THE ACID COLORS: BY PROFESSOR CHARLES E. PELLEW, OF COLUMBIA UNIVERSITY: NUMBER VI

SOON after the discovery and introduction into commerce of mauvein and the other basic dyes, and chemists, all over the world, had turned their attention to this new and important application of their science, it was noticed that some organic bodies, of a decidedly acid character, had the power of dyeing wool and silk. These early dyes were so-called "nitro" compounds, formed by the action of strong nitric acid upon derivatives of coal tar, and in most cases gave strong and brilliant, but rather fugitive, shades of yellow. The most interesting of these, perhaps, was the compound known as "picric acid," which at one time was considerably used for dyeing silk yellow, but now, abandoned for that purpose, is manufactured on an enormous scale for use as an explosive.

These original acid dyes were of little importance. But in the early seventies chemists began to make use of a reaction known as "diazotizing" for making new organic compounds, by the coupling of aniline, or bodies similar to aniline, with all sorts and kinds of other compounds derived from coal tar. The number of derivatives of this sort proved enormous, and many of them had more or less valuable dyeing properties. And in a very short time new dyestuffs had been discovered, good, bad, and indifferent, numbering not hundreds, but thousands.

A few of these so-called "Azo" dyes were of the "Basic" class, like Bismarck Brown, mentioned in the last article; and still others, discovered ten or fifteen years later, constituted the class of "Direct Cotton colors" or "Salt colors"—discussed in a previous paper. But the great bulk of these colors belonged to the so-called "Acid" class, forming salts with bases and alkalies, and being liberated from the salts by strong acids.

The number of Acid Azo colors is very large. In the catalogues of commercial coal tar colors there are some two hundred and fifty of these dyes, which have been picked out of the rest as having sufficient value to be carefully described, and to have been placed on the market by the great dye houses. Most of these are red and orange colors, with a few yellows. As a rule they are brilliant and clear, but, with a few exceptions, not particularly fast to light.

When these were introduced it was soon recognized that they were of practically no value for cotton and linen. They are as a rule much more soluble than the Basic dyes lately discussed, and hence are occasionally used as stains for wood, rattan and other vegetable materials where considerable penetration is needed without fastness to washing. But such use is of little importance.

These Acid dyes are almost exclusively employed for dyeing wool and silk, feathers and other animal fibers, and for this they are extremely valuable. The introduction of the Acid Azo colors so simplified and improved the dyeing of wool and silk, that every effort was made to increase the range of colors. And when it was found that the Azo colors were weak on the line of blue, purple and green, efforts were made, which after several years proved successful, to change the various powerful Basic dyes, the Methyl Violets, Fuchsin or Aniline Red, Aniline Blue, Malachite Green and the rest, into Acid dyes, so that they could all be used in the same dye baths. This has resulted in a very wide range of colors indeed, for the Acid Azo colors cover fully all the shades of yellow, orange, and especially of red, from scarlets of all sorts and kinds, to deep full crimsons. And then the remaining shades are covered by the acidified or sulphonated Basic colors.

These latter, by the way, though very brilliant and strong and rich, are no faster to light than the original Basic colors from which they are derived. Of late years the Acid colors have held their own, and still

monopolize the commercial, as well as the hand, dyeing of wool and silk excepting under special circumstances, when great fastness to washing is required.

DYEING DIRECTIONS:

The Acid dyes, like the Basic, are used in an acid bath; but in the Basic dyes the bath was acidified with a little acetic acid, to keep the color in solution. In the case of the Acid dyes, however, the dyestuffs are almost always put on the market in the form of the potassium or ammonium salts of the color acid. And the presence of some acid is always necessary to liberate the color acid and allow it to combine with the basic principles existing in the animal fibers.

For Wool.—

The goods, well washed and soaked, are warmed gently in a bath containing plenty of water, a little sulphuric acid and a good deal of Glauber's salt. Both acid and salt should be free from iron, or the shade will be dulled.

For a 2½ or 3 gallon dye pot, such as my readers have been recommended to use, a teaspoonful of strong sulphuric acid (or better, three spoonfuls of acid 30 per cent. strong) is about right, and there should be about twice that amount of Glauber's salt.

It is hard to tell just what is the function of the Glauber's salt. It seems, however, to open up the pores of the wool in some way, and to make it dye more evenly and deeply. The bath is gently heated, with constant stirring of the goods, until the right shade is produced, or, if it is desired to exhaust the bath and so waste no color, until near the boiling point.

The goods when taken out of the dye bath must be washed very thoroughly, to remove the last trace of acid, which otherwise on drying would ruin the wool.

It must be remembered that these acid dyes do not affect cotton in the least, and so the goods dyed in this way must be free from vegetable fibers, if level dyeings are to be obtained.

In dyeing wool skeins commercially it is, of course, of the utmost importance to have the colors perfectly level and uniform. This is obtained easily enough, when using these Acid dyes, by having the wool thoroughly wet before placing it in a dye bath; and by having it well loosened out and well stirred so that the color will penetrate evenly every part of the material. And, finally, by starting the bath at a moderate temperature, and heating it gradually, until the proper shade is obtained.

