. If a lighter and redder shade be required, use less logwood and more peachwood. For a darker shade use more of each.

230. Rich Green Drab. Work the goods 30 minutes in a bath with 1 ounce bichromate of potassa, ½ ounce alum, ½ ounce tartar; lift out and wash in cold water; then work for half an hour in another bath with 4 ounces logwood, 2 ounces fustic, 1 ounce barwood (or ½ ounce peachwood); wash and dry. The shades of this can be varied by using different proportions of the stuffs.

231. Rich Drab. Work for 30 minutes in ½ ounce bichromate of potassa; lift, and add 1 ounce of logwood; work in this for 30 minutes; lift out, wash and dry. Different proportions will produce different shades of color.

232. Chrome Blue. 100 pounds of wool are boiled for one hour in a solution of 3 pounds bichromate of potash, 6 pounds alum, 1 pound half-refined tartar; then it is taken out, cooled, and rinsed. Boil 6 pounds good logwood in a bag for half an hour in fresh water, add 3 pounds cudbear, well moistened and dissolved. Cool the dye to 180° Fahr. Enter the prepared wool, and handle it for ¾ of an hour; bring it to a boil in this time. This color ought to be always left a shade lighter when finished, as all chrome colors darken in drying.

In the foregoing receipts, the quantity of water to be used is not material, but will be regulated according to the size of the vessel and the amount of goods to be dyed, but there should always be enough water to cover the goods without the necessity of pressing them down.

Rules for making decoctions, &c., will be found in No. 94.

233. Preparing and Dyeing Silk. New silk is banded in the same manner as cotton (*see No.* 122), in quantities convenient for making up into skeins when finished. After banding, it is tied up carefully in fine canvas bags and boiled three or four hours in strong soap-water to remove all the gum. Yellow silk must be first worked on sticks for an hour in a solution of soft soap at a temperature of about 200° Fahr., and then boiled in bags. It is then washed from the soap and put on sticks for dyeing.

Silk goods to be re-dyed must be steeped in a strong soap solution at nearly boiling point for a few hours, to remove all stains and grease; they are then washed, and if the color on them is light and equal, and they are to be dyed dark, then no further preparation is required; but if the color is unequal, they must be soaked for 15 minutes in a *sour* (*see No.* 105), and then washed out.

The quantities given in the following receipts are for five pounds of silk. If the goods are tightly spun, such as ribbons, dress silk, &c., the quantities must be slightly increased.

There must be sufficient water used to cover the goods laying loosely. When goods are washed from the dye, it is always to be in cold water, unless otherwise stated.

234. Black. Work for an hour in a solution of 8 ounces copperas; wash well out in cold water; then work in a decoction of 4 pounds logwood, adding to it ½ pint chamber lye; lift, and add 2 ounces copperas in solution; work 15 minutes, wash and dry.

This gives a good black, but not very deep.

235. Deep Black. Work for an hour in a solution of 8 ounces copperas (sulphate of iron), and 2 fluid ounces nitrate of iron; and, after washing out, work in the decoction of logwood and chamber lye, as in the last receipt, finishing as there directed.

236. Blue Black. If a *blue black* is required, follow the same directions, but add a little white soap, instead of the chamber lye, to the logwood decoction, and add no copperas after lifting.

237. Full Deep Black. Work for 1 hour in a solution of 1 pound copperas and 2 ounces nitrate of iron; wash out, and work for an hour in a decoction of 5 pounds logwood and 1 pound fustic; lift, and add 2 ounces copperas, and work 10 minutes; wash and finish. If the color is not deep enough, add a little more logwood before lifting.

238. French Black. Work for an hour in a solution of 1 pound copperas and 4 ounces alum; wash out well, then work for an hour in a decoction of 4 pounds logwood, with a little white soap added; wash out and finish.

239. Blue Black by Prussiate. Dye a deep Prussian blue according to receipt No. 131, and work, from the prussiate, for half an hour, in 8 ounces copperas; wash well out in cold water, and then work for half an hour in a decoction of 2 pounds logwood;

lift, and add a little of the copperas solution first used, then work for 10 minutes more; wash and dry.

240. Deep Hat Black. Work for 15 minutes in a decoction of 2 pounds fustic and 1 pound bark; lift, and add 6 ounces acetate of copper and 6 ounces copperas in solution; work for 15 minutes more; then sink the silk below the surface and let it steep over night; lift out and wash; then, to a decoction of 5 pounds logwood, add white soap sufficient to make a lather, and work the silk in it for an hour; wash out and dry.

