The Mixing of Colors and Paints

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The Mixing of Colors and Paints

Description, Properties, Theory, Harmony and Management of Colors

The Mixing and Use of Colors and Paints for Interior Decorating, House Painting, Arts and Crafts, Furniture and Polychrome Finishing.

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PREFACE

A strict interpretation of the title of this book would call for the presentation of only such information as pertains to the mixing of colors, paints and printing inks; but the possession of skill in mixing is only a means to an end, and that end is a more tasteful and effective use of colors.

To select the principles of the science of color essential to a better understanding and use of color by students, apprentices, journeymen, printers, interior decorators and master house painters, and to reduce the statement of such principles to the most simple terms—these are the attainments aimed at in the writing of this work.

The mixing of colors and paints by painters, decorators, and others is intimately related to effective and tasteful color use. Consequently, it seemed essential that all such kindred subject matter as is in any way related to better taste in color use should be included to promote the primary, if indirect, purpose of this book.

The difficulties of the task were many, since the subject of color is involved and can be confusingly technical and scientific. Yet it must be stated simply, if a working knowledge of color use is to be contributed to those whose daily work to decorating, painting and printing does not permit them the time to pursue the study at length.

It is hoped that in this writing the simple interpretation of this fascinating study will lay the foundation for better and more tasteful use of color.

F. N. VANDERWALKER.

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THE MIXING OF COLORS AND PAINTS

CHAPTER I
COLOR AND LIGHT

Sunlight is the source of all color as well as of heat and light. With the setting sun all colors disappear from the earth. If it were not for artificial light our nights would be devoid of colors, relieved only by a contrast of moonlight and shadows.

Color is the property of light rays which causes visual action on the retina of the eye.

The Spectrum.—In the rainbow we see an array of colors. The image is called the sun spectrum. The spectrum is caused by the reflection of light rays from the sun. The same array of colors, or spectrum, you will notice when a ray of light passes through a raindrop or through a piece of three-sided plate glass, or a glass prism.

Prism.—A solid glass body of triangular shape.

A more formal definition of a spectrum is:—an image formed by rays of light passing through a glass prism in which the parts of light are arranged according to their wave lengths, forming a band displaying the colors of the rainbow. A beam of light from any source, such as the sun or ignited vapors (gas), passing through a glass prism is reflected and separated into colored light rays; these projected upon a surface constitute the spectrum. Red is red to the eye because it is composed of light ray vibrations of one wave length; blue is caused by a different wave length; yellow is vibrations of a still different wave length.

The array of colors called the spectrum is identically the same in character, and in the order of their arrangement, whether seen in the rainbow, a raindrop or a glass prism.

Primary Colors.—The strongest colors noted in the spectrum are red, blue and yellow. These are called the primary colors. In color theory all other colors are mixed from red, yellow and blue.

Secondary Colors.—Between these primary colors (red, blue, yellow) in the spectrum will be noticed violet, green and orange. These are called the secondary colors.

Intermediate Colors.—In the spectrum, again, between the primary colors and secondary colors there are six intermediate colors. They are violet-red, blue-violet, blue-green, yellow-green, orange-yellow, orange-red.

The order in which the colors of the spectrum are arranged is illustrated in Plate I.

In nature color is lavished in over a thousand (actually counted) delicate tints and shades on wild flowers, fish, birds, butterflies and other insects, or rocks, earth formations and elsewhere. And all of these colors are simply gradations of the primary, secondary and intermediate colors of the spectrum seen in the rainbow, the raindrop and the glass prism through light reflections.

Before passing on it is an excellent idea to study the spectrum. Since neither a rainbow nor a raindrop are likely to be handy when you want them, secure a glass prism or a piece of thick plate glass. Lay the glass flat on a desk or some dark surface in such away as to cause the direct rays of the sun to pass through the glass at an angle of about 45 degrees. It is easiest to do this with a late afternoon sun.

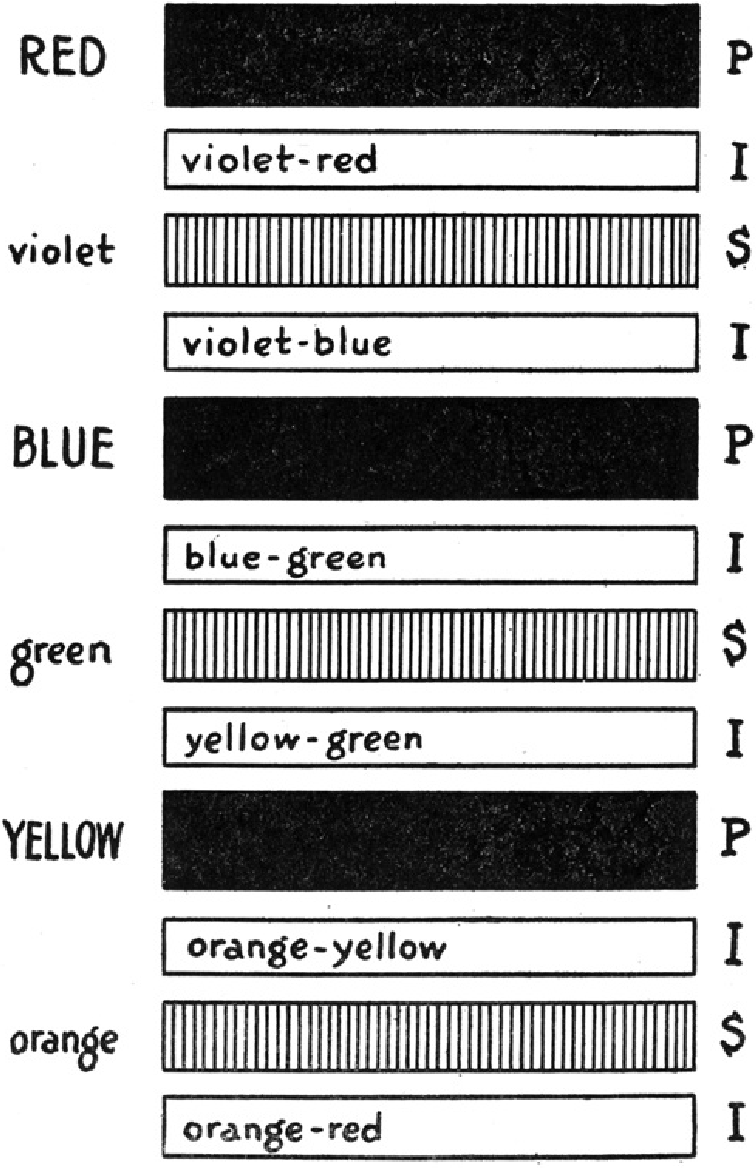


Plate 1.—Spectrum order of colors: Primary, Secondary and Intermediate Colors

When we come to the subjects of color mixing, color harmony and color use, later on in this book, more will be included about the practical use of primary, secondary and intermediate colors. So it is well for the student to keep these divisions of the spectrum in mind, and, particularly, that they are given to us through the laws of nature and the science of man. Man had nothing to do with the creation of the spectrum, but simply named it, classified its colors, and noted how they exist throughout the world.

It is interesting to note that objects do not possess colors of their own, but depend for color upon light reflected from their surface. By way of illustration, surfaces which are capable of reflecting all color rays appear red in red light, blue in blue light and white in daylight. In daylight all the color waves are present. Some surfaces are capable of absorbing all the light rays and reflect none;—these surfaces appear black, no matter what colored light falls upon them.

When part of all the light color rays is reflected and part absorbed, the surface appears gray.

In the case of leaves on plants, they appear green because they reflect green rays and absorb all other colored light rays. If, however, a leaf is taken out of the sunlight and flooded with red light it will appear black, because there are no green rays in the red light to be reflected by the leaf to the eye.

Flowers are red, yellow or blue, depending upon their ability to absorb some colors and reflect others;—that is true of all opaque objects.

In the case of transparent surfaces, they are colored by their ability to screen out certain light rays. Glass is red when only red rays pass through it. A glass or other surface which transmits all colors equally well, as does pure water in small amounts, is considered to be colorless.

CHAPTER II
DESCRIPTIONS OF COLOR PIGMENTS

We cannot paint and decorate with light rays and color reflections from the spectrum of the rainbow, raindrops or a glass prism, as described in Chapter I.

Man has therefore searched out material substances from the soil, mines and vegetation, through his ingenuity in manufacturing and chemistry, to match the colors he sees in the spectrum. What these color substances are should next concern one who is anxious to become skilled in color mixing and use.

The number of shades of a single color found upon the market today is legion;—the siennas, umbers, venetian and Indian reds, chrome yellows and ochres varying in shades depending upon what part of the world they come from, upon manufacturing, chemical, grading and toning processes employed in their production.

These differences also have a bearing on prices charged for colors. The matter of price is always relative as to colors; care must be exercised in buying and in using them. Each grade of colors is made for certain purposes and it is wasteful or disappointing to use them indiscriminately; for instance, the use of a low-priced grade of tinting colors for rough barn painting may prove satisfactory and economical, but such colors certainly would prove disappointing if used on fine interior decorating. And the use of decorators' or artists' colors for rough work would certainly prove expensive and wasteful.

THE EARTH COLORS

Among the first color pigments used by man in the early stages of civilization and, indeed, during the savage ages, were colors which were nothing more than natural deposits of colored earth found in many parts of the world. The colors of these earth pigments are due to their content of more or less oxide of iron and other mineral substances. As a class they are permanent in color, durable and economical.

The principal earth colors are raw umber, raw sienna, yellow ochre, mineral browns, venetian red and Indian red—the last two are now made by chemical processes. These are used just as they are dug out of the ground after washing and screening to eliminate roots, stones, etc. They are dried and ground to make them fine and are classified according to shades of color. Next they are mixed or ground in linseed oil or water, or Japan to make them ready for the painter.

The earth colors are also burned, or calcined, to change their colors. Raw umber which is a dull, grayish brown, becomes a deep chocolate brown when calcined and is called burnt umber. Raw sienna, a rather dull yellow, becomes a cherry red in the burning process and is then called burnt sienna.

Raw Sienna.—One of our most valuable colors, an earth pigment, named after the city of Sienna, Italy, near which natural deposits of an especially bright and clear yellow raw sienna earth were found. These were very fine, rich and transparent colors of great beauty and permanence. When mixed with a white base, clear and delicate tints result.

Sienna earth is found in pockets surrounded by earth of a different character. It owes its color to hydrated silicate of iron, probably precipitated from ponds and bogs containing a solution of iron and silica. There are great variations between different deposits as to brightness of color, texture, fineness and freedom from sand and stone. High quality raw sienna is essentially a yellow ochre of great purity as to color. It is not only brighter in color but has greater tinting strength than yellow ochre and so produces clearer tints when mixed with a white base. It is not muddy, or cloudy like yellow ochre, but quite transparent, which makes it valuable for mixing stains, graining and glazing colors. Both raw and burnt sienna are in the group of most permanent colors known and have been used for hundreds of years.

Burnt Sienna.—Made by roasting raw sienna, which process changes the yellow color to rich brownish red. Burnt sienna, when properly roasted, possesses substantially the same qualities as the raw sienna from which it is made, and is used for the same purposes in decorating and tinting where clear reds and pinks are wanted.

Raw Umber.—Italy claims the origin of umber as well as sienna. The color takes its name from Umbria, Italy. However, in modern times the island of Cypress, in the Mediterranean Sea, appears to be in possession of more deposits of this drab earth color. It has been marketed through Constantinople and so gained the name of Turkey umber.

The characteristics and history of umber are much like sienna. The difference in color is due to its content of a large percentage of manganese in addition to oxide of iron. This possession of manganese makes the umbers very good drying colors—raw umber, in fact, is used in the manufacture of liquid driers.

Raw umber in color is a dark, greenish brown. It is almost transparent, has great tinting strength and produces clear tints when mixed with white.

Raw umber is very durable, permanent to light and invaluable for mixing dark greens, olive greens and cold drabs which are more permanent in strong light than those mixed from chrome green alone. Some of the umbers possess a reddish rather than a greenish tone and, of course, are not cold, but warm colors not so suitable in the mixing of greens.

Burnt Umber.—Substantially the same as raw umber except for color. The calcining or roasting of raw umber changes its color from a greenish brown to a deep chocolate brown. This warm brown makes burnt umber a valuable color for tinting a white base to tan and many other useful colors in paints. It is a quite transparent color and so is extensively used for mixing stains, for glazing color and for graining.

Yellow Ochre.—In this color we have another earth pigment. And it is doubtful if any color is found on the market having greater variations of quality. The name yellow ochre on a product may mean any one of several materials or grades.

Deposits of yellow earth are found broadly distributed over the earth's surface in the form of sand or clay. Not many of them have any real value as a color or paint pigment.

In France deposits of the best quality yellow ochre are found and they are very similar to raw sienna. High grade French yellow ochre is clear and bright, as to color, but cannot be used as a glaze, stain or graining color. It is durable and permanent in strong light. Domestic and some other foreign yellow ochres are muddy and dull in color; they have not the tinting strength of French ochre and have but little in common as a color, paint or tinter with French ochre.

Correctly made yellow ochre is one of the most useful tinting colors, but unusual care must be shown by manufacturers in washing, floating and separating to eliminate coarse sand, if a color with good tinting strength is to be produced.

Yellow ochre is the body, the solid opaque yellow of nature, while raw sienna is the transparent yellow which can be used as a glazing color and a stain.

For the mixing of yellow tints—tans, creams, buffs and olive green—good French yellow ochre has no superior; it is durable, fast to light and economical.

Vandyke Brown.—An earth pigment of a rich, deep brown similar to but richer than burnt umber. It takes its name from the old Dutch master, Vandyke, who used the color with remarkable effect. It is of bog origin and contains iron and bitumin. As made today Vandyke brown is quite permanent, is an excellent tinting color and so transparent that it is invaluable as a glazing and graining color where a richer brown than burnt umber is needed. It is unsurpassed for glazing old bronze effects and for staining to imitate old English, antique and bog oaks. Used to color a white base, the tints have a lavender tinge to them.

CHEMICAL COLORS

The chief chemical colors commonly used are Prussian blue, ultramarine blue, cobalt blue, black oxide of iron, black lead sulphide, graphite, manganese black, chrome green and chrome yellow. Chrome yellow is made in orange, medium and lemon. The vermilions—American, Chinese and English—are chemical colors, as are also Venetian red and Indian red.

Such chemical colors as Prussian blue, chrome yellow and green are manufactured by mixing together certain chemical solutions. The reaction which then occurs causes a precipitation, or throwing down, of a very fine colored pigment. When the chemical action has spent itself the water is drawn off the top of the tubs and the wet pigment is put into filter presses which squeeze out the balance of the water.

These chemically pure colors are very strong and it would be wasteful, as well as expensive, to use them in the pure state; so they are ground in linseed oil, water (distemper) or Japan and at the same time inert white pigments are added as extenders to make the paste tinting colors such as the painting trade uses. These colors, like the earth pigments, are sold also in the dry powder form, principally for mixing calcimine.

Lampblack.—A paint pigment of rather ancient origin and well known to all. It has great opacity and is an excellent pigment both for solid color and tinting purposes. A slow drying color which requires the addition of more than the usual amount of Japan drier.

Lampblack is made in many ways and from many materials which will burn with a slow, smoky flame. It is made from dead oil resulting from coal tar distillation, also from rosin and tallow.

The smoke from burning these oils is collected in chambers or bags attached to flues. The burning must be controlled by the amount of air admitted. Too much air makes grayish blacks and not enough air adds oil or volatile acid to the lampblack. In fact, much skill is required in the manufacture of lampblacks. Time must be allowed; if the burning is forced too rapidly an inferior black is produced which contains both oil and acid sufficient to cause spontaneous combustion. Thus a dangerous dry pigment to handle results and one which is slow to dry and likely to corrode metal because of the acid content. Such a black paint destroys metal surfaces it is supposed to protect. Lampblack made of rosin is especially likely to do this and it is difficult to detect from other blacks.

Gas and carbon blacks often added to high quality carbon black with the intention of giving greater tinting strength are really detrimental because they cause jet blacks to take on a brownish tone and also cause the pigment to separate from oil with which it is ground or mixed—uneven, streaky black paint and muddy gray tints are so produced.

A high quality lampblack, then, is clear, jet black, of good tinting strength with white bases, one free from dangerous oils and acids and a black which will dry within a reasonable time without using an excess of drier.

Drop Black.—The name comes from the fact that when first marketed this pigment was sold in the form of small drops or lumps. It is no longer marketed that way.

Drop black consisted of mixtures of animal and vegetable blacks ground to a very fine pigment in water, oil or Japan. The bulk of this black manufactured is used by sign, carriage and automobile painters.

As now made drop black is a very fine quality of pigment resulting from burning animal bones to make charcoal, which is then ground, first in water, and then reground in oil, Japan or water and glue or gums for binders.

For the manufacture of the finest ivory drop black only the hardest animal bones are used such as teeth and shinbones. The bones are crushed and roasted in crucibles to make the charcoal. Soft bones make blacks which have a brownish tone and which lack clearness. Such blacks are, obviously, much less valuable.

Cheap bone blacks, called sugarhouse blacks, are made from the bone charcoal used in sugar refineries to bleach the sugar. When this charcoal has become saturated with color matter it is re-burned and ground for a cheap paint pigment. It lacks the beauty and clearness of ivory drop black.

High quality drop black makes a beautiful pigment both for solid colors and tints and shades with a white base. Pearl grays, rich warm olives and bronze greens of pure and lively tone are mixed with it.

Drop black takes less oil than lampblack and is a slow drying pigment. It has greater density and opacity than lampblack.

Ivory Black.—While a limited amount of ivory black is made from ivory chips and turnings, the bulk of this pigment is made from selected hard animal bones, the choice bones which are also valuable for making buttons and knife handles.

This is a very clear, jet black particularly valuable as a solid color. It is not so strong for tinting purposes as some other blacks.

Ivory Black is made, like drop black, from bone charcoal and is also called ivory drop black.

Indian Red.—One of the original colors extensively used and at first it was strictly an earth pigment. It was an especially bright oxide of iron earth found as a natural deposit near the Persian Gulf.

As manufactured today Indian Red is really classed with the chemical color group. In steel mills certain acid liquors are used to remove scale from iron and steel. After such use these liquors were dumped as waste in years past and were very destructive of fish in the lakes and streams into which this waste was run.

Today this waste acid containing iron scale is evaporated and from it sulphate of iron (copperas) is crystallized out. When this copperas is roasted a pure oxide of iron powder is recovered and the acid is again used to remove more scale.

This oxide of iron is Indian red. Its quality, shade and strength vary according to the care and ability shown by its manufacturers in roasting the copperas, in freeing it from acid and in grinding it. If the acid is not eliminated completely it will start an iron or tin roof to rusting, instead of protecting such surfaces as a paint should. Consequently, this Indian red must be made by able chemists and manufacturers.

High quality Indian red, then, must be pure oxide of iron, free from corrosive acids, have a deep, rich red color with a purple tinge to it, have a non-fading quality and possess good tinting strength.

Venetian Red.—Originally an earth pigment, venetian red is made by substantially the same process as Indian red and should therefore be classed with the group of chemical colors.

Venetian red is an oxide of iron red made by partially neutralizing the acid liquors used in removing mill scale from iron and steel as described under the section on Indian Red.

In making venetian red the acid liquors are mixed with lime. What is precipitated is sulphate of lime and hydrated oxide of iron. When this precipitate is roasted the acid is eliminated at a lower temperature than is needed in recovering Indian red and so venetian red is lighter and brighter in color.

Some of the cheap venetian reds used for box cars and rough barn work are recovered by crude processes and on a coarse, cheap base. While they are useful for some rough work, they do not compare favorably in value with venetian red made by highly efficient processes and better materials.

The cheaper venetian reds are not suitable for use as tinting colors and are not as good even for solid red paints. High class venetian red produces bright, lively tints and shades and is clear enough for delicate pink.

Carefully selected venetian red ground to a fine pigment in linseed oil makes about the most durable red paint known today.

Ultramarine Blue.—A most pleasing and valuable color made originally from a precious stone called Lapis Lazuli. It is a deep sky blue to a greenish blue in color. Made by a chemical process of burning in crucibles, such substances as China clay, carbonate of soda, sulphate of soda, sulphur, quartz, infusorial earth, charcoal and rosin.

It is interesting to note that in this process, discovered in 1828 by Guimet, a French chemist, the hot mass changes first to a beautiful rich brown which takes fire and burns in defiance of many efforts to hold it as a color pigment. Next the mass turns green and this color also disappears in flames on exposure to the air. Blue appears next, but if heated too long, it turns to violet, then to red and finally to white. After the mass cools off, if the fire is extinguished at the right time, the top layer is a clear bright blue. The bottom layer is a greenish blue of a lower grade.

Ultramarine blue is a combination of silica, alumina, sulphur and soda. The sulphur content of this color makes it an unsatisfactory blue to use with white lead, since sulphur turns white lead carbonate to lead sulphide, which is black. Traces of sulphur and sulphide in ultramarine blue discolor many pigments but not zinc oxide. It is not safe to use this blue with white lead.

The deep, rich color of ultramarine blue with its purple tinge is far more pleasing than Prussian blue, which has a greenish cast to it. Ultramarine blue is an excellent tinting color and glazing color; it is permanent in light (except with white lead) and durable on exposure to weather.

Ultramarine blue may be used on new plaster or cement walls, since lime, soda and alkali do not affect this blue. Fading and spotting occur when Prussian blue is used on such surfaces.

Cobalt Blue.—This is a color which is substantially the same as ultramarine blue—it is the purest and lightest blue so made, having neither the purple tone of most ultramarine from the top of the crucible nor the greenish cast of the bottom layer.

Cobalt is a most beautiful color pigment deserving of wider use by painters and decorators for delicate azure tints, using zinc oxide as the white base. White lead should not be used, unless in small proportions with zinc, since the sulphur content of cobalt blue may discolor the white lead, changing it to lead sulphide.

For the mixing of clear, light greens with zinc, or compounds where zinc predominates, cobalt is very fine. It is strong in tinting strength, durable and permanent in strong light. Hot lime and alkali spots in new plaster or cement walls do not spot and fade this blue as with Prussian blue.

Real cobalt blue is a combination of oxide of cobalt metal with alumina. It is so made for use as artists' water colors. It isn't so good as an oil color. The high cost of real cobalt blue prevents its general use in quantities.

Prussian Blue.—The best known and most extensively used of the blue pigments. Varying shades of Prussian blue are marketed under such names as Berlin, Chinese and Milori blue.

This is a chemical color discovered by accident. In the year 1700 a Berlin colormaker learned that when oxblood and wood were burned together, the ashes yielded a yellow solution which could be precipitated by iron as a brilliant blue color pigment. This yellow solution was yellow prussiate of potash or ferrocyanide of potassium.

The chemical process used in making Prussian blues now has, of course, been perfected far beyond its crude beginning. As done today yellow prussiate of potash is mixed with sulphate of iron (copperas) and the result is that a fine white pigment is precipitated. On being exposed to the air this white substance oxidizes into blue.

The blue color may have a purple, bronze or green cast to it or it may be quite a pure blue, depending upon the manipulation during the chemical process of formation.

Lime, soda, white wash, hot spots in new plaster and cement walls cause Prussian blue to fade and tints made with it to become spotty.

Prussian blues are rather fugitive in sunlight and are not used on exterior painting. They are among the strongest tinting colors and produce bright and clear tints on any white base. Prussian blue is used considerably as a glazing color.

Chrome Yellow.—Chromium is a metal remarkable for the beautiful colors it compounds. The precious stone called emerald has wonderous beauty because it contains chromium.

Chromium combined with lead produces a series of yellows which is most valuable. These yellows range from pale canary, citron or lemon yellows, through medium shades of yellows to orange chrome and finally to orange, red and scarlet.

These beautiful colors are made by the mixture of chemical solutions. Solutions of bichromate of potash, or soda, are mixed with solutions of nitrate or acetate of lead; from this a yellow pigment is precipitated. The water is drawn off, the pigment is put through a filter press to remove more moisture and is then ground in oil for the market.

Manipulations of the chemicals and other elements in the process enable the manufacturer to make the many yellows in this group: Canary, Lemon, Light Medium, Medium, Light Orange, Orange and red-orange chrome yellows.

Chrome yellows are bright, clear and opaque colors with great tinting strength. Because they are not transparent they are not suitable for glazing colors, stains or graining. They are very durable as protective coatings and quite permanent as to color in strong light. If not well made they are easily affected by gases of the atmosphere and strong light, which cause them to fade, get spotty and dingy.

Chrome Green.—The combination of Prussian blue and lemon chrome yellow makes chrome green. The combination is made intimately at the time the two color pigments are precipitated from the solutions.

This intimate mixture is very important; that is, the time when the blue and yellow are mixed. When each color is made separately (a yellow and a blue) and mixed later to make green a separation may occur and fading is pronounced. For this reason it is much better for painters to mix tints and shades of green by adding chrome green to white or a color than by adding blue and yellow to white or a color. When the medium chrome green is used the paint will not fade so soon as when blue and yellow are used to make green. In one case it is an intimate chemical mixture, while in the other purely a mechanical mixture, and so the two colors are more likely to separate and fade in the mechanical mixture.

Chrome greens, except the very dark colors, made largely of raw umber, are not permanent in sunlight. They are excellent tinting colors, and are bright and clear. They are used for glazing colors and may be used for stains.

Chinese and English Vermilions.—A chemical color, a sulphide of mercury, which is quite a permanent, brilliant red. English vermilion is practically the same as Chinese, but American vermilion is quite a different pigment. Though its color is brilliant, too, the latter is permanent in strong light.

The Chinese and English vermilions should not be used with white lead, chrome yellows, chrome greens, any of the copper colors or emerald green. Unfavorable chemical reactions result.

American Vermilion.—A basic chromate of lead, brilliant red, made by the same chemical process as are the chrome yellows. It is fine in texture, has a clear color, is a strong tinting color and has remarkable covering capacity.

ANILINE AND COAL TAR COLORS

These, too, are chemical colors, but they are taking such an important part in painters' materials that special mention is due them. Anilines are made from coal tar products, the by-products of coke ovens. Thousands of products come from the coal tar derivatives, but the aniline colors—dye stuffs—interest the painter chiefly.

The anilines resulting from chemical processes are very fine pigments in texture and have great coloring strength. These colors are precipitated upon inert base pigments like barytes and are sold as dry stain colors, as tinting colors, and for many other purposes. Some of the dull earth pigments, venetian red, ochre and others are toned or brightened by adding aniline colors to them.

The transparent and semi-transparent colors used by artists and decorators are such as have good staining and tinting ability but have little or no opacity, no ability to hide a surface.

The lakes are used as glaze coats or stain coats by mixing them with oils, varnishes and volatile liquids. The surface is first painted in opaque pigments for correct ground colors and the glaze coat is then put on as a finish to give depth of tone; to be wiped-out or highlighted in places.

Furniture and polychrome finishers use glaze colors over burnished gold and silver leaf or bronze covered surfaces. The auto and carriage painter uses them on fine body finishing to produce deep, lustrous colors. The artist uses lakes for floral and other hand decorations.

At first lake colors were made from natural vegetable and earth products. Few are so made today. Most lake colors used today are made from artificial substances, principally from coal tar dyes. They consist of every possible color, shade, tone and degree of permanency.

Aniline lake colors are used in much greater quantity by the printing ink industry and dye manufacturers than by the paint industry.

The first artificial aniline dyes called mauve and magenta were made by Perkins from coal tar in 1865. From that beginning a tremendous development has taken place. Now all the dyestuffs are of artificial aniline origin with but one or two exceptions. Natural madder lake and even natural indigo have been largely displaced.

The dyestuffs derived from coal tar products are legion. In the paint industry we hear most about aniline, alizarine red, nigrosene black, para red, chinolin and coal tar indigo, but there are many more.

The coal tar dyes come to the painter in dry powder form for use in mixing wood stains. Some are soluble in water, some in alcohol and some in oil. Many of the colors now used are toned with these aniline and other coal tar dyes.

LAKE COLORS

Painters and decorators in the building trades do not have occasion to use many of the lake colors except for decorating in the fine arts, although rose lake, rose pink and Dutch pink, lake colors, are rather generally known. Automobile and carriage painters use lakes extensively for high class work, and decorative artists also use them.

Lakes are made by a variety of manufacturing processes. Generally speaking, they consist of organic color united with metallic and mineral bases as definite compounds. The name—lakes—is rather odd and not at all descriptive, but it probably just happened from the practice of artists and craftsmen hundreds of years ago who used the dried scum skimmed off the top of "lac" dye vats.

Natural dyes extracted from woods and vegetation of various kinds at first constituted the organic portion of lake pigments—Brazil wood, sapanwood, parnambuc, oak bark, quercitron, fustic, lac and cochineal from insects were commonly used. The modern manufacturing processes use aniline colors from coal tar principally for the organic part of lake colors, although some dyes of vegetable origin are still in use to some extent.

The mineral or metallic bases for lake colors are alumina, tin, lead and chromium in solution.

By way of illustration, rose lake, rose pink and Vienna lake are made by cutting into chips the wood and bark of Brazilwood, sapanwood or parnambuc from South America. These woods contain, when fresh, a dye substance called brazilein. The chips are permitted to dry out thoroughly and by this oxidizing the dye color is made available. The chips are next placed in large steel cylinders and subjected to the action of steam under pressure. The colored liquor thus extracted is allowed to stand so all sediment and foreign particles may be taken out by settlement and by filtering.

The clear liquor is mixed with alum or tin. Carbonate of lime is used in making cheaper lakes. From this mixture a clear, fine transparent and rich wine-colored pigment is precipitated. The color is then separated from the liquid by filtering and drying. When ground with oil, Japan or water it is ready for the trade.

This group of lakes is valuable principally to artists, decorators, furniture finishers and automobile painters. They must be protected by varnish or other transparent coatings, as they are too fugitive for outside exposure. It is difficult to find anything to equal them for rich wine, maroon and pink tints.

Dutch pink isn't pink at all, but a transparent yellow lake. It is made of the extract from oak bark or quercitron precipitated by alum on a base of carbonate of lime. The peculiar quality of Dutch pink is that it retains its yellow tone at night even when subjected to gas light. It produces greens and olives which also retain their tones in artificial light.

The more expensive lakes of this group—Carmine and madder—cost too much to be used in quantity, or for any except decorative purposes where small amounts are needed.

VEGETABLE COLORS

Before the advent of chemical and aniline colors, vegetable colors were extensively used, especially for stains and dyes. Some were made from decayed vegetation found in swamps—Vandyke brown was one of these. Brunswick black is a vegetable color made from charcoal secured by burning twigs and vines. Walnut hulls, oak tree bark (tan bark) and some of the transparent lake colors used by automobile painters are of vegetable origin.

ANIMAL COLORS

Bone black, ivory drop black and some of the carriage or coach blacks are made from burned bones of animals. The charcoal obtained is ground fine in linseed oil, turpentine, Japan or water (distemper).

Carmine is an insect color, since it is secured from cochineal, a scarlet dyestuff consisting of the dried bodies of certain insects gathered from the cactus plants of Mexico and from the West Indies.

In addition to the bronze powder and paints commonly used for painting steam and hot water radiators in homes in gold and aluminum, there are other grades and colors used extensively by artists, interior decorators and furniture finishers.

These bronzes come in dry powder form in one-ounce papers and one-pound cans. The bronze color pigments are made of real metals. By rolling and beating them into very thin sheets and grinding them exceedingly fine, very serviceable pigments are made.

ARTISTS' AND DECORATORS' COLORS

Such color pigments as are commonly used for interior decoration, furniture finishing, polychrome finishing and by artists for pictorial painting constitute quite a different class from colors made for exterior house painting.

While many of the principal colors, like the umbers and siennas, used for exterior paints are also made in clearer, brighter and more select grades for use by artists and decorators, many of the color pigments in the artists' and decorators' palette are too fugitive and expensive to use for exterior paints.

Descriptions of colors used for exterior paints will be found in Chapters II, III and IV.

The following brief descriptions of colors in common use will help to identify them in the students' mind:

REDS

Vermilions.—Above in this chapter American vermilion is described. It is a basic chromate of lead and is quite a different color from English, French and Chinese vermilions, which are made of sulphur and mercury. These colors are found naturally in large quantities as the mineral cinnabar. The natural cinnabar is not brilliant enough in color, however. Most of the English vermilion is made by chemical process.

American vermilion is used mostly in the commercial arts, while English, French and Chinese vermilions are used in the fine arts and are more expensive. The latter colors seriously retard the drying of oil and also tend to turn black on exposure to the air.

American Vermilion, is commonly used where a brilliant red is needed, although a durable red of even greater brilliance for some decorative purposes can be made by toning alizarine crimson with cadmium orange.

All of the sulphide of mercury vermilions—(except American, which is a lead chromate color)—should not be mixed with white lead or such lead colors as light, lemon, medium and orange chrome yellows nor with American vermilion. The sulphur of the mercury colors causes the lead colors to darken. The mercury vermilions also cause unfavorable chemical reactions on colors from a copper base such as emerald, verdigris and malachite greens.

American vermilion was very extensively used a few years ago for painting farm machinery, but it has been displaced by the more brilliant artificial para reds made from coal tar dye and which are less expensive.

American vermilion is superior to most pigments as a protective coating for iron. It is very heavy and too expensive for general use in this manner.

Vermilionette.—Made from the coal tar dye eosine as the coloring matter for tinting an inert base like barytes. The colors range from rather pale pink to deep scarlet. These colors have been much used in automobile and carriage paints. Vermilionettes fade in sunlight.

Tuscan Red.—Rather a bright red made by toning to brighten the color of oxide of iron red—reds like Venetian and Indian—with alizarine red, which is a coal tar red. As made today it is permanent as to color, stable chemically and doesn't bleed.

Harrison Red.—A permanent bright red coal tar product. Not so brilliant as vermilion but used in place of it at times. It is more transparent than vermilion and is quite stable, mixing well with madder lakes and cadmium yellows. A slow drying pigment.

Light Red.—A very permanent red which has great tinting strength and good drying qualities. Stable chemically and mixes well with all colors. Made by roasting yellow ochre.

Magenta (*Mauve*).—A purple red made from coal tar dyes on an alumina base. Brilliant and beautiful but very fugitive to light. Used only for temporary work.

Mars Red.—An oxide of iron pigment similar to the ochres. Rather slow drying. Permanent in color and may be mixed with all mineral colors, but not with genuine or natural lake colors.

Scarlet Vermilion.—A sulphide of mercury vermilion similar to English, French and Chinese vermilions.

Terre Rosa.—A natural earth pigment which drys well and is permanent in color. It is stable and mixes with other colors. Chemically it is sesquioxide of iron and clay.

Scarlet Lake.—Genuine natural madder lake.

Geranium Lake.—A coal tar lake color made from eosine.

Crimson Madder.—A deep red of transparent character. Genuine madder is made from madder root. Permanent when used with good judgment only as a glaze color. Not stable when mixed with chemical colors, or ochres.

Carmine.—The lake color called French carmine is made by extracting coloring matter from cochineal insects. Vast quantities of these insects are secured from Mexico and South America. Carmine is transparent, rather a slow drying color and not permanent for long in strong light, though a most brilliant red. The insect bodies are dried, the color is extracted by boiling them in water and then precipitated on an alumina clay base. Carmine lake has been made over 200 years. This, like all lake colors, must be used over correct ground colors, since it is too transparent to hide the surface. They are strong in tinting and staining power, but have little opacity.

Pink Madder.—Similar to genuine madder lake or alizarine lake, but a lighter color.

Alizarine Crimson Lake.—One of the coal tar lakes. Transparent, permanent in color and a good drying color. A purple-red in color. Genuine or natural crimson lake is made from the same cochineal insects and in largely the same way as carmine.

Alizarine Lake.—A transparent aniline lake color of great tinting and staining ability. Quite similar to scarlet and carmine in color. Alizarine is used extensively for making fast mahogany stains and also for a glazing color by decorators in place of natural madder lake. Its greatest use is for brightening oxide of iron in making permanent Tuscan reds.

Alizarine Red.—A coal tar dye color of brilliant hue. Permanent in color and stable.

Eosine Red.—A coal tar dye used with orange mineral to make vermilions. It is fugitive to strong light.

Para Red.—One of the most extensively used of the coal tar reds. It is used alone and also mixed with orange mineral for vermilions. This para nitranaline red has remarkable opacity. One pound of it in a gallon of varnish will cover solidly in one coat and hide black. Its opacity is so great that it is commonly sold in the proportion of only 10% to 12% of color on a white inert base like barytes or whiting. And certain farm implement manufacturers specify this red to be made with 5% color, 10% zinc and 85% barytes.

The weakness of para red is its tendency to "bleed". It is soluble in oil and works its way up through varnish, enamel and paint. Sometimes shellac will seal it up and sometimes aluminum paint will seal it.

Toluidine Red.—A coal tar aniline color similar to para red but lighter in color. It does not bleed like para red and is the fastest known organic color, being quite remarkable in permanence. It is greatly used as a sign painter's red. Because its cost is much greater than that of para red, it is not used in the implement manufacturing industry.

Rose Pink.—A lake color mode from hypernic. Transparent but has an agreeable red color, good staining and tinting ability. Made quite like scarlet lake, using amanarth and acid rubine.

Rose Lake.—Similar to rose pink in manufacture but slightly different in color hue.

Rubens Madder.—Genuine natural madder lake.

Rose Dore.—Genuine natural madder lake.

Rose Carthame.—made at first from the flowers of the carthamus plant. Now made from eosine dye, a coal tar product. Not permanent as to color.

Rose Madder.—Genuine natural madder lake.

Scarlet Madder.—Genuine natural madder lake.

Madder Lake.—Made from madder root and is consequently of vegetable origin. A beautiful, transparent lake which is extensively used by artists and decorators. A deep red in color useful only for glazing. Genuine madder is quite permanent when so used.

The vegetable madder lake has been almost entirely superseded today by a color made artificially and known as alizarine lake.

Nopal Red.—This is an aniline color which is fugitive in strong light. Nopal orange has the same characteristics.

Orange Vermilion.—A yellow red similar to English, French and Chinese vermilions. A sulphide of mercury color.

Scarlet Lake.—A different color from scarlet vermilion. Scarlet lake is quite like carmine as to color. Made from scarlet acid, barium chloride, blanc fixe and soda sulphate or sulphuric acid.

BLUES

Among the blues used extensively by artists and decorators probably ultramarine, called French blue sometimes, is most popular. French blue is really ultramarine blue and is the most carefully prepared pigment of that series. It contains less sulphur than other ultramarines. French blue is especially valued for use with alizarine crimson to mix purples, having great plastic qualities.

Cobalt Blue.—Oxide of cobalt metal. It is very valuable since it possesses the most extensive utility among the sulphur blues. It is chemically stable and may be mixed with nearly all colors and white bases. When well made it has but a very small sulphur content. New blue has about the same appearance of purity of tone and is a less expensive cobalt blue. Cobalt blue is used extensively in ceramic manufacturing, for pottery, dishes and many other articles of merchandise. In the past its cost has been a bit higher than that of Prussian blue.

Cerulean Blue.—Related to cobalt blue and when made from the oxides of cobalt, zinc and chromium it is permanent and stable for mixing with other colors. It is sometimes gritty and hard to manage; also it possesses a tendency to turn to a greenish hue with age.

Cobalt Violet (*cobalt purple*).—A good pigment for use with ultramarine in mixing violets, making brilliant colors. Cobalt violet (or purple) is an excellent drying pigment which doesn't have much tinting strength, but is a good base for use with rose madder and others of the lake pigment class.

Prussian Blue.—Has a greater tendency to fade in strong light than other blues, but when used with other colors which form agreeable chemical combinations it is a valuable blue which is permanent. Faded Prussian blue regains its full color when placed in absolute darkness. Artists and decorators usually mix a Prussian blue color by adding emeraude green to ultramarine blue and a color permanent to light results.