For certain kinds of arts and crafts work, however, extremely interesting effects can be obtained by dyeing skeins of wool irregularly, giving the so-called "Rainbow effects." If, for instance, a thick, wet skein is tied into a loose knot and dyed for a few minutes in a weak bath of blue, and then taken out, knotted in another place and dyed a light shade of red, it is evident that after shaking out the skein, and carefully washing it, the wool will be found colored a great variety of shades, ranging from pure blue to pure red, through all the varieties of lavender, violet, etc. Still different effects are obtained by using three baths of color, the wool being all lightly dyed in one bath, and then shaded in the two other baths, either by dipping different overlapping portions, or else as before, by knotting up the skeins and dyeing them in one bath, and then, after untying and knotting in a different place, dyeing them in the other bath.

Several modifications of these methods will suggest themselves to the skilful dyer and, if the colors are connected judiciously, extremely interesting results can be obtained.

Before leaving the subject of wool dyeing, I would like to say that, during the past few months, several inquiries have come to me with regard to strong, hand-woven worsted yarns for use, especially as warp, in blanket and rug weaving on hand looms. During the summer I visited one of the small islands off the Maine coast, where, in times past, the women were accustomed to spin their own yarns

for the making of blankets, and also for the mittens and stockings used by their husbands, who were usually sailors and fishermen. This industry has now disappeared, owing to the competition of inferior, but cheaper, factory-made yarn; but I was able to find samples of the old yarns, and learned that, if there was any demand for such material, at a price which would be at all remunerative, some of the women would be willing to take their old spinning wheels down from the garrets, and, in the long winter evenings, start up the now abandoned industry. In case any of my readers should be interested in this matter, I would be glad to correspond with them on the subject, if they will direct their letters to the office of THE CRAFTSMAN.

For Leather.—

The directions, given in the last paper, for dyeing leather with the Basic colors, apply equally well to the dyes of this class. It will be found that few, if any, of the dyes included in our list of Selected Colors, given below, show any of the metallic luster characteristic of the Basic dyes.

For Feathers.—

The dyeing of feathers is almost exclusively done by means of these Acid colors, but, in order to get successful results with the more delicate and valuable stock, like ostrich feathers, some special precautions have to be taken. The feathers after bleaching, and careful washing to remove the grease, are immersed in a shallow dye bath (an agateware basin is as convenient as anything), butt foremost.

The feathers consist of two parts—the butt and stem and the flues, and the test of a well-dyed feather is to have the stem well colored from the butt as far up the feather as the color is meant to go; and then to have the flues dyed to match the stems, and, at the same time, to have them in proper physical condition, so that they are neither stringy nor woolly, but have a smooth, well-filled appearance.

The flues dye very much easier than the stems, and hardest of all to dye is the butt. So in dyeing, the feathers are always held by the tip, butt foremost, and soaked for a considerable time in a lukewarm bath of the dyestuff, which is heated very gently until the proper shade is reached. In many cases it is desirable to dye the butts darker than the tips; and, where the tips are to be left white, this is effected by wrapping the tip of the feather carefully and tightly in tissue paper, or even in oil paper, for the proper distance, thereby keeping it from the action of the dyestuff.

To prevent the flues from becoming stringy, the dye bath is always acidified with a few crystals of oxalic acid, for sulphuric and other strong acids have a very corrosive effect upon the fine and delicate portions of the feather. After dyeing, the feather is rinsed off in water and then thoroughly impregnated by dipping and rubbing with a thick milk, not a paste, made by stirring finely powdered corn or wheat starch with *cold* water. After this the feather is carefully dried between sheets of blotting or filter paper, and then dried still further in the sunlight, or over a hot radiator, or even, if great care is used to avoid overheating, above a low gas flame, until absolutely dry. The dried starch is then beaten out of it by striking it sharply against the edge of the hand, or against the top and sides of the table. And, when this has been carefully done, the flues will come out in the proper condition. Other kinds of feathers are dyed in the same general way, but these as a rule are not so liable to injury as ostrich feathers.

It may be of interest to some of my readers to say a word about the cleaning and bleaching of white feathers that have become soiled by wear. If these are still of good quality and not broken, they can be scrubbed, quite thoroughly, in a basin with warm soap and water, provided that a good neutral soap, such as Castile, is used. After rinsing they should then be very delicately blued, by dyeing them in a cold bath made acid with a little oxalic acid, and with the least trace of some dark

blue or purple color added to it. They are then finished with starch, as above.

Selected Dyes.—

While the Acid dyes in general are not particularly fast to light, it is only proper to say that certain special ones, among which are those included in the following table, will be found exceedingly permanent, even in the lighter shades. A series of ten skeins of wool and yarn, dyed in different shades from a deep blue, through a range of colors covering delicate grays and pink, up to a full deep red, have been standing exposed to diffused and, for a part of the time, to direct sunlight in my laboratory for a year and a half, without the slightest change of color being perceptible.

Badische:	Induline N N.
	Acid Yellow B R E.
	Cochineal Red R R Double.
Cassella:	Tetracyanol S F.
	Acid Yellow A T Conc.
	Brilliant Cochineal R R.
Elberfeld:	Alizarine Blue S A P.
	Diamond Flavine G.
	Azo Fuchsine G.
Kalle:	Bicbrich Alizarine Blue B.
	" Acid Red 213.
	Carmoisine A.
	Wool Yellow T A.
Metz:	Fast Acid Blue B B.
	" " Yellow 3 G.
	" " Red M.
	" " Eosine G.
	" " Phloxine A.

The last two colors in the above list, Fast Acid Eosine G, and Fast Acid Phloxine A, Metz, while not as fast as the others, will be found interesting as being the fastest representatives of the "Eosine" family, which, on wool, and especially on silk, give beautiful shades of pink, with yellow and blue fluorescence.