241. Brown. Dye an annotto orange (*see No.* 159); then work for 20 minutes in a decoction of 3 pounds fustic, 8 ounces sumach and 8 ounces peachwood; lift, and add 3 ounces copperas in solution, and work for 15 minutes; wash out in two waters, adding ½ pint alum solution in the last water. If the particular tint is not obtained, it may be given in the last alum-wash by adding as follows: for yellowness, a little fustic; for redness, a little peachwood; for depth or blueness, logwood. A number of different tints of brown may be obtained by varying the proportions of fustic, sumach and peachwood. A great many particular hues of brown may be dyed by this method; for instance, by using only fustic and sumach in the second operation, a California brown is obtained, &c. So that any intelligent person may regulate his colors and tints.

242. Red Brown. Dye a deep annotto orange (*see No.* 159); then work for 15 minutes in plumb liquor (*see No.* 111); wash well and dry. Particular tints can be made by adding fustic, peachwood or logwood to the last washing, as described in the last receipt.

243. Red Brown. Steep the silk for an hour in a solution of 8 ounces alum to each gallon water, then wash out in warm water; next, work half an hour in a decoction of 1½ pounds fustic, 1½ pounds peachwood, and 8 ounces logwood; lift, and add 1 pint of the alum solution; work 10 minutes, wash and dry.

244. Chocolate Brown. Steep the silk for an hour in a solution of 1 pound alum to each gallon of water; wash once in warm water, and then work for half an hour in a decoction of 3 pounds peachwood and 1 pound logwood; lift, and add 1 pint of the alum solution, work again for 15 minutes; wash out and dry.

For deeper shades use less peachwood and more logwood; for a still deeper tint, add about 4 ounces fustic.

245. Bronze Brown. Work for half an hour in a decoction of 8 ounces fustic, to which 4 fluid ounces of archil liquor has been added; lift, and add 2 ounces solution of copperas; work 15 minutes, wash and finish.

246. Cochineal Crimson. To every gallon of water used, add about 2 fluid ounces bichloride (oxychloride) of tin, allow any sediment to settle, and warm the clear solution; work the silk in this for an hour or more. Boil 2 pounds cochineal by suspending it in a bag on the surface of some water; add this to a quantity of water sufficient for working the goods, and bring it to a blood heat. Wring the silk from the tin solution and work it in the cochineal solution for ½ hour; then let it steep for several hours well under the liquor; wash out well in cold water. If the shade is not blue enough, add to the water a little cochineal dissolved in ammonia; work in it for 10 minutes, wring out and dry.

247. Common Red. Work the goods for 15 minutes in a decoction of 2 pounds peachwood and 1 pound fustic; lift, and add 4 fluid ounces red spirits (*see No.* 108); work for 15 minutes, wash in cold water and finish.

Different shades are made by varying the proportions, and claret tints are obtained by adding a little logwood. These common dyes are apt to fade.

248. Cochineal Pink. This is dyed in the same manner as cochineal crimson (*see No.* 246), using much less cochineal; about half a pound makes a good pink, and intermediate shades are produced by adjusting the proportion of cochineal.

249. Cochineal Scarlet. First dye a deep annotto orange (*see No.* 159); then dye a cochineal crimson according to No. 246.

250. Mixture for Dyeing Common Reds. Make a strong decoction by boiling 1 pound limawood or brazilwood to each gallon of water. Let the wood settle; decant the liquor, and let it stand to cool for 24 hours; decant the clear liquor and add ½ pint plumb spirits (*see No.* 111) to every gallon of liquor; after standing a few hours it is ready for use.

251. Common Crimson. Put some of the common red mixture (*see No.* 250) into a copper or stoneware vessel, and work the goods in it for ½ an hour; then wash out thoroughly, wring and dry.

252. Common Scarlet. Dye an annotto orange (*see No.* 159), then dye a common crimson according to the last receipt.

253. Ruby, Maroon, &c. Take 1 pound cudbear, and boil in a bag for 15 minutes; and work the silk in this for ½ an hour.

For a *bluish* tint, lift, and add 3 fluid ounces liquid ammonia; work 10 minutes, wring and dry.

For a *red* tint, lift, and instead of the ammonia, add 2 fluid ounces red spirits (*see No.* 108); work 10 minutes, wring and dry.

For a *brownish* hue, make a decoction of 1 pound cudbear and 4 ounces fustic; work for ½ an hour; lift, and add 2 ounces red spirits; work for 10 minutes and finish.