Antwerp Blue.—A Prussian blue to which alumina hydrate has been added. The latter pigment is responsible for the translucency of Antwerp blue. Rather a permanent color except when mixed with lead colors like chrome yellows and American vermilion; it is likely to turn to a greenish hue when mixed with these colors. Antwerp blue is mixed by artists and decorators from ultramarine blue and emeraude green when a permanent color is needed.

Chinese Blue.—A Prussian blue of a slightly different hue.

Verditer Blue.—A light blue made from sulphate of copper; color used extensively at one time by the wall paper industry.

Mars Violet.—A selected and specially prepared form of yellow chrome which owes its color to oxide of iron. Rather slow to dry but permanent as to color and in mixtures except that it must not be mixed with lake colors.

Purple Lake.—Same as crimson lake with a variation of color.

YELLOWS

In the artists and decorators' palette cadmium lemon or pale yellow, cadmium yellow, cadmium deep yellow and cadmium orange are sulphide colors and should not be mixed with white lead or light, lemon, medium or orange chrome yellow, nor with American vermilion. Mixing such colors together releases sulphur and causes detrimental discoloration—darkening the mixture.

Cadmium Yellow.—The cadmium yellows—pale, lemon, deep and orange—are artists' and decorators' colors of considerable value. Prices for these colors are apparently high, but they are economical because they have great tinting strength. Cadmium lemon yellow, even though it has somewhat of a warm hue, transmits an exceptional amount of green staining strength when mixed with blue—and likewise makes strong and clear orange colors when mixed with red.

Cadmium yellows as a class are quite permanent for interior decoration, furniture finishing and pictorial painting—orange cadmium is especially permanent. It ought not to be mixed with white lead, chrome yellows, American vermilion nor with any of the colors made from a copper base.

Lemon Zinc Yellow.—Mixed with blue black produces warm durable greens of great value in landscape painting. Zinc yellow is balanced in color exactly between Chinese vermilion and emeraude green. Zinc yellow, alizarine scarlet and cobalt blue constitute a palette of permanent colors for artists and interior decorators which meets nearly every demand in color mixing. A chromate of zinc which changes to a greenish hue when exposed to strong light and remains fixed with that color. A permanent color after changing to greenish yellow.

Cobalt Yellow (*aureolin*).—A yellow which has good transparency for glazing. A good drying color and one which is fairly permanent to light except when mixed with certain lake colors. Used as a glazing color, it is serviceable over any color. For making light yellow tints from this yellow, zinc oxide should be used. Chemically cobalt yellow is a double nitrate of cobalt and potassium.

Citron Yellow.—A chromate of zinc pigment which is fairly permanent to light. What fading does occur in time is toward a greenish hue, where it remains permanently fixed. A stable color, chemically, which mixes well with other colors. Varnishing retards the fading of this color.

Naples Yellow.—A useful color mixed from cadmium orange and zinc oxide. Permanent and a good drying pigment.

Indian Yellow.—A useful color which is rather permanent except when placed so the direct rays of the sun strike it. When faded it regains its color in darkness. Indian yellow is a good drying pigment which is stable chemically and mixes satisfactorily with other colors.

Mars Yellow.—This color, together with Mars Orange, Mars Brown, Mars Violet and Mars Red, belongs to the ochre class and owes its color to oxide of iron. Slow drying colors which are permanent and which may be mixed with other colors of a mineral nature. They should not be mixed with lake colors.

Permanent Yellow.—A color made of chromate of barium and zinc oxide. Permanent to light and stable chemically for mixing with other colors. It should not be mixed with raw ochres.

Lemon Yellow (*Perfect Yellow*).—A chromate of barium color. Permanent to light. Generally a stable color, but should not be mixed with madders because of unfavorable reactions.

Strontian Yellow.—A fairly permanent yellow of a neutral hue. Made of chromate of strontium.

Golden Ochre.—Raw sienna.

Dutch Pink.—A yellow color made from quercitron, the bark from trees. Not a really permanent color. Has good transparency but is superseded by more permanent yellows.

Yellow Lake.—Made from quercitron bark, as are also Dutch pink and brown pink. A fugitive yellow transparent color as made originally, but coal tar yellow lakes now made are more nearly permanent.

Gamboge.—A yellow gum resin of natural origin. Has the same transparent nature as lake pigments, but is not permanent in color. Of little value for permanent decoration.

Italian Pink.—A transparent lake nearer yellow than pink in color. Made from aniline color and is permanent. It is stable chemically and dries well.

BROWNS

Asphaltum (*bitumen*).—A transparent mineral pitch used to some extent as a stain when thinned with benzine, and for a glazing color with other colors added to it.

Brown Ochre.—Similar to yellow ochre but having a brown color. It is a native earth pigment.

Caledonian Brown.—Not a color pigment but made by mixing burnt sienna and Vandyke brown. A good drying and permanent color.

Mars Brown.—See *mars red* and *mars yellow* for same description except as to color.

Sepia.—Made of coloring matter from the cuttle fish. Not permanent to light. Sepia color is commonly mixed from other colors which are permanent.

Vandyke Brown.—See *Chapter II*.

Bone Brown.—Made from charred bone dust. A fugitive color of no value for permanent decoration. Ivory black toned with raw umber will reproduce the color of this pigment and give you a permanent, stable color.

Brown Madder.—Made from the natural madder root the same as genuine madder lake, but of a brownish hue. Fairly permanent in color, but in time fades to a yellow hue.

Brown Pink.—A warm brown lake color made from quercitron bark. It is a fugitive color of little value for permanent decoration.

GREENS

There is an abundance of valuable green pigments useful for interior decorating, furniture finishing and general decorative purposes which are not commonly used for tinting exterior paints. Emeraude green (called veridine green), cobalt green and oxide of chromium are all dependable greens where brilliance and clear tones are needed.

Beautiful olive green tints and shades may be mixed from emeraude green and raw sienna toned with zinc yellow.

Cobalt Green is a semi-transparent color and is permanent and stable for intermixture with other colors. Mixed with zinc it makes beautiful green tints.

Permanent Green.—The colors called permanent greens are less expensive than emeraude and veridine greens and serve many purposes quite as well. They are chemically the same, but are extended with alumina hydrate.

Emerald (*Paris*) *Green.*—An aceto-arsenite of copper color and the most brilliant of all greens. It has little strength as a tinting color. Used alone it is opaque. It is not a good color to mix with other colors, being not chemically agreeable. Green tints and shades quite as useful can be mixed from emeraude green and lemon cadmium yellow. Being a compound of copper and arsenic, emerald green is very poisonous and is used much more as an insecticide than as paint.

Emeraude (*viridian*) *Green.*—A brilliant color and the most permanent to light. Completely stable chemically and may be mixed with all other colors. Chemically it is hydrate sesquioxide of chromium.

Malachite Green.—Made from a copper base and has little tinting strength. It is especially fugitive in the presence of sulphuretted hydrogen gas from stagnant water. Chemically it is hydrated carbonate of copper. Its color can be matched with emeraude green, zinc oxide and raw sienna.

Verdigris Green.—Used alone for glazing to a limited extent, but rather fugitive to light and especially affected by sulphur gasses. Must not be used with lake colors, which it destroys. Chemically it is acetate of copper.

Brunswick Green.—Also called Bremen green. A variation of chrome green.

Chrome Oxide Green.—An oxide of the metal chromium. A very useful green permanent in light. Stable chemically and may be mixed with all other colors. It is opaque and drys well. It is not the same as ordinary chrome green made by precipitating Prussian blue and chrome yellow together. Chrome oxide green ranges in color from dull olive to bluish green. It hasn't much tinting strength for mixture with white, but it is very fast in color. It doesn't fade in strong light and is little affected by acid or alkali.

Lime Proof Green.—Used for calcimine and cement tinting purposes. Made from a natural earth called terre verte or green earth which absorbs Emerald (Paris) green crystals and auramine yellow, an aniline basic color. These greens are not changed by alkali and are much improved in their permanence of color in strong light.

Sap Green.—A rather permanent color made from coal tar dye.

Zinc Chromate.—Bright yellowish green of a deep lemon yellow color.

BLACKS

Blue Black.—A black pigment made from charcoal secured by burning vines and twigs. A carbon black which is permanent and of good drying character.

Indigo.—A natural color extensively used by the dye industry. It is an extract from the indigo plant. A blue-black pigment which drys slowly and fades in sunlight. It should not be mixed with lead or lead colors. The blue tone of indigo can be duplicated by mixing ivory black, ultramarine blue and a bit of emeraude green. This makes a permanent and good drying black.

Indigo is now made from coal tar dye and is widely used.

WHITE AND GREY

Blanc de Laque.—A transparent white pigment. Alumina hydrates called white lake and used by mixing with opaque colors to add translucency.

Payne's Grey.—A mixture of ultramarine blue, ivory black and a bit of yellow ochre.

Artists' and Decorators' Palette.—Colors which are permanent and may be intermixed by artists and decorators for interior building and furniture decoration, but not for exterior paints, are these:

Alizarin Madders	Permanent Blue
Genuine Madders	Cobalt Blue
Cadmium Yellow	Cobalt Violet
Cadmium Orange	Cerulean Blue
Lemon Yellow (Barium Chromate)	Indian Red
Emeraude Green	Light Red
Viridine Green	Burnt Sienna
Oxide of Chromium Green	Burnt Umber
Ivory Black	Vandyke Brown
Blue Black	The Mars Colors
Lamp Black	Raw Sienna
Vermilion, American	Raw Umber
Vermilion, Mercury, (with zinc, not lead)	Venetian Red
Ultramarine (with zinc, not lead)	Lead Whites
Transparent Gold Ochre	Zinc White
Yellow Ochre	

CHAPTER III
PROPERTIES OF COLOR PIGMENTS

Opaque Colors.—These are such as hide the surface more or less completely.

The blacks are the most conspicuous, of course, in this group.

In the red group of tinting colors for house paints all cover well; venetian red, Indian red and American vermilion hide the surface very well.

Among the blue pigments all are quite opaque, except when mixed thin for glazing and staining.

Of the yellows, the chrome yellows being made on a white lead base, are the most opaque. In fact, the other yellows are commonly used as glaze colors because they possess a degree of transparency. Yellow ochre, except in the high grades of French ochre, is rather opaque and too muddy, as the decorator puts it, to be used for glazing or mixing stains.

Greens are all opaque, yet they are transparent enough in most grades to be used for glazing when mixed thin.

Browns are also fairly opaque when finely ground and used in a thick film, but all are excellent glaze colors, because of their degree of transparency when mixed thin.

White pigments which are really opaque are limited in number. White lead has held first place in the matter of opacity for hundreds of years and its many virtues may keep it in first place indefinitely.

Of recent years titanium oxide has made claim to honors as the most opaque white pigment, but its case has not yet been fully substantiated as an all-around equal to white lead.

Zinc Oxide has held second place for opacity among white pigments suitable for outside painting and it has held first place in the matter of fineness for years. It is not as opaque as white lead, however.

Then, considering only the quality of opaqueness and not general utility as a paint pigment, china clay and whiting, silica and barytes are less opaque white pigments, but are very useful for some purposes in interior decorating.

For interior wall paints, window-shade paints and enamel undercoaters, lithopone has first claim to popularity, because of its very great opacity and moderate cost. It is not suitable for exterior paints, however. It is quite likely that titanium oxide will find its greatest field in the manufacture of interior flat wall paints because it is a very opaque pigment.

Transparent Colors.—These are not really transparent in the sense that glass is transparent, but they are semi-transparent when mixed thin. The glaze colors listed in Chapter II, and especially the lake colors and aniline colors are the best examples of the transparent class, but even the commonly good grades of tinting colors for house paints are satisfactorily transparent for some jobs of glazing, mottling, blending and Tiffany finish.

For mixing stains, only the transparent colors are suitable. The aniline colors, being especially transparent, are very fine for both staining and glazing.

The Fading of Colors.—Among all the colors used some are very permanent, some fairly permanent and others are quite fugitive when placed in strong light or subjected to the elements on exterior surfaces. And it should also be remembered that many colors which prove quite fugitive and unsatisfactory when used for the wrong purpose are really suitable and satisfactory when used for the purpose for which they were manufactured. For instance, the beautiful lake colors made for superfine automobile painting and to be protected by many coats of varnish, would not give satisfactory service if used to tint outside paint. Bright colors made with Prussian blue, chrome green and certain anilines will not hold their colors long in direct sunlight, yet there are no more permanent colors of their kind to take their place. If judgment is shown about using fugitive colors, placing them out of strong light or on interior surfaces, they are completely satisfactory.

Earth colors such as venetian red, raw and burnt umber, raw and burnt sienna, yellow ochre, and some few others are, generally speaking, more permanent than chemical colors like Prussian blue, chrome green and chrome yellow; but, as stated, the latter are sufficiently permanent for the purpose of house decorating, and there are no others to take their place. If blues and greens are to be used for exterior exposure, mix them with earth colors to increase their permanency; that will dim their brightness, but when added to white or black, pleasing tints and shades are secured.

Following is a tabulation of colors arranged according to their permanence in light:

NON-FADING

Raw Sienna	Vandyke Brown
Burnt Sienna	Venetian Red
Lamp Black	Chromium Oxide Green
Ivory Drop Black	Toluidine Red
Carbon Black	Yellow Ochre
Black Oxide of Iron	Tuscan Red
Indian Red	Vermilion

Raw Umber	Ultramarine Blue (except when used with white lead)
Burnt Umber	Cobalt Blue

FAIRLY PERMANENT

Chrome Green, Light	Chrome Green, Dark
Chrome Yellow, Light	Chrome Yellow, Orange
Chrome Green, Medium	Cadmium Yellow
Chrome Yellow, Medium	Para Red (aniline)

FUGITIVE

Prussian Blue	Carmine
Antwerp Blue	Crimson Lake
Chinese Blue	Scarlet Lake
Dutch Pink	Purple Madder
Red Lead	Madder Lake
Aniline Reds (except Toluidine)	Rose Madder
Indigo	Purple Carmine
Indian Yellow	Violet Carmine
Yellow Lake	

Chemical Reaction of Some Colors.—Certain combinations of colors and pigments result unfavorably because they set up chemical reaction which should be avoided. The principal ones which a decorator is likely to encounter are the use of ultramarine blue, cobalt blue, English vermilion and Chinese vermilion, with white lead. In the making of ultramarine blue and cobalt blue, sulphur enters the process and this reacts unfavorably upon the white lead, turning it from lead carbonate, which is white, to lead sulphide, which is black. When you cannot produce the blue tints or shades wanted without using ultramarine blue, use oxide zinc for the white pigment instead of white lead. Prussian blue, Antwerp blue, and in fact all blues except ultramarine and cobalt, may be used satisfactorily with white lead.

Ultramarine and cobalt blues, however, possess the valuable trait of being proof against active lime, soda and alkali in new cement and plaster walls. Consequently, tints and shades made with these blues do not fade and spot as do tints and shades made from Prussian blue when used on new plaster and cement surfaces.

Until such surfaces have aged, which requires a matter of months, their caustic properties are still active, and will cause these colors to change to a spotty appearance and fade out in places. A new surface of this kind can be chemically aged by brushing on a solution consisting of ten or twenty parts zinc sulphate to eighty or ninety parts water.

English, French and Chinese vermilions being compounds of mercury and sulphur should not be mixed with white lead, chrome yellow, orange chrome or American vermilion. Such vermilions have a tendency to turn black when mixed with lead and lead colors.

Mercury vermilions should not be mixed with copper colors like Emerald green (Paris), verdigris green and malachite green if unfavorable chemical reactions are to be avoided. American vermilion is a basic chromate of lead resulting from the same process, generally speaking, as chrome yellow, and it may therefore be used where Chinese and English vermilions are not advisable.

Indian red as made today is a chemical color produced from iron and steel scales removed by the use of certain acid liquors in the mills. If the acid is not completely eliminated, paint made from Indian red for use on iron and tin surfaces will cause rusting instead of protecting such surfaces, for which purpose the paint is used. Careful manufacture, however, completely eliminates or neutralizes the acid. Venetian red, being manufactured in substantially the same way, is likely to possess the same characteristics.

Bleeding Colors.—In past years rather large quantities of aniline red stains have been used for producing mahogany finished wood trim in homes and for furniture finishing in mahogany. Some of these mahogany stains were of the para red class of anilines, which have exceptional penetrating ability. As long as the finish of the wood remained mahogany no difficulty occurred, but when the finish is changed to white paint, white enamel or light tints in paint or enamel, these para red anilines soon penetrate the new finish and turn it to a clouded pink color.

In some of the simpler cases the aniline can be sealed up by brushing on a coat or two of shellac. In some cases a coat of flat black mixed from coach or ivory black ground in Japan and turpentine will stop the bleeding. In the most radical cases nothing but a coat of aluminum bronze paint has been found effective. The enamel or painted finish, of course, is produced on top of the bronze coat. In some cases decorators have stripped off the old finish down to the bare wood and washed the wood thoroughly with alcohol, and later with liquid varnish remover, in order to remove all of the original stain possible from the pores of the wood. After this stripping-off process the new finish is built up on top of a coat or two of shellac.

Slow-Drying Colors.—In the use of certain color pigments it is well to keep in mind that some dry more slowly than others. For instance, the principal slow-drying colors are lampblack, chrome yellow, yellow ochre, chrome green, and the oil soluble aniline colors.

In using slow-drying colors, where only a small quantity is added to a white paint to make light tints, you will experience no difficulty with slow-drying or tacky paint, but where these colors constitute a rather large proportion of the paint mixture it is wise to increase the amount of Japan drier and turpentine in the paint, especially for hot, humid or cold wet weather.

Madder Lake (not alizarine Madder) should not be mixed with Mars yellow, Mars red, Mars violet or golden ochre. This to avoid unfavorable chemical reactions.

Cadmium yellow ought not to be mixed with any of the lead colors, chrome yellow, orange chrome or American vermilion, or with copper colors like Emerald green, verdigris green or malachite green as unfavorable chemical reactions result.

Zinc yellow when exposed to strong light changes to a green hue but after such a change it remains a permanent light green valuable for lemon and greenish yellow tints.

Cerulean blue has a tendency to turn to a greenish hue with age.

Verdigris green must not be mixed with lake colors. It violently attacks them and is quite fugitive in light itself.

Antwerp blue and raw sienna should not be mixed together. The sienna destroys the blue color rather rapidly.

CHAPTER IV
HOW COLORS ARE PREPARED FOR THE TRADE

The colors made for tinting white paint for outside house painting are ground in linseed oil to a thick paste. They are put up in one-pound and five-pound cans and 12½-pound and 25-pound pails. Larger packages can be had for special purposes.

There are several grades of tinting colors. It will pay to buy the best grade, because such colors are brighter, clearer and have greater tinting strength. A lesser quantity of high grade tinting color is required to tint a white paint to a desired color. Cheaper grades of tinting colors not only lack tinting strength, but are apt to be cloudy, or muddy.

There are some variations in names of tinting colors since some manufacturers give special names to certain grades of standard colors, but the principal colors ground in oil for tinting house paints are these:

TINTING COLORS GROUND IN OIL

REDS

Indian Red	Scarlet Vermilion
Tuscan Red	Unfading Vermilion
Turkey Red	English Vermilion
Venetian Red	Permanent Red

BLUES

Chinese Blue	Prussian Blue
Cobalt Blue	Ultramarine Blue

YELLOWS

Light or Canary Chrome Yellow	Golden Ochre
Medium Chrome Yellow	Yellow Ochre
Orange Chrome Yellow	French Yellow Ochre
Dutch Pink	

BLACKS

Coach Black	Lamp Black
English Blue Black	Carbon Black
Ivory Drop Black	Black Iron Oxide

GREENS

Light Chrome Green	Forest Green, light, medium and dark
Medium Chrome Green	Emerald Green
Bottle Green	Olive Green
Bronze Green	

BROWNS

Raw Sienna	Burnt Umber

Burnt Sienna
Raw Umber
Vandyke Brown
Brunswick Brown

DECORATORS' OIL COLORS

For the use of decorators, artists and furniture finishers, a finer ground, brighter and clearer toned grade of color is ground in oil. They are used for all manner of decorating jobs such as on wall and furniture stencils, polychrome finishing and painting of pictorial and mural subjects on theatre scenes, signs, banners and wherever high class oil colors are needed.

Following are the colors of this class, ground in oil and put up in tubes and one-pound press-top cans:

REDS

- Decorators' Red
- Indian Red
- Permanent Red
- Rose Pink
- Turkey Red
- Tuscan Red
- Venetian Red
- American Vermilion
- English Vermilion

BLUES

- Antwerp Blue
- Cobalt Blue
- Prussian Blue
- Ultramarine

YELLOWS

- Chrome Yellow, Lemon
- Chrome Yellow, Light
- Chrome Yellow, Medium
- Chrome Yellow, Orange
- Dutch Pink
- Golden Ochre
- Yellow Ochre, French

GREENS

- Chrome Green, Light
- Chrome Green, Medium
- Chrome Green, Dark
- Sap Green
- Zinnobar Green
- Ultramarine Green

BLACKS

- Ivory Black
- Lettering Black

Lamp Black

BROWNS

Burnt Sienna
Raw Sienna
Burnt Umber
Raw Umber
Vandyke Brown

LAKES

Alizarine Lake
Blue Lake
Carmine Lake
Crimson Lake
Geranium Lake
Green Lake, Light
Green Lake, Dark
Mauve Lake
Olive Lake
Orange Lake
Rose Lake
Scarlet Lake
Yellow Lake

WHITE

Flake White (white lead)
Zinc White (zinc oxide)
Cremnitz White (white lead)

DECORATORS' GLAZE COLORS

For high class glazing, mottling, blending, Tiffany and other special wall finishes, colors are needed which are not alone brilliant and clear, but also quite transparent. These are called glaze colors. The following list of glaze colors is quite complete. They are ground in oil and put up in tubes and one-pound cans:

YELLOW

Brown Pink
Gamboge
Italian Pink
Indian Yellow
Orange Lake
Yellow Lake, Light
Yellow Lake, Deep
Royal Golden Lake
Raw Sienna

GREEN

Alizarine Green, Light
Alizarine Green, Deep
Blue-Green
Emerald Green
Green Lake, permanent
Malachite Green
Sap Green
Vert Emeraude
Verdigris

BLUE

Cobalt Blue
Chinese Blue
Italian Blue
Steel Blue
Verditer Blue
Ultramarine Blue

RED

Alizarine Crimson
Alizarine Lake
Carmine No. 40
Florentine Lake
French Nakaret Carmine
Geranium Lake, Bluish
Geranium Lake, Yellowish
Permanent Turkey Red
Permanent Vermilion, Light
Permanent Vermilion, Deep
Rose Madder
Scarlet Lake
Vienna Rose Lake
Asphaltum

Permanent Crimson Lake

PURPLE

Deep Purple, extra	Heliotrope
Royal Purple	Magenta

DECORATORS' DISTEMPER WATER COLORS

These are such colors as are used for graining and for wall decorating. They are finely ground, clear and bright. They were extensively used in past years for wall decorations, stencils and other ornamental forms in what was called fresco decoration.

These colors are ground in water and are thinned with water, adding glue or other binders. This is practically a calcimine proposition, although ordinary calcimines were made by the painter with dry whiting, cheaper dry colors, glue or casein and water. Distemper colors come in glass jars.

BROWNS

Cologne Brown	Raw and Burnt Umber
Raw and Burnt Sienna	Vandyke Brown

BLACKS

Ivory Drop Black	Lamp Black

BLUES

Antwerp Blue	Italian Blue
Azure Blue	Paris Blue
Chinese Blue	Prussian Blue
Cobalt Blue	Ultramarine Blue

YELLOWS

Chrome Yellow, light, medium and dark	Ultramarine Yellow
Dutch Pink	Yellow Ochre
Golden Ochre	

GREENS

Antwerp Green	Malachite Green
Chrome Green, light, medium and dark	Moss Green
Emerald Green	Neuwieder Green

Leaf Green
Lime Green
Olive Green

PURPLES

Ultramarine Violet

WHITES

Flake White (white lead)
Zinc White

REDS

American Vermilion, light and dark
English Vermilion, light and dark
Indian Red
Rose Pink
Turkey Red, light and dark
Tuscan Red
Venetian Red
Ultramarine Rose

LAKES

Carmine Maroon
French Maroon, Dark
Geranium Lake
Green Lake
Maroon Lake
Purple Lake
Rose Lake
Rose Madder

ARTISTS' COLORS

These are similar to decorators' oil colors and glaze colors—identical in most cases. They are put up in tubes and are used for all manner of decorative work by artists and decorators.

French Carmine
Rose Madder
Scarlet Lake

Madder Lake
Geranium Lake
Madder Carmine
Alizarine Crimson
Orange Vermilion
Scarlet Madder
Scarlet Vermilion
Pink Madder
Rubens' Madder
Carmine No. 2
American Vermilion
Madder Lake Deep
Harrison Red
English Vermilion
Rose Carthame
French Vermilion
Nopal Red
Rose Dore
Chrome Orange
Light Red
Venetian Red
Mars Red
Terra Rosa
Indian Red

Chinese Vermilion
Crimson Madder
Crimson Lake

Lamp Black
Blue Black
Ivory Black
Sepia
Asphaltum
Bitumen
Burnt Umber
Raw Sienna
Mars Brown
Flesh Ochre
Caledonian Brown
Bone Brown
Brown Ochre
Brown Pink
Raw Umber
Burnt Sienna
Vandyke Brown
Mars Orange
Nopal Orange
Chrome Yellow, No. 1-L
Chrome Yellow, No. 2-M
Chrome Yellow, No. 3-D
Indian Yellow
French Naples Yellow

Antwerp Blue
Permanent Blue
Prussian Blue
New Blue
Chinese Blue
Cerulean Blue
Indigo
Cobalt Blue
Ultramarine
Ultramarine Ash
Gray Tint
Payne's Gray

Naples Yellow, No. 1-L
Naples Yellow, No. 2-M
Naples Yellow, No. 3-D
Lemon Yellow
Strontian Yellow
Kings' Yellow
Citron Yellow
Cobalt Yellow, light
Cobalt Yellow, deep
Cadmium Lemon
Cadmium Pale
Cadmium Yellow

Cadmium Deep
Cadmium Orange
Perfect Yellow
Gamboge
Aureolin
Yellow Lake
Transparent Gold Ochre
Italian Pink
Zinc Yellow
Brilliant Yellow
Yellow Ochre
Permanent Yellow
Mars Yellow
Mars Violet
Cobalt Violet
Violet Carmine
Mauve
Magenta
Purple Lake
Purple Madder

Olive Green
Chrome Green, No. 1-L
Chrome Green, No. 2-M
Chrome Green, No. 3-D
Emerald Green
Veronese Green
Emeraude Green
Malachite Green
Oxide of Chromium
Viridian
Terre Verte
Cobalt Green
Permanent Green, light
Permanent Green, medium
Permanent Green, deep
Verdigris Green
Zinnober Green, light
Zinnober Green, medium
Zinnober Green, deep
Sap Green

Brown Madder

AUTOMOBILE AND SIGN PAINTERS' JAPAN COLORS

Although colors ground in Japan are used by decorators and furniture finishers to some extent, automobile, carriage and wagon painters use the bulk of these colors. Sign painters likewise use quite a quantity of Japan colors.

The name might suggest to some that these colors are made in the orient, in Japan, but that is not the meaning intended. They are colors which are ground in a special, quick-drying varnish for a binder and painters thin them with a volatile liquid (turpentine usually) which, when it evaporates, leaves a dead flat surface of color.

Colors ground in Japan are needed when tinting white enamel or varnishes. They are thinned to brushing consistency with turpentine.

The colors usually ground in Japan are these:

REDS

American Vermilion, Pale	Parisian Red
American Vermilion, Deep	Princess Louise Lake
Carriage Part Lake, Light	Runabout Red, Light
Cherry Red	Runabout Red, Deep
Cinnabar Red	Saginaw Red, Light
Insignia Red	Saginaw Red, Medium
Motor Car Red, Light	Saginaw Red, Deep
Motor Car Red, Medium	Tuscan Red
Motor Car Red, Deep	Tuscania Red

WINES AND MAROONS

Rich Maroon	Deep Wine

GREENS

Alpine Green	Emerald Green, Light
Apple Green, Deep	Liberty Green
Brewster Green, Light	Milori Green, Light
Brewster Green, Medium	Milori Green, Deep
Brewster Green, Deep	Napier Green, Light
Car Body Green, Double Light	Olive Green, Medium
C. P. Green, Light	Phaeton Green

C. P. Green, Medium
C. P. Green, Double Deep
Roumanian Green
Sage Brush Green, Light

BLUES

Alsace Blue
Annapolis Blue
Azure Blue, Light
Blue Devil Blue

English Violet
Holland Blue
Insignia Blue
Packard Violet
Peacock Blue
Prussian Blue
Rolls-Royce Blue

Car Body Blue, Light
Coach Blue, Light
Coach Blue, Deep
Coventry Blue

Suburban Blue, Light
Suburban Blue, Medium
Town Car Blue, Light
Town Car Blue, Medium
Town Car Blue, Deep
Ultramarine Blue
Violet Purple

BROWNS

Antwerp Brown
Beaver Brown
Beige Brown, Light
Beige Brown, Deep
Brussels Brown
French Brown
Golden Brown
Khaki Brown
Moleskin, Light
Moleskin, Deep
Mojave Brown
Olive Brown
Onondaga Brown
Packard Brown
Sienna, Raw
Sienna, Burnt
Umber, Raw
Umber, Burnt

YELLOWS

Cream Color, Light
Chrome Yellow, Light
Chrome Yellow, Medium
French Ivory
Old Ivory
Orange, Light
Orange, Medium
Orange, Double Deep

Italian Cream
Lemon Yellow, Pale
Permanent Yellow, Medium
Straw Color

BLACKS

C. P. Lamp Black
Coach Painter's Black
Drop Black
English Coach Black
English Drop Black
Ivory Jet Black

WHITES

Flake White (white lead)
Zinc White in Damar

GRAYS

Artillery Gray
Battleship Gray
Dustproof Gray, Deep
Fawn Gray
French Gray, Light
French Gray, Medium
French Gray, Double Deep
Gun Metal Gray, Light
Gun Metal Gray, Deep

GROUND COLORS

Azure Blue
Light Blue
Light Red
Deep Red
Rich Red
Medium Vermilion
Deep Vermilion
Deep Maroon

DAY TINTING COLORS

Painters and decorators use dry colors for putty, calcimine, special wall finishes, stains and other purposes. The above colors listed as ground in oil are practically all sold in dry form.

Following is a list of the dry colors and other dry pigments sold by painters' supply houses:

BLACK

Graphite
English Powdered Drop Black
American Powdered Drop Black
Swedish Black
1-lb and 25-lb packages and barrels

LAMP BLACK

Coach Painters', in 1-lb papers
Germantown, in 1-lb papers
Germantown, in ½-lb papers
Germantown, in ¼-lb papers
1-lb and 40-lb packages and barrels

GREENS

Union Chrome, medium or dark
No. 3 Chrome, medium or dark
Paris
Bottle Green
Bronze Green
Olive Green
1-lb., 25-lb. and 100-lb. packages

VENETIAN REDS

York Venetian Red
Craydon English Venetian Red
Regent English Venetian Red
1-lb. and 100-lb. packages

REDS

Red Lead in 25-lb. kegs
Indian Red, Super
Oxide of Red

Permanent Red
English Rose Pink
English Rose Lake
Turkey Red, Light, No. 2
Turkey Red, Deep, No. 3
English Vermilion, in 30-lb. bags, Light and Dark
Agricultural Vermilion
American Vermilion
Tuscan Red
Litharge
1-lb. and 25-lb. packages

LAKES, ETC.

Carmine, No. 40
Geranium, AA
Vienna
No. 16 Lake
1-ounce and pound packages

MINERAL PAINTS

French Gray
Zinc White Mineral
Metallic Brown, Prince's Shade
Dark Red Iron Paint
Prince's Metallic Brown
Red Iron Primer
Red Oxide
1-lb., 100-lb. and barrel packages

YELLOWS

C. P. Chrome Yellow, Light, Medium or Dark
Genuine Chrome, Light, Medium or Dark
Dutch Pink
1-lb., 25-lb. and 100-lb. packages

YELLOW OCHRES

Chrome Ochre, Light or Dark
Imported Golden Ochre
Imported French Ochre
Rochelle Ochre
1-lb., 25-lb. and 100-lb. packages and barrels

BROWNS

Vandyke Brown
Raw or Burnt Turkey Umber
Raw or Burnt American Umber
Raw or Burnt Italian Sienna
Raw or Burnt American Sienna
Bismark Brown (red)
1-lb. and 25-lb. packages

WHITES

Flake White (white lead)
Extra Gilders' Whiting, lump or bolted
Zinc, French Green Filler
White Primer
Silica
Dental Plaster Paris
Pure White Lead
1-lb., 25-lb. and 100-lb. packages and barrels

BLUES

Celestial Blue
Cobalt Blue
S. P. Prussian Blue
Soluble Blue
Ultramarine Blue, H. B.
1-lb. and 25-lb. packages

WOOD-FILLERS

Silver White Filler
Orange Mineral
Pure Silex (silica)
1-lb. and 100-lb. packages

BRONZE POWDER COLORS

The less expensive decorators' bronze powders come in grades designated as Pale or Rich Gold; Fine Pale or Rich Gold; Extra Fine Pale or Rich Gold; Superfine Pale or Rich Gold.

Then there is a grade of bronze powders which are more brilliant and finer in texture described as: Roman Gold; Koh-i-Noor Pale and Rich Gold; Hochglands Pale Gold; French Gold Leaf; Karet Gold Leaf, XX Deep; Vernis Martin.

Another grade, called colored metallics, is made for decorative artists, sign painters, window shades, wall paper, button and artificial flower manufacturers. The colors in this line are: Gold, Copper, Red, Dark Green, Light Blue, Crimson, Purple, Orange.

There is a grade known as Patent Bronzes which includes such colors as: Lemon, Fire, Crimson, Orange, Blue.

For less expensive decorative work a grade called specialty Bronze Powders includes such items as: Radiator Gold; Statuary Bronze; Handmade Lining and Striping; Aluminum A; Chemically Pure Aluminum; Aluminum Striping; Natural Copper.

COLOR VARNISH

These are rubbing varnishes made for the automobile, carriage and wagon painters. They contain very little color. Painters often make their own color varnish by adding a few ounces of color to a gallon of rubbing varnish. The color is thinned a little with turpentine and strained, then it is thoroughly mixed into the varnish and the whole mixture is again strained.

COLOR LACQUERS

These are quick drying varnishes bought in ready prepared form or mixed by decorators by adding bronze powder or other colors to clear wood lacquer.

Some of the poor grades of yellow ochre retard the drying of a paint film. They are inclined to retain moisture, and that characteristic promotes the growth of mildew in certain climates. The popularity of yellow ochre twenty-five or thirty years ago was eclipsed by the use of cheap grades of yellow ochres, because they contained moisture and did not anchor firmly in the pores of the wood. Much cracking and scaling of paints resulted. The use of real French ochre did not result in this condition, but the cost of this high-grade color was greater than the cheap ochres, and so it was not extensively used.

Raw umber has a rather large content of manganese, which makes it an excellent drying color; in fact, raw umber is used sometimes in the manufacture of liquid driers.

Lampblacks are made in so many different ways that it is difficult to determine upon examination just what quality a package contains. In the burning of oils or other substances to make lampblack, the introduction of too much air produces grayish blacks, and too little air results in a content of oil or volatile acid. When the burning process is forced too much, the resulting product is not only an inferior black, but one which contains both oil and acid in sufficient quantities to cause spontaneous combustion. This is a dangerous dry pigment to handle; it is slow-drying and likely to corrode metal surfaces because of the acid content. In other words, black paint made from such lampblack is apt to destroy metal surfaces which it is supposed to protect.

Gas and carbon blacks, which are sometimes added to good lampblack to increase tinting strength, are detrimental, not alone because they change jet blacks to brownish tones, but because they result in a separation of the pigment and the oil. Uneven, streaky black paint and muddy gray tints are also caused by these inferior gas and carbon blacks.

CHAPTER V
BASIC PAINT PIGMENTS

The term "paint" is broad in its meaning, and many mixtures for many purposes are called paint. The materials which are suitable for use by decorators and house painters as pigment bases for paints are limited to a comparatively small group, because such paints must possess good working qualities, opacity, permanency of colors, and general durability, as a rule.

What Is Paint?—Briefly, it is a mixture of basic white or colored pigments and tinting colors with oil, varnish, glue or casein binders, volatile solvent spirits and driers.

The purpose served by the basic white or colored pigments is that of covering, hiding and protecting a surface from decay, rust or abrasion caused by the elements—sun, rain, frost, snow, sleet and cold. By excluding moisture, paint performs its most valuable service on exterior surfaces. On interior surfaces paints are not needed as protection, but to give uniform color, texture and decorative value.

The purpose served by tinting colors is principally that of decoration, although in white paints made with pure white lead alone, colors have a tendency to harden the paint film and retard or prevent excessive chalking of the paint.

The purpose served by the binders is that of cementing the pigment and color particles together and to the surface. In outside house paints the binder is linseed oil; in interior paints and semi-enamels the binder may be linseed oil, varnish, glue or casein.

The purpose served by the volatile spirits such as turpentine, benzine or mineral spirits in paints is that of assisting the paint to penetrate into the pores of the surface more deeply and also to make the paint brush out more freely, especially in cold weather. These are solvents of oils, varnishes and resins.

Benzol, alcohol, amyl acetate and methyl alcohol are solvent spirits used principally in the varnishes, lacquers, enamels and specialty products used by painters, decorators and factory finishers on furniture, metal and all manner of manufactured products which are decorated or coated to gain protection.

All of these liquids evaporate more or less completely on exposure to the air.

The purpose served by driers in paints and oils is that of increasing the speed of drying and to produce a harder surface. The saving of time, permitting one coat to be placed on top of another within a reasonable time, and to cause the paint to dry before dust and clouds of insects accumulate on the wet surface, disfiguring it, are the principal purposes served by driers.

For years without number, painters have made outside paints from a mixture of white lead, linseed oil, turpentine and Japan drier for white paint; and for colored paints the same mixture plus tinting colors have been used.

For the last quarter century or so there has been much research and experimenting done to prove that a combination of pigments is better than white lead alone. From this has resulted the extensive manufacture of prepared house paints called ready mixed paints. The higher class prepared paints of today are rendering good service, and there are many technically minded men who believe that a combination of basic paint pigments is better than any single pigment, their idea being that the strength and weakness of each of the principal pigments differ, and that by combining two or more of these pigments in suitable proportions, the virtues of all are gained and the weaknesses of all are overcome.

Most paints are made with a white pigment base as the major item, although very dark colors—the blacks, dark greens, browns and reds—are mixed without white pigments and from a color pigment alone, or from a mixture of two or more color pigments. Some of these dark colored paints are among the most durable paints known. For example, the great popularity of the red barn on American farms, box cars and railroad cars, was the result of the fact that real venetian red and good linseed oil made about as serviceable and economical paint as was known. Today the non-fading quality of venetian red is not always present, because some of these dark reds are not earth pigments like the original venetian reds, nor well made chemical venetian reds, but, rather, are made by coloring white inert pigments with aniline colors to match venetian reds. No deception is intended, usually, and the manufactured reds are marketed under private brand names for what they are.

The black and the brown earth pigments also make very durable paints.

Before instruction in mixing of colors and paints can be given, a brief description of the basic paint pigments is essential. There is much of interest to be written about each of the principal pigments, but to go into the technical qualities and manufacture of each pigment would in itself constitute an extensive book. So only the outstanding characteristics of each paint pigment is proper in this work.

White Lead.—First mention is given this venerable white pigment because it has been the backbone of the paint industry for over two hundred years. Its good qualities are legion, and when it comes to mixing white paint for exterior surfaces it has no real competitor in its combination of essential qualities.

