

SILK DYEING (CONTINUED): BY PROFESSOR CHARLES PELLEW OF COLUMBIA UNIVERSITY: NUMBER VIII

Skein Dyeing.—When weighting or adulteration is not employed, i. e. in the so-called “pure dye” process, the dyeing of skein silk resembles very closely the piece dyeing described in the last article. The degummed silk is immersed in a dye-bath containing the dyestuffs (Acid Colors) dissolved in “boiled-off liquor” slightly acidified with sulphuric acid. The bath is heated nearly to the boiling point and the silk turned in it until the desired shade is produced. It is then taken out, washed thoroughly in water to remove the last traces of acid and then brightened by passing through a soap bath with some oil, and later through a bath of weak acid to develop the “scoop.” A very important part of the process is the final drying and finishing. The drying should be done slowly and carefully and not proceed too far or the silk will be brittle. As is well known to dyers, silk has the power of absorbing 25 or 30 per cent. of its weight of water without becoming perceptibly damp to the hand, and this moisture when not carried too far is an actual benefit to the material, making it stronger and more elastic. This property is often made use of by the honest (?) dyer when, in case some of the silk in a lot has been spoiled by accident or carelessness, he makes up the difference in weight by the liberal use of the watering pot.

The finishing process is perhaps the most difficult and technical of all, for the value of the finished product depends very largely on it and it is almost impossible for an amateur to accomplish it. The skeins, after drying, are hung on a heavy polished wooden bar and with a heavy smooth wooden stick are shaken out, straightened, pulled, twisted and worked until the fibers are all parallel, the kinks taken out, any weak or injured portion cut out and the whole skein has acquired the proper amount of luster.

Sometimes, for especially brilliant fabrics, the skeins are “lustered” by ma-

chinery, the so-called “metallic lustering,” when the silk, generally enveloped in steam so as to be both hot and damp, is pulled out between two steel arms until it has been stretched a considerable percentage of its original length. This undoubtedly lessens the strength of the fiber considerably and diminishes its elasticity, but under this strain each fiber is stretched out perfectly smooth and thus becomes much more brilliant and lustrous.

Dyeing Silk Black.—The above process, though well suited for quickly producing colors on silk which will be bright and lustrous and, if desired, fast to light although not to washing, is not adapted for blacks. The silk fiber is too transparent and shining to dye a full deep black with any soluble dyestuff. The color, to give really good effect, must be laid on in an insoluble form, either by the use of metallic mordants or by some process of oxidation or condensation. The best that can be done with the Acid Dyes is to give a dark, deep gray, which by itself may look fairly satisfactory, but does not hold its own when matched against a real full black.

The commercial way of obtaining this effect is by the use of the well-known vegetable dyestuffs contained in logwood. Comparatively few dyers take the trouble to make their solutions from the wood itself, but three or four large companies make a business of preparing and marketing logwood extracts of great purity and uniformity, both in solid and paste form. To produce a black with logwood it is necessary to mordant the silk carefully with iron, tannin and in some processes with salts of tin and of chromium. In all cases, therefore, silk dyed black with logwood contains a certain percentage—say, 15-20 per cent. of its weight—of foreign ingredients. When carefully done this does no harm to the material and the “pure dyed” logwood blacks are perfectly satisfactory, both for shade, luster and durability.

Weighting of Silk.—Unfortunately, raw

FURTHER DETAILS IN SILK DYEING

silk commands a high price in the market, from \$3.50 to \$6.00 a pound, and there has been for many years a keen and steady competition between the various dyers and manufacturers to substitute cheaper materials for this expensive raw product. During the last few years this has resulted in the production of the different varieties of artificial silk, concerning which more will be said in a future article. Besides this, however, the dyers and chemists have been straining every nerve to make a small amount of raw silk go a long way by first increasing its weight, and secondly, and as a necessary consequence, materially increasing its bulk by the use of chemicals in the dyeing process.

The first efforts in this direction were based upon the saving of some or, indeed, nearly all of the gum which is wasted in the washing or degumming process previously described. This gum, which amounts to from 25 to 35 per cent. of the raw silk, makes the silk stiff in texture and dull in color, and more difficult to dye. But by modifying the dyeing and especially the finishing process, it was found possible to produce the so-called "souples," i. e. silks with little or no luster, but with the characteristic "scroop" or "feel" and capable of replacing bright silk as a filling in many fabrics and yet with almost all the natural gum left in the fiber.