For a *deep violet* hue, proceed as in the last receipt, using 4 ounces logwood instead of the fustic.

254. Sky Blue. To 1 pint sulphate of indigo add 2 or 3 gallons boiling water; steep in this a piece of woolen cloth, such as an old blanket, for a day; take it out and wash in cold water.

If the *sky blue* is required to be light, warm some water in a vessel to about 98° Fahr., steep the woolen cloth in it for a few minutes, and wring out; this will leave sufficient blue in the water to dye the silk; add 1 ounce alum in solution, and work the silk in it for 20 minutes; wring out and dry.

255. Dark Blue. If a *deep blue* be required, blue the water as before with the woolen cloth, add 1 ounce pearlash; then add 1 ounce alum in solution, with a few drops of sulphuric acid; then work the silk in it as before.

Half an ounce of indigo extract (*see No.* 99) may be used for bluing the water, instead of using the woolen cloth for that purpose. The exact quantity of indigo extract depends on the shade of blue required.

256. Sky Blue Dye for Silks. For 5 pounds of silk goods, add to a sufficient quantity of water to work the goods ½ pint of nitrate of iron; work in this for 20 minutes, then wash out in cold water. Into another vessel of cold water add 3 ounces ferrocyanide of potassium in solution, and 1 fluid ounce of strong sulphuric acid; work through this for 10 minutes, then wash in cold water with 1 ounce of alum dissolved in it, and finish.

257. Royal Blue. Into a vessel of cold water add 2 pints nitrate of iron; then take 1 pint water and ½ pint of hydrochloric acid, and add to it 3 ounces crystals of tin; when dissolved, add this (or 1 pint chloride of tin) to the vessel containing the iron; stir well and work the goods in it immediately for half an hour. Into another tub dissolve 8 ounces of the ferrocyanide, and add to it 2 fluid ounces of sulphuric acid; the goods are wrung out of the iron solution, and put directly into this second vessel, and worked for 15 minutes; then wash out in cold water with 2 ounces of alum dissolved in it, and finish. If the shade is not sufficiently deep, before washing them in the alum water, they may be passed through the iron solution, and the ferrocyanide solution, working in each the same time as at first, only adding 2 ounces more ferrocyanide before passing the goods through the second time; then finish as before stated. Deeper shades are obtained by using more iron and tin, or by repeating the dips. Some wash out the iron solution in water before going into the ferrocyanide, and also wash it again in clean water before putting back into the iron; the shade will not be so deep, but there is less risk of an unequal color.

258. Rich Deep Blue Dye for Silk Goods. To dye 5 pounds of silk goods, add to the water required to work the silk, 2 pints chloride of iron and 1 pint *double muriate* or chloride of tin; work in this half an hour; lift, and work in a solution of 8 ounces ferrocyanide of potassium; if the color be not deep enough, repeat the operation through both solutions; then wash out in water in which 2 ounces of alum have been dissolved.

259. Deep Blue Dye for Woolen Goods. To dye 5 pounds woolen goods, add to the requisite quantity of water, 2 pints chloride of iron and 1 pint chloride of tin; work in this for half an hour; lift, and work half an hour in a bath with 4 ounces of the ferrocyanide. If the color is required to be deeper, repeat this through the same stuff, adding 2 ounces more ferrocyanide; then wash out in cold water, and dry.

260. Lavender. Add 1 pint plumb liquor (*see No.* 111) to sufficient water to work the goods easily; stir well and work in this for 20 minutes, then wash in cold water and dry. A darker or lighter tint is obtained by using more or less plumb liquor.

If a *blue* tint is required, add to the solution before putting in the goods, 2 or 3 drops either of sulphate, or of extract of indigo. (*See Nos.* 98 *and* 99).

261. Fine Lavender. Into a vessel of water as hot as the hand can bear, dissolve a little white soap—enough to raise a lather; then add 1 gill archil liquor, and work the goods for 15 minutes, wring out and dry. To obtain a *redder* tint, boil 1 ounce cudbear, and use instead of the archil liquor. A *still redder* tint is attainable by leaving out the soap altogether.

262. Violet, Lilac, Wine Color, &c. Work the goods for 20 minutes in plumb liquor (*see No.* 111) in a copper pan or stoneware vessel; wash out repeatedly until the goods cease to taste of the liquor, then dry. To obtain a rich blue shade, add to the plumb liquor 1 fluid ounce either sulphate or extract of indigo. For a *red* shade, first dye a lavender by cudbear without soap. (*See No.* 261.)