White lead is made by several manufacturers and by two principal processes—one, the Old Dutch process; the other, the Carter process. The former makes lead in from ninety to one hundred days; the latter makes it in about twelve days. There is little choice as between the products of both processes as to serviceable qualities. In the matter of whiteness the Carter process will, on an average, produce whiter lead. In the matter of texture, fineness, opacity (hiding power) and uniform composition there is little choice.

White lead is the most opaque white pigment known to chemistry for exterior painting. All high-grade white and light-colored paints for exterior use contain a large amount of white lead—from 60 to 80 per cent, to be more specific.

While white lead possesses most of the desirable qualities of good paint, it has one weakness; namely, it makes a paint that is a little too soft, one which chalks or dusts off the surface after a couple of years when white paint is used. This peculiarity can, however, be easily overcome by the addition of from 10 to 15 per cent of zinc oxide to the paint to make a little harder film. In some localities, notably along the sea cost, the tendency of white lead paint to chalk is greater, and the addition of from 20 to 25 per cent of zinc oxide is made by some painters.

Zinc should never be used in the priming, or under coats;—use it only in the last coat. If too much zinc is used and if it is put in to the priming coat there is some likelihood that the paint will crack and scale off, because the film becomes too hard and brittle to expand and contract with the surface during temperature changes.

The use of a moderate amount of tinting colors with white lead paint to mix tints and shades retards the chalking.

The ideal in paint mixing is to make a film which will be hard enough to avoid chalking and soft or elastic enough to avoid cracking and sealing. It is better, of course, to have a paint chalk than to have it crack and scale, because a chalking surface is ready to be repainted any time, while a cracked and scaled paint must be burned and scraped off and that proves rather expensive.

White lead is a natural drying pigment. It combines readily with linseed oil and has the desirable brushing and sanding qualities looked for by decorators and painters.

White lead can be secured in dry powder form, but it is more commonly used as a thick paste which is composed of 92 per cent white lead and 8 per cent linseed oil.

Sublimed white lead, which is a basic lead sulphate, is accepted in government specifications as equal to basic carbonate white lead.

White lead is manufactured from three principal elements—lead metal, acetic acid (vinegar) and carbonic acid gas. No matter what process is used, the same raw materials enter into the manufacture of white lead. In other words, pure white lead is the result of the action of acetic acid and carbonic acid gas on lead metal. The lead metal is corroded into a white powder by the action of acetic acid and carbonic acid gas, and the fine white powder is then ground with pure linseed oil to a thick paste and is ready for the painter.

One of the interesting and useful peculiarities about white lead is that the pure pigment as it is marketed can be reduced or returned to the metallic form by fire. A piece of white lead paste as large as a nickel will reduce to a bit of lead metal about as large as an ordinary pea when placed on a charcoal block and subjected to the heat from a blow torch. The test is infallible. If the lead has been adulterated to any appreciable extent it will not reduce the lead metal.

You can cut a splinter about the size of a match from a house painted with pure white lead twenty years ago, hold a match under it, blow it gently to increase the heat, and you will notice little beads of bright lead metal forming. In the same manner a little white lead paste from a keg put on the head of one match and burned with another match will reduce to beads of metallic lead.

Coach and Car Lead.—This is a white lead manufactured for many years and used by carriage and wagon painters. It is very fine and is ground in refined, bleached linseed oil. It dries hard and sandpapers without gumming. It possesses the characteristics in general with pure white lead.

Flake White.—This pigment is a pure carbonate of lead (white lead) made for artists, decorators and factory furniture finishers. The dry white lead is sifted to secure the very finest texture. The lead is ground and reground with refined, bleached linseed oil, which makes it dry hard and rapidly and to sandpaper without gumming. Flake white is marketed in the dry form and ground in oil.

Flake white is sometimes called Cremnitz white, blanc d'argent and silver white.

Zinc Oxide.—Zinc oxide is used extensively by painters and decorators and has most commendable characteristics. It is probably the finest in texture of all white pigments, and the whitest.

Zinc is used to a very great extent in the making of white enamels and the manufacture of enamel undercoats. Zinc, being very fine, is great in bulk—it occupies about 50.77 cubic inches to the pound, while a pound of white lead in the same condition occupies 14.69 cubic inches. The extreme fineness of zinc causes it to require more oil in mixing a paint ready for the brush than is needed by any other white pigment.

The mixture of colors and other pigments with zinc oxide does not affect the latter in the matter of chemical reaction, and gases present in the atmosphere do not affect it.

The weakness of zinc comes from the fact that, when used alone as the base for exterior paint, it makes a film which is too hard and brittle and which may crack and scale off in consequence of the expansion and contraction of the surface during temperature changes. This brittleness is overcome by the addition of white lead or other pigments to zinc.

Oxide of zinc is manufactured by two processes—one called the American process and the other the French process. Briefly, oxide of zinc is made from zinc metal which has been burned in a furnace, and it is the product of combustion. In the burning process the zinc metal is vaporized and drawn off to collecting chambers where it is deposited in the form of a very fine white powder.

Zinc is one of the most valuable pigments among decorators' and painters' materials, and while it is not as opaque as white lead, lithopone and titanium oxide, nevertheless it has its peculiar advantages. It is used successfully with colors which cause unfavorable chemical reactions on white lead and other pigments.

As a rule colors mixed with zinc oxide for a white base will be clearer and brighter than when mixed with other white pigments.

Titanium Oxide.—This is a new white pigment for exterior and interior painting in which considerable interest has been shown of late. It is produced from an ore which is rather widely distributed throughout the world.

The claims made for titanium oxide are that it has greater opacity, or hiding power, than any other white pigment when mixed with linseed oil, and that, while it will chalk when used alone as the pigment for an exterior paint, excellent results come from combining it with zinc oxide. The proportion recommended is about 20 percent zinc oxide to 80 per cent titanium oxide. This new pigment has been tested for several years, and when repainting is necessary, the surface has been found to be in excellent condition. The paint is not affected by gases and does not darken on exposure.

The bulk of titanium oxide is used by paint manufacturers in combination with other pigments to make up prepared materials. Paste paints for use on exterior work and also white enamels made from titanium oxide are now available on the market.

Lithopone.—This is a very white and very opaque paint pigment which is a compound of barium sulphate (blanc fixe) and zinc sulphide. The very dense white and hiding power of this pigment makes it valuable as the base for most of the flat wall paints which are used extensively. It is also used in manufacturing processes for painting purposes;—the painting of window shades is a notable example of the use of lithopone.

Lithopone in ordinary grades turns gray when exposed to sunlight, but recovers whiteness when placed in the dark. In the higher classes of lithopone the material retains its whiteness when exposed to light.

Whiting.—This is calcium carbonate and appears on the market as a bolted whiting for ordinary purposes such as making putty and as Cliff Stone and

Paris white and gilders' whiting in finer grades.

Whiting is a fine white powder, the product of limestone which has been crushed and graded by floating off the fine chalk in water. The fine chalk pigment, after being separated from the coarse rock, is dried and then is ready for the decorator and painter.

Whiting is the principal base for calcimine. Plaster of Paris, which is sulphate of lime, is a kindred product and is used by decorators in filling cracks in plaster walls.

Silica (*Silex*).—This is a product obtained from crushing rock crystals, quartz, sand and flint into a fine powder form.

The principal characteristics of silica are its great hardness and the fact that it is inert, having no chemical reactions on any other pigments, colors or oils with which it is mixed. In the dry powder form it is rather white, but on being mixed with an oil it changes to a yellow sand color. As the particles themselves are colorless, they take on the color of the oil with which they are mixed. The use of silica by the painter and decorator is largely in the form of paste wood fillers. Small quantities are used in undercoats of wall paints to give them a "tooth" which will make the second coat of paint hide the surface better, because more pigment can then be retained on the surface without running, sagging and wrinkling. Manufacturers use silica in the making of prepared paints because of this same characteristic.

Barytes.—This is a white pigment which is found as a natural product the world over and usually with lead and zinc metal ores. It is prepared for the paint trade by grinding and the separation of the impurities by an acid bath and water washing.

Barytes is a stable product chemically and does not set up chemical reaction with any of the materials with which it is mixed. This character of being inert has made it the most popular base upon which chemical colors are made. Barytes is practically colorless, so takes on the color of whatever substance it is mixed with. It can be used to dilute strong colors without modifying their tone.

Barytes is not used by the painter as such, but has long been used by manufacturers, both in color making and paint making, and authorities claim that it actually increases the durability of paints.

Asbestine.—This is a product of asbestos which does not come to the painter as such, but is used in the manufacture of prepared paint because it is very light and fluffy. Its particles are rather long and narrow fibres, rather than round, and it is used as sort of a reinforcement in paints just as hair is used in plaster. Its other prime purpose is to help hold the paint pigments in suspension in the liquids. Some paints have a tendency, when sealed up in cans and allowed to stand on the dealers' shelves for a long time, to settle to the bottom of the can. The asbestine, as stated, has a tendency to keep the paint pigment in solution.

Red Lead.—This is a brilliant red pigment made by melting lead metal in a saucer-shaped kettle. When the lead is held in a metal solution for a certain time it takes up oxygen from the air and forms first a light yellow powder pigment which is litharge. More time and heat change the litharge to a brilliant red which is red lead. If the heat is maintained and the red lead subjected further to oxygen from the air it changes to a very brilliant red called orange mineral. Orange mineral is more commonly made by roasting white lead.

Litharge and all of the lead oxides of this class are excellent driers and are used in making Japan drier.

Red lead is used by the painter principally as the first coat when painting metal surfaces, for which it has great virtue. Red lead comes to the painter in dry form and also in the form of thick paste which is ground in linseed oil.

The brilliant color of red lead fades and gradually becomes lighter. As a color it has little value, but the fading of the color does not impair the durability of the paint or its ability to protect a surface.

Graphite.—The other names for this paint are black lead and plumbago, and its principal use is as a paint for metal surfaces.

Graphite is a carbon which is mined from the earth like lead and zinc ores. Graphites are decomposed stone which may contain as much as 90 per cent iron. The process of making this mined product ready for the market consists of mining, cleaning to separate the impurities, and grading of the soft, dry pigment which is secured in that manner.

Graphite has a great many uses in addition to its value as a metal paint. It is used for making lead pencils and as a lubricant for machinery. For the latter purpose the graphite is mixed with grease.

Graphite varies in its black color and has a metallic sheen, but is always very dark, which limits its use as a paint. As a protection for a surface it is very durable. In mixing paint from graphite a little silica is added along with linseed oil, and then you have a paint that is extensively used for the painting of machinery, metal roofs, structural iron bridges, and many other metal surfaces.

Bronze Metal Powders.—These pigments were described in Chapters II and IV, with a special reference to the color phase. In addition, it may be of interest to add here that the bronze pigments are made by beating up and grinding such metals as copper, brass, zinc and aluminum. In reducing them to pigment form it is simply a physical change from metal bars, or ingots, to thin metal sheets which are ground to fine powder form. These pigments are simply powdered metals.

The many grades of bronze metal powder range from Number 1000, which is a bit coarse for making paints such as are used on radiators and machinery, to 6000, which is a fine grade suitable for decorative purposes. Number 10,000 is the finest grade made.

The brilliancy of bronze metal pigments becomes dull when exposed to free circulation of air for any length of time. The brilliancy of the metal can be retained, however, by coating the surface with a thin varnish or lacquer.

For exterior work, aluminum bronze when varnished holds its brilliance well, but for gold finishes on the outside, real gold leaf is used instead of bronze gold powder.

The bronze powders come in many brilliant colors as described in Chapter IV. They are prepared in dry powder form and are put up in one-ounce paper packages and in tin cans. See Chapter VI for bronzing liquids.

Painter-Made Ready-Mixed Paints.—At some time or other most painters and decorators wonder why they cannot make their own ready-mixed or prepared paints and save some money. They learn that formulas for these materials contain such inert pigments as silica, barytes, whiting, asbestine or magnesium silicate; they note that prices on inert pigments are much less than for white lead and zinc, and wonder why they cannot make cheaper paints than they can buy from manufacturers.

This is a logical line of thought, but the whole story of what such attempts involve is not at all apparent on the surface. In the first place, manufacturing of paints deeply involves chemistry; not chemistry in theory as most of us learned it at school, but manufacturing chemistry in all its ramifications. The combination of certain pigments, colors, oils and spirits thinners in theory may look easy enough on paper, but the question of securing an adequate supply of raw materials of suitable quality at the right prices enters. The purchase of carload quantities and large investments are often involved.

Next, the whole problem of adequate and correct machinery and equipment comes up. Then, it is not at all difficult to see how a considerable investment is essential. And if a satisfactory solution of these two considerations were found by the painter, he would then be only making a beginning on the making of high-class prepared paints.

The knowledge of how to do it is probably the most important angle. A great many men with professional chemistry training have tried to make good paints, and a considerable proportion have failed. It is not an easy undertaking to master. The making of high-class ready-made paints is a manufacturing undertaking of major importance, not a simple side line which can be taken on by craftsmen without experience and training in this field. An intimate knowledge of the characteristics, the chemistry and sources of supply of basic materials, as well as manufacturing facilities, are essential.

The following brief outline of the composition of high-class prepared paint will indicate the magnitude of this undertaking:

You can make high-class paint from white lead alone as the basic material by simply adding colors and thinners. You can do likewise with zinc oxide. The weakness of white lead used alone as paint is commonly stated as that of chalking. After two or three years of service white lead paint begins to powder or dust off of the surface. In other words, it wears out in that manner. It does, however, leave a surface in perfect condition for repainting.

Zinc oxide used alone as a paint pigment has the fault of being too hard and inelastic to accommodate itself to the expansion and contraction of surfaces during temperature changes. It wears out by cracking and scaling. Then the old paint must be burned and scraped off before the surface is safe to repaint.

By mixing together these two basic paint pigments in about the proportion of 15 per cent of zinc to 85 per cent of white lead you overcome the defects of each pigment and gain the virtues of both, according to the reasoning of many men in the paint industry.

The ready-mixed paint manufacturers base their formulas upon the theory that the addition of certain inert pigments reinforces a paint made with white lead and zinc and makes even a better paint. It is their thought that a judicious mixture of paint pigments makes a more stable chemical compound and durable paint than the use of any single pigment can provide.

There are many who agree that the mixture of lead and zinc in the proportion of about 60 per cent lead to 40 per cent of zinc, plus a small percentage of inert pigments, makes the best prepared paints for average surfaces. The white lead may be all carbonate of lead, or part sublimed lead.

The inert pigments, it is thought, should be made up in these proportions:

Five per cent asbestine (magnesium silicate); used to keep the total pigment in suspension in the liquid. Asbestine particles are elongated in shape, not round. The theory is that because of their shape they bind the paint pigments together like hair in plaster.

Two and one-half per cent of inerts. It is thought that this should consist of calcium carbonate (whiting) used to offset acidity in linseed oil which may develop when paint is sealed up in a can.

Two and one-half per cent of water-floated silica (silex) is used by some on the theory that it gives "tooth" to paint, helping the first coat to anchor itself in the wood pores and the second coat to lodge itself on the first coat, retaining enough pigment to hide the surface and avoid running, which occurs when an excess of pigment is put on to the surface.

A standard formula for high-class prepared paint, then, might be stated as follows: White lead, 55 per cent of total pigment; zinc oxide, 35 per cent of the total pigment; inert pigments, such as asbestine, calcium carbonate and silica, as 10 per cent of the total pigment. The balance of the paint mixture to be made up of pure linseed oil, turpentine or high-class mineral spirits and drier plus color pigments.

CHAPTER VI
PAINT OILS

Leading up to the mixing of colors and paints, we have described the various colors and the principal basic paint pigments. Before we are ready to begin the mixing operations, it is essential that a study be made of the liquids which are a part of the paints.

There are quite a number of drying oils known to chemistry and the manufacturing field.

The outstanding oil which has greatest utility and value is linseed oil, which comes to the painter and decorator in several forms, such as raw, boiled, refined, bleached and what are called special oils. The other drying oils in common use are poppy-seed oil, China wood oil (tung oil), nut oil, parella oil, lumbang oil, sunflower-seed oil, and a fish oil under the name of menhaden. There are other oils now going the rounds of chemical laboratories, but their commercial values have not been established.

Painters and decorators need concern themselves with none of these oils except linseed, poppy-seed and, possibly, China wood (tung) oil. Linseed oil is used almost exclusively for exterior paints and, in small quantities, as the binder for interior paints. When used in white paints for interior decorating, linseed oil is likely to turn yellow, but will bleach out white again when subjected to strong light. Poppy-seed oil and nut oil are used with artists' colors for pictorial painting and for some other special paints where the quality of extreme whiteness is valuable. China wood oil is used chiefly in the manufacture of certain kinds of varnish and flat wall paints for interior use. The balance of the drying oils are used for special purposes by manufacturers in the making of paints which require peculiar quality; for instance, fish oil will withstand a great deal of heat, when mixed with a paint, without causing the paint to blister. Fish oil, therefore, is valuable for use in paint to be used on engines, smokestacks and radiators, which are subjected to high temperatures.

There are some other oils classed as semi-drying oils which painters and decorators hear about, but which are of no use to them in their natural state. These oils are corn oil, cottonseed oil and soya-bean oil; all are classed as vegetable oils. They are used by manufacturers to some extent for admixture with linseed oil and driers in the grinding of paste paints and colors.

The use of a drying oil in paint mixing serves several purposes. In the first place it takes dry color and basic paint pigments and changes them to the liquid state; then an oil makes it possible to spread the pigments to a uniform depth over the entire surface; the oil binds the pigment particles together and to the surface; and lastly the oil gives the paint pigment a gloss finish when linseed oil is used and a flat, or semi-gloss, finish when China wood oil is used.

Linseed Oil.—This is the most extensively used paint oil, not only because of its valuable characteristics, but because it is obtainable in abundant quantities at moderate prices wherever flax is grown. The abundance of linseed oil naturally keeps the cost down to a moderate figure. It is generally understood the world over, and consequently uniformly good results are secured from its use. Linseed oil is, of course, used extensively in the making of soap, linoleum, and in many manufacturing processes where all manner of merchandise is made.

It is interesting to note that linseed oil and most of the drying oils become dry from the outer surface inward. They absorb oxygen from the air. In the case of linseed oil, the oil film actually weighs more after it becomes dry than when it was wet on the surface.

China wood (tung) oil is an exception in its manner of drying, since it appears to set or harden simultaneously, like cement.

It is well for painters and decorators to avoid the use of any of the drying oils except linseed oil, and possibly poppy-seed and China wood oil in case of artists and decorators, unless they are technically minded and will conduct such experiments as will teach them the properties and actions of the other oils for special purposes.

The manufacture of pure raw linseed oil is accomplished by crushing flaxseed, known to some as linseed, between large steel rollers in mills constructed especially for the purpose. The oil is squeezed from the seed, allowed to settle and age in order to remove the mucilaginous matter which settles to the bottom of the tanks. The longer the oil is aged, the better; but in the modern process of manufacture most of the mucilaginous matter, called foots, is removed by filtering the oil while it is hot.

Raw linseed oil is, as its name implies, a rather crude raw product, and when used in paints must have a drier added to it, usually, to make the paint dry rapidly enough during cool and damp weather. As a matter of fact, on outside painting it is customary to add drier to raw linseed oil in any weather, although during hot, dry seasons the oil will dry without the use of Japan drier. There is always some risk that the paint will dry too slowly without driers to avoid the accumulations of dust, small flies or gnats in swarms.

Boiled linseed oil is much to be preferred to raw oil when you can secure one of the brands made by a reputable manufacturer. The average manufacturer considers raw linseed oil simply as a commercial product, a commodity, which must be made within certain standards of purity, to be sure; but boiled linseed oil is made with pride and especial care to give maximum results in drying and brushing qualities as well as in the matter of durability.

A great many painters have steadfastly bought pure raw linseed oil because it offers less opportunity for unscrupulous manufacturers to cover up adulteration; it is more difficult to detect the addition of dope oils to the boiled linseed oil. However, it is a better buying policy to secure high-class boiled linseed oil from a manufacturer of good reputation who makes advertised brands. Such an oil is an institution with the manufacturer and he takes pride in setting up and maintaining a high standard of quality in his boiled oil. He makes an oil of uniform quality, doubly filtered and free from moisture and foots. With that kind of an oil, painters and decorators will get better results, have fewer painting problems, and even though the oil costs a few cents a gallon more than if raw oil were used, it will be a better investment.

The mucilaginous matter, or foots, found in linseed oil is a substance which may appear in even the best filtered and prepared oil, because it is a substance formed by changes of temperature and it comes entirely from the oil itself. In other words, the best of care known to manufacturers may be exercised in the manufacture of a pure linseed oil, either raw or boiled, and yet if the barrel is subjected to many or extreme changes of temperature after it leaves the factory, the painter may find a considerable quantity of foots in the last few gallons drawn from the barrel. Foots do not constitute adulteration of the oil, and when they occur they can be returned to the reputable manufacturer and exchanged for clear oil without cost to the painter.

In brands of high-grade boiled linseed oil most of the foots have been removed by heating, chilling and filtering. The oil when it leaves the factory is entirely suitable for painting purposes. It is possible and practical to completely remove all foots from linseed oil; indeed, that is regularly done with oils made for special manufacturing purposes. It requires a rather elaborate chemical process to remove all foots, and that makes the oil cost eight or ten cents per gallon more. For ordinary painting purposes there is no advantage in removing every trace of foots from the oil; at least, it is not worth the extra cost, generally speaking.

If the painter will just be alert and not use any of the thick oil from the bottom of an occasional barrel containing foots, he will experience no difficulty. If this oil is used by a careless workman it may retard the drying of the paint, causing it to remain soft and tacky for a long time. Then it may become discolored by accumulations of dust or insect swarms.

High-class boiled linseed oil is made by filtering and heating the raw oil in large tanks to 240 degrees of temperature. This is to eliminate the moisture. Then high quality drying substances, such as manganese, red lead, litharge, raw umber and cobalt driers are added while the oil is still hot to thoroughly incorporate them. After this the oil is cooled down and thoroughly filtered. The oil is not actually boiled, as the name would indicate, as that would require raising the temperature to 600 degrees of heat. Such a high temperature will cause the oil to become thicker and darker in color. For all practical purposes raising the temperature to 240 degrees is sufficient to eliminate the moisture.

There is reason to be cautious in buying boiled linseed oil from any but the well known and firmly established manufacturers, because there has been a practice indulged in by some paint jobbers and others of making so-called linseed oil which has not been high-grade material. This material has gained the name of bunghole boiled oil, because it has been the practice of these firms to buy barrels of pure raw linseed oil, draw out a few gallons through the bung-hole and replace the pure linseed oil with driers of their own making. In some instances adulterated oils have been put into the barrels because they were cheaper. This is bound to be inferior oil, even when these men start with pure, raw linseed oil and have no intention of doping it. They have not adequate manufacturing facilities to make good boiled linseed oil, and even if good driers were added they would not be thoroughly incorporated when put into the barrel in this manner with the cold oil. In other words, to make the oil right they would have to remove it from the barrels, heat and filter it and thoroughly incorporate the driers. They are not equipped to do that.

When the makers of bung-hole boiled oil add cheaper oils, like deodorized fish oil and mineral oil, to pure linseed oil in order to increase their profits, the painter is likely to have considerable trouble with his paints because they are slow drying or remain soft and tacky indefinitely. In the ease of white paints the adulterated oils may cause the paint to turn yellow.

For general painting purposes outside, there is no successful substitute for pure linseed oil known to chemistry today. Authorities on the subject of paint oils have looked diligently for a cheaper oil than linseed oil and one that would be just as good or better. They have not found one available in sufficient quantities up to this time. When such an oil is found, and has been proven by a few years of testing to be equal to the job, you will hear all about it from the paint trade in general and the reputable manufacturer. There are offered to you from time to time paint oils which are claimed to be equal or superior to linseed oil. Some of these oils have fancy names which are likely to deceive unless you are alert. Some such names as improved linseed oil, linseed oil compound, Manchurian linseed oil and some others have been put upon the market, only to have short careers because of their adulterated nature.

As a general proposition, paint oils offered as a substitute for linseed oil for outside house paints are valuable only in proportion to the amount of pure linseed oil they contain. Usually their cost is only a few cents per gallon less than linseed oil and, of course, it is claimed for them that they are better than linseed oil. You will, however, be money ahead to let somebody else do the experimenting to prove or disprove the claims for these oils. At best you could save only a dollar or two on the average job by using questionable oil, and if a job goes wrong it may cost you fifty to one hundred dollars to do the work over again to satisfy your customer.

To the average painter or decorator pure linseed oil is all alike, but as a matter of fact there are differences, even though the prices are all about the same. It is therefore a wise policy to select a brand of boiled linseed oil of known quality made by one of the manufacturers who has an acknowledged reputable standing in the trade, and therefore secure oil which is uniform in quality from the beginning of the year to the end. You will do your mixing of paint after certain set formulas which you may have in print, or simply in your head from long practice, and it is obvious that any formula will give you better results if the basic materials specified in the formula are always of the same quality as to the small content of foots, uniform color and absence of moisture. There is some ground for doubting that painters can mix as durable or as uniform paint oil by using pure, raw linseed oil and Japan drier as is produced by manufacturers of high-class boiled linseed oil. By using boiled linseed oil you avoid the risk of having careless workmen adding too much drier to your raw linseed oil, thus wasting the drier, which is expensive, and injuring the paint. Of course, Japan drier should always be measured before adding a quantity to your paint, but it is only human for a painter to guess at it. If he has good judgment, guessing is all right, but many workmen are careless about this.

It should be perfectly obvious, of course, that where there is any question about the high quality of the boiled linseed oil at hand it is much better to use pure raw oil with the addition of good Japan drier.

The preference for raw or boiled linseed oil will be found to vary considerably in different parts of the country. Something more than half of the total amount of linseed oil in the United States is boiled. In some sections almost 100 per cent boiled oil is used, while in others raw oil is used in the largest proportion, depending somewhat upon habits and training of the painters.

There is just one certain way to secure a dependable linseed oil, either raw or boiled—that is, to buy from one of the reputable manufacturers of such products. Following is a list which is complete as far as careful investigation has made it possible to print of the manufacturers of pure linseed oil. There are no dependable tests for determining the purity of linseed oil which can be used by the amateur. The tests which are dependable require the services of a chemist and his laboratory. In several states laws have been enacted which require manufacturers of linseed oil to attach labels to the barrels, or cans, which read "pure linseed oil." Such a label, which carries the name of a reliable manufacturer and his address is assurance in these states that the oil is pure.

American Linseed Company's Brands—American Linseed Co., New York, Boston, Chicago, St. Louis; Archer & Co., St. Paul, Minn.; Campbell & Thayer, New York City; Cleveland Linseed & Oil Co., Chicago and Cleveland, O.; Close Linseed Oil Works, Iowa City, Iowa; Crown Linseed Oil Works, St. Louis, Mo.; Dean Linseed Oil Co., New York City; Des Moines Linseed Oil Works, Des Monies, Ia.; Detroit Linseed Oil Works, Detroit, Mich.; Douglas & Co., Minneapolis, Minn.; Douglas & Co., Cedar Rapids, Ia.; Evans Linseed Oil Co., Indianapolis, Ind.; Hawkeye Linseed Oil Works, Marshalltown, Ia.; Kansas City Lead & Oil Works, Kansas City, Mo.; Kellogg & McDougal Linseed Oil Works, Buffalo; Metzger Linseed Oil Co., Toledo, Ohio; Portland Linseed Oil Works, Portland, Ore.; Sioux City Linseed Oil Works, Sioux City, Ia.; Topeka Linseed Oil Works, Topeka, Kan.; The Metzger Linseed Oil Co., Chicago; The Toledo Linseed Oil Co., Toledo, Ohio; The Griswold Linseed Oil Co., Warren, Ohio; The W. P. Orr Linseed Oil Co., Pigua, Ohio; Woodman Linseed Oil Works, Omaha, Neb.; Wright & Hills Linseed Oil Co., Chicago, Ill.; Wright & Lawther Oil & Lead Mfg. Co., Chicago.

H. H. Clark's Brands—Pioneer Linseed & Lead Co., Kansas City, Mo.; Clark's Owl Brand Linseed; Decatur, Ill., Linseed Oil Co.; Mendota, Ill., Linseed Oil Co.

National Lead Co.'s Brands—"Armstrong & McKelvey," "Atlantic," "Collier," "Kentucky Lead & Oil Co.," "John T. Lewis & Bros. Co.," "National Lead & Oil Co.," "Southern," "Dutch Boy."

Alston Mfg. Co., Chicago.
Archer-Daniels-Midland Co., Minneapolis.
R. B. Brown Oil Co., St. Louis, Mo.
George W. Blabon Co., Philadelphia, Pa.
Chicago White Lead & Oil Co., Chicago, Ill.
Crescent Linseed Oil Co., Chicago, Ill.
Euston & Co., Chicago, Ill.
Grove Linseed Oil Co., Philadelphia, Pa.
Hauenstein & Co., Buffalo, N. Y.
Hirst & Begley Linseed Works, Chicago.
Kelloggs & Miller, Amsterdam, N. Y.
Lyster & Co., Fredonia, Kan.
Mann Bros. & Co., Buffalo, N. Y.
Metzger Seed & Oil Co., Toledo, O.
Spencer Kellogg & Sons, Buffalo, N. Y.
Minnesota Linseed Oil Co., Minneapolis, Minn.
Northern Linseed Co., Minneapolis, Minn.
O'Brien Varnish Co., South Bend, Ind.
H. L. Pope & Co., Dayton, O.
Red Wing Linseed Co., Red Wing, Minn.
Sherwin-Williams Co., Cleveland, O.
Thompson & Co., Allegheny, Pa.
Amsterdam Linseed Oil Works, Amsterdam, N. Y.
Ankeney Linseed Oil Co., Des Moines, Ia.
Fredonia Linseed Oil Works, Fredonia, Kan.
Northwestern Linseed Oil Works, Minneapolis, Minn.
W. P. Orr Linseed Oil Co., Cincinnati, O.
Pacific Oil & Lead Works, San Francisco, Cal.
Wm. O. Goodrich & Co., Milwaukee, Wis.
Bisbee Linseed Co., Philadelphia.

Perilla Oil.—Produced from seeds of perilla which grows in China, Japan and India. While it is a drying oil and appears in the American market in a very limited way, it is not used in a commercial way in the paint industry. Tests made of this oil by the American Society for Testing Materials and the Paint Manufacturers' Association resulted in its being considered superior to linseed oil by some. Perilla oil is considered of a high commercial value as a paint and varnish material in the Orient. The cultivation of the plant is being introduced into the United States.

China-Wood Oil (Tung).—The use and popularity of this oil has increased greatly in the last ten years, and while the decorator and painter do not come in contact with it often as an oil, they do use vast quantities of it as part of interior flat wall paint and varnishes.

From China-wood oil a varnish is made which dries flat and is the principal liquid of flat wall paints. Although this oil is not extensively used in paints for general purposes, it may be so used in the future. It is used in making marine paints today, because of its ability to withstand the action of salt air and salt water.

China-wood oil comes from the Orient and is made from nuts of certain trees. Unlike most oils, it dries with a flat, waxlike appearance and is not transparent when dry. It has an odor which is not forgotten easily, though it is not unpleasant. This oil is not used in its raw state, but is usually cooked with resins or such drying substances as manganese, lead oxides, red lead, litharge or cobalt, and then thinned with turpentine or mineral spirits. The cooking causes China-wood oil to dry with a gloss, rather than the flat appearance of the raw oil. This oil is used in the making of some excellent varnishes.

Soya-Bean Oil.—A vegetable oil made from soya beans, grown extensively in Manchuria and Korea, and to some extent in the United States as animal feed. Soya beans belong to the same family as the ordinary pea and bean. This oil dries very slowly and makes a soft film. The cost of it is low compared to linseed oil, and it is, therefore, used sometimes to adulterate linseed oil. Soya-bean oil is in rather general use by manufacturers in the paint industry for prepared materials, but is not used by painters and decorators as a raw oil. Chemists say that as much as 25 per cent of soya-bean oil can be added to linseed oil for painting purposes without injury to the film. Certain colors ground in soya-bean oil appear to be more satisfactory than when ground in linseed oil.

Menhaden Oil.—Produced from menhaden fish, mostly. Considered a drying oil and recommended by the chemists for use in smokestack paints and for paints subjected to moist, salt air. It will not blister the paint on hot surfaces.

Kerosene and Petroleum Oils.—Except benzine, these oils serve no good purpose in paints used by the painter and decorator, as they are non-drying liquids. They are used for certain special metal paints where a small quantity of these oils is needed to retard the hard drying of the paint, but they should be used only by expert manufacturers who know exactly what to do and how.

Kerosene used by painters and decorators is quite certain to cause trouble with tacky paint. It will turn white paint yellow. Some marine painters claim to have used kerosene successfully on wood boats, but it is more than likely that they had more luck than good sense in the work.

Creosote Oil.—An oil distilled from coal tar and which is heavier than water. It is also called heavy oil and dead oil in some industries.

Its outstanding value is as a preservative of wood, and so it is best known as a base for shingle stains.

The odor of creosote oil is a strong characteristic and one not likely to be forgotten easily.

When not carefully refined for use in stains, creosote oil is apt to throw down a sediment in cold weather. This settling or separation of color and liquid can be overcome when the manufacturer exercises due care in chilling and filtering the oil before permitting its use in stains.

Flatting Oil.—About the time special flat wall paints appeared on the market there appeared also special oil compounds called flatting oils.

These oils are made for use by painters when they wish to mix their own flat wall paints, using white lead, zinc and tinting colors for the purpose.

Flat wall paints mixed in this way hide the surface well, flow out, level up, and have good brushing qualities and dry with a beautiful flat luster. Such a surface is washable and, of course, the paint can be tinted any color needed to execute an individual color scheme.

Flat Mixing Varnish.—This is a type of thin varnish suitable for mixing with certain paint pigments for making flat wall paints which dry without gloss, with a dull luster and a washable surface. Flat mixing varnish may also be used in mixing enamels and enamel undercoats, but is not generally distributed except in quantity or on special order. Used chiefly by manufacturers.

Floor Oil.—This is simply a mixture made by decorators and manufacturers of drying oils and spirits for use in oiling maple and birch floors. Floors which cannot withstand the travel of many feet, as in offices and factories, are treated with oil, because it is cheaper than varnish and varnish could not withstand such hard service. The oil gives a uniform color and makes a floor which is easy to clean.

Mineral oils are used for floors, but usually decorators use linseed oil to which some turpentine and beeswax or paraffin wax are added. A pot of this mixture should be heated in a pail of hot water or on a steam radiator (not an open fire). Apply it hot with mops and wipe up any excess with rags.

Unfilled oak trim in houses is finished this way for an antique effect. Table tops oiled two or three times are very serviceable,—hot dishes and water do not mar them.

Gloss Oil.—This is not really an oil but a thin varnish made, usually, of rosin—the residue from the distillation of turpentine—and benzine, turpentine or mineral spirits. A cheap product made for finishing barrels. It scratches easily and is no material for decorators to use. It is sometimes used as a size to stop suction on plaster walls. Used under calcimine and cold water paints, satisfaction usually results, but it should never be used under paint. Wallpaper, canvas or other fabrics will not long adhere to surfaces coated with gloss oil, and sometimes not even if paint is put on top of the gloss oil. The oil must be removed with hot water having some wallpaper paste in it and considerable sal soda or Gold Dust. It is brushed on with a calcimine brush and washed off with a sponge and clear water.

Polishing and Rubbing Oils.—These are usually mineral oils of light weight,—sewing machine oil is good. Used with pumice stone or rotten stone for rubbing varnish on pianos, fine furniture and wood trim.

Megilp Oil.—Used by artist painters for pictorial work on canvas. It is a mixture of pale drying oil and mastic varnish. If unwisely used this oil will cause alligatoring and cracking of the painted surface.

Bronzing Liquids.—For interior decorating purposes the purchase of a prepared liquid in gallon cans is usually most convenient and economical. These prepared liquids are usually made with amyl acetate (banana oil) which is mixed with dry bronze powders to make a paint; in fact, there are many lacquers made with a cellulose nitrate or acetate base. As a rule these are for use only indoors where protected from the weather and moisture.

Decorators often make a bronze liquid by adding a little turpentine or benzine to good interior varnish to thin it to just the right consistency, and when this is mixed with dry bronze powders a satisfactory metallic paint results.

For aluminum paints used on exterior metal surfaces, or any exterior surface, ordinary raw linseed oil is not suitable; it is too thin and permits the paint to run and streak. But, on the other hand, a special oil called heavy bodied boiled linseed oil is excellent for a moderate priced exterior metallic paint.

Spar varnish thinned to proper consistency with turpentine or benzine makes a good bronze liquid for exterior surfaces and for all surfaces that are to be washed. A mixture of spar varnish and regular or heavy bodied boiled linseed oil makes a less expensive exterior paint which is very serviceable.

Compounds of China-wood oil (tung oil) and many other mixtures can be used for bronzing liquids. Care must be taken to make sure of proper drying properties in the liquid, however, since the leaf formation of a bronze pigment tends to retard drying.

A bronze liquid composed of linseed oil principally does not make a very hard film, and for that reason bronze paints which are to be subjected to abrasion, as on furniture, should be composed largely of good varnish.

To sum up, then, a bronze liquid must possess sufficient body to carry the metallic pigment and brush out into a smooth surface; it must contain enough drier to dry in a reasonable time; it must dry with a surface hard enough to resist abrasion when used for some purposes.

For mixing directions using bronze paints see Chapter XI.

CHAPTER VII
VOLATILE THINNERS AND DRIERS

In the mixing of paints, fillers, stains and shellac such liquids as turpentine, benzine, alcohol and mineral spirits are used to make these other substances fluid, in order that they may be brushed out to a film of uniform thickness over a surface.

To assure a more advantageous use of these liquids an understanding of their properties is essential. And so the chief outlines following have been written without any attempt to go into the chemistry of each liquid.

Turpentine.—This is probably the most important volatile thinner used by the painting trades for paints and varnishes. It is manufactured by distilling the resin of the long-leaf pine trees in America. Rosin also results from the distillation of the sap of pine trees. At first turpentine was made only from the resin or gum obtained from the tree, and that product is now known as gum turpentine. Turpentine is also extracted from the sawdust and stumps by steam distillation or destructive distillation of the wood and is known as wood turpentine.

Wood turpentine has a disagreeable odor if not very carefully refined and usually is not so uniform in quality. The odor can be removed to a satisfactory degree and the characteristics of wood turpentine can be refined to approach closely those of gum turpentine. Turpentine has certain very valuable solvent and flatting properties for paint and varnish products. The painter and decorator finds that when mixed with white and colored pigments it makes a paint which flows well, penetrates and dries without gloss.

The ability to penetrate into the pores of a surface is one of the outstanding virtues of turpentine. Pure turpentine evaporates almost completely after it has made the paint fluid, assisted in spreading the pigment to cover the surface uniformly and to penetrate it. But turpentine is not a binder in itself; on evaporation it leaves the pigment about as it was before it entered the paint, except that the pigment is more closely packed.

Turpentine has two objectionable properties for use inside of buildings; one, its very strong odor, which nauseates some people and is objectionable to a great many; the other is the ill effects turpentine causes on one's kidneys. Unless decorators are unusually careful about securing ample ventilation when working with turpentine, they are apt to feel such ill effects as will prevent them from using turpentine for interior work. That is why many painters prefer benzine and appear to produce quite as good results with it on interior decorating. Benzine should not be used in place of turpentine for exterior painting.

Among the spirit thinners turpentine evaporates most slowly, more slowly than benzine or gasoline and very much more slowly than alcohol and benzol. Some of the especially distilled mineral spirits evaporate quite as slowly as turpentine. Sometimes turpentine is adulterated with non-volatile petroleum oils.

