COLORS

LECTURE XIX

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Colors can be used at any stage in the production of ceramic wares but the source of the color may vary with the method of use and especially with the temperature of firing. Not only do the ingredients of the palette change but the same ingredients may give different results. Color effects can be produced in the clay body, on the unfired clay, on the biscuit ware under the glaze and over the fired glaze. Thus the composition of the color falls into two general groups: 1. An infusible color substance which is to receive the high temperatur of the body or glaze fire and 2. A fusible color substance which is to receive a low temperature only and which contains its own flux.

All ceramic colors are derived from compounds of metals, generally the oxides. Occasionally other salts are used because of certain physical properties but after firing, as explained in the discussion of glazes, only the oxide remains. Rare exceptions will be cited later.

The following are the elements in common use with the colors derived from them:

Cobalt	Blue
Chromium	Green
Iron	Ocher - Brown - Red
Copper	Turquoise Blue - green
Manganese	Violet - Brown
Nickel	Gray - Brown

There are also certain compounded colors such as Pink from Chromium and tin, yellow from antimony and lead and chestnut brown from iron, zinc, and chromium. Variations are pro-

duced in a strongly reducing fire as Red from Copper and Black or Pale green from iron. Certain substances, colorless in themselves, exert strong influences upon coloring oxides; Alumina develops a brilliant blue with cobalt, zinc and cobalt produce a greenish blue, magnesia and cobalt a violet. The alkalies, potash and soda when used in glazes produce the well known turquoise blue from copper and aubergine from manganese.

All the oxides mentioned can be used in a clay body except that of copper which is both fusible and volatile. Copper oxide, however, can be laid on a red clay and will produce a dense metallic black. Sometimes the coloring oxide can be mixed with the clay without preparation but unless care is taken to see that it is very finely ground there will be unsightly specks in the ware. A good plan is to grind the required amount of color with a small quantity of slip and then to add this to the batch. It is much easier to add stain to a slip than to a plastic clay, in fact it is almost impossible to color a clay uniformly in any other manner. Under glaze colors can be used for staining clays and sometimes better results follow than in using oxides. The cost is somewhat higher and a larger proportion must be used because the manufactured colors are not as concentrated as the oxides. The least expensive practice, if any extensive use is intended, is to prepare one's own colors. In order to do this it is well to provide a supply of ground pottery. Commercially this is known as "pitcher". Fragments of white ware, unglazed, are crushed and ground in the mill until perfectly fine. The ground material should freely pass 200 mesh. The material is dried and kept for color making. A single

example may suffice as there are numberless recipes available. Suppose a bluish green is required:

Take

Green Oxide chrome	35
Black Oxide Cobalt	15
Ground pitcher	30
Feldspar	20

The ingredients are weighed, mixed well in a mortar and sifted through 40 mesh. The material which does not pass is returned to the mortar and pulverized. Any hard grains found should be rejected. The fine powder is placed in a clean crucible and fired in the hottest part of the kiln. The firing will develop the color but the mass should still be soft. It can now be ground fine on the mill, dried and stored for use. The preparation of colors is a good deal of trouble but the cost is very much lower than the purchase price of commercial supplies.

Colors for use in the clay body or under the glaze are made, with variations, in the manner described and there is a good deal of interest in following the procedure and developing new hues.

For colored glazes the same oxides are used and, in general, the same effects produced. In this case it is not necessary to compound the color mixtures in advance, the oxides, in their respective proportions, can be added to the glaze batch. Some experimenting will be necessary in order to determine the amounts to be used. Some oxides are much more powerful than others. Under glaze colors can be used perfectly well but there is always the matter of cost to be considered. For pink and crimson glazes it is best to purchase an under-

glaze red base. This can be made in the studio but the trouble is hardly worth while. A single oxide added to a glaze generally produces a crude tone of color. The oxides modify each other just as do the colors on a painters palette. The harsh blue of cobalt can be softened with the gray of nickel or the ocher of iron and the grass green of copper can be modified by cobalt on the one hande or by iron and manganese on the other. It is an interesting study to take some natural object, a leaf or a piece of bark and to reproduce the hue in a glaze; or a dry-goods color can be used as an example. The texture cannot always be imitated but a close match of the hue is generally possible except in the case of the more brilliant tones.

Excellent results are obtainable by laying one colored glaze over another. This is done best by atomizing. It is hardly possible even to brush a glaze over a dry glazed surface much less to dip it. Nor is it easy to reglaze a fired piece but the atomizer offers a simple method and compressed air is not difficult to procure. Even a foot blower with a rubber bulb is effective. The first glaze should be quite dry and the second should be sprayed on gradually so as to avoid any tendency to flow. A fairly thick coating can be laid on provided that time is allowed for drying as the work proceeds.

Overglaze colors must be prepared with a suitable flux because they are to be self fusing. In underglaze colors the glaze itself supplies the flux but overglaze colors, as the name implies, are laid over the fired glaze and receive a gentle firing in a special kiln. Some of the colors are, in the

preparation mixed in their complete substance and melted in a crucible; others are made by preparing and melting the flux in advance and grinding the coloring material with it but not melting it. The reason is that some of the coloring oxides must be suspended in the flux and not dissolved as they would be if the whole mass were melted.

Some examples are given here:

Red Brown		Green	
Flint	36	Flint	20
Borax	38	Borax	28
Zinc Oxide	12	Red Lead	18
Chromate of Iron	9	Zinc Oxide	6
Red Lead	5	Chrome Oxide	21
		Cobalt Oxide	7

These amounts are to be weighed, mixed, and sifted as described above and each mix is then placed in a crucible which should not be more than two thirds full. It is a good plan to paint the crucible inside with a thick layer of flint slip. This must be dried before the powder is poured in. The crucibles are then set in the kiln and after firing the color should be a brilliant glassy mass. This is crushed and ground very fine for use.

Some of the most frequently used fluxes are:

No 1.		No. 5		No. 8	
Red Lead	70	Red Lead	64	Red Lead	50
Flint	30	Borax	12	Borax	33
		Flint	24	Flint	17

Each of these is mixed as described, melted, and ground. They can then be used with coloring oxides or under glaze colors by simply grinding very fine.