263. French and Pearl White. Dissolve in hot water sufficient white soap to make a lather; then add ½ fluid ounce archil liquor; work the goods for 10 minutes, and wash out. A little cudbear may be used instead of archil, less or more, according to the shade required.

264. French and Pearl White. Put 1 fluid ounce plumb liquor (*see No.* 111) into a vessel of cold water; work the goods in it for 10 minutes; wash out and dry. For these shades the goods must be perfectly white (*see No.* 233) previous to dyeing.

265. Weld Yellow. Work the silk for an hour in a solution of alum, about 1 pound to the gallon; wring out and wash in warm water. Boil 2 pounds weld, strain the liquor, and work the silk in it for 30 minutes; lift, and add 1 pint of the alum in solution, to the weld liquor; work the silk 10 minutes longer, wring out and dry.

This gives a rich lemon yellow; deeper shades are made by using more weld: straw and amber tints are obtained by the use of a little annotto.

266. Bark Yellow. The process is the same as for dyeing *weld yellow*, using 2 pounds bark instead of the weld. The bark should be boiled in a bag.

267. Deep Rich Yellow. Proceed as in the receipt for *bark yellow*; except that, after lifting, instead of a pint of the alum solution, 2 fluid ounces single chloride of tin are added to the bark liquor; work 10 minutes, wash in water, and finish in a solution of white soap.

268. Gold and Straw. To warm water containing white soap, add 2 pints annotto liquor (*see No.* 95), work in this 15 minutes; wash out, then work for 20 minutes in a decoction of 8 ounces bark; lift, and add 1 fluid ounce red spirits (*see No.* 108); work 10 minutes more, wash out and finish. Different quantities of annotto and bark produce different shades.

269. Nankeen, Buff, &c. Make a solution of soap in warm water, add to it 1 pint annotto liquor (*see No.* 95); work in this for 20 minutes, wring out and finish; a deeper shade is obtained by using more annotto.

270. Salmon, Flesh, &c. Dye a nankeen according to the previous receipt, and add 2 ounces alum in solution to the cold water used for finishing.

271. Orange. Work the silk for 15 minutes in a strong warm solution of annotto

(*see No.* 95); wash out in warm water and dry.

272. Yellow Drab. Into a vessel of warm water put 1 pint annotto liquor (*see No.* 95); work for 15 minutes and wash; then work for 15 minutes in a decoction of ½ pound sumach and 1 pound fustic; lift, and add 4 ounces copperas and 1 ounce alum in solution; work 10 minutes, wash in cold water and dry. A variety of drabs may be dyed in this way by varying the proportions of the sumach and fustic, and by introducing a little logwood or peachwood.

273. Drab. Work for 15 minutes in a decoction of 8 ounces sumach and 8 ounces fustic; lift, and add 4 ounces copperas; work for 20 minutes, and wash out in cold water; then work 15 minutes in a vessel of warm water containing ½ pint archil liquor, and dry.

274. Greenish Drab. For a greenish drab, add to the archil liquor a decoction of 4 ounces fustic and ½ fluid ounce chemic. (*See No.* 162).

For a purple tint, use 1 ounce alum in solution, instead of the chemic.

275. Slate or Stone Color. Work the silk for 30 minutes in a decoction of 1 pound sumach, 4 ounces fustic, and 4 ounces logwood; lift, and add a solution of 4 ounces copperas; work 30 minutes more, wash in cold water, and finish.

For different tints, vary the proportion of sumach, &c.

276. Common Green. Steep for an hour in a solution of 1 pound alum to the gallon of water; wash in warm water, then work for 30 minutes in a decoction of 6 pounds fustic; lift, and add 2 fluid ounces indigo extract (*see No.* 99); work for 30 minutes more, wash and finish. For blue-green use more indigo extract. Darker or lighter shades are dyed by using more or less in proportion of each ingredient.

277. Green. Work for 40 minutes in a decoction of 4 pounds fustic; lift, and add 1 pound alum in solution, and 2 fluid ounces indigo extract (*see No.* 99); work in this for 30 minutes, wash out in cold water containing ½ pint alum solution, and finish.

278. Pea Green. Steep for an hour in a solution of 8 ounces alum to the gallon of water, then wash out in warm water; boil 4 pounds ebony wood chips for an hour; take the clear liquor and work the silk in it for 30 minutes; lift, and add ½ fluid ounce indigo extract (*see No.* 99); work for 10 minutes; wash in cold water containing ½ pint alum solution, and dry.