Turpentine oxidizes (takes on oxygen from the air like linseed oil) to some extent and assists the drying of paint. And while pure turpentine evaporated from a dish apparently leaves no residue, chemical analysis of paints containing turpentine recovers less of it than was put into the paint. A bit of rosin from the turpentine must, therefore, remain in the paint. On the other hand, all the benzine put into paint can be recovered by chemical analysis.

Turpentine Substitutes.—These spirit liquids are usually mineral spirits made from Texas petroleum having an asphaltic base. They vary considerably in their properties as to specific gravity, flash point, ability as solvents and how completely they evaporate. The best grades should evaporate completely during drying, have good solvent power and cause no precipitation of gums or polymerized oil in paint and varnish. For the use of painters and decorators the mineral spirits having a flash point near that of turpentine are less of a fire risk and are the most desirable for that reason. In these petroleum spirits having satisfactory volatility and solvent power there may still be differences which cause satisfactory or unsatisfactory flowing, spreading and general brush-working qualities in varnish, enamels and paints.

Mineral Spirits.—Petroleum from the Ohio and Pennsylvania oil fields has a paraffin base, while petroleum from the Texas oil fields has an asphaltic base.

Benzines of a higher gravity, and which evaporate more slowly, are made from the Texas petroleum rather than from petroleum having a paraffin base. These benzines from Texas petroleum are called mineral spirits and they can be distilled to dry quite as slowly as turpentine.

Careful regulation of fractional distillation of petroleum with a paraffin base, however, produces mineral spirits similar to such benzines made from asphaltic petroleum.

Benzine.—While this spirit is a petroleum product, it is an exception to the rule against the use of this class in paint. It is a volatile thinner which evaporates more or less completely after it has served the purpose of making the paint liquid so that it can be spread uniformly thick over a surface.

Benzine is a distilled, colorless liquid made from crude petroleum. It has a gravity of from 55 to 72 degrees by Baumé hydrometer while gasoline, the lighter product from the same base, shows a gravity of from 60 to 62 degrees

Baumé. The heavier oils, like fuel oil and lubricating oils, are distilled from the same petroleum base.

Painters have been criticised for years because of their use of benzine, but such criticism has seldom been justified. Once in a while a lazy painter will add too much benzine to outside paint in order to make it brush onto the surface easier, but he usually gets caught soon enough, because the paint then dries without gloss.

Benzine has many good uses in a paint shop aside from its value for washing surfaces, brushes and pots. For flat wall finishing and in the hands of skilled decorators it serves quite as well as turpentine. It will, of course, cause the paint to brush out "short" and to "pile up" if not properly mixed as to proportion with oil.

Benzine has no place in exterior house paints because it does not possess the same ability as turpentine to penetrate the pores of the surface.

While benzine used in large amounts in rooms without ventilation causes ill effects—a "benzine jag"—as the painters call it, as generally used in place of turpentine it is far safer, less harmful to health and pleasanter.

Do not confuse benzine—(spelled with an "i")—with benzene. Benzine is a petroleum product, but benzene is similar to benzol and toluol, which are definite compounds derived from the light oil of coal tar.

Benzol.—A light oil distillate from coal tar which is a volatile spirit with a boiling point of 82 degrees C (180 degrees F). A powerful solvent of gums, resins, oils and varnishes. Sometimes called 160 degree solvent naptha. Used by painters to add to paint for pitch pine surfaces or to brush on to such resin filled wood to cut the resin and give the paint an opportunity to penetrate and anchor itself.

Solvent Naptha.—A distillate of light oil from coal tar. It boils principally between 130 degrees C (266 degrees F) and 160 degrees C (320 degrees F).

Solvent Naptha is commonly known to painters and decorators as 160 degree benzol and is used by them in small amounts occasionally in exterior paint to be spread on to pitch pine or other woods the pores of which are completely filled with resin or an oily substance.

Solvent naptha is less volatile (it evaporates more slowly) than benzol or toluol.

The excellent properties of solvent naptha, as a solvent for bituminous paints, varnishes, gums, oils and resins has made it widely used in the paint and varnish industry. It is a common ingredient in paint and varnish removers and in substitutes for turpentine.

Amyl Acetate (Banana Oil).—This is the oil used commonly as the vehicle and binder for bronze paints—called bronzing liquid.

Amyl acetate, amyl alcohol and methyl alcohol are solvents used by manufacturers in nitrocellulose lacquers and, while painters and decorators read mention of them occasionally, there is little or no use for them as such in the ordinary course of business.

Alcohol.—That used by painters is almost entirely denatured alcohol. It is grain alcohol to which poisons are added according to government requirements, to denature it and make it unfit for human consumption.

Painters use denatured alcohol for many purposes,—for thinning shellac, for washing up wood trim after an old finish has been stripped off with liquid varnish removers and for mixing with water stains to secure penetration.

Wood alcohol is not so extensively used. It is a powerful solvent of varnish and paint films and is used to some extent as a remover of these coatings. Wood alcohol is also a deadly poison.

Vinegar (acetic acid).—Mention ought to be made of this liquid, because it is used for several purposes by decorators. Most of the graining done now is distemper graining rather than oil graining. In distemper graining distemper colors—those ground in water—are used. Glue is added as a binder and ordinary table vinegar is used as the liquid with which to make the colors fluid. Cider and beer have been extensively used for this purpose.

Vinegar is also used to neutralize plaster or cement surfaces which have "hot spots" of active lime in them, although zinc sulphate (10 parts of zinc to 90 parts of water) is a better wash for this purpose. Also vinegar is brushed on to a floor bleached with oxalic acid to neutralize it. A painted wall which has too much gloss or which is too greasy to permit spreading another coat of paint on top (when new paint runs, sags and wrinkles) can be cut enough by washing down with vinegar to make possible the application of new paint.

Driers.—Such metals as lead, manganese, cobalt, calcium, iron and zinc put into chemical compound solutions and added to drying oils hasten the drying of these liquids. For instance, linseed oil becomes dry by taking up oxygen from the air. The addition of drier speeds up the rate of absorption of oxygen by the oil.

Driers are used by manufacturers in various forms. In Europe, and in America for many years, a paste drier was in common use, but today liquid driers are in universal use as far as the painter and decorator are concerned. Driers are always purchased ready for use by painters. No attempt should be made to compound them, as that requires the services of professional chemists.

In the manufacture of driers the metals, lead, manganese and cobalt are used, and also certain drying pigments,—red lead, lead acetate (sugar of lead) and litharge, principally.

In the trade driers are listed as driers, oil driers, Japan driers and as Japans. The name on the can or barrel may not fairly indicate what class of drier will be found in the container, however, because these names are used rather indiscriminately.

Japan drier is a liquid most commonly made from solutions of lead and manganese salts, neutral linseed oil, resin or gum and turpentine or mineral spirits. It should dry to a hard film well attached to the surface when spread alone on a piece of glass for testing. Some such driers are made very light in color for white paints, but most of them are dark brown. Lead acetate (sugar of lead) and litharge are principally used in making the white or light colored driers.

Oil driers when properly made contain no gums or resins and do not dry to a hard film. As a rule oil driers made of both lead and manganese salts as an oleate are considered better than resinate driers and Japans. A manganese drier will expand while drying and resists moisture better than lead driers. But, on the other hand, driers made from lead salts, while they contract on drying, will withstand heat better. The usual manufacturing practice, therefore, is to use both lead and manganese salts to gain the virtues of both.

Some oils and pigments dry naturally to a greater or lesser degree in their own time. To hasten this drying, to make semi-drying liquids dry hard, driers are essential. And, generally, driers are needed to make the use of paint, varnish and other decorative and protective coatings dry within a reasonable time and with a hard surface having no tacky or sticky character.

Without the use of drier in paint during hot, humid or cold, wet weather, the paint may dry so slowly that dust, flies or gnats in swarms may accumulate on the paint and disfigure it.

As a matter of convenience it is essential that paint and varnish dry within a reasonable time to permit workmen to proceed with a job from day to day with one coat after another; and fairly rapid drying is essential, too, so that decorating done in buildings where people must continue to live and work will not soil clothes and persons.

For practical purposes, then, driers are essential in paint, varnish and other decorative and protective materials, but the durability or life of the coating is lessened by the use of driers. Therefore the use of the least amount of drier which will serve the purpose is always the proper guide when a coating is expected to be durable. As a general principle it may be said that the quickest drying coatings are the least durable; the slower drying the most durable.

This is readily understood when you know that the final destruction of a paint film is the result of oxidation.

A substance like driers, which speeds the drying of paint, then, by that very fact, makes the life of that paint shorter.

This principle is of vital importance as a guide in mixing exterior paints used as a protective coating on any surface. The use of too large a quantity of drier simply burns out the life of the oil and destruction of the paint film proceeds rapidly. It is for this reason that well informed master painters use a high grade boiled linseed oil and permit their journeymen painters to use no Japan driers; a careless use of too large a quantity of Japan drier with raw linseed oil is thus avoided. The use of Japan drier which is not very strong overcomes this risk to some extent, but even then the careless workman simply guesses that even a larger quantity is needed, and so continues the abuse. Every ounce of driers used ought to be measured, but in actual practice the man who measures quantities of any material is a rare fellow in the painting business.

The use of driers in interior paints is quite another proposition. Durability is not, relatively, an important consideration. The paint will wear out from abrasion, or be repainted because it has become soiled or because a change of color is wanted, and so the life of the liquid binder calls for little consideration.

A common sense policy to follow in the buying of driers and in their use is to select an advertised brand made by a reputable firm; carefully note the quantity you use in a gallon of paint and the time required for it to dry in hot humid weather and in cold wet weather; then use as little as is practical, considering the result wanted. It is a good plan to study the manufacturer's directions and literature. And once you have learned the best use of a good quality drier, don't change brands, or it will be necessary to acquire experience again from the beginning to learn the reaction of the new brand.

Tests to determine the strength of different brands of driers, the speed with which they cause the paint to dry, and the ultimate durability of a paint containing various amounts of driers can be made by the painter if he wants to go to that trouble.

To test the strength and speed of drying, use pieces of glass about a foot square,—one piece for each brand of drier to be tested. On one-third of the glass brush a coat of raw linseed oil; on the next third brush a coat of the same oil to which about 3 per cent of the drier has been added; and on the last third of the glass brush paint mixed with the same oil and drier used on the second strip. Note the time when this test is completed and then record the number of hours required for each set to dry to the touch and to dry hard.

To test the durability of an oil film and a paint mixed with a given brand of drier, follow the same method on wood panels and expose them to the weather. Two or three years' time will be required to make any fair determination.

CHAPTER VIII
GENERAL PAINT MIXING METHODS

The mixing of paints, enamels and colors to make serviceable and decorative coatings for many surfaces, under greatly varying weather and climatic conditions, calls for exercising considerable discrimination. Success to an ordinary degree is not at all difficult to attain, but to gain the utmost durability from paints and at the same time leave the surface in good condition for repainting when the old paint wears out, is an accomplishment which tests the skill of experienced painters and expert paint makers.

There are some well established rules for use in the mixing of paints which have been developed during years of mixing and applying paint and the observation of results. If the knowledge of the practical men who have gained the experience summed up in the rules and principles set forth here is utilized, one making a study of paint mixing can readily become expert without waiting long years to gain the knowledge by the slow process of personal experience, success, failure, observation, deduction and seeking the remedy.

In Chapters I to VII color pigments, basic paint pigments and paint liquids were enumerated and their characteristics described. These are the ingredients essential to the mixing of colors and paints.

Before beginning experiments and practice work in mixing, brief consideration of necessary tools, utensils and working methods is in order.

TOOLS NEEDED

The tools and utensils needed on a well planned and equipped mixing bench for any trade or arts and crafts shop where colors and paints are mixed are these (Plate 2):

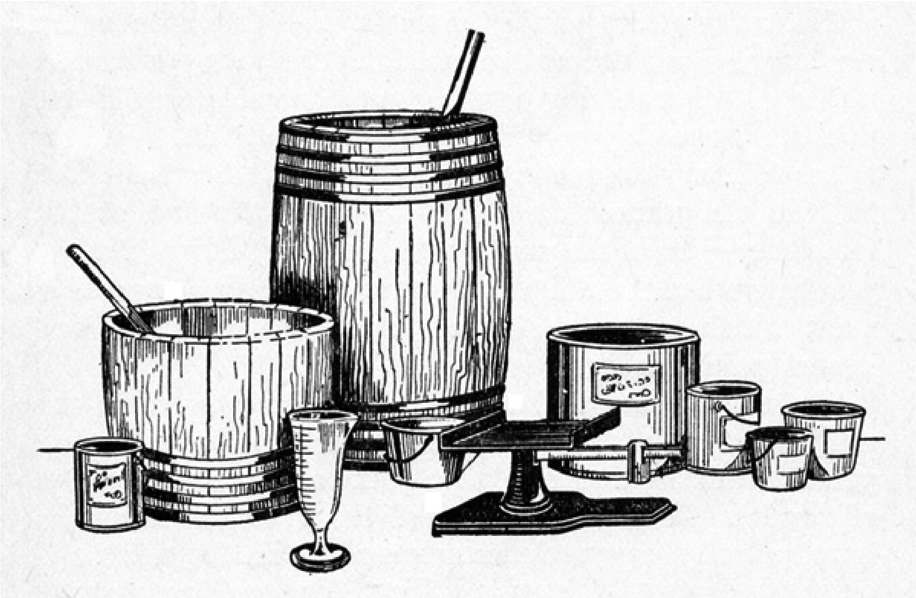


Plate 2.—Mixing Pots, Tubs and Equipment

Scales.—Mixing formulas are written in pounds, ounces, fractions of ounces, pennyweights and half pennyweights. Or a formula may be stated thus, for example: 2 parts medium chrome yellow, 1 part raw umber and 3 parts white lead. This may be interpreted as pennyweights, or ounces, or pounds, depending upon how large a batch of paint you wish to mix. Usually a balance scale which accurately weighs ounces and pounds will serve all purposes, but where very small amounts and accuracy are essential, druggist scales are needed to weigh pennyweights and half pennyweights.

Measures.—For liquids a glass graduate measure and pint, quart and gallon measures are needed.

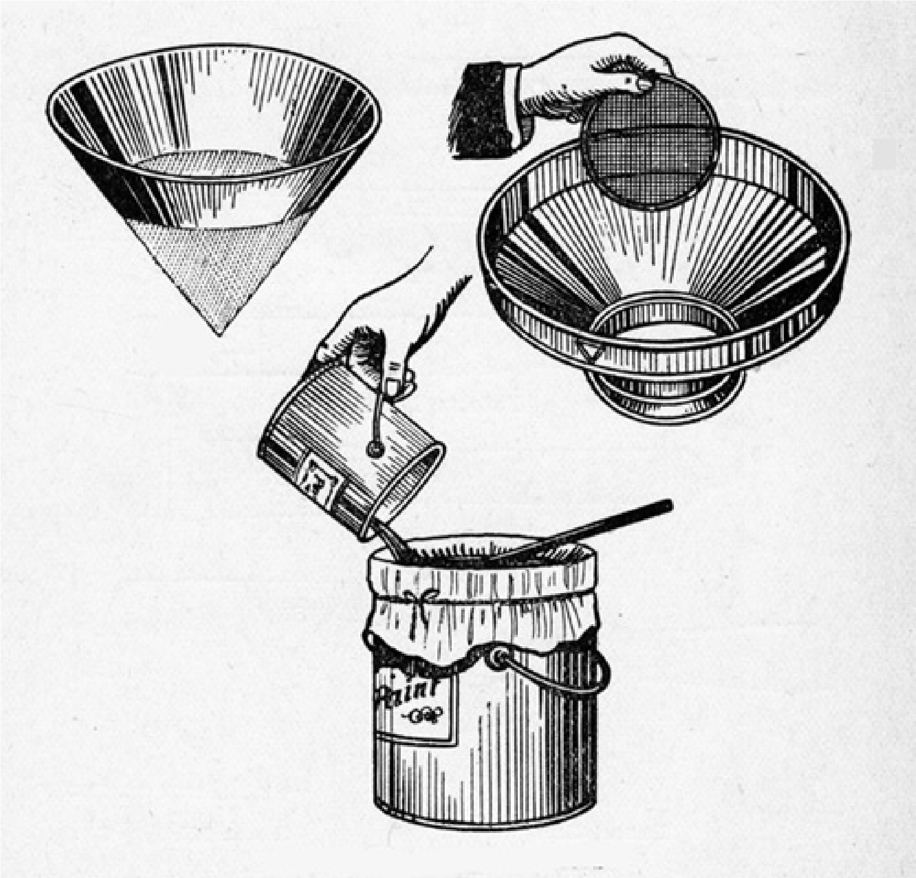
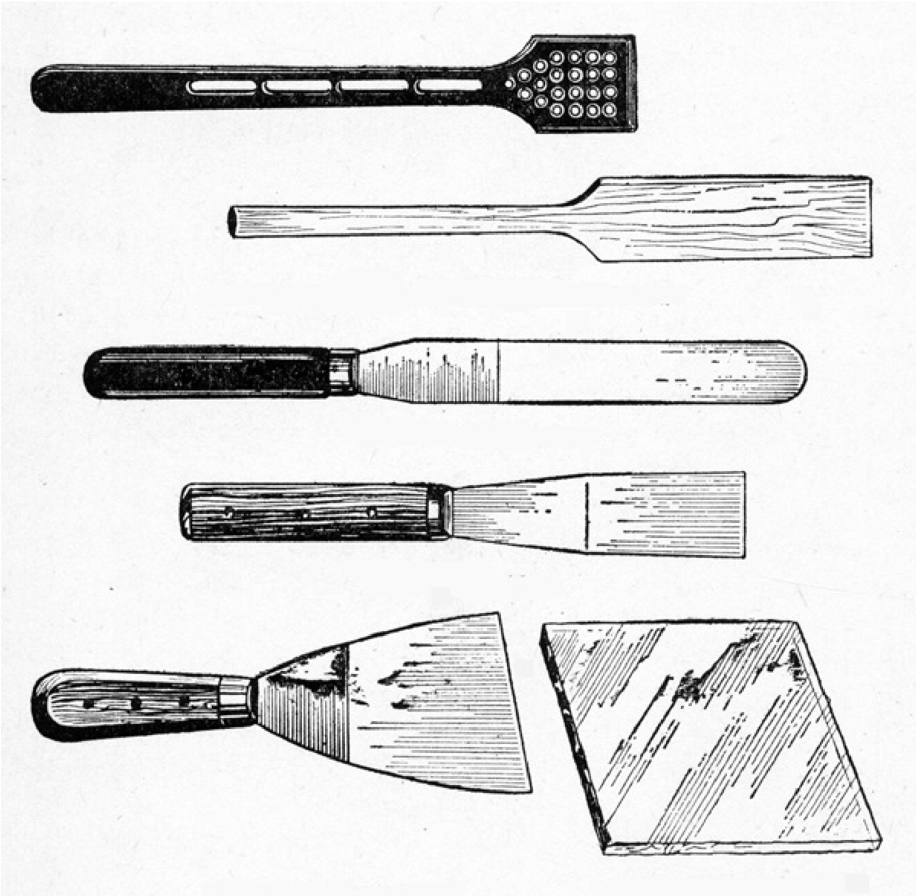


Plate 3.—Paint Strainers

Pots, Pails and Tubes.—Plenty of clean, empty pots and pails are essential for ordinary mixing. Empty white lead kegs of 12½, 25 and 50 pound size, and one-gallon prepared paint pails, are useful. Small press-top cans are handy for small batches of colors and paints; while for large batches empty white lead kegs of 50-pound, 100-pound and 300-pound size are very good. Often barrels are used for mixing very large lots of paint, stain and calcimine. Sometimes a barrel is sawed through the middle, thus making two tubs in which ten to fifteen gallons of paint can be mixed.

Strainers.—Manufactured strainers such as are shown on Plate 3 may be used. The cone, or funnel-shaped, strainer is made of paper and cloth. It is designed to be used once or twice and then destroyed, to save the time needed to clean it. The cost is low. The other strainer pictured is made of tin and is provided with a removable screen bottom which is easily taken out for cleaning or to be replaced with a new one.



Iron and Wood Mixing Paddles
Palette Knife
Putty Knife
Broad Scraper   Glass Mixing Slab
Plate 4.—Mixing Tools

Strainers most commonly used are made by placing a piece of cheesecloth, double, over the top of a paint pot. Then a string is wound around the pot two or three times to hold the cloth in place while pouring and stirring the paint through the cloth.

Paddles.—On first thought any stick would seem to be suitable for paint and color mixing, but that is not true. Mixing can be done more quickly and better with paddles of wood or iron which are flat and rather wide at the bottom. When mixing large batches a long paddle which can be used with both hands is necessary;—one about the size and shape of a canoe paddle is very good.

Palette and Putty Knives.—A putty knife is needed for opening small cans of color and paint, while a strong large screwdriver is needed for prying off covers from lead kegs. A palette knife is handy for mixing small daubs of colors on a piece of plate glass to try out for color matches, to note transparency of colors and the fineness or texture of pigments.

Other Tools.—Several pieces of plate or ordinary window glass about six inches square are needed. These are of use as slabs upon which to mix small batches of colors to note how nearly they match samples. The color is spread on with a palette knife (spatula) or a putty knife.

Some pieces of waxed paper, all of uniform size to insure accuracy on scales, are needed. Colors, or basic paint pigments, are placed on paper in order to weigh them on a scale when doing experimental and practice mixing.

Wiping rags and a bottle of benzine for cleaning up glass slabs, knives and mixing paddles are needed also on a mixing bench. An empty quart ink bottle with a small screw cap is a handy and safe benzine container.

A few dozen ordinary watch crystals (old, odd sizes from your jeweler) are very handy for testing comparative whiteness, tint or shade of paints.

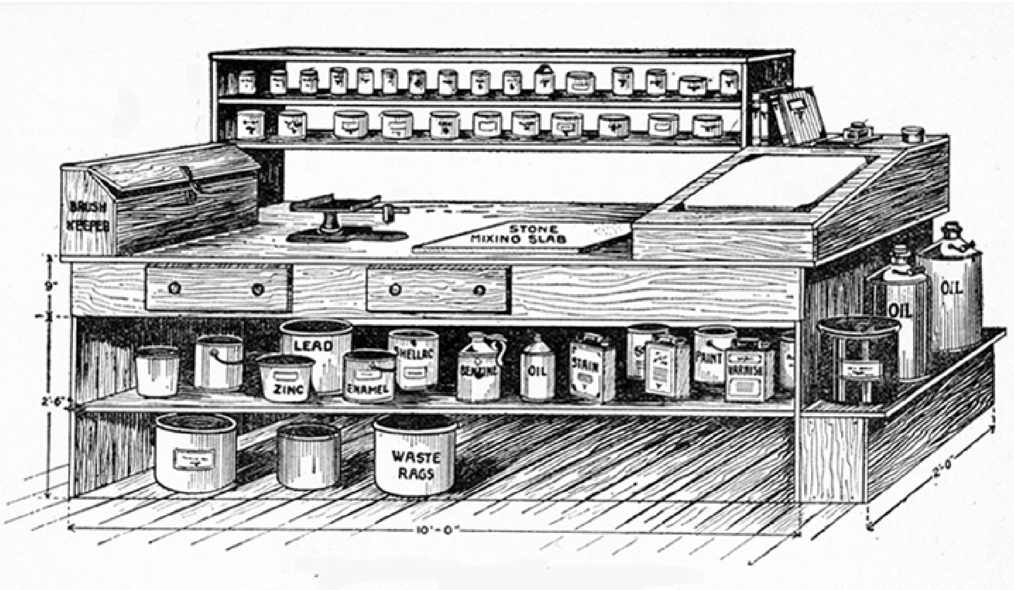


Plate 5.—A Handy Paint Mixing Bench Hand Mixer

A suggested plan for a handy mixing bench is shown in Plate 5.

Paint Mills.—For the mixing of large batches of paints, colors, putty, paste floor fillers and printing inks, hand and power mills and mixers are great time savers and a convenience in a paint shop.

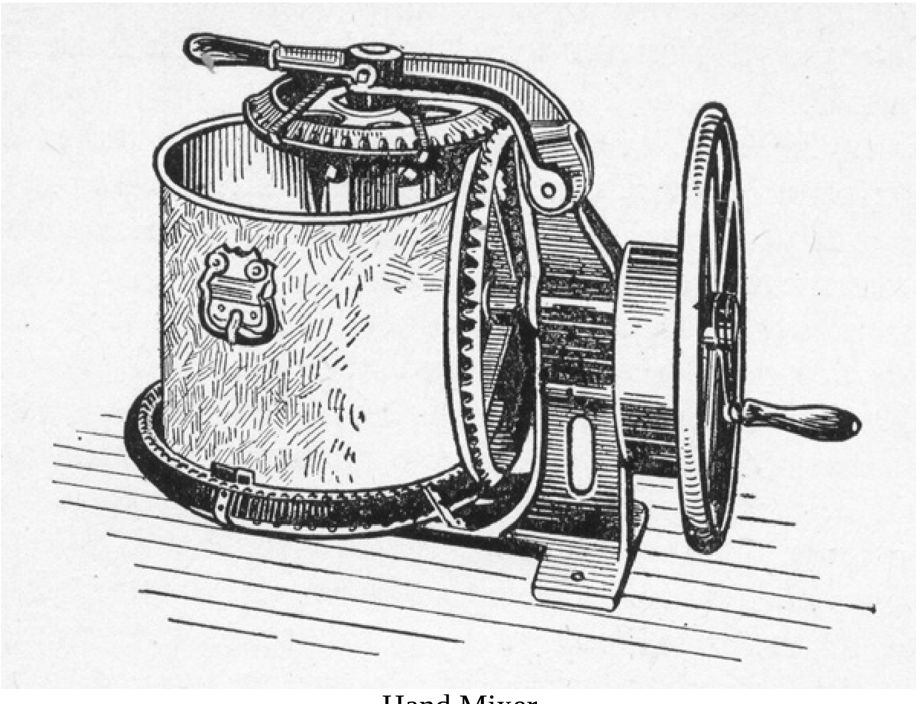
A generation ago painters bought colors, lead and zinc in dry powder form and ground them in oil through hand mills as needed. This is not done today. Time and money are saved and more uniformly ground and mixed pigments are secured from manufacturers in paste form.

Hand and power mixers, such as are illustrated on Plate 6, are used today in paint shops for mixing large batches of putty, paint and color with oil, turpentine and drier to brushing consistency. With these machines much more thorough mixing is done than can be accomplished by hand; they are a convenience and assure a saving of time. The investment is not large. Mixing machines are constructed to assure quick and easy cleaning.

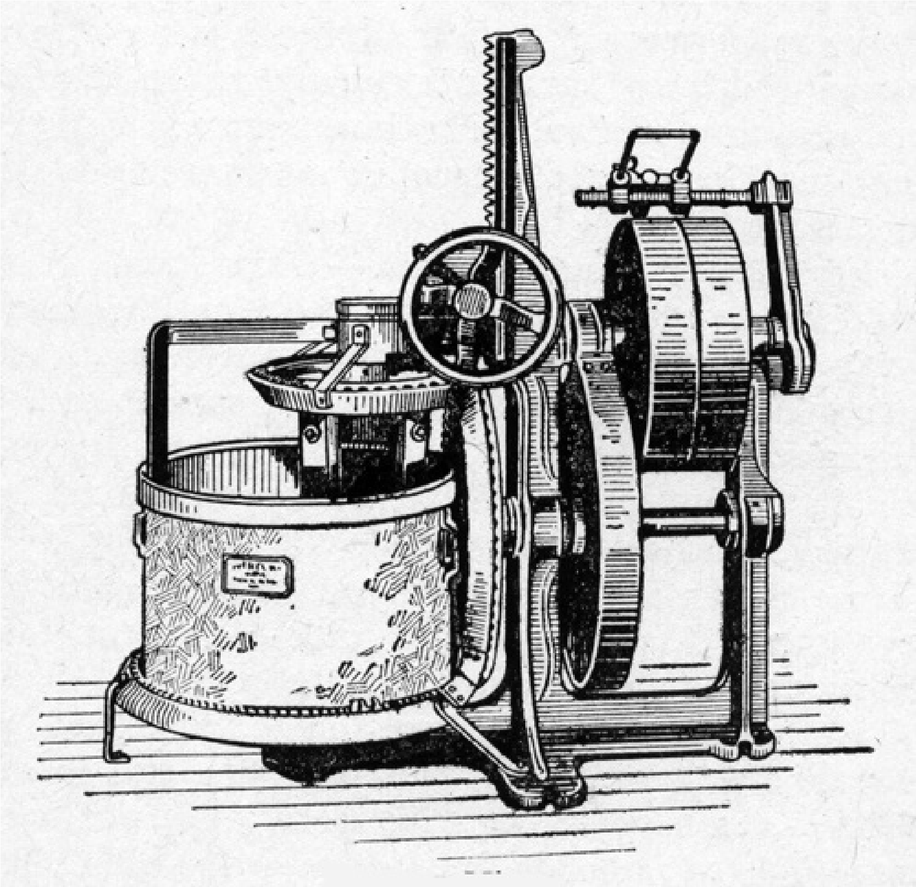
Mixing Ready-Mixed Paints.—White and colored paints already prepared are available on the market. They are prepared for interior and exterior house painting on wood, metal, plaster, brick and cement surfaces.

Prepared paints contain all necessary basic pigment, color, oil, turpentine and drier and are mixed ready to be brushed onto a surface.

To use these paints cut the top of the can out with a putty knife. Then pour the liquid off the top into a clean pot and stir the pigment in the bottom of the can until it is soft and well mixed. Next, pour back part of the liquid into the pigment and continue stirring until it is absorbed; repeat this until the paint is well mixed. To complete the mixing pour the whole batch from one pot to the other several times and stir until all pigment has dissolved in the liquid.



Hand Mixer



Power Mixer
Plate 6.—Machine Paint Mixers

Mixing White Lead Paint.—Paints for all purposes to be mixed in white and colors from white lead as a base are made ready for the brush in this manner:

White lead comes to you in thick paste form; in tubes; 1-pound, 3-pound and 5-pound cans; 12½-pound, 25-pound, 50-pound and 100-pound steel kegs; 300-pound and 500-pound wood casks. It contains 8 per cent pure raw linseed oil and 92 per cent white lead. One hundred pounds of white lead paste bulks about 2.85 gallons.

To break up this thick paste, place the amount needed in a clean pot or tub (an empty 100-pound white lead keg is good for mixing two- or three-gallon batches). Now add a very little linseed oil (or turpentine) and stir it into the lead. It is important that you put in not over one-fourth of the oil at first; less is better. When the first lot of oil has disappeared into the lead, add a little more and repeat until all the oil needed to bring the paint to stout brushing consistency has been added by thorough stirring with a paddle or in a machine mixer.

With the paint in this condition, add the necessary turpentine (and Japan drier if raw oil is used), also the colors, which have been previously mixed with oil and strained.

It is important that this method be followed, as it is the only economical way to mix the paint correctly. If too much oil is put in at first, little gobs of lead paste will swim around in the oil and dodge your mixing paddle for some time. The proper time to mix paint is when it is in thin paste form. If this is well done the balance of the oil can be easily and quickly stirred into the batch.

The mixing of other paste paints can be accomplished to best advantage in exactly the same way.

Dry white lead is not used by painters and decorators for mixing paints. It is first ground through stone mills with oil by the manufacturers.

Mixing Lead and Zinc Paint.—Various combinations of white pigments are used, as well as white lead, as the basic material for white and light-tinted paints. In some instances a leaded zinc combination made by manufacturers is used, and in others painters and decorators mix together white lead paste and zinc oxide paste, both ground in linseed oil.

The mixing and thinning with oil or turpentine is best accomplished by exactly the same method as was described for breaking up white lead paste. Break up the two pigments separately and when each is nearly thin enough for brushing mix the two together by pouring one into the other and then boxing the whole batch; that is, by pouring the paint from one pot to another several times.

The turpentine, drier and colors (the latter being first mixed thin separately with oil or turpentine) should next be added, if colored paint is to be mixed; if not, simply add the final quantity of oil (or turpentine for flat paint) needed to thin the paint to brushing consistency.

The proportions used when mixing lead and zinc paint vary according to the purposes for which the paint is to be used. For interior paints the question of durability doesn't enter, when mixing enamels, enamel undercoats and paints; but for exterior house paints which are subjected to temperature changes, sun, wind, rain, hail and frost, too much zinc may make a paint film so hard and inelastic that it will crack and scale off. White paint used on the sea coast and subjected to moist, salt air continually is especially in need of 15 or 20 per cent of zinc to 85 or 80 per cent of white lead.

When mixing these two basic white pigments it is important to remember that zinc, being finer than white lead, bulks much more per hundred pounds and requires more oil to thin it to brushing consistency. On an average, zinc paste is ground with 15 to 19 per cent of linseed oil to 85 or 81 per cent of pigment; while white lead is ground with 8 per cent of oil to 92 per cent of pigment. One hundred pounds of pure zinc oxide bulks about 4-1/8 gallons, while 100 pounds of white lead bulks a little more than 2¾ gallons.

Zinc oxide is marketed in steel kegs and pails of various sizes—12½-pound, 25-pound, 50-pound, 100-pound—and in small tubes for artists and decorators.

Consequently, care must be shown in mixing quantities of white lead and zinc oxide pastes ground in oil, if correct proportions are to be maintained.

Below is a tabulation which shows the quantities of each pigment, in pounds of paste, to mix together to make 100 pounds of combination paste of any given proportions. In other words, the dry pigment of such a paint mixture will analyze as per the proportions shown in this table:

Proportions Desired		Use Zinc Oxide in Oil	Use White Lead in Oil
% Zinc	% Lead	lbs.	lbs.
20.0	80.0	21	78
22.5	77.5	23	76
25.0	75.0	26	73
27.5	72.5	29	70
30.0	70.0	31	68
32.5	67.5	34	65
35.0	65.0	36	63
37.5	62.5	39	60
40.0	60.0	41	58
42.5	57.5	44	55
45.0	55.0	47	53
47.5	52.5	49	50
50.0	50.0	52	48
52.5	47.5	54	45
55.0	45.0	57	43
57.5	42.5	59	40
60.0	40.0	61	38
62.5	37.5	64	35
65.0	35.0	66	33

67.5	32.5	69	30
70.0	30.0	71	28
72.5	27.5	75	25
75.0	25.0	76	23
77.5	22.5	78	21
80.0	20.0	81	18

Straining Paints and Colors.—There are several advantages to be gained by straining your paints and colors, no matter how well they are mixed. Straining paint through fly screen or, better yet, through a finer mesh screen or cheesecloth breaks up the particles of pigments more completely and incorporates them with the oil or other liquid; straining removes sediment, small particles of dried paint skin and foreign substances. By straining you mix paint which not only is cleaner and will make a finer textured film, but you are thus making a paint which hides the surface better and works out more smoothly under the brush.

Straining of paint is not only an advantage when it is first mixed, but high-class painters and decorators will strain the same batch of paint two or three times a day when they are doing fine enamel, undercoatings or other particular work. You may start with a perfectly clean paint pot and strain into it a batch of paint which is clean and fine. Then you may take a brush which has been made absolutely free from dust, loose hairs and old paint skins; but after you have used this brush in transferring the paint to wood trim or other surfaces for an hour or two you will find that the brush has picked up more or less dust and grit particles from corners and crevices and carried this foreign material into your pot of paint. In varnishing and enamel work it is highly important also that you strain the material often.

The straining may be done by using one of the manufactured strainers shown on Plate 3, or you may tie a double thickness of cheesecloth on top of a paint bucket as tightly as possible with twine; then pour the paint, varnish or enamel to be strained on to this cloth and stir it with a putty knife or mixing paddle until it has passed through the cloth.

Drawing the Oil for Dead Flat Finish.—In past years considerable white lead thinned only with turpentine has been used for mixing undercoats for white enamels, for painting woodwork in flat white and colors, and for painting interior walls. For some of this work the lead was first mixed with a little benzine and allowed to stand over night. In the morning it was found that the 8 per cent of linseed oil with which the lead paste was ground was extracted largely by the benzine and was floating on the top. All of the liquid was then poured off and the lead was mixed with fresh turpentine and produced a dead flat paint. This practice is not much used today.

Special preparations of zinc and lithopone are now made for enamel undercoats and for flat finished walls. Also special liquids, called flatting oils, are mixed with a lead paste. When lead is not used for the walls one of the many brands of special flat wall paints on the market is used.

QUANTITIES OF MATERIALS NEEDED

Until you become rather experienced in the mixing of paint it is well to measure your quantities of white pigment, color pigment, oil, turpentine and drier. It is better to weigh your quantities than to use bulk measure.

A gallon of raw linseed oil weighs approximately 7¾ pounds.

A gallon of turpentine weighs approximately 6¾ pounds.

One hundred pounds of white lead bulks a little more than 2¾ gallons (2.85).

One hundred pounds of zinc oxide bulks 4-1/8 gallons.

Ready-mixed paints weigh on an average about 14 pounds per gallon.

White lead paint weighs approximately 20 to 22 pounds per gallon.

Covering Capacity of Paint.—One of the first questions which arises in paint mixing is how large a quantity will be needed. The answer to that depends upon how much surface a gallon of paint will cover.

Several elements enter into the answer to this question. One who is experienced in using a paint brush will usually spread a gallon of paint over 15 to 25 per cent more surface than a man with less experience, and the surface will be quite as well covered. When paint is spread thin it will, of course, cover more surface than when put on thickly. Paint brushed out thin is usually more durable and becomes dry more quickly. It is well to brush paint out as far as it will go and yet hide the surface well.

When brushing white paint and light paints over dark surfaces the paint cannot be spread out as thin as when being put onto a light-colored surface. Black and dark-colored paints can, by the same token, be spread out thinner and will be so spread as a matter of habit.

A gallon of any paint will spread over fewer square feet of rough surface than of smooth surface, and, obviously, soft, porous wood will absorb more paint than hard, close-grained wood.

There are differences in covering capacity between various brands of ready-mixed paints, and some difference between brands of pure white lead as to covering and hiding ability. The differences in ready-mixed paints are accounted for by differences in pigment combinations, while with white lead brands differences may be due to varying proportions of carbonate and hydrate. Differences in hiding power of either class of paints may also be due to relative fineness or coarseness of the basic pigments.

Per Gallon Coverage.—On an average surface it is probably safe to figure that a gallon of white paint or light tints will cover about 450 square feet of surface one coat. On new wood surfaces which are hard and well filled and after the priming coat has been applied, a gallon of high-class paint may cover as much as six or seven hundred square feet one coat. If, however, the priming coat was absorbed considerably, and if many porous spots appear without gloss, your gallon of paint will cover less.

On old wood surfaces which are very dry and absorbent, a gallon of paint may not cover to exceed three or four hundred square feet one coat.

When tinting colors are added to white paint, and when dark-colored paints, such as dark brown, grays and reds are used, the covering and hiding capacity of a gallon of paint may easily be doubled, depending upon how far the paint is brushed out.

The covering and hiding capacity of paints used on metal surfaces is much greater than when used on wood. For instance, paint mixed from red lead and linseed oil and spread onto smooth, plain metal surfaces will cover in the neighborhood of 1800 square feet per gallon on the first coat. For the second and third coats, using the same kind of paint on the same surface but mixed a little thicker, about 1200 square feet per gallon, one coat, will be covered. When painting ordinary structural steel, like bridges, a gallon of red lead paint will cover between 600 and 800 square feet on the first coat and from 500 to 700 square feet for succeeding coats.

Number of Gallons from a Mixing.—When figuring the amount of paint you will have by mixing certain quantities of white lead, zinc oxide or color pigments, consult the following table of average bulking values. It is necessary simply to add together the number of gallons which your paint and color pigments bulk and the number of gallons of liquids which you use in mixing a batch of paint.