The black silks were then attacked and an elaborate system of mordanting was introduced before the dyeing proper began. For instance, the silk can be dipped alternately into solutions of iron and then of ferrocyanide of potash, thus forming Prussian blue in the fiber. Then the excess of iron can be converted by immersion in tannin solutions, such as Gambier or Cutch, into black tannate of iron, or ink, and finally, after perhaps a bath in chromium or tin salts, the final color is brought out by boiling in logwood extract. The silk is then brightened by boiling with good neutral Castile soap, and after drying and finishing the finished product may easily weigh two or even three times as much as the original raw silk did and still

retain its strength, luster and elasticity.

The weighting of colored and bright silks did not proceed so rapidly, and it was not much more than ten years ago that by accident some French dyers discovered that by immersion in a strong bath of tin chlorid (stannic chlorid acidified with some hydrochloric acid) the silk fiber would absorb a large percentage of tin salts without necessarily losing luster or dyeing power or even strength. This at first was kept a secret, but its use gradually spread until now it is a very poor silk dyer who cannot weight his silk 100 or 150 per cent. without spoiling its immediate commercial value.

Without going into unnecessary details the process is somewhat as follows: The silk, after being degummed and thoroughly washed free of soap, is plunged in a bath of tin chlorid and kept there for some hours. It is then taken out and the loose tin salts are washed off in a tank of water (technically called a box) or in a washing machine. To further "set" the tin, the silk is then placed for a short time in a solution of phosphate of soda and again washed thoroughly. It has now gained from 15 to 25 per cent. of its original weight (3 to 4 ounces to the pound of raw silk). If further weighting is desired this treatment, first in tin chlorid and then in phosphate of soda, can be repeated three or four up to five or even six times, increasing in weight with each immersion. Then a bath is usually given of silicate of soda, which adds a little weight, $\frac{1}{2}$ to $\frac{3}{4}$ of an ounce, and it is claimed benefits the luster and strength of the goods. Then after a final washing the silk is ready for the dye-bath.

The weighted goods are dyed, dried and finished about the same as with the "pure dye" process, and the proud dyer can rejoice at returning to the honest manufacturer from 150 to 250 pounds of finished silk for every 100 pounds of raw silk (containing, by the way, 25 to 30 pounds of gum) which was sent in to the dyehouse.

This "tin-weighting" process is also applied to black dyeing, and enables the black

FURTHER DETAILS IN SILK DYEING

dyer to build up his weight with tin salts instead of limiting him to iron, chromium, ferrocyanide of potash, tannin and log-wood.

Properties of Weighted Silk.—It is scarcely necessary to point out that silk weighted to the extreme limit is hardly to be considered as the most durable and trustworthy of fabrics, even when dyed by the most expert workman. Silk dyed carelessly and weighted heavily is less valuable, liable to crack and wear away with the least provocation.

It may be worth while reminding some of my fair readers that the old test of a silk taffeta, "so thick and stiff that it will stand of itself," nowadays is anything but a proof of good quality. One or two manufacturers in this country have during the past two or three years revived the almost forgotten art of making and selling pure-dyed goods, and one trouble that they experienced in disposing of their products, outside the high price, was the criticism that their silk felt so light and thin.

Tests for Weighted Silk.—At present it is almost impossible, at least in New York, to buy pure-dyed heavy silks. The writer, at any rate, tried hard this last autumn to find for some special experiments a piece of white taffeta which was not markedly weighted. After visiting not only department stores but the very best drygoods stores in the city, at all of which he was informed that no such material now existed, the best he could do was to find one make of silk where the organzine or warp was fairly pure, the tram being well weighted. Light-weight Japan and China silk dyed in the piece can still be procured with little or no weighting.

The test, known to all buyers in the trade, is a simple one. The threads of silk should be pulled and combed out, separating carefully the warp from the filling, and each of them touched with a lighted match. Pure silk burns fast and freely to the end, leaving little or no ash, while weighted silk burns slowly, leaving much residue, and if heavily weighted will not carry the flame at all.

The chemical analysis of weighted silk is not very satisfactory, and in general can hardly be made, excepting by a chemist expert in silk dyeing and weighting as well as in ordinary analytical methods.