The indigo extract must be added with caution, as too much will make the green too blue; it is safer to add less, and then, if necessary, lift, and add more.

279. Bottle Green. Work for an hour in a solution of 2 pounds alum and 1 pound copperas; wash out in warm water, then work for 30 minutes in a decoction of 6 pounds fustic; lift, and add 2 fluid ounces indigo extract (*see No.* 99); work for 20 minutes, wash out and finish.

280. Bottle Green. Proceed exactly as for *common green* (*see No.* 276) with the addition of 1 pound logwood to the 6 pounds fustic. The addition of a little more logwood makes a still deeper shade if required.

281. Olive. Work the silk for 30 minutes in a solution of 1 pound copperas and 4 ounces alum; wash out in hot water, then work for 30 minutes in a decoction of 2 pounds fustic and 4 ounces logwood; lift, and add 2 ounces alum in solution; work 10 minutes, wash and dry.

A little chemic (*see No.* 162) added to the last wash water will induce a greener hue if required.

282. Light Olive. Dye a light Prussian blue (*see No.* 256); then work for 20 minutes in a decoction of 2 pounds fustic and ½ pint archil liquor; lift, and add 1 ounce alum in solution; work 10 minutes and finish.

283. To Dye Mixed Fabrics Two Colors. Mixed fabrics of cotton and wool, such as coburgs, damasks, &c., may be dyed all of one color, or the cotton and wool in them each dyed a different color. This is seldom done except with new goods, or with very light colored goods which are desired to be dyed dark colors. As the process for dyeing woolens will seldom impart the same color to cottons, the two are dyed separately, and the method is quite simple. For most colors it is necessary to dye the woolen portion first, and then the cotton; but in a few cases the cotton must be the first to be acted on.

284. Green and Pink. First dye the woolen *green* by either of the methods given in Nos. 206, 207, &c. The cotton is then dyed pink, according to receipt No. 248.

285. Green and Crimson. Dye the woolen by working for an hour in 2 pounds tartar, 4 pounds alum, and 6 pounds fustic; lift, and add ½ pint indigo extract (*see No.* 99); wash out, and lay over night in 6 pounds sumach; then work for 30 minutes in red spirits (*see No.* 108) made to a strength of 1½° Baumé; wash out, and work for an hour in 5 pounds peachwood at blood heat; lift, and add a little alum; work in this, then wash out and finish.

286. Blue and Orange. First dye the cotton by the blue vat (*see No.* 130), wash out, and then dye the woolen by working an hour in a bath made up of 2 pounds tartar, 8 ounces cochineal, 2 pounds fustic, and 2 pints bichloride of tin; wash and dry.

In this way almost any two colors may be dyed upon woolen and cotton, although woven together, by proceeding according to the receipt for the color required on each sort of fibre. The wool is always dyed first, excepting in the case where the cotton is dyed in the blue vat, when the cotton has to be treated first. The same principle is applicable to silk and woolen fabrics, although in many cases the silk becomes more imbued than the cotton by the woolen dyes. A mixture of silk and cotton can be dyed in the same manner, but it is much more difficult, and cannot be done with all kinds of colors, and the process is seldom resorted to. But the intelligent dyer will be able to combine a variety of tints by following the rules and receipts given.

287. To Dye Mixed Fabrics one Color. If the mixed fabrics are required to be dyed one uniform color, the double process has often to be adopted, especially for cotton and woolen fabrics, thus:

288. Black on Cotton and Woolen

Goods. First dye the woolen according to No. 192; then, after steeping the goods in sumach, dye the cotton by receipt No. 139.

289. Brown on Cotton and Woolen Goods by one Process. Work for 2 hours in catechu, as in No. 147; then work at a boiling heat for an hour with 8 ounces bichromate of potassa and 2 ounces tartar; next work for an hour in 2 pounds fustic and 8 ounces cudbear; wash and dry. For a deeper shade, or of a more chocolate hue, add 4 ounces logwood to the cudbear.

290. Black on Silk and Woolens by one Process. Work for an hour in a solution of 8 ounces tartar and 8 ounces copperas; wash out, then work for 15 minutes in a decoction of 4 pounds logwood; lift, and add 1 ounce chrome; work for 30 minutes and dry.

291. Black on Cotton, Silk and Wool, by one Process. Steep for 6 hours in 2 pounds sumach; then work for an hour in a solution of 6 ounces tartar, 6 ounces sulphate of copper, and 6 ounces copperas; wash out, and then work for half an hour in a decoction of 4 pounds logwood; lift, and add 1 ounce copperas; work for 10 minutes, wash and dry.