For example, 100 pounds of white lead in paste form bulks approximately 2.85 gallons (a little more than 2¾ gallons). Now, if you add to this 4 gallons of linseed oil, 1 gallon of turpentine and 1 pint of Japan drier, you will secure approximately 8 gallons of white paint; and if you add a considerable quantity of color pigments to make a dark shade of paint, you naturally increase the total quantity of paint mixed by just that amount and the extra liquids needed. Of course, in mixing the average light tint the quantity of tinting color pigment and drier added doesn't bulk very much, and it is usually ignored in computing the number of gallons mixed.

In mixing red lead paint for metal surfaces, painters usually use 33 pounds of dry red lead and 1 gallon of linseed oil. This mixture makes approximately 1.22 gallons of paint.

Red lead is marketed now in a stiff paste form similar to white lead and is more convenient to use that way. When mixing any heavy dry pigments like red lead and bronze paints it is necessary to stir the pot of paint every few minutes because the heavy pigments settle to the bottom and there is a tendency to use the thin paint from the top, only to find later that the paint in the bottom of the pot is too thick.

With aluminum bronze paints in the proportion of about 1½ to 2 pounds of dry powder to 1 gallon of heavy bodied boiled linseed oil, the covering capacity per gallon is approximately 600 to 900 square feet, one coat, on a smooth, non-porous surface. For exterior surfaces spar varnish is used to the extent of from 20 to 60 per cent of the vehicle, the balance being boiled linseed oil. See Chapter VI for bronze liquids.

AVERAGE BULKING VALUES FOR 100 POUNDS OF PASTE COLORS AND WHITE PIGMENTS

COLOR	Percentage of pigment in paste	Percentage of oil in paste	Bulking values in gallons
Venetian Red (40% FeO)	78	22	5.9
Indian Red	78	22	4.7
Ochre	70	30	6.8
Raw Sienna	55	45	7.8
Burnt Sienna	55	45	7.5
Raw Umber	54	46	8.3
Burnt Umber	54	46	7.6
Metallic Brown	75	25	5.9
Pure Para Red	30	70	11.3
Ultramarine Blue	65	35	7.8
Prussian Blue	43	57	10.1
Carbon Black	20	80	11.6
Drop Black	50	50	8.7
C. P. Green (average)	77	23	5.0
C. P. Yellow (average)	80	20	4.2
20% Green (Barytes base)	88	12	3.9
20% Yellow (Barytes Base)	85	15	4.1
10% Para Red (Lime and Barytes Base)	82	18	6.0
Red Lead	94	6	2.13
Lithopone	80	20	4.8
Basic Sulphate White Lead	91	9	2.86

Basic Carbonate White Lead	92	8	2.85
Zinc Oxide	82	18	4.05
Titanium Pigment BXX	80	20	4.6

Standard Formulas.—It is not possible to state an exact formula for mixing a gallon of paint which will be suitable for use on all kinds of surfaces, such as wood, plaster, brick, cement and metals.

It is obvious that some surfaces are more porous and absorbent than others, —that when mixing paint to be spread on to such dry and porous woods as white pine, cedar shingles, poplar and fir, your paint will require a larger proportion of oil than when you are mixing paint to be spread upon well filled surfaces like yellow pine or cypress, both of which have pores that are saturated with resin or other oily substances. When mixing paint for the latter group of woods, and for all non-porous surfaces, more turpentine and less oil are needed.

Another consideration which governs the proportions of oil and turpentine to be added to basic paint pigments, or color pigments, is that which concerns the amount of gloss wanted on the paint. For exterior surfaces, as a rule, the more gloss you can produce the better, which means that you want to use as large a proportion of oil as possible.

When a semi-gloss or a dead flat finish is wanted for interior painting, it may be secured by using less oil and more turpentine, or by using what are called flatting oils in place of linseed oil. The flatting oils are useful for interior surfaces only.

The mixing formulas for white paint which follow at the end of this section give quantities of lead, oil, turpentine and drier needed for new and old exterior and interior surfaces. They are as accurate as they can be made for average conditions. The paint mixer must, however, size up the surface to be coated and mix his paint accordingly.

The best way to determine whether your paint is mixed too thick or too thin, is to dip a brush into it and spread a little of the paint onto the surface to be coated. If the surface is a very dark color, your paint must be mixed thicker, or stouter, than if you are painting on top of a white or light-colored surface. Dark colors may be mixed thinner and will ordinarily be brushed out to a greater extent than white paints, and still they will hide the surface well.

The condition of an old painted surface is a factor which will govern to some extent the amount of oil put into a new batch of paint to be used on such a surface. If the old paint is quite hard and the surface well filled, it will absorb less oil than if the old paint is chalking badly and, consequently, is quite porous.

Other points which should be kept in mind about the quantities of oil and turpentine needed in paint mixing are that you will find some slight variations in the thinning qualities of the different brands of linseed oil, depending upon what manufacturers made it and from which of the world's markets the flaxseed came. The white lead which has been mixed with part of the linseed oil a day or two before the final thinning will be found to absorb more oil than when freshly mixed. In other words, you may mix a batch of lead paint today and thin it down to what seems to be the correct brushing consistency, but if you allow it to stand a day or so it will be too thick and you must add more oil.

Less turpentine than linseed oil is needed to thin 100 pounds of white lead to brushing consistency. For instance, 100 pounds of white lead mixed for new outside work will take up 3½ to 4 gallons of linseed oil and 2 gallons of turpentine before it is thin enough for a dry and porous surface, while the same amount of lead will take up only about 2½ or 3 gallons of turpentine to bring it to brushing consistency.

In the mixing of paint your aim is to make it thin enough to brush out freely and into a smooth paint film, but not so thin that it will fail to hide the surface uniformly.

In the mixing formulas which follow raw linseed oil is specified. When a brand of high-class boiled linseed oil can be secured it is better to substitute boiled oil for raw in all these formulas and eliminate the drier.

Extra Drier Needed.—Under certain weather conditions—on cold, damp winter days and during hot, humid days in the middle of the summer—it is sometimes difficult to mix your paint so that it will dry as rapidly as it should. During such weather additional Japan drier to the extent of about ¼ to ½ pint should be added to 100 pounds of lead when raw oil is used. It is not often necessary to add any drier to boiled linseed oil, but there are some extreme conditions where a little is needed.

During difficult drying weather a little extra turpentine will accelerate the drying.

When using slow drying color pigments such as lamp-black, chrome yellow, chrome green and ordinary yellow ochre in considerable quantities to make dark-colored paints additional turpentine and drier are needed.

Standard Formulas for White Paint

NEW OUTSIDE WOODWORK

First Coat

100 lbs. pure white lead
4 gal. pure raw linseed oil
1 gal. pure turpentine
1 pt. Japan drier
Makes about 7¾ gal. of paint

Second Coat

100 lbs. pure white lead
1½ gal. pure raw linseed oil
1½ gal. pure turpentine
1 pt. Japan drier
Makes about 6 gal. of paint

Third Coat

100 lbs. white lead
3½ to 4½ gal. pure raw linseed oil
1 pt. pure turpentine
1 pt. Japan drier
Makes 6½ to 7½ gal. of paint

On the sea coast, where paint is subjected to salt air and hard, driving rains, some painters add from 10 to 15 per cent of zinc oxide to the last coat only.

First Coat

100 lbs. pure white lead
2 gal. pure raw linseed oil
2 gal. pure turpentine
1 pt. Japan drier
Makes about 7 gal. of paint

Second Coat

100 lbs. pure white lead
3 gal. pure raw linseed oil
½ gal. pure turpentine
1 pt. Japan drier
Makes about 6½ gal. of paint

Third Coat

100 lbs. pure white lead
3½ to 4½ gal. pure raw linseed oil
1 pt. pure turpentine
1 pt. Japan drier
Makes 6½ to 7½ gal. of paint

For two-coat jobs simply omit the second coat above. On weatherbeaten and very dry surfaces use more oil and less turpentine in the first coat.

First Coat

100 lbs. pure white lead
1 gal. pure linseed oil
3 gal. pure turpentine
1 pt. Japan drier
Makes about 7 gal. of paint

Second Coat

100 lbs. pure white lead
1½ gal. pure raw linseed oil
1½ gal. pure turpentine
1 pt. Japan drier
Makes about 6 gal. of paint

Third Coat

Same as Second Coat for Old Inside Woodwork.

First Coat

100 lbs. pure white lead
1 gal. pure linseed oil
2 gal. pure turpentine
1 pt. Japan drier (if raw oil)
Makes about 6 gal. of paint

Second Coat—Oil Gloss

100 pounds pure white lead
3 to 3½ gal. pure linseed oil
1 pt. pure turpentine
1 pt. Japan drier (if raw oil)
Makes 6 to 6½ gal. of paint

Second Coat—Semi-Flat

100 lbs. pure white lead
1½ to 2 gal. pure turpentine
¾ gal. linseed oil
½ pt. Japan drier
Makes about 5½ gal. of paint

Second Coat—Flat

100 lbs. pure white lead
2½ gal. pure turpentine
½ pt. Japan drier
Makes about 5½ gal. of paint

Third Coat—Full Gloss

3 lbs. pure white lead broken up smooth with turpentine
1 gal. white mixing varnish

Third Coat—Flat Finish

100 lbs. pure white lead from which
the oil has been drawn, as described previously
3 gal. pure turpentine
Makes 5¾ gal. of paint

Use of Zinc Oxide.—The use of half zinc oxide and half white lead for second and third coats makes a harder, finer-textured surface and one which is very white. Zinc bulks more than lead and so a little more oil, turpentine or varnish thinner will be needed, depending upon which coat is being mixed. More gallons of paint will result from the mix, also.

Use of Flatting Oil.—In place of linseed oil, turpentine and mixing varnish, a flatting oil may be used with white lead and zinc for flat and semi-gloss finishes. This paint is suitable for interior wood surfaces as well as for plaster and cement.

First Coat

Mix the same as previously specified
for new or old wood, interior trim.

Second or Finishing Coat—Flat

100 lbs. of white lead
2 to 3 gal. flatting oil
Makes 4¾ to 5¾ gal. of paint

Finishing Coats—Semi-Gloss

100 lbs. of white lead
¾ gal. light mixing varnish
1½ to 2 gal. flatting oil
Makes from 5 to 5½ gal. of paint

Mixing White Paint for Dark Rooms.—When linseed oil mixed with white paint is placed away from strong daylight the paint will turn yellow. To avoid this with white paint and light tints, use flatting oil or use no linseed oil, aside from a very little in the first coat.

For second and third coats, to dry semi-flat, on new or old interior surfaces, mix your paint in these proportions:

100 lbs. of pure white lead
1½ to 2½ gal. pure turpentine
¾ gal. white mixing varnish or white enamel varnish
½ pt. Japan drier

Less turpentine and more varnish will give a gloss finish.

100 lbs. pure red lead (ground in linseed oil like white lead)
1½ gal. pure raw linseed oil
¾ gal. boiled linseed oil

or

100 lbs. pure dry red lead
2¼ gal. pure raw linseed oil
1-1/8 gal. pure boiled linseed oil

Succeeding coats should be mixed the same as the above. If the bright color of red is objectionable, add a pound or two of lampblack ground in linseed oil and about ½ pint Japan drier. After one or two coats of red lead the finishing coats are sometimes mixed from white lead tinted to suit, as per formulas given for old outside wood surfaces.

Metal surfaces to be painted should be washed down with benzine or hot water and sal soda to remove grease and dirt. Loose scales should be removed with steel wire brushes. On tin roofs the seams particularly need cleaning. Do not paint until the metal is dry.

Before painting new galvanized iron a wash should be brushed on to cut the metal enough to permit anchorage of the paint. The wash, which should be brushed on and allowed to dry, is to be a solution of 6 ounces of copper acetate in one gallon of water.

Another suitable wash is made by mixing:

1 quart of warm water
½ ounce nitrate of copper
½ ounce chloride of copper
½ ounce sal ammoniac
Mix above in a glass or earthen jar and then add ½ ounce of crude hydrochloric acid.

Apply the wash with an old flat brush. The white powder which forms when the solution becomes dry should be brushed off before painting. The metal will be black when this wash has been applied.

The use of one of these washes before painting eliminates the likelihood of having the paint scale off.

Galvanized iron which has been subjected to the weather a few months doesn't need this wash.

First Coat

100 lbs. white lead
4 gal. pure boiled linseed oil
1 gal. turpentine
Makes about 7¾ gal. of paint

Second Coat

100 lbs. white lead
4 gal. pure boiled linseed oil
1 pint turpentine

Third Coat

Same as for new outside woodwork.
Flat and semi-flat finishes same as
for old inside woodwork.

Before painting new plaster or cement walls which have not been allowed to age more than 30 days, the causticity of the surface should be neutralized, or it may burn out the life of the oil in spots. Active alkali spots will change the color of some paints, notably tints and shades mixed from chrome yellow. A wash composed of 4 pounds of zinc sulphate crystals dissolved in 1 gallon of water should be brushed onto this surface. When the surface is dry brush off any loose particles with a broom before painting.

NEW PLASTER WALLS

If the walls have not stood for several weeks or months, and painting is to be done immediately, a wash should be brushed on to neutralize any hot lime spots which might burn the life out of oil or cause the paint to discolor. The wash should be mixed by dissolving about 4 pounds of sulphate of zinc crystals in 1 gallon of water. When the surface is dry brush off any powder or dust that may be loose on the surface.

First Coat

100 lbs. of pure white lead
5 gal. pure boiled linseed oil
1 gal. pure turpentine
Makes about 8¾ gal. of paint

Size Coat

In order to save coats of paint it is customary to seal up the surface with a size which should be placed on top of the first coat of paint and not on the bare wall. This is especially important where glue size is used. If glue size, or other water soluble size, is used on top of the plaster instead of between coats of paint, dampness in the walls later may cause the paint to scale off.

It is not wise to seal up the pores of a plaster wall by placing on it immediately a size of gloss oil, hard oil, suction varnish or shellac, because this may make an unstable foundation. It may stand a while, but when the wall has been painted two or three times, scaling may result. Furthermore, should you want to cover the walls in later years with canvas, or other wall fabrics, the fabric will pull off of the surface, bringing the coats of paint with it. When the first coat is oil paint you secure an anchorage in the surface which is very important. The directions for mixing size coats will be found immediately following this section.

Second Coat

100 lbs. pure white lead
1½ gal. pure boiled linseed oil
1½ gal. pure turpentine
Tinting colors
Makes about 6 gal. of paint

Finishing Coat—Flat

100 lbs. pure white lead
2½ to 3 gal. pure turpentine
Tinting colors
Makes about 5½ to 6 gal. of paint

Finishing Coat—Flat

100 lbs. pure white lead
2 to 3 gal. of flatting oil

Finishing Coat—Semi-Flat

100 lbs. pure white lead
1½ to 2 gal. pure turpentine
¾ gal. white enamel varnish, or
1 gal. pure boiled linseed oil
Tinting colors
Makes 5 to 5½ gal. of paint

Finishing Coat—Semi-Flat

100 lbs. pure white lead
¾ gal. white enamel varnish
1½ to 2 gal. flatting oil

Finishing Coat—Gloss

100 lbs. pure white lead
3½ to 4½ gal. pure boiled linseed oil
1 pt. pure turpentine
Tinting colors
Makes 6½ to 7½ gal. of paint.

If the new wall has been covered with canvas, use the above formulas also.

OLD PLASTER WALLS

Mix your paint for old plaster walls, and canvas covered walls which have been painted before, the same as specified for new plaster walls, omitting the first coat and the size coat.

Glue Size

The use of a glue size on top of the first coat of paint is quite a general practice. It stops suction of dry and porous spots. This is not a good practice, however. Another coat of paint makes a better foundation than glue size and costs very little more.

When glue size is to be used it should never be mixed strong. A strong solution of glue and water will certainly cause paint to crack and scale off. In mixing the size soak first class glue in water for two or three hours; simply add enough water to submerge the glue.

Next boil the glue and water, stirring it enough to prevent its sticking to the bottom of the pail. When the glue has come to a boil, add enough hot water to it to make it very thin. No exact proportions can be given, because different brands and grades of glue vary considerably in strength. The glue size should be just strong enough so that it will feel slightly sticky on your fingers after they have been dipped in and allowed to dry. It is much better to have your size too weak than too strong.

Varnish Size

A better size than that made from glue is mixed from first class interior varnish—coach or spar, thinned with turpentine and to which you add enough of the paint mixed for the finishing coat to offset the brown color of the varnish.

This size should be very thin. It will stop the suction of the wall and serve, to some extent, as a covering or hiding coat. The varnish size should be spread on after the priming coat. It should not be mixed too rich or it will dry with a gloss.

Varnish size should not be made from the cheaper suction, or ceiling varnishes, nor from gloss oil or hard oil. These products are simply mixtures of rosin and benzine, usually, and they do not make a satisfactory foundation for paint or canvas.

Sizes containing gloss oil may remain soft and tacky for quite some time; they may disfigure the paint and sometimes the rosin works up through the paint and remains tacky. Wall paper, muslin, canvas and burlap cannot be made to adhere permanently to walls coated with gloss oil sizes.

There are, however, some special brands of wall size prepared by manufacturers which have considerable merit and are satisfactory.

Varnish sizes of any quality should not be used on sand-finished or rough-stucco walls. Glue, soap and sugar sizes are better for these surfaces.

For wall board a first class varnish size is better than a glue size and, generally speaking, high class varnish size is to be preferred, because it not only stops suction and seals up the pores but also serves as a coat of size and a coat of paint together. Varnish size is water proof and, while it may be spread directly upon the plaster, it is really better to place it between coats of paint.

Oil and Glue Size

Hard finish and rough stucco interior walls are quite popular and probably always will be, because of their artistic merit. Such walls often have considerably more suction than smooth plaster walls. To seal up the suction on such surfaces before painting a good size may be mixed as follows:

A quantity of first class gelatine glue should be melted in hot water and brought to a boil. When the glue is about as thick as paint ready for the brush, add one gallon of raw linseed oil which has been previously made hot. A little dry color may be added to the size to bring it around to approximately your finished color, being lighter preferably.

Next cut up a bar of yellow laundry soap into thin slices and stir them into the hot glue and oil solution until they are thoroughly dissolved. This mixture can now be thinned with hot water to the right consistency for sizing.

The size should be a little thinner than cold linseed oil and, yet, somewhat thicker than glue size. It is better to brush this size onto the walls while it is warm. The walls should be first brushed down with a broom to remove loose sand.

A size mixed in this manner is water proof and will stop the suction of a wall sufficiently to permit finishing with two coats of paint. This size should be put on to the plaster and not between coats. Oil and glue size is not suitable for smooth plaster walls.

Sugar Size

A wall which has been coated with gloss oil size and which is to be covered with canvas, muslin, burlap or wall paper must be given some preliminary treatment. The gloss oil size can be scrubbed off, using strong sal soda water, hot, but this is a slow and tedious process.

The common practice is to give the wall or ceiling a coat of paint mixed largely with turpentine to dry flat and tinted to suit. When the paint is dry a coat of sugar size puts the surface in condition to be covered with fabrics or wall paper with reasonable assurance that the coverings will adhere to the surface.

Sugar size is mixed by adding dark brown sugar to water. Just enough sugar is put into warm water to make the solution slightly sticky. The strength of the solution should be tested by dipping the fingers into it and allowing them to dry. On top of this the paste for wall paper or canvas will gain good anchorage.

FORMULAS FOR WHITE ENAMEL

100 lbs. pure white lead
8 to 4 gal. pure boiled linseed oil
2 gal. pure turpentine
Makes 7¾ to 8¾ gal. of paint.

Allow at least twenty-four hours for drying; putty nail holes; sandpaper when the putty is dry and wipe off dust from the surface.

Second Coat

100 lbs. pure white lead
1½ to 2 gal. boiled linseed oil
1½ gal. turpentine
Makes about 6 gal. of paint.

Or the second coat may be mixed this way:

100 lbs. pure white lead
2 to 3 gal. of flatting oil

The second coat is to be rubbed down smooth with fine sandpaper after it has been allowed to dry at least 24 hours. Wipe the surface clean to remove dust.

Third Coat

50 lbs. pure white lead
50 lbs. pure zinc oxide
3 to 3½ gal. turpentine
1 qt. white enamel
Makes about 7 to 7½ gal. of paint.

Or, the third coat may be mixed this way:

50 lbs. pure white lead
50 lbs. pure zinc oxide
3 to 4 gal. of flatting oil

Allow the third coat to dry twenty-four hours or longer. Sandpaper very lightly with fine paper or steel wool and wash up with a cloth dampened with benzine to remove dust.

Fourth Coat

First class prepared white enamel should be used as it comes to you in the manufacturer's can, or thinned slightly with 1 pint of turpentine per gallon of enamel. The turpentine should be well mixed into the enamel, using an absolutely clean paddle. The room should be warm and the enamel not colder than 70 degrees, for proper brushing qualities. At least 48 hours should be allowed for drying and a longer time is of considerable advantage. This coat should be rubbed very lightly and evenly with No. 00 sandpaper, steel wool, or a wad of horse hair for rubbing will be sufficient if the surface is very clean and smooth. Wash up, being especially particular to make everything clean and ready for the final coat.

Fifth Coat

High class prepared enamel should be used for this coat, without thinning. It should be not colder than 70 degrees temperature. Flow the enamel on with a full body, but being careful to lay it off so that there will be no runs, sags or wrinkles. It is better to brush it out too thin than to put it on too thick and to have it run and sag. You cannot spread enamel out like oil paint. It must be flowed on. Diligence and watchfulness, as well as extreme care in brushing, are essential. Once an area has been coated with enamel and the material laid off, you should not go back to it or you will cause a roughing or piling up of the material. Enamel will level itself and flow together, so there need be no worry about brush marks.

The enamel used may be of the kind that drys with a full gloss or you can purchase what is called eggshell gloss, or satin finish, enamel to give a semi-flat hand rubbed appearance.

See Chapter XI for mixing colored enamels.

Using Paint Brushes.—The correct way to hold and use a paint or varnish brush depends somewhat upon the material being spread and upon the character of the surface. Nevertheless, the brush should be held in the hand so as to allow a free and easy wrist motion as well as good arm action. The brush should not be grasped tightly, rather a light firm hold upon it will best serve your purpose. Your fingers must, naturally, be used to brace and support your hold, but the fingers should not extend below the metal ferrule or leather strap with which the brush is bound. With the fingers held too low on the brush there is a tendency to exert more pressure on the center of the brush and will, therefore, wear into a shape which resembles a fish tail. High-class brushes are so constructed that the bristles are properly distributed, and when a brush gets out of shape and wears more in one part than another, it is because the brush has been improperly used.

One of the most common misuses of paint brushes occurs with oval and round paint and varnish brushes. Unless a mechanic is careful he will allow the brush to turn in his hand in a circular fashion more or less and that will wear the bristles so that the whole brush body will have a pointed shape. In that condition the brush is quite useless until the shape is trimmed or worn again so that all of the bristles are of the same length except a few on each side to give it a chisel shape, as some brushes are made.

In the case of flat wall brushes, the manner in which they are commonly injured is that of using a 4 or 4½-inch brush to paint narrow strips of trim or other narrow surfaces. When any except large flat surfaces are to be painted it is the part of wisdom to change brushes, using a small sash tool for the narrow surfaces. When a large flat wall brush is used on narrow surfaces the corners of the bristles are soon worn off and then the brush is almost useless for any except rough work. When using any brush the tip or flag ends of the bristles are intended to do the work, the brush should not be inclined too much so as to force the sides of the bristles to do the work. Brushing with the sides of the bristles wears the outer layers until they are shorter than the center bristles. That is a bad shape for a brush.

When a brush is properly used all of the bristles will wear down evenly, and when a brush gets into a bad shape it is evident that the mechanic using it has some bad habits which should be corrected. The appearance and shape of a brush is usually a pretty fair indication of the knowledge of the painter or decorator using it.

One of the bad habits to be avoided in the use of any brush is that of poking a large brush at a corner or crack. Such a practice bends or turns over the flag ends of the bristles and soon makes the tool unfit for careful work. A brush in this shape spatters more or less and, generally speaking, does sloppy work. In painting carved surfaces, grills and ornamental iron work it is well to get into the corners.

High-class brushes are well worth all they cost. Cheap, poorly made brushes cannot be depended upon to do good work and, furthermore, their life is short as a rule. It is only with a first-class brush that paint can be spread out and laid off smoothly and it is only with such brushes that clean sharp edges can be cut up close to moldings and on window sash bars.

In the manufacture of high-class brushes an honest effort is made to remove loose hairs and dust, but even in the best of brushes both will sometimes be noted. A few loose hairs in a new brush do not indicate necessarily that the brush is not well made. It is wise to spend a few minutes cleaning up a new brush by passing it over your fingers to remove loose bristles and dust and finally by washing it in benzine. Do not attempt to jar out loose bristles and dust by pounding the handle of the brush on a board; that will do serious injury. It is well to begin the use of new brushes on work which is not so particular and when they have been broken in well, use them for finishing coats.

A new brush should be well worked into the paint, varnish or enamel by dipping it only deep enough to cover about half the length of the bristles. Then scrape the paint out on the mixing paddle and repeat this operation several times.

When your brush is ready for use dip it into the paint, not more than about an inch on a four-inch brush, then slap it against the inside of the pot lightly and carry the brush to the surface to be coated. Do not dip the brush too deeply into the material, as nothing will be gained by it and you will thus avoid having the paint creep up on to the ferrule and handle. Every brush has a certain capacity for holding material, just as a sponge will hold only so much water. The bristles in a paint brush have little spurs at the bottom which are forked and which pick up and hold the paint. An overloaded brush really slows up rather than hastens a painting job. First-class brushes are made with these flagged-end bristles, which are distributed back from the outer surface bristles, and some of the flagged-end bristles are longer than others, so that as the brush wears on the tip, new flagged-end bristles will come into use all during the life of the brush. There is much more to the construction and manufacture of good paint brushes than is apparent on the surface. For instance, if a brush is made with all the flagged-end bristles the same length it is a toppy, full-faced brush which would seem to have a great capacity for carrying paint, but as a matter of fact, this kind of a brush is a nuisance because it leaks paint badly when working on ceilings or high places. The bushy flagged-end bristles do pick up quite a quantity of paint, but as soon as the brush is raised overhead the paint runs down the smooth bristles, over the ferrule and down the handle, with much spattering as a result.

After all, nothing but experience in the use of a brush will teach correct methods, but if the correct idea is held in mind, skill will come much more quickly. Paint is supposed to be brushed into the pores of the wood and laid off smoothly, but, on the other hand, if you "ride" the brush, as the painters call it, too much energy will be spent and the brush will be injured. What you want to develop is a free and easy stroke with an even pressure along the wrist to do most of the work. The paint should be roughly spread on to the surface first and then brushed out the length—not across the grain of the wood. Then it should be gone over with a few light quick strokes to lay it off evenly and to pick up any runs of excess paint. Excess paint or fat edges around corners, moldings and edges of boards are particularly to be brushed out evenly.

The brushing of varnish, shellac, enamel and flat wall paint requires quite different action than is needed for brushing out paint. In the case of paint, you have a rather thin easy-working material which can be brushed and rebrushed almost indefinitely when most of the liquid part of the paint is oil. When a large proportion of the paint liquid is turpentine the paint is "short;" that is, you cannot stretch the paint film so far. If you brush it too long the film will rough up and the pigment will pile up, leaving brush marks and rough places. In the case of brushing varnish, enamels, shellac and flat wall paints, the brushing must be done with a minimum of strokes. In using these latter materials a brush full of paint is to spread upon a small area, often only about one square foot at a time, and then you must lay it off and smooth up quickly. Once this has been done the brush should not be again put upon this finished area. These materials set rather quickly and when you go back to them after once finishing you lift and rough-up their surface. Brush marks might appear immediately after you lay-off such a surface, but these brush marks will disappear of their own accord.

CHAPTER IX
COLOR THEORY, PRINCIPLES AND USE

Much that has been written about color theory leaves one in a confused state of mind. This occurs, probably, because after a consideration of what constitutes color—light ray reflections, the spectrum and the chromatic circle, the relation between the pure spectrum light ray colors and the color pigments used in painting and decorating is not explained.

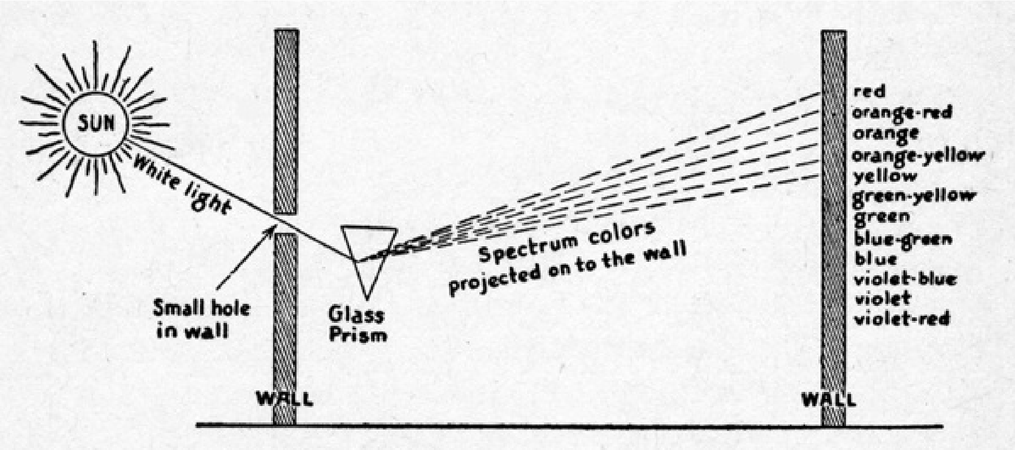
Good theory will practice. Color theory is capable of being used in everyday work, once this missing link between color theory and color use is understood.

Color has been described in Chapter I as the property of light rays which causes visual action on the retina of the eye; the reflection of light rays and their effect on the eye.

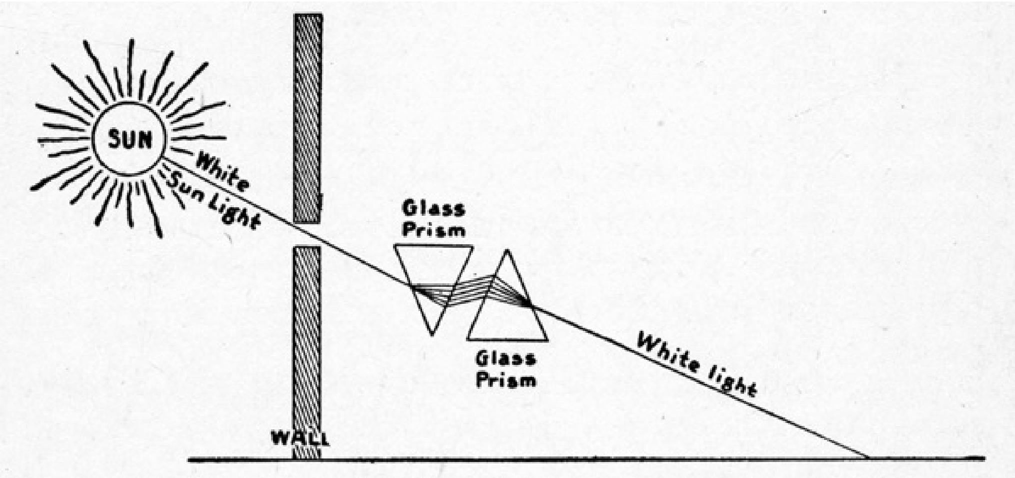
The white light rays of the sun are composed of many colored light rays. Also the white rays of the sun contain the ultra-violet rays used by the medical profession today and they are invisible.

Sir Isaac Newton discovered that the color of any substance is due to the light which falls upon it. By removing the source of light any substance loses its color identity; as when a red painted board is taken into a dark room. Altering a light which falls upon an object changes its color—passing white light through a yellow glass, for example, and holding a blue object in the transmitted light, the blue surface appears green.

When white light, daylight, passes through a glass prism, we find by placing the prism at a certain angle that the reflected or transmitted light is split up into bands of several colors. These are called violet, blue, green, yellow, orange, red. Plate 7 illustrates Sir Isaac Newton's experiment.



White light rays separated into colored light rays by a glass prism and projected upon a wall in a dark room.



Spectrum light ray colors reflected back into a straight line of white light by a second prism.

Plate 7.—Sir Isaac Newton's Experiment demonstrating that white light is composed of colored light rays Chromatic Circle.

If, by means of a second prism, we gather the various colors together and reflect them back into a straight line, then we have again a projection of white light.

In consequence of this peculiarity, when a white light falls on any substance it is either entirely or partially reflected or entirely or partially submerged or absorbed.

Surfaces which reflect all of the sun's light rays appear white.

Surfaces which reflect none of the sun's rays appear black.

It is reflected light rays which give a surface its color. A surface which absorbs yellow and blue rays appears red because it reflects red rays. If some of the yellow rays are reflected with the red rays the surface will be orange; if some of the blue rays are reflected with the red rays the surface will be violet or purple.

No surface reflects only one color of light rays. For that reason no pigment paint colors are as pure as the light ray colors seen in the spectrum.

COLOR PIGMENTS TO MATCH SPECTRUM COLORS

But since we cannot paint with light rays a question arises as to which of the color pigments available to painters and decorators for commercial work most nearly represent the pure colors shown in the spectrum of the rainbow and the same spectrum seen in a glass prism.

There are no color pigments which match perfectly the pure light ray colors of the spectrum. That may account for the discrepancies between color theory and color mixing.

We have, however, ample color pigments which are near enough to pure light colors to make it practical and wise, indeed, for painters, decorators and all who work with color to study and become proficient in color theory.

Pure Red Spectrum Light Rays.—The red color pigment which is nearest to this is American vermilion. Its slight imperfection comes from the fact that it possesses a bluish hue. English, French and Chinese vermilions are slightly too yellowish in hue and are more expensive.

Scarlet vermilion is another red pigment which approaches pure spectrum red light rays, but it is even more yellowish than English vermilion.

Crimson lake pigment is near the pure spectrum red. It is imperfect because it has a bluish hue.

Indian red color pigment is not so near the spectrum red because it is too dull in tone and has even a more pronounced bluish hue than crimson lake.

Venetian red is both too dull and too bluish in hue to match pure spectrum red.

Pure Blue Spectrum Light Rays.—Prussian blue is a color pigment which is a near match to spectrum blue. It is not a perfect match, owing to its greenish hue.

A pure toned cobalt blue is quite the nearest match for and most representative of spectrum blue; but it, too, may have a greenish hue or a reddish hue, depending upon how it is manufactured.

Ultramarine blue is not so good a representative for the spectrum blue because of its reddish hue.

Pure Yellow Spectrum Light Rays.—A color pigment which nearly matches the pure spectrum yellow is light chrome yellow. Its imperfection is due to its slightly greenish hue.

Lemon chrome yellow pigment is near pure spectrum yellow but it has too much of a greenish hue.

Medium chrome yellow is the best color pigment representative for the spectrum yellow. It has a reddish hue which constitutes its imperfection as a perfect match.

Orange chrome yellow is a color pigment which is too reddish in hue to match pure spectrum yellow. It is too yellowish in hue to match pure spectrum red.

Primary Colors

These are red, blue and yellow and are best represented in pigments by American vermilion, cobalt blue and medium chrome yellow. Primary colors are the principal colors into which white light rays are separated by a prism, the dominant colors seen in the spectrum of the sun in the rainbow.

The primary colors red, blue and yellow cannot be made from mixtures of other color pigments.

From combinations of the primary colors, and with the addition of black and white to make shades and tints, nearly all colors can be mixed using color pigments.

White is the absence of all color, while black is produced when the three primary colors—red, blue and yellow pigments—are mixed together.

A difference between color theory and color mixing practice is the fact that when the primary colors in light rays are fused together white light is the result (as proved by Sir Isaac Newton's experiment). While in the fusion of color pigments the primary colors red, blue and yellow mixed together produce black, or very dark blackish-green.

Secondary Colors

When two primary colors are mixed together the color thus produced is a secondary color:

Red and blue mixed together make purple, or violet.

Blue and yellow mixed together make green.

Yellow and red mixed together make orange.

Study the color card chart to learn how this works out.

Tertiary Colors

When two secondary colors are mixed together the color resulting is a tertiary color:

Purple mixed with green makes olive.

Green mixed with orange makes citrine.

Orange mixed with purple makes russet.

Examine the color card chart in this chapter to note this result.

Complementary Colors

These are the colors which show the greatest contrast with the secondary colors. They are their opposites in colors.

When two primary colors are mixed together the result is a secondary color; then the third primary color not used in mixing this secondary becomes the complement, or perfect contrast, to the secondary color.

Consequently, when red and blue are mixed to produce purple, yellow being absent from the mixture becomes the complementary color of purple.

Likewise, when blue and yellow are mixed to produce green, red is not used in the mixing; red is the complementary color and perfect contrast for green.

Yellow and red primary colors are mixed to produce orange; blue is not used in the mixture and so it becomes the perfect contrast for orange.

By the same mathematical progression olive becomes the perfect contrast for and complementary to orange; citrine becomes complementary to purple; russet becomes complementary to green.

White is the exact opposite and the perfect contrast for black.

The use of opposite colors, contrasting complementary colors, is one of the most simple and certain ways to produce color harmony.

Some of these colors are much stronger, more intense, than others and consequently equal areas of contrasting colors should not be used. Small areas of the stronger colors will balance large areas of the less intense colors.

Each of the complementary colors, when placed along side of its opposite complementary, intensifies the other;—red seems redder and green seems greener along side of each other. The same increased intensity is noticeable as between purple and yellow as well as between orange and blue and other complementary colors.

Color harmony by contrast is well illustrated, therefore, by this tabulation:

COLORS MIXED TOGETHER	COLORS RESULTING	COMPLEMENTARY COLORS PERFECT CONTRASTS
red and blue	purple	purple and yellow
blue and yellow	green	green and red
yellow and red	orange	orange and blue
purple and green	olive	olive and orange
green and orange	citrine	citrine and purple

orange and purple	russet	russet and green

There is only one green that is complementary to any one red; there is only one yellow that is the direct complement of a given violet; there is only one blue that is the perfect complementary contrast of a particular orange. Now, we should not go so far as to say that a color of slightly different hue will look badly, but it will not be in perfect harmony unless it is the color which is in the exact contrast relation.

The green which is the perfect contrast for red (English vermilion) is a bluish-green; the perfect contrast for greenish-blue (Prussian) is a yellow-red orange; the perfect contrast for yellow (light chrome yellow) is a purplish-blue.

One way to prove a complementary color is by the after image in one's eyes. If you will look steadily at a spot of any intense color on a white surface for a minute or two, the image of that color will be fixed in your eyes; then, without shifting the eyes from that color spot, cover the color with a piece of white paper. The complementary color of that color will appear on the white paper as an after-image.

Selection of the perfect contrast for any color is simple. The chromatic circle shown in Plate 8 is an arrangement of the spectrum colors. The complementary or perfect contrast for any color is that color which is immediately opposite in this chromatic circle.

The color which is in perfect harmony by contrast for violet-red is yellow-green; the perfect contrast for violet-blue is orange-yellow; the perfect contrast for greenish-blue is red-orange.

And to neutralize one of these colors you would add a touch of the other, its complementary. If a color and its complementary color are mixed together in about equal proportions a black will result, or at least a very dark gray-green, depending upon the purity and strength of the colors.

COLOR TERMS

A Tint.—A degree of color resulting from the addition of white to a principal color; a more luminous and lighter color. A lighter tint of blue, for example.

A Shade.—A degree of color resulting from the addition of darker color or black to a principal color. A darker shade of green, for example. When two colors have the same hue, but one being darker than the other, the darker color is a shade of the lighter color.

Hue.—The quality of a color which distinguishes it from all other colors. It is the slight change made in a color by the addition of a small quantity of another color. A blue like ultra-marine has a reddish hue; while Prussian blue has a greenish hue. The original color in a mixing predominates still, the color added to it simply influences it to a small degree,—that small degree is the hue.