Silk Dyeing by Amateurs and Craftsmen.—It is hardly necessary to point out that the above processes need skilled dyers and chemists to produce satisfactory results.

Craftsmen can, however, get quite satisfactory results by "pure dyeing" piece goods and even skeins with acid dyes, in a soap bath acidified with a little sulphuric acid, as described in the last article, although it is hard to finish the skeins without instruction from a professional.

The Acid Dyes, however, are not always satisfactory on account of their behavior to moisture. The best ones are exceedingly fast to light and the range of shades is great, but the colors strip entirely and easily in hot soap baths, and, which is more objectionable, they generally bleed and stain when wet with even pure water.

Colors faster to washing, although not as a rule so fast to light, can be readily obtained by using the Salt or Direct Cotton Dyes, described in the August number of *THE CRAFTSMAN*; these dye silk readily in a soap bath with the mixture, first, of a certain amount (three or four times as much as of the dyestuff) of salt or Glauber's salt and later of a little acetic acid. Silks dyed with these Salt Colors are "fast" but not "embroidery fast"—that is, they will not stain in water or with light soaping, but cannot be put in the washtub and boiled with cotton goods without bleeding and staining the white goods.

To stand the latter test, the simplest method is to dye the silk with the Sulphur Dyes previously described, care being taken to avoid tendering the silk with the strong alkali of the sodium sulphide. To protect the silk from this it is necessary to use as little sodium carbonate and sulphide as possible, consistent with dissolving the dyestuff. Then, by using a large excess of dyestuff, the silk need be immersed for but

FURTHER DETAILS IN SILK DYEING

a short time, and finally various chemicals can be used to protect the fiber.

Glucose is often used for this purpose. But, for full shades, the best way is to add sodium bisulphite to the bath, containing dyestuff and sodium sulphide, until the liquid is just about neutral.

To get the best results the reaction of the bath should be tested in the manner known to all chemists, with an alcoholic solution of phenol-phthalein. This solution is colorless in the presence of acids or even when neutral, but turns pink or red with the least trace of alkali. After the dyestuff, dissolved in hot water with sodium sulphide and sodium carbonate, has been put in the dye-bath, a solution of sodium bisulphite is added, little by little, stirring well until a drop of the liquid, spotted on a piece of blotting paper and touched with a drop of the phenol-phthalein, remains colorless for a minute or two and then turns a light purple. If the purple color does not develop at all the bath is too acid and needs the addition of a little more sodium sulphide. If the color appears at once the bath is too alkaline, and more of the bisulphite should be added.

In a bath made up in this way silk can be warmed with impunity and by the use of plenty of dyestuff and the addition of two or three tablespoonfuls of salt to the bath after the dyeing has proceeded for some little time, full deep shades can be produced, which, after exposure to the air to oxidize them, can be washed in boiling soap baths without running or fading.

Of course, for lighter shades the bath need not be neutralized with so much care. Bisulphite should be added to diminish the alkalinity, and then the silk dyed as quickly and with as little heating as possible.

Black Dyeing for Craftsmen.—The process just described is of still greater importance as a means for getting satisfactory blacks on silk without the long, tedious, complicated and difficult process of logwood dyeing. Excellent sulphur blacks are on the market which will give very fair results even to the amateur dyer, and which offer the decided advantage of dyeing cotton and linen fibers in the same bath quite as deeply as they do the silk.

Of course, to get full shades of black, great care must be taken to have the bath the exact degree of alkalinity, and to get the full strength of the dyestuff. A good dye for this purpose is Thiogene Black liquid M.pat (Metz) for the use of which this process was patented.

Besides the Sulphur Colors, dyers sometimes use some of the Alizarine Colors, and, especially, of the new Salt or Direct Cotton Colors suitably fixed, for the production of blacks without the use of logwood.

The Alizarine Colors properly mordanted give excellent shades on silk as well as on wool and cotton, which are among the fastest colors known both against light and washing. Their use, however, is too complicated to be of much value to craftsmen.

During the last three or four years the Salt Colors have been coming greatly to the front, and not only are used for colors but also for blacks upon silk with considerable success. To obtain a really good black it is necessary first to dye the silk thoroughly, as before described, with one of the Salt Colors, and then to fix it by the so-called diazotizing and developing process. This, however, is rather too delicate a chemical process for the average craftsman, and hence it hardly needs describing here.