292. Deep Black. To obtain a very deep black, add 1 pound of bark to the logwood, and proceed as in last receipt.

293. Drabs on Cotton, Silk and Wool, by one Process. Work for half an hour in 8 ounces copperas and 4 ounces tartar; lift and drain; then work for half an hour in 4 ounces logwood and 1 ounce bichromate of potassa; wash out and dry. By varying the quantity of logwood, and by introducing a little fustic or peachwood in combination with the logwood, a great variety of drabs, slates or fawns can be produced.

These few receipts for mixed fabrics will show the care required in such operations, although, by practice, they become comparatively simple.

294. To Detect Animal or Vegetable Fibres. Treat the fabric with bichloride of tin heated to from 130° to 150° Fahr., when the cotton and linen become black, and the wool and silk remain unchanged.

295. To Detect Mixed Fabrics of Cotton and Wool. Dip a piece of the cloth in bleaching liquor; after a little while the woolen turns yellow, and the cotton white, and may easily be distinguished.

296. To Detect Cotton in Linen. The piece to be tested should be boiled to remove all dressing, and then dried; put a portion of the piece into common vitriol for about one minute; take it out and wash it in water several times, and then into a weak solution of soda or potash, and all the gummy matter formed is removed by gentle rubbing. By this process the cotton is dissolved and the linen remains, or any portion of the cotton that is not dissolved becomes opaque white, while the linen is transparent. By comparing the portion thus tested, with a similar portion not tried, the quantity of cotton present can easily be estimated.

297. To Detect Cotton in Linen. Take a small piece of the cloth, boil in water and dry; then take 3 parts, by weight, of sulphuric acid, and 2 parts of crushed nitrate of potassa; put the dry piece of cloth in this mixture for 6 or 7 minutes, and then wash it in water until there is no taste of acid; dry it at a gentle heat; next put it into a mixture of ether and alcohol, which will dissolve the cotton and not the linen. If the piece be weighed before and after putting it into the ether and alcohol, the quantity of cotton in the fabric can be accurately ascertained.

298. To Distinguish Cotton and Wool. Take a small piece of the cloth and boil in caustic soda; the wool will be dissolved, and the cotton remain. If the threads have been previously counted, their relative mixture can be found.

299. To Detect Cotton with Silk or Wool. Put a piece of the cloth into chlorine water or bleaching liquor. The cotton is whitened, and the silk and wool turn yellow, and can easily be distinguished by the aid of a pocket lens.

300. To Detect Cotton in Silk or Wool. Take a small piece and unravel the threads, and inflame them; the cotton burns away freely and leaves little or no black charcoal; the wool and silk shrivel up, leave a black charcoal, and give a strong smell.

Decidedly the best and safest method, and one applicable in all cases, is a microscopic examination, by which not only the structure, but also the nature of the fibre can be demonstrated. Cotton, wool and silk are easily distinguished by the microscope, as they differ materially in appearance. Cotton forms flat, narrow ribbons, curled up in spirals like those of a corkscrew; wool fibre is stouter than all others, and may be recognized by its scaly surface, while silk is the thinnest fibre, has the smoothest surface, and possesses the least structure. These appearances are very characteristic, and any one who has observed them once will ever afterwards recognize them again at first sight.

301. To Distinguish Silk and Wool in Fabrics. Silk can always be identified in a mixture with any other animal or vegetable fibre by means of concentrated hydrochloric acid, which dissolves it completely and immediately, without appreciably affecting any woolen or woody fibre with which the silk may have been interwoven. Strong sulphuric acid has also a powerful solvent effect upon silk, and is likewise much more destructive in its action upon cotton than the other acid. Should it be desired to determine the nature of any fibres remaining after the solution of the silk, it is first necessary to wash and collect them, when they will usually be found destitute of color. To decide whether wool is present or absent, a solution of picric acid may be employed, which instantly imparts a full yellow tint to the wool, but does not in the least affect cotton, linen, or China grass; so that it is only necessary to immerse the fabric in the dye, wring it out, and wash well with water. Should any portion remain of a yellow color, the presence of wool is indicated. Other methods can be employed similar in principle, but the picric acid is believed to be best. Discrimination between the different kinds of fibre can best be prosecuted by means of the microscope, but their quantity is best found by dissolving away one fibre, as already directed, and weighing.