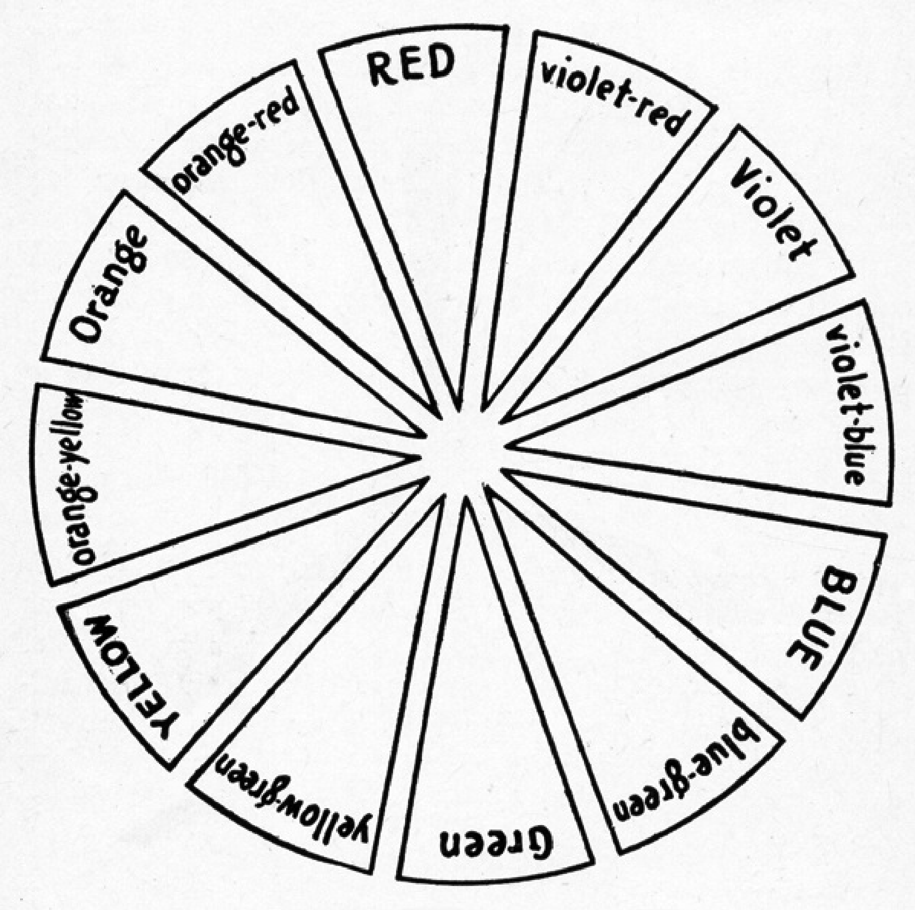


Plate 8.—Chromatic Circle

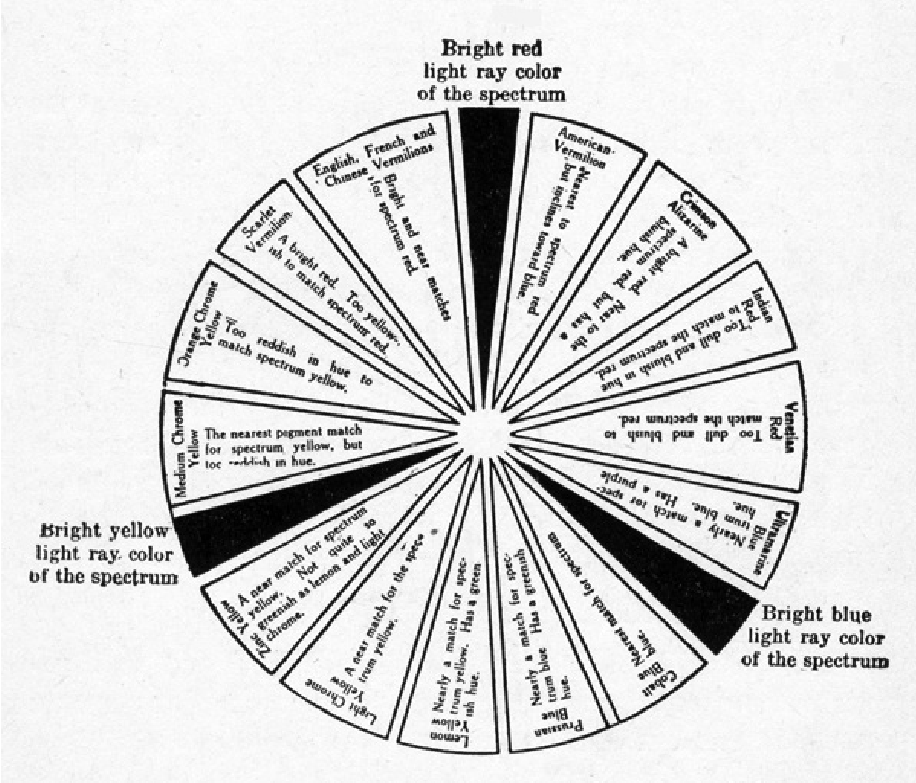


Plate 8.—Color Pigments to Match Spectrum Colors

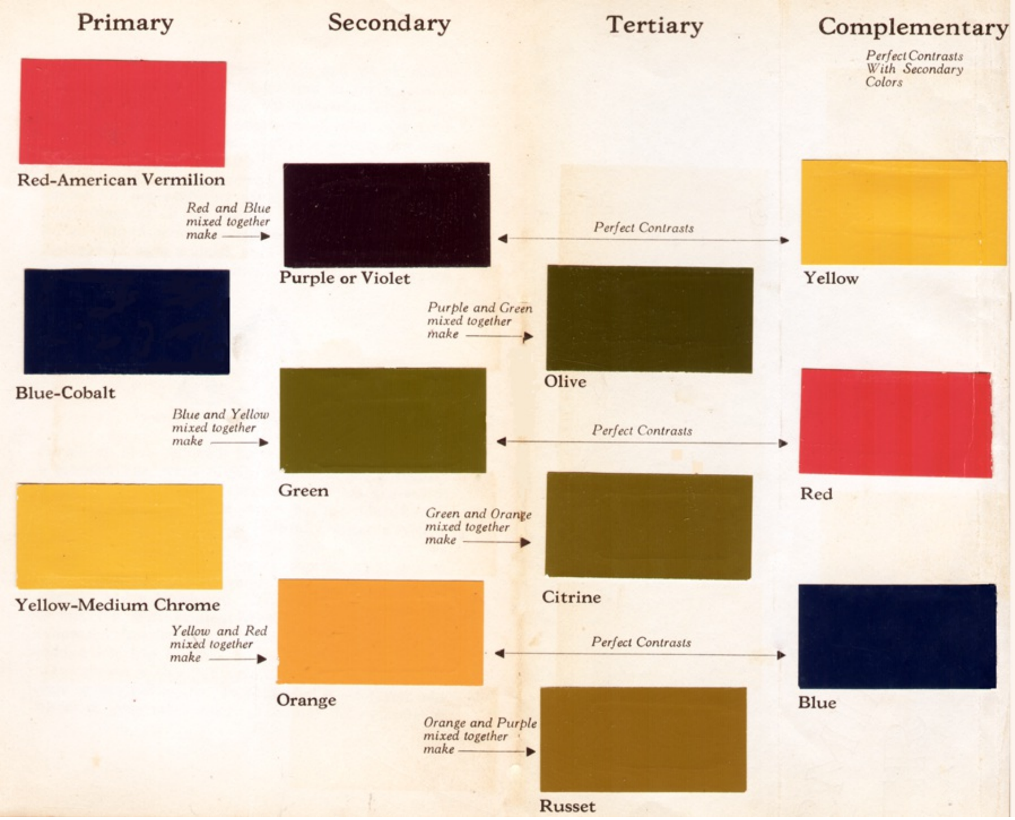
Dominant hue.—The hue which is most conspicuous in any color.

Tone.—The brightness or luminosity of a color. A color is lighter or darker in tone according to the amount of light reflected.

Pure Colors.—Those having the least amount of white or black in them. White tends to neutralize, subdue and sadden colors.

It is interesting to note that the spectrum fails to connect violet and red by several intermediate hues as it connects other colors. A series of red-violets and violet-reds are needed to complete a color circle which is continuous.

In this circle the change of hue is gradual from red through orange-red and red-orange to orange; then from orange through yellow-orange and orange-yellow to yellow; and from yellow through green-yellow and yellow-green to green; thence from green through blue-green and green-blue to blue; from blue through violet-blue and blue-violet to violet; and finally from violet through red-violet and violet-red,—the point of beginning the color circle.


Primary
Secondary
Tertiary
Complementary
Perfect Contrasts With Secondary Colors
Red-American Vermilion
Red and Blue mixed together make
Purple or Violet
Perfect Contrasts
Yellow
Blue-Cobalt
Purple and Green mixed together make
Olive
Blue and Yellow mixed together make
Green
Perfect Contrasts
Red
Yellow-Medium Chrome
Green and Orange mixed together make
Citrine
Yellow and Red mixed together make
Orange
Perfect Contrasts
Blue
Orange and Purple mixed together make
Russet

EXPLANATION OF COLOR CARD CHART

The color cards in this chapter are included to illustrate how the science of light ray color reflections proves practical and useful as applied to color pigments.

The pigment colors used in this mixing experiment were from one of the best lines on the market and are those in common use by painters, decorators and artists.

A study of these color cards, at the same time comparing them with the light ray colors projected by a glass prism, will make evident the discrepancies between the fusion of colored light rays in the spectrum and the mixing of color pigments. These differences exist because man has not yet discovered, or manufactured, color pigments of the same purity and which match perfectly the colored light rays seen in the spectrum. Right here in such a study the possession of a small glass prism to project a spectrum of color rays from the sun's white rays is well worth the seventy-five cents it will cost you. (Plate 9.)

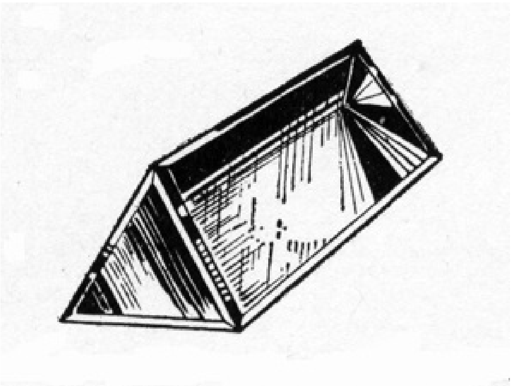


Plate 9.—Glass Equilateral Prism

These discrepancies between color theory and color mixing are not confusing after one learns the characteristic hues of all the common color pigments; for instance, that American vermilion, crimson lake and Indian red all have a bluish hue; while scarlet vermilion, English, French and Chinese vermilions and orange chrome all have yellowish hues; that Prussian blue has a greenish hue, while ultra-marine blue has a reddish hue; that light or lemon chrome yellow has a greenish hue while medium chrome yellow has a reddish hue.

Knowing these hues you naturally select a yellow with a greenish hue and a blue with a greenish hue for mixing bright, vivid greens; likewise, when mixing purples and violets you chose a reddish blue (ultramarine) and a bluish red (American vermilion); and to mix the most brilliant orange color the brightest yellow-red (scarlet vermilion) with a yellow having a reddish hue like medium or orange chrome yellow.

In careless mixing you have illustrations of the principle of neutralization. To neutralize a color you add white or some other color, preferably its opposite or perfect contrast. So, you neutralize and mix a dull, subdued green when you select instead of greenish yellow (lemon) a reddish yellow (medium chrome); and instead of a greenish blue (Prussian) a reddish blue like ultramarine. The reddish hue of the medium chrome yellow and of the ultramarine blue are opposite to the bright green you want to mix and these reddish hues neutralize and dull the green.

Mixing Purple and Violet.—To illustrate these discrepancies further examine the purple color card. This color resulted from mixing American vermilion with cobalt blue. It is not a bright, vivid purple because neither the red or the blue from which it is made are perfect matches for red and blue spectrum light ray colors.

If white is mixed with this purple to make a lighter purple, the tint resulting will be lighter (violet) but the white will neutralize or gray it. A lighter purple can be secured by first painting a surface white and then spreading a thin glaze coat of the purple over it.

A purple or violet which is not so dark can be mixed from English vermilion and ultramarine blue. If crimson lake and ultramarine blue are mixed together a purple results which is quite as dark and which will have a bluer hue. If white is mixed with either of these purples to make a lighter color very interesting purple and violet tints result, but they, too, will be neutralized or grayed off by the white.

Mixing Greens.—The green resulting from the mixing of cobalt blue and medium chrome yellow in this experiment is not so bright and attractive as the green most prominent in the spectrum. The most brilliant greens can be matched by mixing Prussian blue with light or lemon chrome yellow or zinc yellow; that is, by mixing a greenish blue with a greenish yellow.

Medium chrome yellow was selected by the author to represent the spectrum yellow because it makes better orange colors. Lemon chrome yellow and American vermilion mixed together produce a dull terra cotta red—not a bright orange.

THE NEW COLOR THEORY

Color theory as it particularly refers to spectrum light ray colors has not been dealt with to any extent in this work because it has not been the intention to present advanced considerations in the science of color.

The old school of color scientists, notably Newton and Brewster along with others, considered the primary colors to be red, blue and yellow, the secondary colors to be purple, green and orange. According to their theory green is the complementary or the perfect contrast for red, orange is complementary to blue and purple is complementary to yellow. The average person has learned color theory in this manner and the mixing of color pigments in the arts and crafts and commercial fields has proceeded on this basis.

The color scientists of today, and particularly Munsell, do not accept red, blue and yellow as the primary colors. Their experiments with light ray colors separated from sunlight by the spectrum prove that the primary colors are red, green and violet-blue. In this modern theory the complementary color of red is blue-green, the complementary color of green is red-purple and the complementary color of violet-blue is yellow.

According to the modern theory green is not produced by the mixture of yellow and blue light rays as it is produced when mixing pigments; green is a fundamental primary color which cannot be produced by mixing any other light ray colors.

On the other hand, yellow, according to this theory, is not a primary color but is caused by the mixture of red and green light rays.

In this new theory the yellow-reds, yellows and green-yellows can be produced by mixing certain proportions of red and green light rays. The blue-greens, blues and purple-blues can be produced by the mixing of green and violet light rays. Purple-blue, purple and red-purple can be produced by the mixing of violet and red light rays.

In other words, according to the modern theory, there are no mixtures of light rays which will produce red, green and violet-blues and these are, therefore, the primary colors. From these three all other light ray colors are produced by mixing.

Within the scope of this book it is not wise to include the whole theory of light ray spectrum color mixtures and a consideration of the physics of color. For those who wish to pursue the study of color at length time can profitably be spent in the study of the Munsell theory as well as other modern views which have been adopted as working principles in the printing ink industry.

CHAPTER X
COLORED PAINT MIXING METHODS

Art in decorating is based upon the ability of a craftsman to mix color hues, tints and shades from principal tinting colors exactly to suit the needs of his problem. Nothing short of study, diligent pursuit of the subject, and experience will develop masterful skill in color mixing. And after acquiring such skill the craftsman must then forget, as a mere tool, as a means to an end, his knowledge of the technicalities of mixing colors and apply himself whole-heartedly to expression of beauty in color use.

The mixing and matching of colors comes naturally enough to some, but others can become accomplished by a study of color principles most of which are simple.

Adding the Colors.—For mixing light tints and moderately dark shades of paints, the white paint mixing formulas in Chapter VIII are useful. To the white paint made by these formulas you simply add enough tinting colors (ground in oil) to produce the tints or shades wanted.

Tinting colors should be mixed with a little turpentine or linseed oil in a separate pot and strained before they are added to the white paint. The color should be mixed into the white paint only a little at a time and should be thoroughly stirred to take their full effect before you decide that more color is needed. If too much color is added it will take a considerable amount of additional white paint to make the color light enough again. If your mixing is not thorough the paint will show dark streaks on the surface when brushed out.

It is well to test your batch of paint for color by brushing it out on a board and then noting whether it is too light or too dark to match the sample you are working to. The color in the pot always looks darker than when brushed out on a flat surface.

Dry tinting colors such as are used for tinting calcimine and putty are not to be used for tinting paint. If added to liquid paint, dry colors do not readily become assimilated and they may make the paint lumpy or gritty.

If dry colors must be used in an emergency, they should first be mixed with oil and thoroughly knifed out on a slab to incorporate the oil before adding any color to the paint. Even with such precautions, paint tinted with dry colors must be strained with unusual care, and there will be more or less waste.

Dark Colored Paints.—In mixing very dark colored paints such as chocolate brown, dark reds, greens and blues, little or no white lead or zinc are used. When only small amounts of these colors are needed, the most convenient way to mix them is by using the regular color pigments made for tinting white paint, but when a number of gallons of dark paint are needed it is more economical to purchase such colors in the form of ready-mixed paint.

High-grade tinting colors are necessarily stronger in tinting quality than dark colored prepared paints which are not made for tinting purposes. If you use tinting colors in quantities, you are therefore wasting this strength to no purpose. Paint manufacturers are able to mix the dark colors in a less expensive way, and it is cheaper to use these when quantities are wanted. Manufacturers use for this purpose chemically pure tinting colors with less expensive basic pigments which are not commonly available for painters' use.

It has been suggested by some of the older generation of decorators that students of color mixing should make up samples and keep a card record of various tints and shades made from tinting colors. Granted that this is valuable practice in mixing and is worth while for that reason. There is not, however, much likelihood that such a card index would be referred to or be handy when and where wanted under present working methods, which require the decorators to work away from the shop most of the time.

The important thing is for the students to do enough practice mixing with each of the principal tinting colors mixed with white and black bases and with each of several other principal tinting colors to become thoroughly familiar with the tinting strength and characteristics of each of the principal tinting colors. When such a study has been made the student soon acquires the ability to analyze a color sample easily when viewed in good light and to judge it accurately as to the color used in mixing such a sample. Such an analysis and remembering the characteristics of each of the principal tinting colors enable one quickly to duplicate a color sample.

Study, experiment and practice in mixing tints and shades from principal colors soon teach the student such important facts about color harmony as are set down in the pages which follow.

Experimental Mixing.—The theory of color mixing has now been presented sufficiently to enable the student to learn more quickly by actual practice work with colors than by continued study of principles. To present adequately the broad field of the influence of color and color mixing in their many phases requires the effort of a lifetime. The subtle influence of color and light in decoration and the principles involved constitute a science which will take the best efforts of any man for many years before mastery will have been acquired.

To make a beginning with experimental practice mixing where the student has not the available facilities of a first-class paint shop and its mixing bench, the following materials should be purchased. Diligent and careful use of them will soon make one proficient in mixing:—

Scales, druggist type	Yellow ochre
Glass graduate measure	White lead (or flake white)
Pots, cans or paper drinking cups	Zinc oxide
Mixing paddles	Raw sienna
Palette knife	Burnt sienna
Putty knife	Vandyke brown
Strainers	Medium chrome green
Glass mixing slabs	American vermilion
Lampblack	Tuscan red
Prussian blue	Indian red
Cobalt blue	Linseed oil
Ultramarine	Turpentine
Raw umber	Japan drier
Burnt umber	Benzine
Venetian red	Wiping rags
Light chrome yellow	Wallboard panels
Medium chrome yellow	Small flat brushes
Orange chrome yellow	

(Above colors to be ground in oil)

There are many other colors which should be experimented with, but the above are the principal tinting colors used in mixing exterior paints. For a complete list of tinting colors see Chapter IV.

With these materials on hand, proceed to mix up very small amounts of color by placing on the glass mixing slab a bit of color paste—not more than the size of a pea to begin with.

In mixing little gobs of these paste colors on the plate glass slabs the palette knife is used. Then to note the transparency or opacity of the colors when spread out into thin coats, as will be done when paints are brushed on, just dip your finger into the paste and carry the paint to a piece of white cardboard or a surface painted white. By daubing the paint on and rubbing it out thin with your finger, you will gain a good idea of the hiding qualities or the transparency of colors. See Plate 10.

Plate 10.—Method of Examining Color Sample

Test out the mixing of secondary and tertiary colors as given in the color chart. Red and yellow make orange, so start with a bit of vermilion and add to it a bit of medium chrome yellow. You will note that the orange is brilliant. Then if you will mix a bit of dull red, like Venetian red, with medium chrome yellow or even with the light chrome yellow, you will see that rather a dull orange results.

In this same manner proceed to test out the theory that yellow and blue produce green. Take notice that the brightest green comes from the mixing of light chrome yellow and Prussian blue. Next try mixing other yellows and blues and note the result.

The next principle taken from the spectrum chromatic scale is that blue and red produce purple. Mix a bit of American vermilion with ultramarine blue and you have a bright, vivid purple. Next try mixing a dull red, such as Venetian red, with a greenish blue like Prussian, and you have produced a dull purple which is not nearly so interesting.

Continue this series of mixing to prove that a mixing of orange and green results in citrine; that green and purple make olive; that purple and orange produce russet.

When these practice mixings have been made and the findings clearly noted in your mind, another series of mixing might be made to advantage in this way. Take each one of the tinting colors and add a very small amount of white; then add more white and, later, still more, to note the various tints produced.

Next follow the same procedure exactly, but add black to the color, a little bit at a time, to see the shades of that color which result.

To continue the practice mixing after the above series have been completed and learned, begin a series of mixings which will include mixing two of the primary colors—say, red and blue—adding gradually small amounts of white and noting the tints which result.

In the next series do the same thing, but add black to the two primary colors.

In the next series follow the same method with blue and yellow for the mixings, first with black and then with white.

For the next series proceed in the same way, using red and yellow primary colors and adding first black and, next white, noting the many tints and shades resulting.

From this indication of practice work worth while you can readily multiply these series almost indefinitely. Make different combinations of primary colors in groups of one, two and three with black separately and white separately, then with black and white together.

Choice of Tinting Colors.—After one has experimented and practiced mixing and matching colors, using the primary red, blue and yellow, the inference which is apt to be made is that all colors should be mixed from the primary colors. In theory this is true, but it would be expensive in some instances.

In actual practice nearly any given color can be matched by the use of any one of several formulas. As experience is acquired this fact is particularly impressive. A color sample might be given to several experienced painters and decorators, with the request that they mix paint to match it, and it is quite possible that no two of them would follow exactly the same method in mixing and matching. Some of them would use different tinting colors than were employed by the others. With these facts in mind, it is well to remember that the most simple mixture which will match the sample is usually the best.

Other factors enter into your selection of tinting colors. One of the most important is to keep in mind the tinting colors which are most permanent in strong light and which have no adverse chemical reactions. Note the list of permanent and fugitive colors in Chapter III. As an illustration of this point;—better judgment will be shown by mixing cream color, especially for outside paint, with raw sienna than with medium chrome yellow. Sienna is an earth pigment of great permanence to light and is generally very stable. Chrome yellow is a chemical color which is less permanent in strong light. Chrome yellow is a valuable color and we have no other bright yellows which possess the same merit. When it comes to mixing bright, light yellow tints, raw sienna is too dull in color.

When mixing tints and shades following the principles of color theory, it is well to keep in mind that these principles call for the use of bright, clear colors of good tinting strength. A color may be bright in itself and yet may have been extended with inert pigments to the point where it retains little tinting strength. Then, again, the use of dull colors will not often give you the result wanted.

Probably the disappointment most often met with is in the mixing of purple and violet shades. For instance, color theory tells us that when you mix red and blue together the resulting color is purple or violet. This is true only when a clear, bright red of good tinting strength, like vermilion, is mixed with a clear, bright blue, like Prussian blue. Mixing these two colors will result in purple, but if you mix a dull Venetian red with blue, you will likely produce a dull, drab, muddy color, not purple.

And, again, when mixing a brighter, richer purple, using red and blue, it is even better to use a red which has a bluish hue, like crimson, than a red with a yellowish hue, like scarlet. The blue, then, should have a reddish hue like ultramarine blue, not a greenish hue like Prussian blue.

A bright orange color is likewise mixed from reds having a yellowish hue like vermilion and scarlet. The yellow must have a reddish hue like medium chrome and orange chrome yellows. Lemon chrome yellow with its greenish hue is not so good, although orange lacking some brightness may be made with it.

The point to remember about these mixing facts is that should either of two tinting colors have a hue opposite to the third color you wish to mix, that third color will lack brilliance. The opposite hue tends to neutralize the mixture.

In the same way you cannot mix a bright green by using a dull yellow ochre with blue,—a bright, clear blue and a strong yellow will give you a bright green.

To mix a pure vivid green from blue and yellow, the blue must be one with a greenish hue, like Prussian blue. The use of ultramarine blue with its reddish hue will dull the brilliance of a green. And the yellow used should incline toward a greenish hue,—lemon chrome yellow is correct for this mixing of green, while orange chrome and medium chrome yellow with their reddish hues will not produce such bright greens.

In the mixing of tints and shades of green it is much better to use a chrome green with a white base or a raw umber base than to add Prussian blue and chrome yellow to the base to make a green. The reason for this is that while chrome green is manufactured by the use of Prussian blue and chrome yellow, the mixture is made very intimate and a chemical compound by mixing together at one time the chemical solutions which form this blue and this yellow. When the two colors are precipitated together at the same time a separation of the colors later does not occur, and fading in strong light is very much retarded.

Another illustration of wise choice of tinting colors is in mixing dark greens. Greens as a class are fugitive in strong light, yet we have no green tinting pigment which is as valuable as medium chrome green. More durable dark greens for the painting of shingle roofs and window blinds can be mixed from raw umber to which a little raw sienna is added; it is then brought around to the green shade by the addition of chrome green.

In the choice of tinting colors it is well also to keep in mind the nature of each color with reference to being transparent, semi-transparent or opaque.

Tinting colors are classified in this respect in Chapter III. As a general principle, when you are mixing paint to dry with a solidly covered, opaque appearance, use an opaque tinting color in preference to a transparent color. And, on the other hand, when mixing glazing colors, wood stains and graining colors, the transparent and semi-transparent tinting colors are needed.

The principal opaque colors are chrome yellow, light lemon, medium and orange, yellow ochre, vermilion, Indian red, Venetian red and, of course, lampblack and ivory black.

The semi-transparent colors are raw sienna, burnt sienna, raw umber, burnt umber, Turkey red, Tuscan red.

Transparent colors are Prussian blue, ultramarine blue, cobalt blue, crimson lake and other lake and aniline colors.

More Interesting Colors.—When a single tinting color is added to a white paint a less interesting tint is usually secured than when two or more tinting colors are added to a white base. A good illustration on this point is found in mixing light browns. When you add burnt umber to white paint you secure a rather lifeless brown. When, however, you add also a very small amount of chrome yellow and a touch of Venetian red or vermilion, a much more lively light brown is the result. Neither the yellow nor red is noticeable, as such, in the color, but the influence is evident. In mixing light greens by the use of medium chrome green and white, rather crude and raw tints result, but when you add also just a touch of red and yellow or blue, greater interest is gained.

Gray and Grey Paints.—These two names are used rather interchangeably referring to light and dark paint. As a matter of fact there is a distinction which should be drawn in the use of these names. When black is added to white the resulting color is gray and when white is added to black we again have a gray. These are the crude raw slate colors and dark grays, which have little interest.

Taking one of the grays as a base and adding a color pigment, such as a minute quantity of yellow, red or blue, you produce a grey, whether one or all three of these colors have been added to the black and white base. Either the black or the white will predominate in quantity and you will not be able to recognize the red, blue or yellow, as such, but they will have their influence and produce much more interesting tints and shades. The French greys, warm greys, ash, pearl and silver grey are all made this way.

Greys of this character are also made by simply adding a touch of raw sienna or raw umber to the black and white pigments.

The character of grays differs according to the kind of black pigment used with the white;—lampblack, ivory black, gas black and vegetable blacks all influence the color in their own way.

Gray is gray to the average mind and yet when you come to study colors a little you soon learn what the experienced interior decorator and artist take as rudimentary; that there is a great variety of greys, some having a cold, bluish cast and others with a warm, red tone; some are yellowish and others have a brown or green cast, yet all are grey. And the particular shade of grey which looks so well with certain other color combinations doesn't hold its own when placed amid new color surroundings.

The tendency among house painters for years has been to simplify color formulas as much as possible. For outside house painting there may not be great reason to do otherwise, yet without adhering to simple formulas too closely much more beautiful tints and shades are always produced. The grays made by tinting white with lampblack only, with their crude, cold impression can never equal those produced with both lampblack and raw umber or other color added to the white.

When it comes to mixing greys for interiors it is very necessary that they be given a warm red, yellow, brown, green or neutral drab hue, according to what colors are much in evidence in rugs and furnishings. It is generally true that colors mixed from simple formulas cannot possibly have the life, brilliance and charm of those mixed with two or three tinting colors and a white base. A grey may contain a touch of red in its composition which you cannot see as such, but it is there and has its effect in the impression given by the grey. This fact is noticed when you try to match some fine colors;—your mix comes very near matching, yet you can see or feel that something is lacking. You don't know what color ought to be added to tone up your mix, because you cannot *see* the missing color.

MATCHING COLOR SAMPLES

If you were always called upon to mix paint to match samples of other liquid paints, the task would not be very difficult. You will also be called upon to mix paint to match samples of other paint which is dry and has a gloss surface; likewise, samples of dry paint having a flat surface, samples with a smooth finish or a rough finish, samples which appear in large area or in small area, samples of colors which appear alone and those which appear alongside of other colors. You will be expected to match certain colors selected from wallpaper having many colors, from window drapes, from rugs, from furniture, paintings and picture frames.

To succeed at all of these matchings sorely tries the skill of decorators with a lifetime of experience. In some cases the matching of a color sample is done largely by instinct based upon years of experience. Some of the methods developed by the ingenuity of experienced decorators will help you, but often you will be thrown upon your own resources. In such cases, if you really know tinting colors and their characteristics, together with the peculiar effect of light reflections upon them, you will have no difficulty in securing a match.

It is more difficult to match a gloss paint to a flat color sample than to another gloss sample; it is more difficult to match flat paint to a gloss sample than to a flat sample; it is more difficult to mix a paint to match a color sample which is one of many colors appearing alongside of each other, as in wallpaper, window drapes, rugs, etc.

Another point, paints which dry without gloss appear to be different in hue from paints having a gloss finish. Paint spread upon dark surfaces or upon old surfaces which are bright in color have quite a different appearance than when spread onto white or light color surfaces.

As to quantities of colors to be mixed when you are to match a sample, it is worth while to remember that you should begin the mixing with only about half of the white paint, or principal color, needed for a base; that is, begin the mixing with about half of the material you estimate you will need. Then keep a record of the amounts of colors added to the base as you proceed with the mixing, so that you may duplicate the batch if not enough color is obtained at first.

The tendency is to mix too much paint when matching colors. On some occasions you will find that when you have finally secured the match you will have two or three times as much paint as you have use for on the particular job at hand. If you discount this factor when you start the mixing you are less likely to waste materials.

Then there is another advantage to be gained by this procedure; you may accidentally put in too much color. In order to make the paint lighter, then, you must add more white, in some eases considerably more white. Under these circumstances, if you started with only half or two-thirds of the total amount of white needed you can correct the error without wasting material.

Light for Matching Colors.—Colors not only appear slightly different to some other people than to you, but the kind of light which prevails at the time of mixing and matching makes a difference in the way in which you see color values.

With some colors it is confusing to have a light which is too strong, such as direct rays of sunlight; this is particularly the case with very light ivory, cream, yellow and tan tints. On the other hand, a very strong sunlight is particularly useful when mixing and matching deep blues, greens and blacks, as with sunlight the exact character of the color is more easily seen.

Usually a good north light is best for average mixing conditions. Light which is reflected from having the direct sunlight strike a colored wall and being reflected into your mixing room is likely to cause no end of trouble when matching colors. Artificial light, except the special electric bulbs made for the special purpose of color matching, and which duplicate daylight, is likely to give trouble if used in a color mixing room.

In the mixing of colors keep in mind that artificial light changes most colors;—they appear different at night than in a daylight room.

Rest Your Eyes Often.—Color, you will remember, is a sensation produced upon your eyes by light reflection. If you look steadily for some time at a color which you are mixing you will temporarily lose your ability to judge the character of that color. To avoid this it is well occasionally to cast your eye upon other colors, or simply leave your mixing for a minute or two in order to clear your vision, to readjust it by looking at other colors or at your surroundings in general. This will enable you to regain sensitiveness to the color and you can judge it more accurately.

In making a very close match between a batch of paint and a color card, drapes, wallpaper or any other material, it is very important to remember this point about your eyes becoming tired, or saturated with the color you are mixing. A color looked at too steadily appears to become a bit neutralized or faded,—it loses its brightness in your eyes, but not in the eyes of others.

In order to maintain balanced appreciation of color, one's eyes should have within their range all three of the primary colors, red, blue and yellow. You probably have heard it said that an interior color scheme which is completely in harmony must contain all three primary colors—red, blue and yellow—in some proportion. This should not be misunderstood to mean that all three of these colors must be present in equal area, nor in equal brightness. To illustrate, the general tone of a room may be soft yellow used on large areas, while the red may be present in the form of a small area of bright red on a vase. The blue may be only a dull color appearing incidentally here and there in small areas.

One Color Influences Another.—A color placed alongside of other colors reflects a different hue than when seen alone on a white background.

Green placed near blue causes these alterations:—green appears yellower and the blue appears more violet than when alone on a white background.

Turquoise blue placed between cobalt and navy blue, or between apricot yellow and greenish yellow, will result in very noticeable differences being apparent. The turquoise blue is greener when closely related to cobalt and navy blue; while turquoise between apricot and greenish yellow appears bluer.

Lilac placed with a flesh tint on one side and a deeper pink on the other is more intense, a deeper color than when the same lilac is placed between dark green and violet.

Areas of red and green are both more intense alongside of each other,—the red appears redder and the green is greener.

Areas of black and of white, on a grey background, are more intense when placed close to each other than when separated.

The Watch Crystal Test.—The most satisfactory way to note exact matches, or differences in colors and in blacks and in white pigments, is to secure a few dozen watch crystals from jewelry supply houses (odd sizes will do). Place your colors in the concave side of the crystal. Cover one-half of the crystal with a piece of blotting paper while you fill the other half with one of the colors in thick paste form; then remove the blotter and fill the other half of the crystal with the second color. The blotter can then be placed on the open side of the crystal to hold the colors in place. When the crystal is turned over you will see clearly any slight difference in hue of a tint or shade. See Plate 11. You may have two batches of white, black or any color which, when looked at separately, appear to be exactly alike, but when they are placed so intimately together on a watch crystal, or a piece of clear white glass, you will be surprised to note the differences. You will find that some whites have a yellowish cast, others are bluish, while still others have a muddy, gray cast. The blacks appear jet black, brownish black, grayish and reddish black.

Matching Liquid Samples.—If you have one pot of paint in the liquid form and want to mix an additional quantity to match it, proceed by making a white paint as indicated elsewhere. Examine in good light the color sample you are to match to decide what tinting colors are needed. Mix a little of the principal tinting color paste with linseed oil or turpentine in a separate pot; also a little of each of the other colors which you think will be needed. Strain these tinting colors and add the principal color to the white base, stirring it in thoroughly until the paint approximately matches the sample, but is still lighter than the sample.

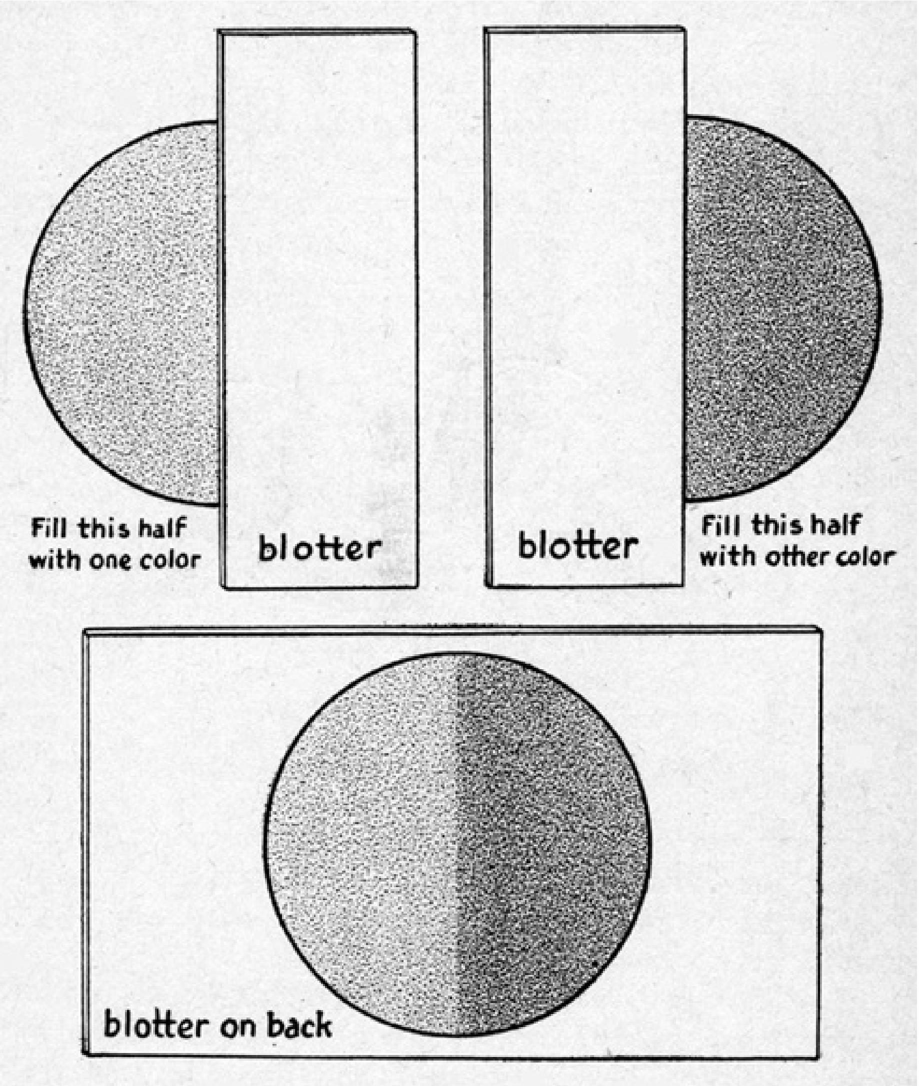


Plate 11.—The Watch Crystal Test

Next add a little of each of any other colors which appear to be needed. Thoroughly mix these colors into the white base. To test your color match take a clean mixing paddle of wood or iron and dip it into the color sample; lift it out and let the excess paint drain off; then dip the paddle into the new batch of paint, and where the two mixings join you will be able to see whether your new paint is too light or too dark, whether it needs a touch of red, blue, yellow, black or white to complete the match. See Plate 12.

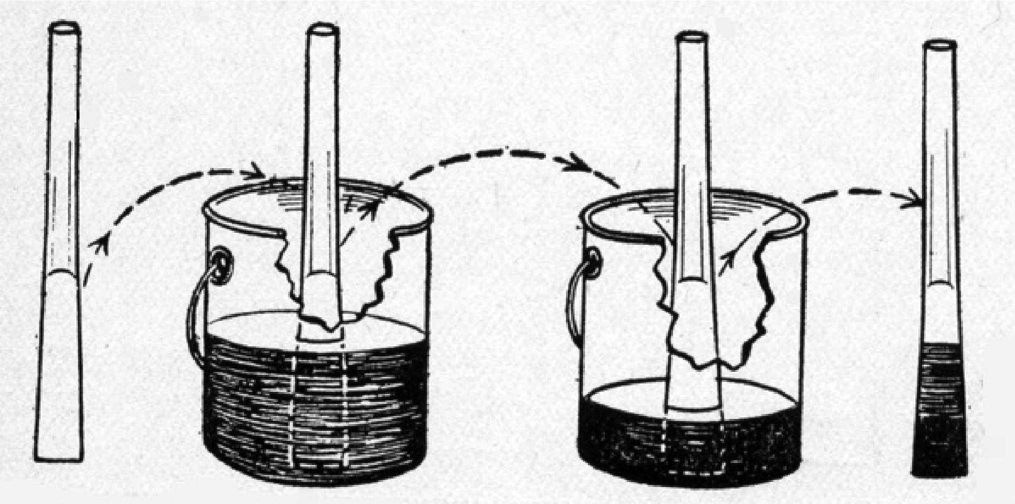


Plate 12.—Testing for Color Match

In judging the principal tinting colors used in a sample of wet paint, one of the best means is to dip a finger into it and carry a bit of the paint to a white painted or paper surface; by rubbing the paint out with the finger you can soon decide whether it was mixed principally with one color or another and whether it was mixed largely with linseed oil or turpentine.

Matching a Dry Paint Color Sample.—Most colors change some when drying. You must mix your new paint a little lighter, spread it out on a surface and allow an hour or two setting before you can know that your match has been made. Your new paint color being matched, it should be spread alongside of the dry paint color sample and permitted to dry. There are changes in colors due to oxidation and to the fact that there is a separation of colors from the liquid in some cases. For instance, a green mixed from chrome yellow and Prussian blue is more likely to show a separation between color and liquid than a green mixed from medium chrome green.

Matching Gloss to Flat.—One of the difficulties you will experience in mixing paint to match a sample is that of trying to make a gloss paint match a color which has no gloss. After your eye is trained you will be able to do this without difficulty, although it is sometimes necessary to put water or oil onto the flat color before you can mix your paint exactly to match it. In other words, you can mix a gloss paint to match a gloss sample and a flat paint to match a flat sample without difficulty, but to mix a gloss paint to match a flat sample you will have to temporarily give the sample a gloss, too. Also mix your gloss paint a little lighter than the flat sample; it will darken when drying.

When a color sample given you to match has no gloss and you are to mix a gloss paint of the same color you can make the match easily enough while your batch of gloss paint is wet, but when it becomes dry it may have a brighter and richer tone than the flat sample. For that reason it may be necessary for you to add a bit of white, black or some other color to the gloss paint to dull its rich tone.

Matching Flat to Gloss.—And when the reverse is true, that is, when you are mixing flat drying paint to match a gloss color, you must spread both onto a surface and allow them to dry before being certain that you have a match. It is more than likely that the paint which dries without gloss will be lacking in richness or brilliance and will appear a little lighter than when it was wet. To avoid this difficulty it is necessary to mix your flat paint a little brighter in tone than the gloss sample. For example, in mixing reds and pinks with Venetian red in a flat color it may be necessary to add a touch of vermilion, which is a brighter red, before your flat color will match the gloss color when dry.

When mixing a flat blue to match a gloss blue you are likely to find that a brighter hue is given to the flat color by a touch of yellow or green.

One Color to Match Several.—You will often find that when you have successfully matched one of the colors of a wallpaper pattern and have painted, for instance, the wood trim of a room with the matched color, the effect is not at all what is wanted. The reason for this is that the color appears in small area in the wallpaper and when used in large area on the trim the color is entirely too strong. Such a color neutralized by mixing with gray, or made much lighter with white, produces harmony which is much more pleasing.

There are other instances where new color must be mixed to match a single color in wallpaper or drapes, such as one certain green, for example, and when it is better to match the general tone. In that case a green approximating the one in the wallpaper is first mixed. Then very small amounts of each of two or three other colors appearing in the wallpaper are added to this green. The resulting green harmonizes with the general tone of the wallpaper and is related to the particular shade of green in the paper, but does not match it.

When you are called upon to mix a color to match a surface which has a mottled color effect, such as tapestry, brick of blended colors, Tiffany glaze finish painted walls or cloth drapes, there are two ways in which you can handle the problem. One color in the wall may predominate and you can mix your paint to match that. The other way would be mixing a neutral gray or drab color paint which will tone in and harmonize with the whole surface. To do this simply add to your white paint, or basic color, a little of each of the several colors appearing in the mottled finish.

Matching Rough and Smooth Surfaces.—You may encounter difficulty at times when matching paint for a smooth colored surface with a rough colored surface. For example, take a rough plaster wall and paint it with a color shown on a smooth paper color card; on the rough wall you will see the exact color of the card in places, but in many other places darker shades of the color may be noted, because of the shadows cast by high points and the manner in which the daylight or artificial light strikes the rough wall. If you could subject such a surface to strong direct rays of light, the shadows would disappear and the rough surface would be exactly the same color tone as the smooth surface.

Matching Fabric Color Samples.—The play of light reflections on silks and other materials which drape naturally and have a high sheen is sometimes very difficult. The colors appear different at every angle from which they are viewed because of shadows and reflections. These characteristics cannot, of course, be matched in paint. About all you can do is match the general effect with paint.

The way to go about it is to mix a color match for the darkest shades appearing on the silk and another batch matching the lightest tints to be seen. Then by adding these two mixings together you get an approximation which will harmonize in a general way.

By brushing out the paint on a fairly large surface alongside of the silk hangings, you can readily judge whether a mixing needs a slight toning by the addition of minute quantities of red, blue, yellow, black or white to make the harmony perfect. A semi-gloss mixing of paint will more readily match silks than will flat paint.

A Few Mixing Points.—A mixture of any two or more colors results in a darker shade than any of them.

Yellow is the color pigment to add to any color to make it brighter.

White mixed with colors makes them lighter in hue but not brighter; white greys or softens and takes off the sharp appearance of a color with which it is mixed.

White, grey and black are neutral and reflect no color rays to the eye.

Black is the total absence of color. In theory black results from mixing together the primary colors—red, blue and yellow. What actually results from such a mixture is a very dark, muddy grey of a brownish or greenish hue, depending upon what pigments are mixed.

CHAPTER XI
MIXING SPECIAL PURPOSE MATERIALS

Undercoat Colors.—Where two or more coats of paint are to be put on to exterior or interior surfaces, upon signs, automobiles and furniture, the question arises as to whether the undercoats should be the same color as the finishing coat. The question is answered yes or no, depending upon what colors and surfaces are being treated.

For exterior painting, generally speaking, it is better to mix all of your coats the same color. There are exceptions to this, however. When you are painting the exterior of a house a deep Colonial yellow it is good practice to mix your undercoats pure white, or a cream color produced with raw sienna or medium chrome yellow. Your finishing coat will be made by tinting white paint with a considerable quantity of medium chrome yellow. Chrome yellow is higher in price than white paint and, naturally, the use of more of the color than is necessary is wasteful and brings up the cost of the job. There is no need to use enough chrome yellow in this case to make your undercoats the same as your finishing coat. Chrome yellow is an opaque color which hides the surface well in one coat. When spread over a white or cream-colored paint the last coat only need be full in color. This same principle holds good wherever the mixing of a finishing coat involves a large amount of expensive color.

On interior surfaces some decorators believe that undercoats should be lighter than the finishing coat, while others prefer that it should be darker; they reason that the finishing coat may be brushed on more rapidly when there is quite a difference between the colors. This is not the best practice because it necessitates mixing at least two batches of paint, and that wastes time.

Since most colors change a little during the drying process, there is enough difference between a dry coat on a wall and a fresh wet coat to facilitate brushing. By mixing all coats the same color time is saved, because the paint can be mixed in thick paste form to be thinned with turpentine or flatting oil for a flat finish or with linseed oil for a gloss finish. The undercoats may be put on and when dry the color noted. If any slight change in hue is desired, after seeing the color in large area on the surface, it is a simple matter to correct the color before the final coat goes on.

An exception to the rule that most interior paints should be mixed the same color for all coats is the finishing of walls with transparent colors to give mottled and blended Tiffany effects. Where final coats are transparent or semi-transparent colors, the undercoats must be opaque, flat colors which cover solidly and which are several degrees lighter in color than the finishing coats. This principle is carried out also in the finishing of automobiles where, for instance, the transparent lake colors such as maroon lake are used. The undercoats for the transparent lake finishing coats are lighter tints. In sign painting the same practice is followed to some extent.

On painting jobs where the finishing coat is made up largely of such transparent colors as Prussian blue, chrome green, raw and burnt sienna, raw and burnt umber, it is very important that the undercoats be mixed so as to be opaque and solid covering so as to hide the surface, and it is especially necessary that the undercoats be exactly or as nearly the color of the finishing coat as possible. This is true only, of course, when the finishing color is to have a solid opaque appearance. When a glaze appearance is wanted, particularly with the special wall finishes which are stippled, mottled and blended, this principle is not involved; then the undercoats are usually very light complementary, related or self-tone colors.

VARIOUS KINDS OF PUTTY

The skillful use and mixing of putty for many purposes is a subject which is deserving of more thought and interest than is apparent today. Too often painters and decorators use indiscriminate mixtures of putty for all kinds of surfaces and conditions.

The skilled craftsman knows how to mix a putty which will dry just as fast as is necessary to accommodate his work, one which is soft and porous when dry or very hard; he mixes putty which can be sandpapered freely to make a smooth and level surface, a putty which can be rubbed with pumice stone and water to a fine finish, or one which can be knifed on for a heavy filling or for a thin surfacer.

As a general working rule to follow, it is well to keep in mind that putty should be mixed as nearly as possible of the same color, texture, degree of intensity and hardness of surface as the material into which it is placed as a filler. A very soft porous putty should not be used for stopping up holes in very hard dense surfaces, and the reverse is equally true, that very hard drying, dense putty should not be used to stop up soft, porous surfaces.

There is much to be said about using the right kind of putty in the right place. Disappointment is sure to result, for instance, from using whiting and linseed oil putty for filling cracks in hard surfaces where a quick job is to be done and with only one or two coats of paint. Such a putty dries slowly and the oil from it will stain coats of paint and disfigure the job. This is especially true where an oil putty is used on interior surfaces finished with flat coats of paint. In these cases the sweating of the putty results in shiny spots in the paint and discoloration; in some cases the paint may scale off.

Formulas for mixing putty are innumerable. The common putty which you will secure from hardware stores and paint stocks generally, made up for window sash, is usually marble dust. This putty may be good enough for barn sash, but it gets hard and brittle shortly and will not remain in place. A little white lead paste or dry white lead added to this putty makes a better material.

The use of a straight whiting and linseed oil for plugging cracks and nail holes on exterior surfaces is a bad practice.

First Class Putty.—The common way to make a first class putty for ordinary outside work is to take a small quantity of white lead paste from the keg and add dry whiting to it until a stiff mixture is secured on a slab. Pound it a while with a mallet or club. Then the putty is taken into the hands and kneaded until a thorough mixture is secured. If the mixture gets too dry and thick, add a few drops of linseed oil. If you want a putty which will dry very hard and adhere even more firmly to a surface, add a few drops of hard-drying varnish—floor varnish or good spar varnish.

Such putty is colored to match paint, or stained interior wood trim, by adding tinting colors in the dry form.

Window Glass Putty.—The common putty made by mixing a fine quality of bolted whiting and a little white lead with linseed oil is good for glazing window sash, but for glazing steel sash a putty should be mixed from dry red lead and linseed oil.

Knifing Putty.—For repairing damaged places in walls and woodwork a putty which is to be spread on and smoothed with a putty knife may be mixed by adding white lead paste to fine bolted whiting to make a stiff putty with equal parts of Japan gold size, linseed oil and turpentine. This putty is made thin enough to be applied with a broad putty knife to rough places and smoothed up. When it is dry the rough edges can be sandpapered and the whole patch rubbed down level.

When a very hard drying, knifing putty is wanted, and one which can be rubbed with pumice stone and water, it may be mixed by adding to white lead in oil paste enough fine dry whiting and fine pumice stone to make a stiff putty. When a liquid is needed a few drops of any hard drying or rubbing varnish or Japan gold size will serve the purpose.

Swedish Putty.—What is called Swedish putty is made by decorators when large quantities are needed for filling many large cracks in floors, in plaster walls, and for making special wall finishes. Swedish putty is made with varying proportions of several ingredients. One way to make it is to start with a bit of paint mixed for outside wood surfaces—a lead paint or ready mixed gloss paint. To this is added a bit of dry whiting, or dry calcimine, a little glue dissolved in hot water, a little dry color, and in some cases a bit of dry China clay. In some cases paperhanger's flour paste is added. A composition of Swedish putty depends largely upon what working qualities you wish, how hard it is to dry and how rapidly it is supposed to dry.

Quick-Setting Putty.—On jobs which are to be puttied and then followed up within an hour or two with paint the putty may be best made by mixing a stiff paste with dry white lead and Japan gold size. Add a few drops of turpentine if a quicker drying putty and one with a more porous texture is wanted.

Another way to make a quick drying putty is by mixing white lead in oil paste with dry white lead to a stiff putty, adding Japan gold size and floor or rubbing varnish.

Plaster of Paris Putty.—Probably more putty for filling holes in plaster walls is made from plaster of Paris than from any other material. This makes good filling material when properly used. The plaster of Paris should be submerged in water. Only a small portion, about the size of an egg, should be lifted from the water with a stopping knife and kneaded in the hand and made ready for placing in the hole. This material sets rapidly and it should be put in place before it has set. When in place it should be smoothed over repeatedly with the broad knife so as to glaze the surface, making it hard and non-porous like the plaster itself.

Some painters have the bad habit of lifting too much plaster of Paris from the water at a time and when it begins to set in their hand they add a little more water or vinegar. This should not be done. When a batch of plaster takes its initial set before placing it in the hole it should be discarded for a fresh lot taken out of the water.

For mixing a knifing putty to be used on plaster walls some decorators prefer to take a little prepared calcimine or other water paints and add dry whiting until the proper consistency for knifing is reached. These are handy mixtures, often, and they make a good filling which can be rubbed down smoothly with sandpaper.

Floor Paints.—There are many first class ready mixed paints which give good service on pine and other floors. To mix them ready for the brush it is necessary to handle them in the same manner as was described in the first part of Chapter VIII under the title of *Mixing Ready-Mixed Paints*.

When it is desirable to mix floor paint to match some particular color using white lead and zinc as the basic pigment the mixing should be done in this manner:

New floors which have never been finished with any material require a first coat made by mixing white lead, the necessary color pigments, turpentine to the extent of about three-fourths of the liquid and boiled linseed oil to the extent of about one-fourth of the total liquid. These materials should be mixed as described in Chapter VIII for breaking up white lead paints.

The second coat on new floors should be mixed with three-fourths white lead and one-fourth zinc oxide, plus necessary tinting colors and turpentine, using very little or no linseed oil. This coat will dry without gloss. When the paint is thoroughly dry, one or two coats of first class floor varnish will make a durable job. A coat of wax on top of the varnish will make a floor which is easy to clean, and the wax will protect the varnish.

Your aim in mixing floor paint is to produce a hard, dry, tough film, and for that reason only enough linseed oil should be used to satisfy the suction of the new wood. If too much oil is used the film would not dry as hard as it should, and, furthermore, it will be more elastic than the varnish coats and may have too high a gloss to permit the varnish coats to take hold of the surface properly. With too much oil in undercoats on floors there is some likelihood that the paint will expand more than the varnish on floors which get quite warm over furnaces; the result will be cracking or alligatoring of the paint.

The painting of old floors which have been finished in varnish, shellac or wax requires a little preparatory work. As a rule, varnished floors require only scrubbing and the sandpapering of rough places a little and they are ready to paint. Floors which have been waxed should be washed up with turpentine to remove as much wax as possible. Floors which have been painted before require washing, sandpapering of any rough places and filling of large cracks with putty before painting.

From this point on finish old floors the same as was described for new floors, beginning with the second coat.

Another way to mix your paint for old and new floors where a less costly job is to be done is to treat your new floor with a coat of paint composed of white lead, tinting colors, three-fourths turpentine and one-fourth boiled linseed oil. Then, for a second coat on new floors and for both coats on old floors, mix your paint with three-fourths white lead and one-fourth zinc oxide; one-fourth of the liquid to be turpentine, one-fourth boiled linseed oil and one-half first class floor varnish. The varnish to be thinned with the turpentine before adding it to the paint with the linseed oil. Some painters mix floor paint with white lead, zinc oxide, tinting colors and boiled linseed oil, adding only about half a pint or one pint of floor varnish to a gallon of paint.

Floor Fillers.—For open-grained floors like oak a filler is mixed using dry silica, sometimes called silex, with about four-fifths benzine and one-fifth boiled linseed oil. A little Japan drier, about two tablespoonfuls to a gallon of filler, is sometimes needed. To color the filler, dry color such as burnt umber for brown finished floors is used. Color ground in oil may also be used.

It is not possible to give exact mixing directions for a floor filler because the temperature of the room and ventilation are governing factors. The filler must be tempered by adding a little boiled linseed oil to slow the drying, or more benzine to hasten the drying.

The filler should be so tempered that when you brush it on to about one square yard of floor it will begin to set immediately and turn flat; that is, the benzine evaporates immediately.

The filler is brushed on to the floor freely like paint *with* the grain of the wood and across the grain, being careful to rub it into the pores of the wood. As soon as the dull surface appears the filler should be wiped off of the surface with a wad of excelsior. Rubbing with excelsior also forces the filler into the pores.

The wiping with excelsior should be done *across* the grain only. If the filler has been mixed correctly it will roll up into a thick paste and all excess filler not needed to stop the cracks and pores will come off readily onto the excelsior. If too much oil has been used the filler will not dry rapidly enough and it will not lodge in the cracks and pores of the wood as it should.

As each square yard is coated in with the filler and takes on a dull finish it must be wiped immediately, or it will get so hard and stiff that a great amount of labor will be needed to remove the excess filler from the surface. Plenty of excelsior should be used, and if the filler sets so rapidly that you do not succeed in wiping it off before it becomes dry, wash up the surface freely with benzine and start all over again.

In floor fillers for natural finished oak no color is needed. For dark oak burnt umber will color the filler and at the same time stain the wood. Where dark finishes are wanted it is well to put on an oil stain or a spirit stain before the filler.

White and Colored Enamels.—The name enamel covers quite a variety of paints which dry with a high gloss, semi-gloss or satin finish. For use on interior wood trim and on walls occasionally, undoubtedly the best enamels for painters and decorators to use are those which are bought from manufacturers already prepared for brushing onto a surface. High class prepared enamels can be secured to dry with a gloss and to dry with a semi-flat satin finish which gives the appearance of a hand-rubbed surface. Most of the prepared enamels come in white, cream and light gray; some brands, however, may be had in half a dozen beautiful bright but soft colors.

If you wish to mix a colored enamel for interior trim or furniture finishing you can do so by adding Japan colors thinned with turpentine to white enamel—gloss or satin finish. The Japan color selected is to be thinned with turpentine to about the same consistency as the enamel; it should then be strained and poured into the enamel a little at a time until the desired color is secured. When your color has been added be very careful to stir the enamel thoroughly until all of the color has been incorporated. Then as a precaution a good decorator will strain the enamel into a clean pot.

Undercoatings for enamel can be purchased ready prepared for the brush, and they may be colored to suit in exactly the same manner as just described for enamels. If you wish to mix your enamel undercoats you may do so by using one-half white lead and one-half zinc oxide thinned with turpentine to the extent of about three-fourths of the total amount of liquid and one-fourth of the colored enamel to be used as a finish.

See *Chapter VIII* for formulas for mixing white enamel.

Color Varnish.—Automobile painters and furniture finishers sometimes wish to use a color varnish. Color varnishes can be purchased ready prepared for use on automobiles, carriages and wagons. When the painter himself wishes to mix color with the varnish it may be accomplished by mixing two or three ounces of Japan color with turpentine to bring it to about the same consistency as the varnish. Strain the color and add it to about one quart of rubbing varnish. This is just enough color to slightly stain and offset the brown color of the varnish.

Aluminum Paint.—For descriptions of bronze pigments refer to Chapter V and for bronzing liquids, Chapter VI.

The mixing of aluminum paint is accomplished in a reverse manner to that used for other paints, in the respect that the dry aluminum or colored bronze pigments are poured into a pot containing liquid. It is easier to mix any dry pigment with a liquid by placing the liquid in the pot first and stirring the dry pigment into it than if the reverse operation is followed.

The metallic pigments are very heavy and they settle to the bottom of the pot quickly. They should not only be thoroughly mixed, but it is essential to agitate the paint every few minutes by stirring in order to keep the paint of the same consistency all the time.

Aluminum paint should be mixed for average surfaces in the proportion of about 1½ to 2 pounds of dry aluminum powder to 1 gallon of heavy bodied boiled linseed oil. This will make approximately 1-1/8 gallons of paint.

For some purposes the liquid used is entirely special heavy bodied boiled linseed oil. Ordinary raw linseed oil is too thin for use with this pigment. Some brands of heavy bodied boiled linseed oil can be thinned with turpentine or mineral spirits in the portion of 40 parts oil to 60 parts of turpentine and the resulting mixture will be of just about the right consistency for aluminum paint.

Where aluminum paint is exposed to the weather, spar varnish makes an excellent vehicle with which to mix the aluminum powder in the proportion of 1½ to 2 pounds of powder to a gallon of varnish. If the varnish vehicle is too expensive an excellent and serviceable liquid can still be made by using 20 per cent of ordinary pure raw or boiled linseed oil to 60 per cent of spar varnish.

The pigment particles of aluminum are flat and make up a paint film by a leafy formation, one flat pigment particle overlapping the other like fish scales. This leafing peculiarity retards the drying of linseed oil somewhat, and for that reason boiled oil is preferred. It is sometimes necessary to add a little Japan drier to make the paint dry rapidly enough. And if a harder paint film is wanted, spar varnish should be added to the oil vehicle.

Aluminum paint is very opaque and protects a surface well. It is particularly noted for excluding ultraviolet light rays. Such paint is valuable for protecting not only metal but also surfaces which are subjected to both indoor and outdoor exposure. Aluminum paint reflects most of the light and heat cast upon it and absorbs very little. It is for this reason that aluminum paint is used as a protective medium on balloon fabrics. In past years the large gas bags of airships deteriorated rapidly because of the effect of the direct rays of sunlight. Aluminum paint has materially increased the life of such fabrics by excluding the heat and light. China wood oil is used with aluminum powder for such paints because of its ability to withstand high temperatures.

Aluminum paint is excellent for such surfaces as large oil storage tanks, large gas holders of public service companies and many other metal surfaces. Bright aluminum reflects approximately 70 per cent of the light rays and about 90 per cent of heat rays.

A particular characteristic of aluminum paint to be kept in mind is that it is very opaque and its hiding power is such that often one coat of aluminum paint will obscure a surface which would require two or three coats of ordinary paint to gain the same end. A little aluminum paint spread onto a piece of glass and noted through the other side will give you a clear idea of this virtue. Such hiding power makes aluminum paint valuable for coating signboards which are to be relettered and also for use on mahogany finished doors stained with an aniline bleeding red. Sometimes mahogany finished doors when refinished with white enamel will turn pink even after many coats of enamel are applied. Then a coat of aluminum paint is usually successful in sealing up the bleeding stain.

For use on exterior surfaces at least two coats of aluminum paint are necessary.

Aluminum paint should be fresh each day, because it deteriorates by losing its rapid leafing quality when it stands in the vehicle for some time.

The polished aluminum powder has a higher reflectivity than an unpolished aluminum. The polished pigment reflects between 55 and 70 per cent of light rays, while the unpolished reflects between 45 and 50 per cent of light rays.

It is interesting to note that some very pleasing decorative effects can be gained by mixing tinting color pigments with aluminum paint. The aluminum will conceal small amounts of color, but fairly large amounts will add their color to the paint, while the aluminum adds reflection and brilliance which are very pleasing.

CHAPTER XII
COLOR HARMONY AND MANAGEMENT

Color Differences and Descriptive Terms.—Some of the confusion of thought concerning color harmony and management is the outgrowth of rather indiscriminate use of color terms and descriptive names. The use of such words as tone, tint, shade, hue, cast, blend, contrast, value and neutral inappropriately is bound to make an understanding and judicious use of color harmony more difficult.

Good judgment and analysis of a color scheme as well as correct language needed in a discussion of color come naturally enough after committing to memory a few correct descriptive terms and fundamental principles.

About Contrasts.—In color schemes contrast of three kinds is used;—contrast of values, contrast of color hues; contrast of intensities.

Contrast of Values.—Differences between light and dark degrees of one color or of black are contrasts of value. These are differences between tints and shades of one color.

When you mix white with pure, intense red pigment you produce a lighter red, a tint of red. Add still more white and a still lighter red is produced,—one which you may call pink. Now add black to the same pure red and you have a darker red, a shade of red; add still more black to the pure red, and you mix a very dark red.

Now you have the original bright, pure and intense red, two tints of red and two shades of red,—five colors or hues in all. All have the same color hue—red—yet there are differences between these tints and shades of red. These differences are contrasts of value;—they are values of red. All colors have their degrees of value and each value reflects a different amount of light.

Likewise, the differences between black and a series of grays made by mixing white with black are contrasts of value. Grays mixed in this manner are tints of black.

In contrast of values, black and white afford the extreme, the greatest contrast, while very light gray and white afford the least contrast.

Contrast of value occurs also between unlike colors. Any two or more colors which are not equally light or equally dark produce a contrast of values together. A tint of one color may form a contrast of value with another color or shade of another color.

Contrast of value exists, then, between light and dark colors, between tints and shades of the same color (self-tones) and between tints and shades of unlike colors.

Authorities estimate that the human eye can distinguish about one hundred variations or contrasts in value for any color hue.

In a color scheme in which the contrasts of value are great,—where some very light colors contrast to a great degree with very dark colors there should not also be great contrasts of color hue.

High and Low Values.—The light tints and colors are high values. Shades and dark colors are low values.

A light tint contrasted with a shade or dark color gives a high or great contrast of values.

A light tint contrasted with another light tint, a light color contrasted with another light color, a shade contrasted with another shade, or a dark color contrasted with another dark color, all result in low contrasts of values, because the differences in degree of contrast are small.

Contrast of Hue.—Hue means color. It is the quality which distinguishes one color from another; it is the characteristic which makes red totally different from blue and blue totally different from yellow.

A certain tint of red and a certain tint of blue are unalterably different in hue, but they may be equal in value (equally light or dark), and equal in intensity (equally bright, pure and light-reflecting).

Red is red whether it is a light tint, a dark shade or has been greyed with white. If you mix a different color with red you change its basic character and produce another color. If you add blue to red, for example, a little blue simply gives the red a bluish tinge, a bluish hue. More blue changes the red to violet or purple, which is a different color, a different hue, though a related one.

Contrast of Intensity.—The first dimension in color is value, the second is hue, and the third is intensity. An understanding of all three dimensions equips one accurately to analyze, judge and to enjoy color scheme combinations greatly.

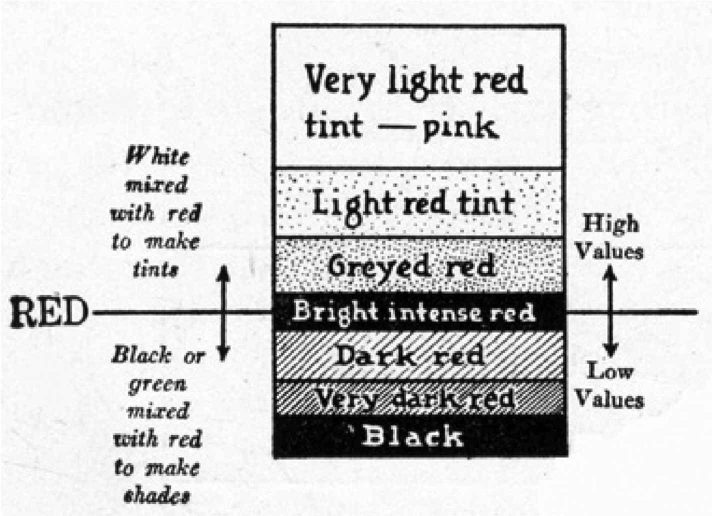
Intensity is the brightness, depth and purity of a color; it is the quality of a color which relates it closely to the light ray color in the spectrum of which it is a reflection.

One blue may differ from another because one is light and the other dark; the light one reflects more light than the dark one because it has more white in its mixture. That is a contrast of values. But two blues which are equally light or equally dark may yet be different in another quality—purity of tone, depth of color; that difference is intensity. The blue of lesser intensity seems dull and grey, even when it is made lighter by mixing pure white with it; the other may be dark, but still be brighter and purer.

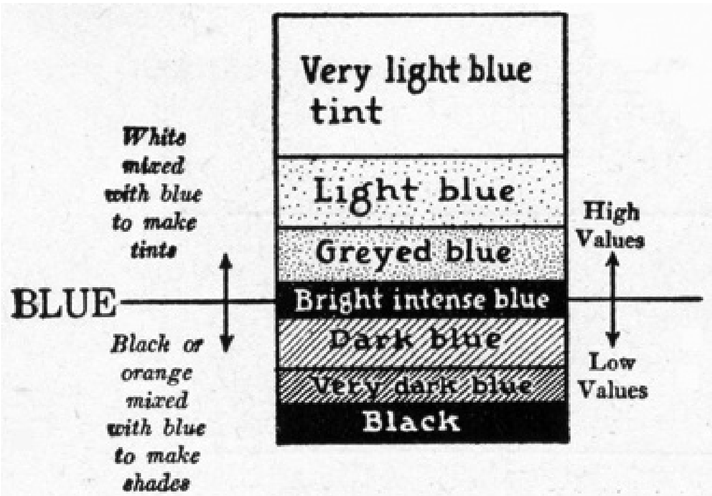
HARMONY PRINCIPLE NO. 1

TONES OF ONE COLOR

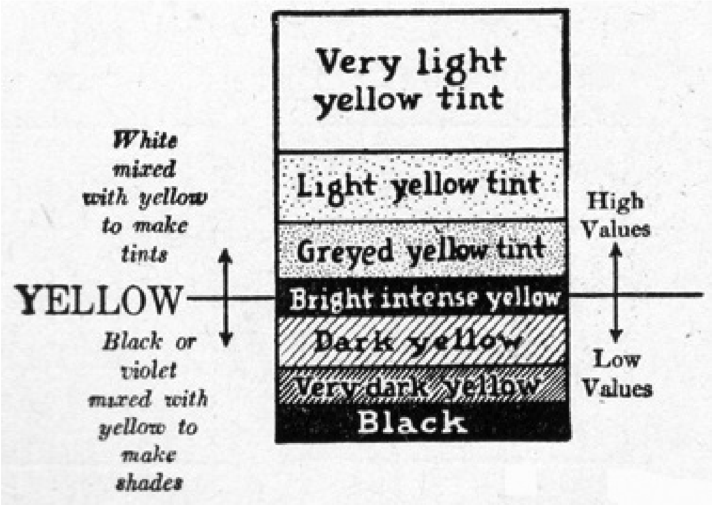
Illustrating *Contrast of Value* only, with self-tints and shades of the same color. Demonstrating one color only, but the principle applies to constructing color schemes in harmony from any color.



Complementary: Climax Color—Intense Blue-green



Complementary: Climax Color—Intense Orange



Complementary: Climax Color—Intense Violet

HARMONY PRINCIPLE NO. 2

RELATED COLORS

Illustrating *Contrast of Values* (tints and shades of one color), also *Contrast of Hues* (related colors)

1. Light Yellow
2. Medium Yellow
3. Greenish Yellow
4. Orange Yellow

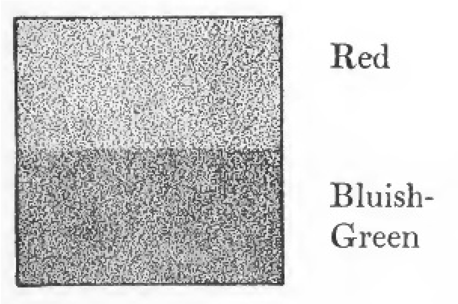
Complementary	Complementary	Complementary
Climax Color for No. 1 and 2—Is Violet	Climax Color for No. 3—Is Violet-Red	Climax Color for No. 4—Is Blue

HARMONY PRINCIPLE NO. 3

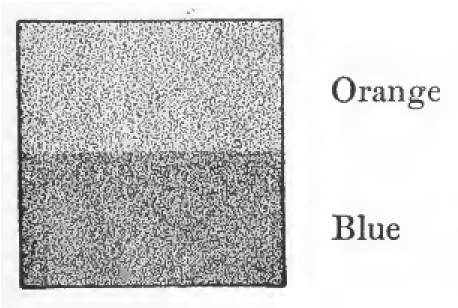
COMPLEMENTARY COLORS

Illustrating:

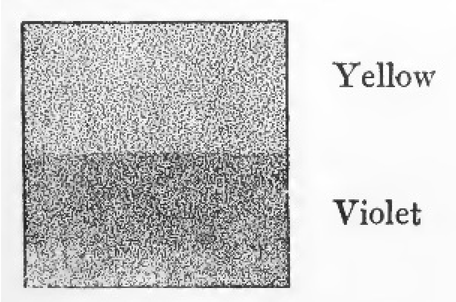
Contrast of Values (tints and shades of one color)
Contrast of Hues (unlike colors)
Contrast of intensities (brilliancy)



All of these are bright, intense colors and as such should be used in small area as climax or focal point colors.



When greyed by mixing with a little white or neutralized by mixing one complementary color with the other these colors may be used in moderately large areas as on drapes, pillow covers, scarfs and ornaments.



Tints and shades of complementary colors are of course very useful for walls and other large areas.

A color combination may harmonize by one principle of contrast or by all three principles—contrast of value, contrast of hue, contrast of intensity.

To illustrate these let us take a dark blue, a medium light blue tint and a very light sky blue. All are of the same color and so there is no contrast of hue (color), there is no contrast of intensity, all are greyed. There is, however, contrast of value, of light and dark tints and the dark blue.

A combination of pure, intense cobalt blue with a light, reddish-blue tint of violet produces contrast of values (a light and a dark color) and also contrast of hues. The violet tint has a reddish hue in it; it is a related color and yet is different because of the red in it.

The combination of pure, intense cobalt blue and a light tint of orange illustrates harmony by three principles: by contrast of value (a light and a dark color); contrast of hues (two different colors); and contrast of intensity (a pure, intense blue color associated with a greyed orange).

Tones of One Color.—Color harmony may be gained for rooms by following one of three principles,—by using:—1. Tones of One Color; 2. Related Colors—Analogy; 3. Complementary Colors.

The handling of a color scheme utilizing the principle of self-tones is easy and simple. Wherever a room is not to be finished in all white, all black, all grey or contrasts of black, white and grey, you are called upon to utilize color hues.

In selecting a color scheme utilizing only tones of one color, self-tones, you simply choose one color and then add white to it to make one or several tints of that color, or black to it to make one or several shades of that color. Then, this principal color, with its tints and shades, is used for all surfaces in the room, including the floor, rug, furniture, walls, wood trim, ceiling, drapes, picture frames and vases.

By way of illustration, let us consider a specific problem. In choosing a color scheme one is seldom able to start from the possession of nothing and acquire each unit which goes to completely furnish a room in accordance with the color scheme wanted. Usually there is one fixed or invariable element from which the color scheme must be constructed. Usually there is a set of furniture or a rug which must be used in the room. The color of this invariable element, then, is your starting point.

Assuming that we have American walnut or brown mahogany furniture as a starting point for constructing a color scheme from tones of one color, the rug and floor should have the same color as the brown of the furniture, although it may be a bit lighter or darker. The walls may be a greyed buff, tan or light brown. The wood trim, if stained, should be the same brown as the dominant tone in the furniture or it may be painted, or enameled in the same color as the wall by utilizing a tint which is a few degrees lighter or a shade which is a few degrees darker than the wall. This is commonly called painting out the trim, meaning that it is made less prominent. That is very desirable in some rooms where there is an excessive amount of wood trim which calls attention to itself to the exclusion of the furnishings. In most instances the walls and wood trim are merely a back-ground, or foil, against which the furnishings of a room are displayed.

The ceiling in this color scheme would be a light cream mixed from raw sienna and white, rather than a yellow cream made from chrome yellow. If the ceiling is high the cream color can be rather a dark one, but if the ceiling is just the average height the cream color should be light.

The drapes in this scheme of self-tones would be in the light browns or tans, while the picture frames would be walnut brown.

If this room is rather dark, or a cool north exposure, the walls might be very light tan bordering on cream color and the wood trim and ceiling even of lighter tint of the same color. These two light tints of the same color should, however, be separated with a band of very dark brown, in order to afford considerable contrast of values, since there is no contrast of color hues in a self-tone color scheme.

If the room is very light and dark walls are preferred, tans and buffs which are greyed can be used on the walls and a lighter tint of the same color may be used for the ceiling. These two colors should, however, be separated by a picture molding or a stencil band of very light color—ivory white or cream—to afford contrast of values, since there is no contrast of color hues.

This points to a principle which is an essential one to keep in mind to avoid monotony and weak effects when using self-tone color schemes. The principle is that when two very light tints of the same color are used on walls and ceilings, or elsewhere, they should be separated by a band of black or very dark self-color; and when two very dark shades of the same color are used they should be separated with a band of white or very light self-color. This band may be picture molding, cornice or a decorative stencil.

In color schemes made up of self-tones only there is no contrast of color hues, since the same color is used throughout. For this reason interest for the mind and attraction for the eye are gained by a contrast of values; that is, the use of light tints of the color with dark shades of the same color.

The disadvantage of using self-tone color schemes is that they constitute an entirely warm effect or an entirely cold effect, depending upon whether you choose a warm or a cold color from which to mix the shades and tints. Self-tone color schemes are usually passive rather than active in stimulating the eye color nerves.

But, on the other hand, self-tone color schemes are very useful for certain rooms. For instance, a sun parlor on the south side of the house may appear very warm, and, in order to make it restful, cool colors are desirable. Then a self-tone color scheme in the greys, blue-greens or greenish-blues or cold greys accomplish the purpose very well.

Another illustration of where self-tone color schemes are useful is in the case of a summer cottage near a beach. The interior of such a home needs the beneficial reaction of cool colors to offset the fatigue resulting from too much eye stimulation by brilliant, warm colors—the yellow beach sand and bright rays of the sun. A living room in such a cottage done in greyed-greens and greyed blues or bluish-greys is altogether restful.

In the case of a cold north room, which may also be dark in a city home, a color scheme of self-tone may be needed to contribute a warm atmosphere. In such a room, rather bright yellows, orange and warm tans accomplish the purpose.

It should be kept in mind, however, that self-tone color schemes are apt to prove uninteresting and tiresome where the rooms are used for long periods. This is true because the one color of the room over-stimulates a certain set of the eye nerves. For continued comfort and relaxation the human eye calls for a balance of color sensations. This balance can be perfectly gained by using all the primary colors—red, blue and yellow. Of course, one of these primary colors would be the dominant or key color used in greatest area of surface. It is almost a greyed form of the one primary color, which may be light or dark in color hue. The second primary color in this case may be used in moderate area and should be, also, a subdued or greyed color. The third primary color in this instance may be used in its pure brilliant tone, but in very small area, such as in a single vase, lampshade, window drapes or a picture, constituting the climax center of interest.

It is well to keep in mind, also, that the principal advantages to be gained by using a self-tone color scheme to accomplish a definite purpose—to give a cool effect or a quiet, restful effect—may also be accomplished by following one of the other two color harmony principles—related colors or complementary colors. And the use of the latter two principles has the advantage of affording greater interest and a continuously comfortable setting.

Related Colors—Analogy.—The use of this second principle for securing color harmony is quite as easy as that involving the use of tones of one color. Harmony produced by this second principle is more pleasing and is likely to be less tiresome after long usage.

A color scheme to be constructed after the principle of related colors is built up at first exactly the same as one made by using the first principle—tones of one color. Instead of carrying tints and shades of the one color to all surfaces of the room, some of the surfaces are given one or two related colors. The one principal color remains the keynote or dominating hue of the room, while a second related color may be used in a fairly large but subordinate area of a greyed color hue; another related color may be used in a rather pure and bright hue but in small area.

Related colors are such as join each other in the color circle which represents the color spectrum of the light rays. This will be clearly understood after examining the color circle in Plate 8.

The related color hues are:

Red is related to orange-red, reddish-orange, orange, orange-yellow, bluish-red, red-violet;

Blue is related to greenish-blue, reddish-blue, blue-violet, violet, purple;

Yellow is related to reddish-yellow, orange-yellow, orange, lemon-yellow, greenish-yellow;

Green is related to yellow, yellow-green, greenish-yellow, bluish-green, greenish-blue;

Violet is related to blue, blue-violet, reddish-blue, reddish-violet, bluish-red;

Orange is related to red, reddish-orange, orange-red, orange-yellow and reddish-yellow.

The use of the first and second principles of color harmony doesn't overcome, except in part, the fact that a color scheme produced by either principle is composed of all warm colors or all cold colors. Even the reddish-blues, violets, purples, greenish-yellows and yellowish-greens are cold color hues; or at best only moderately warm, depending upon how much red or yellow is used in their mixing. Blues and greens are cold colors, while the yellows, oranges and reds are warm colors.

By the use of the related color principle interest is gained mostly by contrast of values; that by using light tints and dark shades of one principal color. By this principle but little contrast of color hues—one color with another—is gained. The interest arousing and sustaining ability of such color schemes is limited. Here, too, a balanced stimulation of the eye nerves by colors is lacking; the use of complementary colors or of all three primary colors is needed to gain perfect balance, greater and sustained interest.

Color schemes utilizing the principles of related colors and self-tones are apt to become monotonous and fail to sustain interest, largely because too much uniformity exists.

To avoid this the color scheme plan should include ample contrasts of values, hues and intensities as well as a positive climax center of interest. Colorful effects and variety can be gained by contrasts of tints and shades, of gloss and flat surfaces, and of intensity and dullness of the same color.

Color schemes of related colors usually require the addition of moderately intense warm colors like yellows, orange or red to supply warmth, variety and interest. The grey combinations especially need this stimulating treatment, since most grey combinations are cool, passive or neutral and a bit heavy.

Variety and interest are especially to be introduced into schemes of related colors and self-tones by use of wall panels, stripes, all-over wallpaper or stencil patterns and artistic textures of special wall finishes.

Wherever two tints or two shades equally light or equally dark are used in such color schemes, the contrast of values is little. A weak, uninteresting impression is thus given. To overcome this monotony a band of darker or lighter self-color, or of complementary color, should be placed between such weak contrasts.

Color combinations, like tints and shades of yellow with yellowish-orange, blue with blue-green, blue with violet and purple, constitute harmony of related colors. There is no balance of eye stimulation in any of these combinations,—a third and complementary color is needed.

Care must be exercised in making color schemes of related colors to avoid using two pure, intense colors of the same value. Pure blue clashes with pure green of the same value, but pure blue with bluish green of lighter tint is harmony; pure red with intense orange of the same value is a clash, while pure red with light orange (mixed with white) gives contrast of values and fair harmony. Violet and blue in pure intensity and of the same value clash, but white mixed with the violet increases the contrast of values and produces a combination not out of harmony. But the third and contrasting color is needed to complete all these harmonies.

Complementary Colors.—Before carrying the study of color harmony further it will be well to review the section of Chapter IX which illustrates how complementary colors come to exist, and especially the Color Card Chart in that chapter.

The primary colors are red, blue and yellow. The complementary, or perfect contrast, for red is a bluish-green; the complementary, or perfect contrast, for blue is orange; the complementary, or perfect contrast, for yellow is violet or purple.

The easiest way to clarify these associations of color is by reference, again, to the color circle, Plate 8. The complementary, or perfect contrast, for any color in the circle is the color which is directly opposite. This is strictly true when dealing with light ray colors, and it is usually true when handling color pigments. There are some slight discrepancies in the latter group, due to lack of purity in the colors. One of these discrepancies is noticed in the case of green, which is the complementary and opposite color to red in the circle. In color pigments the green which is complementary to red is a bluish-green.

Laws of color harmony call for the use of color in pairs in order to produce balanced stimulation to the color sensitive eye nerves. When the eyes behold one color too long they become tired and saturated with that color. Then the fatigue is relieved by looking upon the complementary of that color—the one opposite to its position in the color circle. Consequently, eyes fatigued with too much red seek green; when saturated with yellow they call for purple; when tired of green they call for violet and red.

In the construction of color schemes using complementary colors there are contrasts of warm colors with cold colors; there are contrasts of unlike colors; there are contrasts of value coming from the use of light tints and dark shades of one or more colors. These contrasts are the qualities which add interest to color schemes made by utilizing this third principle of color harmony. The use of all of these contrasts gives the variety of stimulations necessary for comfort and relaxation, for a balancing of the stimulations of the eye nerves. When these perfect contrasts are attained in a color scheme there is a continuous stimulation by one set of colors and a reciprocating reaction by other colors which satisfies the color sensitive nerves in the human eye.

For these reasons the use of a complementary second or third color hue with self-tone or related colors makes for perfect balance.

In theory the use of complementary, or perfectly contrasting colors, produces a reciprocating balance of sensations which ought to satisfy the eye nerves continuously.

As a matter of fact, however, the use of strong, pure colors, even though they contrast perfectly, makes the eye weary just as too much excitement or emotion for the human body causes fatigue and must be followed by a period of calm and rest.

Consequently, if too much bright red in large areas, for example, calls for green and the eyes are saturated in turn with green which again calls for red as an alternative the continued excitement of one color balancing the other causes fatigue. Small areas of red and green spots do not tire, because usually there are large areas of neutral colors to compensate.

One way to avoid this excitement of bright pure colors which contrast in color hues as well as value (equally bright, light or dark tones of pure color) is to use colors which contrast in color hue *but not in value*.

By way of illustration, select colors which are equally light or equally dark; then they contrast in color hue but do not contrast in value as when one color is bright, pure and light, while the other color is bright, pure and dark.

A dark blue and a dark yellow, a light red and a light green are not as tiresome and exciting as are dark blue and light yellow or light red and dark green. In the first set of colors you have contrast of color hues but no contrast of values. In the second set you have contrasts of color hues and also contrasts of values. The colors may be equally pure and bright in all cases.

The principle and practice of neutralization should be read at this point to understand another way to overcome excessive excitement caused by the use of bright colors.

Complementary colors can be greyed by adding white or black or, better yet, by adding to one complementary color a small amount of the other in the mixing. A greyish-green is one to which a touch of red or white has been added. A greyish-red is one to which a touch of green or white has been added. These two greyed colors complement each other perfectly and contrast in both color hue and value. They are not tiresome and exciting like the pure, intense colors, and they harmonize perfectly, not only because they complement each other, but because they have been neutralized.

The handling of color schemes consisting of two complementary colors for interiors must be thoughtfully done. Even though they are in perfect harmony with each other, they are too stimulating and exciting in their pure, intense state. To subdue them three courses are open to pursuit. Small areas of pure color may be used for the climax group, or center of interest, but one or both colors used in large areas should be subdued. Consider orange and blue.

Neutralize the orange.—If the orange is to be used in large area a bit of the blue should be mixed with it. That will bring both colors nearer to each other in analogy. It will decrease the warmth of the orange. The blue may be used rather pure and intense in moderate size areas.

Neutralize the blue.—If the blue is to be used in large area, mix a little of the orange with it. That will neutralize the blue, add a bit of warmth, reduce its intensity and purity and bring it nearer to orange by analogy.

Neutralizing both complementaries.—When both colors are to be used in large areas mix a little of each with the other, thus neutralizing both. Then the contrasts of values and intensities are reduced.

If considerable of one color is added to the other you will change the principle from harmony of complementary colors to harmony of related colors—analogy. It changes the combination from one of interest in different colors to interest in like colors.

Color combinations may be subdued or toned down in the same manner by mixing white with one or both colors. This is called greying the color. If white is added to only one of the colors you decrease its intensity and the contrast of hue, but you increase the contrast of values. If white is added to both colors you grey both, decrease the contrast of intensity and the contrast of values remains as it was.

The mixture of black with either or both colors reduces contrast of value and intensity.

Stippled Pure Colors.—An association of pure, intense complementary colors when both are used in small spots, superimposed on a neutral light colored ground coat, as in the sponge stipple wall finishes, creates a vibrating middle tone. And as the spots are made smaller the two colors blend or are mottled and the contrast is lost in a tone between the two colors.

Color schemes based on the use of complementary colors are likely to produce too much variety of contrasts, likely to set up competing interests and rivals for attention, unless skill is used in securing unity and continuity.

A well ordered plan will organize areas, locations and intensities of colors; it is one which definitely establishes a clear-cut climax as the center of interest and one which neutralizes or greys all but the climax colors.

Neutralizing and Greying Colors.—Harmony in color combinations as used generally by decorators is gained by the addition of white to subdue pure, bright colors, as well as by the use of complementary colors, related colors and self-tones of one color. Then one characteristic (the white) runs through all the colors used and that is what assures harmony. A bright color is greyed by mixing white with it.

The artist painter, however, neutralizes his bright color on canvas for backgrounds, shadows and intermediary tones by mixing with such color its complementary, the color opposite to it on the circle. Plate 8.

The tertiary colors—olives, citrine and russet—are neutralized colors. Hues of red, blue, yellow, violet, purple, orange and green go into their make-up.

Wall surfaces are always a background and therefore subdued colors are essential. Neutralized and greyed colors constitute a foil for a few bright colors used in small area in the decorations or furnishings.

Neutralization is a necessary part of every color scheme. The very shadows of nature—dull blues, violet, green and brown—approach black and are neutralized color.

The ground color for an object, a wall or a painting, may be mixed a neutral color, or neutralization in effect may be gained as the ancient Egyptians often did,—by using white, gold and black along with pure, intense colors. The white, gold and black in a color scheme neutralize or compensate for strong colors.

In the color schemes of the Italian and French peoples, who are noted for their masterly use of color, the three primary colors red, blue and yellow, mixed together to neutralize them, often enter. A bright color may be broken with white to grey it, or it may be broken by mixing with it a very dark neutral color (black) gained by mixing the three primary colors together. And, of course, in their color schemes there is usually a dominant color tone in evidence, the neutralized, broken colors serving as foil or background for the dominant color.

Many ancient peoples used colors which were neutral or greyed, rather than the brilliant, pure colors of our day. The Egyptians often and the Assyrians especially were noted for their masterly use of these to produce color harmony. The red so much used by ancient artists of Japan was a yellow red, while their blue was a neutral, greyish blue. The blue of the Persians so evident in rugs was greenish in hue and a violet-blue was its contrast. Pompeiian red is really a complex color which can be produced now only with vermilion, ochre, raw and burnt sienna and a bit of raw and burnt umber. Pompeiian yellow is an orange yellow having a touch of blue in its makeup. Pompeiian black results from the mixture of red, blue and yellow, the primary colors.

If it were not for the principles of neutralization and greying of colors, colorists would have a difficult time of it. With only intense colors, black, white and gold harmony in color schemes is easy to get, but such combinations are far too eye-stimulating for most interiors, and especially for living rooms, sleeping rooms, libraries and school rooms, where a restful, passive and subdued atmosphere is essential. Such color treatments are possible only by using greyed colors and neutral colors producing contrast values of low tones.

What is especially to be remembered about neutralizing and greying of colors is that when you have mixed two or more colors of strong intensity and are at all doubtful about the harmony of the combination, you can assure harmony by the addition of a little white to both colors to grey them; or by mixing a little of one color with the other you can gain harmony by neutralization—by making them related colors.

Nearly all very light tints of all colors harmonize with each other, some better than others, because they are neutralized or greyed or both neutralized and grayed. In other words, the thread of neutral or greyed tone may run through all such tints and ties them together in harmony.

The Law of Simultaneous Contrast.—There is no such thing as a color which is constant under all conditions as to appearance to the human eye.

The character of a color is always relative. The appearance of a color differs always, depending upon the amount of light it receives, whether it is sunlight, electric light or gas light and especially does the appearance differ according to what other color or colors surround it.

Any two colors will change in character when placed beside each other and when one is superimposed upon the other. One influences the other in its stimulation of the eye nerves.

A light grey placed beside black or any dark color appears lighter because of the contrast of values.

A dark grey placed beside white, light grey or a light color tint appears darker, because the contrast in values is great.

For strong display and striking color schemes this great contrast in values is essential. Moderate contrast in values is desirable to create interest in interior color schemes, but it is possible to produce a contrast in values so strong as to be a discordant note in a room and which breaks in on the continuity or unity of the color scheme.

When the purity, depth and brilliance of dark colors like blue, green, purple, violet and the shades of these colors are to be enhanced, place alongside of them light greys, tints of colors or white.

When the purity, depth and brilliance of light colors like yellow, orange and red is to be enhanced, place alongside of them dark greys, shades of colors and black.

A color displayed on a white or grey background may appear bright and pure, but when it is displayed on its complementary color as a background it will be even brighter and more intense. For instance, a red spot on a green field not only appears brighter and more intense, but the green, too, is more intense.

Colors which are related to each other by analogy, such as yellow, orange-yellow and greenish-yellow, have little contrast in value and when one is superimposed upon the other it tends to dull the other.

The use of a pure, bright color superimposed upon a greyed color tends to deaden the grey, if the grey is not complementary. A pure yellow is not in good harmony with dull red, greyed orange or greyed browns, but, on the other hand, a pure, bright yellow adds life and intensity to a greyed blue.

The greatest display strength is secured by the use of complementary colors together and when one is very pure and strong and light in value, while the other is pure and strong but dark in value. Such a combination is useful, however, only for very small areas in decoration,—what decorators call jewel points. In large areas these intense contrasts in both color hue and value are too exciting and are tiresome.

Decorators and artists depend upon the law of simultaneous contrast for brilliance and intensity of display by placing small areas of pure, intense complementary colors in contrast with each other.

In other words, bright color schemes can be constructed by using pure, intense colors, but the fullest intensity and brilliances comes from the association and contrast of those colors with their complementary colors.

Red placed alongside of green appears redder and the green appears greener;—their purity or degrees of intensity are increased by the close association. A bit of blue tapestry near a heavy gold picture frame appears bluer while the gold appears yellower.

The point about the manner in which one color influences another which should be remembered is this: *A color tends to project its complementary color into adjoining colors.* Thus:—

Red alongside of any color tends to add a greenish hue (its complementary) to colors associated with it:—

Red causes green to appear brighter and more intense;

Red causes yellow to appear greenish in hue;

Red causes orange to appear browner;

Red causes warm, yellowish grey to appear neutral or cooler;

Red causes cold, bluish grey to appear colder.

Blue placed alongside of any color tends to add an orange-yellow hue (its complementary color) to colors associated with it:—

Blue causes orange-yellow to appear more intense and brighter;

Blue causes red to appear yellowish in hue;

Blue causes warm, yellowish grey to appear even warmer;

Blue causes cool, bluish grey to appear warm or neutral.

Yellow placed alongside of any color tends to add a purple or violet hue (its complementary color) to colors associated with it:—

Yellow causes purple or violet to appear more intense and brighter.

Yellow causes red to appear violet or purple in hue;

Yellow causes warm, yellowish grey to appear neutral or cool;

Yellow causes cool, blue grey to appear cooler.

Green placed alongside of any other color tends to add a violet hue to colors associated with it. Its action is the same as that of yellow in this respect:—

Green causes violet to appear more intense, brighter;

Green causes yellow to appear less intense by throwing a violet hue into it;

Green will cause red to have a slight violet hue;

Green will cause warm, yellowish grey to appear neutral or cool;

Green will cause cool, blue-grey to appear cooler and to have a violet hue.

Violet placed alongside of any color tends to add a greenish hue to colors associated with it:—

Violet causes green to appear more intense, brighter;

Violet causes yellow to appear greenish in hue;

Violet causes red to appear brownish in hue;

Violet causes warm, yellowish grey to appear cool or neutral;

Violet causes cool, blue-grey to appear cooler and bluer.

The satisfaction found in the contemplation of color harmony is explained by psychologists as a result of unconscious appreciation of balance. The activity of the color sense, as is the case with the senses of taste and hearing, becomes intensified by contrast. The palate is more responsive to a bitter taste if already cloyed by sweets. Sound seems the greater if arising out of the stillness of solitude. The nerves of the eye, wearied by the excitement produced by red, are quick to appreciate the restfulness of green. As a result of this peculiarity a color appears to tinge with its complementary any adjoining surface. For this reason green is becoming to a woman who is pallid. The eye apparently sees a tint of red in her face.

Colors Influence Life.—Science proves that character and personality are molded by the walls and furnishings with which we live. Color creates environment which either stimulates or depresses the mind. Colors may be selected as we choose music,—to produce cheery atmosphere, warmth, harmony.

Every color of the solar spectrum exercises a corresponding human emotion. These emotions give rise to various states of mind, such as happiness, serenity, excitement, gloom, depression, irritation. Too much of red excites and irritates, while too much of blues and violet depresses.

Certain colors, odors, sounds and substances produce stronger reactions on some people than on others. Pink and vivid violets cause some people to suffer nervous irritation and depression due to too much stimulation of their color sensitive eye nerves.

Some colors, on the other hand, possess curative powers;—chrome yellow, for example, has been found excellent for shell shock victims. And in one experiment a large number of patients in a hospital for those suffering from mental and nervous disorders showed remarkable reactions to color. On dull, gloomy days these patients were very irritable and difficult to manage. But when removed to a large room decorated in sunshine effects to reproduce sunlight as nearly as possible with yellow orange decorations, these patients soon returned to their normal actions noticed on bright days.

Another illustration of color influence was given when a large number of girls in a reformatory were allowed some liberty in color taste. When all were required to dress exactly alike and to occupy rooms or cells colored alike, these girls marked the walls and disfigured them greatly. But when each was permitted to select the color for her cell and was also allowed some liberty in the color of her dress, a pride and interest was awakened which caused them to cease marking up the walls and to be less difficult of management.

Apparently there is quite as much pleasure and satisfaction to humans gained from exercising individual taste in color as in music and other things in life.

How Colors Appeal to Us.—Colors convey an impression of temperature —warm and cold colors; an impression of force—active, advancing colors and passive and receding colors; an impression of weight—dark colors and shades seem heavy, while white and tints seem light in weight.

It should be noted that complementary colors such as purple or violet and yellow, bluish green and red, orange and blue, balance each other perfectly in the above qualities;—

purple is cold, passive, heavy, receding;
yellow is warm, active, light, advancing;

green is cold, passive, heavy, receding;
red is warm, active, light, advancing;

blue is cold, passive, heavy, receding;
orange is warm, active, light, advancing.

In consequence of these facts, complementary colors not only are in harmony by perfect contrast, but used in pairs they supply balanced stimulation of the color sensitive nerves of the eyes.

The eye nerves of one kind become exhausted when exposed to one color too long. The degree of fatigue produced by a color is in direct ratio to the intensity of the color, and the relief is found in the exact complement of the color. Fatigued nerves tend to call up vision of the color which is complementary to the color causing the exhaustion. Thus, over-exposure to red is balanced by green; over-exposure to green calls for red; over-exposure to yellow calls for purple or violet; overexposure to orange calls for blue, etc.

Light tints and colors convey an impression of youth and gaiety.

Dark colors are mysterious, sober, sedate, sombre, mature and dignified, as they appeal to our moods.

Warm colors are exciting, stimulating and active.

Greyed colors are, apparently, a bit sophisticated and melancholy, though very restful.

Orange is the most exciting color, yellow-green is the most tranquilizing color, and violet is the most subduing color.

Cold, Sombre Colors.—

Blue	Violet
Gray	Purple
Green	White

Green is a cold color only when the blue in its composition predominates. These colors seem cool perhaps because associated with the colors of large areas of water, ice and the colors of nature.

Warm, Cheerful Colors.—

Red	Yellow	Tan	Ivory	Pink
Orange	Brown	Cream	Old Rose	Buff

Green (when toned with yellow, red or orange)

Warm Grey (has red or yellow in its make-up)

Restful Colors.—

Browns	}	
Olives	}	
Sage Green	}	
Grey Green	}	These make an excellent background
Greens	}	for pictures also.
Tans	}	
Warm Grey	}	
Old Blue	}	

Colors which harmonize by analogy, especially when pure in tone, suggest quiet, repose and rest.

Excitable, Tiresome, Irritating Colors.—

Bright Red	Bright Blue
Bright Orange	Terra Cotta
Bright Yellow	Emerald Green

Black is cold, heavy in weight, receding, and passive. In combinations where black predominates it ought to be balanced by active colors with high contrast of value; intense, pure red, orange and deep yellow like gold are most effective in balancing large areas of black. Black enriches the beauty and emphasizes the intensity of these colors. Silver and bright green also makes a pleasing combination with black.

White is warm, active, advancing, and light in weight. Combinations to have strong display contrasts are formed with white by the addition of dark, cool colors like intense blue, green and purple or violet. Which of these colors should be used to complement white depends upon the character of the white. Whites have a blue, yellow, red or grey hue.

Poorly selected colors make folks weary, restless and irritable, but they do not always recognize the cause of the disturbance unless the color scheme is very unusual.

Colors That Give Distance—Largeness.—In the color schemes of nature, the green, blue and grey of the ocean and sky predominate and these are the colors which in their lighter tones produce the effect of distance and largeness. But as solid, strong colors these, like all dark colors, would cause a wall or object to seem nearer. They ought to be used in light tints.

Receding colors—blue, green and grey—give a sense of spaciousness; and the advancing colors, such as red and yellow, bring the object nearer us. If an apartment be too large and barn-like, it is no difficult matter to make it seem smaller by the use of a warm, advancing color scheme. Contrariwise, in the case of cramped, small rooms, we may actually seem to have gained room by the choice of cool, retiring blue, green or grey.

Lack of harmony in a color scheme isn't the only tiresome element in color. Some colors are very active and advancing, while others are receding. And these qualities are relative.

Pure, intense blues and greens are receding colors as compared to orange and reds, but pure blues and greens are advancing and nerve fatiguing as compared to greyed blues and greyed greens.

Color and Artificial Light.—Careful selection of a color scheme for rooms will take artificial light into consideration, since most rooms are used with both daylight and artificial light.

Certain colors change considerably under the influence of artificial light. The color spectrum differs somewhat in its colors when the source of light is a burning gas or electricity rather than sunlight.

Light blues are nearly invisible in night light. There are, however, night blues which do retain their color intensity better under the rays of artificial light. Pure blue appears almost black at night.

Colors like yellowish green appear to lose their yellow hue at night and become more bluish green in hue. Creams, yellows and light tans are greyed, while orange becomes more reddish in hue under artificial lighting.

Pure yellow which is free from a greenish or reddish tinge appears under artificial light to be almost white. Scarlet appears normal but brighter. Bright pure bluish green appears normal but a little dull.

Other changes noticeable under the influence of electric or gas lights are:

Azure Blue appears grey and dull.
Cadet Blue appears soft and dull.
Peacock Blue appears soft and dull.
Old Blue appears soft and dull.
Robin's Egg Blue appears grey and dull.
Brown appears softer.
Buff appears to be little changed.
Grey appears softer.
Green appears softer.
Lavender appears adversely affected.
Maroon appears softer.
Pink appears adversely faded.
Purple appears black.
Reds appear to be little changed.
Rose appears adversely affected.
Salmon appears faded.
Terra Cotta appears softer.
Violet appears to be little changed.
Yellow appears softer and faded.

Knowing these changes which occur at night, a good decorator will count on them. Color schemes which include yellows as principals will be so balanced that night light will not make them too weak. More reddish or brownish hues will be given the yellows.

Correction of color schemes which lose their balance and interest at night can be made by using lampshades which project yellow light where needed. Colored lamp bulbs casting colored lights which blend into a color scheme can be most effectively used with a little study.

CHAPTER XIII
SELECTING COLOR SCHEMES

Probably the first idea of importance when one starts out to construct a color scheme for any room is that of making a plan which will consider the room completely furnished as a whole. It is quite impossible to intelligently select colors for walls, wood trim, floors and ceilings without knowing the kind, character and color of the furniture, drapes and accessories in general, which are to be used as a part of the room. And yet this is done every day; more rooms are decorated without reference to the furnishings than after a plan which includes everything. As people in the mass become better educated in the artistic use of color and design, this arbitrary selection of colors for wall surfaces of rooms will diminish.

There is under way today a great renaissance of color, a revival of interest in color which is giving even greater impetus to the painting, decorating and printing industries.

Intense interest is being aroused in the great masses of people in better and more extensive use of colors. Decorators, painters, printers, factory finishers of furniture, textiles and all who use color, are confronted with the necessity for learning more about the tasteful and harmonious use of colors. A greater knowledge of color pigments, liquids, theory of color and principles of color law is imperative for those who would keep abreast of the times.

Having a plan for a color scheme makes one consider the room as a whole and points to the wisdom of correlating colors, textures and designs; it makes one construct the harmony of a room as an author constructs his story and as an artist plans his composition on canvas or in music.

The lack of a plan and organized thought in selecting color schemes is largely responsible for most failures to acquire harmony.

A lecturer who talks and talks aimlessly, who just rambles hither and yon, soon exhausts the patience and interest of his audience. A story in fiction and a drama without plot, direction, progression and climax is a flat failure. There is little or no difference between these and attempted decoration of a room to gain harmony of color in architecture and furnishings. We accept these flat failures because we have grown accustomed to them, and we live with them for years, all the while being influenced unfavorably in mentality and physically by them, unknowingly, as a rule.

When a thoughtful plan has been made all furnishings and colors, textures and designs going into a room are selected with reference to the whole room as a unit. Of course, the question does arise with most people when they buy furniture, drapes or other furnishings, as to "how it will go with this or that," but even then there is usually no plan for the whole room; anxiety is present only lest one piece of furnishings should clash with another. How all correlate and fit together doesn't concern one as often as it should.

There ought to be less promiscuous buying of wallpapers, drapes, cretonne, cushions, scarfs, pictures, rugs, pottery and vases. When this is accomplished much more success will be gained in constructing beautiful, restful and harmonious interiors. The discords will be eliminated and disorder will change to artistic arrangement.

The beauty of art is not a thing apart from all else. It is part of everyday life of people and is expressed constantly in the construction of private and public buildings.

Real beauty, art, comes from the satisfaction one feels when the eye, the intellect and the affections are satisfied.

Ornamentation, which is decoration, should add to the beauty of a structure as a whole. It is not necessary to the utility of a structure or article of merchandise, and it is bad decoration if it interferes with utility.

The result of good decoration should be a color effect as a whole,—not colors.

In color management, selecting colors which go well together is largely a matter of mathematically following rules; choosing colors which go well together is simply a matter of knowing colors and color principles.

The big thing in creating color schemes which are not only in harmony but which possess the quality of interest and have the power to sustain that interest indefinitely, is organization.

The difficult task is that of making a plan for color treatment of a room, gaining harmony by contrast of values, hues and intensities, harmony in balance, proportion and rhythm. That calls for judicious selection of bright and dull, warm and cool, advancing and receding colors, gloss and flat, large and small areas, location, repetition and arrangement of colors.

The perfect color scheme sustains interest, it is livable and grows on one. It possesses neither great variety nor great likeness.

Too much variety causes restlessness; discord and chaos are extreme degrees of variety in contrasts of values, hues or intensities. Too much variety in music or anything else is chaotic.

Too much of sameness, likeness and uniformity, on the other hand, dispels interest and is the extreme in monotony.

Climaxes and Centers of Interest.—Just as a drama and a story require a climax to make an entertaining, harmonious unit which sustains interest, so also must perfect and practical color schemes have climaxes.

Centers of interest which constitute climaxes are essential as elements around which the color schemes can be constructed.

A climax in a room may be a brilliant, intense colored vase, a bit of white statuary or a bouquet of flowers arranged in a vase and grouped on a table so the light will reflect them in a mirror. The climax may be a fine book in art binding of pure, intense color arranged on a very light colored or white scarf on a table; it may be a rather large picture the colors of which are pure and intense and contrasting with great vigor. Window drapes of bright color greyed somewhat are too often the climax of a room.

As a rule the climax color of a room is very bright, but should be used in comparatively small area.

If pure, intense colors are used in more than one center of interest, unless the room is large, anti-climaxes will be present and the effectiveness of the color plan will be injured. Then the room will not be so restful and inviting. Stimulation for the eye nerves will come from too many sources in competition with each other for attention, those who live in the room become weary and uneasy without knowing the cause.

To be sure of balance in a color scheme, the rule to follow is that of having a small area of pure, intensely brilliant color balance a large area of dull, greyed and subdued color.

The principle of constructing a color scheme around a climax doesn't mean that all the colors except those in the climax group must be very dull greys or very low contrasts of value in other colors.

Moderate contrasts of values in self-tints and shades of the keynote color are permissible; moderate contrasts of values and of greyed hues of related colors may be used to good effect, too. And even complementary color, considerably greyed or neutralized by the addition of white or complementary colors, can be used to add cheer and avoid a too sombre atmosphere in the color scheme before the climax color is introduced.

These related colors and subdued complementary colors may well occur in the rugs, drapes, pictures, pottery and odd furnishings.

Appropriateness of Color Schemes.—The eternal fitness of things has most forceful illustration in the selection of color schemes for various rooms.

In a ladies' bedroom we may fittingly employ the light, delicate and airy tints,—greys, grey-greens, pale pink and silver, the delicate yellows and pale blues; but in the trophy room of a men's club such delicate harmony would be ridiculous. There more forceful, strong coloring, though in harmony, is needed. And there the use of quietly insistent complementary colors and stronger contrasts of values, hues and intensities are called for.

A millinery shop calls for a different handling of delicate colors in harmony. A novel and more colorful treatment and arrangements of colors to display greater strength of contrasts than in a lady's bedroom are needed.

The brilliant display of gold, vermilion, ivory and intense blues of the circus wagon finds no appropriate place in the decoration of home interiors. Although the decoration of a business display room for powerful machinery ought by all means to make use of fairly intense complementary colors with strength of contrast of values.

Colors must fit the purpose for which a room is used quite as much as is true in the case of merchandise. A strong and powerful piece of farm machinery is appropriately colored in intense reds and greens; it would look ridiculous painted in the baby blue or pink of a child's bed or high chair.

Balancing a Color Scheme.—On certain occasions a room is purposely decorated to give a warm or a cold atmosphere, as when a cold north bedroom is decorated warmly, or an excessively hot south room is given a cool atmosphere by decorative treatment. Also some rooms, like a dance hall, for example, are planned to have a very active, lively color scheme, while a library or school room calls for quiet, subdued, restful treatment.

The average room, however, needs a decorative plan which is well balanced between warm and cold tones, active and passive design. Neither too warm and stimulating, too cool and chilly, nor so neutral and drab as to be cheerless and uninteresting.

This balance of harmony and atmosphere is gained by judicious handling of pattern, texture or design on walls; skill in the use of bright, intense colors, warm and cool colors, greyed and neutral tints and shades, and, more specifically, by skill in creating contrasts of value (neither too high nor too low), contrasts of color hue and contrasts of color intensity.

Great care should be taken to avoid having extreme contrasts by all three methods—value, hue and intensity—at the same time. Self-tones and related colors may be fairly strong in contrast of value if they are greyed or neutralized without proving too stimulating to the eye.

Comfort and a sense of well-being in humans results from balance. How we react to temperature and to light and dark indicates comfort, balance, or lack of them. Color may put us at ease in comfort or throw a human completely off balance, if there be lack of harmony or too large an area of strong, brilliant color. Such color tires the eye, as do also weak, washed-out colors. The sense of balance seems to come from near the greys in the color scale.

Upon the area of strong color the balance of a color scheme also depends. We like strong colors, but in small amounts. A comparatively small spot of bright red, yellow or blue will balance a great area of grey and other dull, harmonizing color tints and shades. So bright colors only excite and fatigue the eye when used in large areas.

And, of course, the general principle requiring that a gradation of color from floor to ceiling should exist should not be lost sight of. Walls ought to be a lighter tone than the floor; ceiling ought to be lighter tone than the wall. This is a contrast of values; the contrast should not be great; just a pleasing gradation from the bottom up as in nature with its black or dark colored earth to its light blue sky.

Dark colors on top or in the middle just naturally throws a color scheme out of balance. Dark colors appear heavy, as do also bright colors in certain combinations with light tints, and the laws of gravity place weight at the bottom. That is, then, the agreeable, natural and pleasing arrangement.

Color Schemes for the Living Room.—The living room, as the name suggests, has ever been the place where most of the family life is spent, where friends and visitors are entertained. Here should be created an atmosphere of comfort, relaxation and quiet refinement.

Extraordinary or novel effects in this room might entertain or amuse the guests, but they are sure to become tiresome to the family. Such decoration doesn't sustain interest well and is likely to be too stimulating to associate with seven days in the week. A conventional and conservative expression of good taste in decoration is more fitting in the living room.

The color note may be any of the greyed or neutral tints and shades. Tans, moderately light browns, warm greys, old blue, grey-green and neutral blue-green, dull russet, buff, olive or sage green, warm drab and Bedford stone are some of the colors which are suitable.

The selection of a color scheme for a room where there is one invariable element, that is, where the furniture or rug has already been selected must necessarily proceed from the color of such furniture or rugs. In other words, the keynote color of the room must be that of the rug or furniture related to or complementary to them.

This keynote color may, of course, contrast with the rug or furniture in color hue and in value, using lighter tints and darker shades. The character of the room coloring may be made either warm or cool in general atmosphere, even when starting from a fixed element of color, like furniture and rugs, which are apt to be of warm tones. Likewise, the color scheme can be either receding or advancing in character, depending upon the size and shape of the room.

For the purpose of illustration, let us assume that we have a new living room without color, except the natural new colors of walls, wood trim and floor.

The first consideration is the size and shape of the room. Is it too small and does it require giving apparently increased size? Is it a large room in which a wide range of choice in colors, textures and designs is offered? Are the ceilings quite high, affording an opportunity to use fairly dark colors, or are they low, requiring very light colors? Is the room quite ornate, architecturally, or is it plain and simple? Is there a large amount of wood trim or is it of a type which has no door or window casings? Are the walls occupied largely with built-in furniture, resulting in comparatively small wall area? Are the wall surfaces continuous or are they broken up by trim, by wood paneling or by paneling with moldings?

When you have made a study of the room and have a clear idea of its character in answer to these questions, the next step in making a color scheme plan is to decide on a keynote color. Is the general color atmosphere to be very light, moderately light or quite dark? Is the color feeling of the room to be warm, cool or simply neutral? What are the color preferences of the people who are to occupy the room? These should be considered but should not be allowed to dominate the color scheme unless they coincide with the other elements involved.

What is the character of the light—is the room flooded with sunlight, is it moderately light, or is artificial light depended upon much of the time?

Until one is experienced in the selection of color schemes, the safest method to pursue as the first step is to choose one keynote color and then follow the principle of harmony by using self-tones—lighter tints and darker shades of that color for the surfaces of largest area, which are the walls, the floor and ceiling. Then to this related colors can be added in a limited way to gain additional harmony by the principle of analogy; or as one becomes more skilled complementary colors which are in perfect contrast with the keynote color may be used in a greyed tone and in small areas.

The accomplishment sought in working with these principles of color harmony should be to construct a color scheme which is rather subdued, low in tone and quietly harmonious. This refers not alone to the colors for walls, floor, ceilings and trim, but also to the selection of furniture, rugs, pictures and usually the window drapes.

Special care should be exercised to avoid the use of large and fairly large areas of white, such as glaringly white lace curtains, dresser scarfs and table covers. The use of rather large white mats on pictures is especially a glaring weakness of many interior color schemes, because they give the effect of a hole in the wall. There is little reason to have a mat on many pictures, but when a mat is used it should be very subdued in color, should be a self-tone with the dominating color of the picture and frame, or it should be covered with a fabric which will tone in with the picture, the frame and the wall. The general color scheme of a room may be good, and yet, if a comparatively large area of white in lace curtains, picture mats, scarfs or table covers are present they are a discord in the harmony because they attract too much attention to themselves. These furnishings should be of such a color hue as will harmonize with the general keynote color of the room as a soft tint or shade, as a related color, or as a very much greyed complementary color.

The whole color atmosphere of a room should be so quietly harmonious up to this point that when a stranger steps into the room for the first time no single element will draw attention to itself immediately. The general atmosphere should be comparable to a chord of music in its harmony. In other words, your contrasts of color values—light tints and dark shades of the key color—related colors and complementary colors in greyed small areas should constitute one harmonious whole.

Having accomplished this much, there remains one more element to direct in completing the plan for the color scheme. This is to introduce a climax around which the whole harmony revolves. This climax may be composed of a small area of bright color or complementary colors, and it may take one of several forms.

The climax may be a brightly colored vase full of flowers on a mantel, on a bookcase or on a table in a living room; it may be a brilliant vase and flowers on a small table before a mirror in a reception hall in which the mirror, table and the vase are grouped to form a pleasing symphony of color and form.

This climax or feature of special interest in a room may be a bit of statuary in white or bright colors, it may be a rich scarf or table cover, or it may be a picture of brilliant hue of one or more colors. In other words, the charm of a room results largely from directing the attention of one entering the room to one tastefully constructed group or element in that room.

The same principle applies to the bedroom with its beds and beautiful drapes featured, or with a vase of flowers displayed on a dresser before a mirror, or with its beautiful dominant picture.

The climax of the dining room is the completely decorated and furnished table with the meal spread ready for guests; in a library the climax feature may be the brightly colored book bindings or it may be a beautiful picture in bright colors, and if neither of these it may be a bright bit of statuary or vase on the desk.

At times the climax or center of interest is the window drapes, but it is much better to subdue these in favor of some other feature of interest in the room. There is often good reason for using brightly colored drapes, and this can still be done if the colors are subdued or of a greyed character; they may be bright and yet be subdued with overdrapes so as to avoid competition for attention with the real climax of the room.

Color Schemes for the Dining Room.—The atmosphere which is sought in decorating a dining room is one which will radiate an impression of good cheer. What we should seek to accomplish is not alone an atmosphere of good cheer but, also, to impart a sense of comfort, warmth and relaxation.

Probably the color harmony principle of using related colors is most commonly useful and the color should be in the medium dark values, rather than extremely light or very dark. Intensely stimulating colors for the general tone ought not to be used.

If a color scheme selected using light colors tends to appear a bit sombre and too dull the atmosphere of the room can easily be given a cheerful note by the use of a small area of complementary color in the pictures, in vases and window drapes.

After all, the decoration of a dining room should produce a quiet, rather low toned harmony as between the walls, ceiling, wood-trim, furniture and drapes. The central point of interest, the climax, in a dining room setting is composed of dishes and the table decorations. There should be nothing about the walls, drapes or furnishings of the room which is so bright and advancing as to compete for attention with the dishes, decorations and food upon the table.

For specific suggestions these colors might be considered: Delft blue, old blue, dull grayed orange or russet, sage green, gray-green, dark tans, leather brown and dark French gray.

Color Schemes for Kitchens.—In the past few years there has been what might be called a great reformation in the furnishing and decorating of kitchens. It is quite likely that the advertising of kitchen furniture, utensils and equipment is largely responsible for this, because this vast amount of advertising has pictured in the magazines how beautiful and inviting the atmosphere of a kitchen can be.

In this day we like to have a kitchen appear just as bright, spick and span as it really is. This appearance can be gained by the handling of colors for the kitchen. In the first place smooth walls are preferable to rough textures. Gloss or semi-gloss is preferred to a flat lustreless surface. There is a practical reason back of this also. In a kitchen there is a daily releasing of steam laden with more or less grease from cooking; also there is bound to be more or less smoke. Accumulations of smoke and grease occur on the walls and ceiling. If the walls have a gloss and are smooth they can readily be washed, whereas rough walls accumulate dirt and hold it. Flat walls spot easily and cannot be washed, at least not more than once.

Dark colors do not give the right appearance in kitchens. The color should be light, bright and cheerful as well as shiny. A duplication of the semi-gloss evident upon kitchen cabinets, stoves and plumbing fixtures may well be continued on the walls and ceiling.

White, ivory or very light gray, green or blue enameled woodwork is also a necessary part of a color plan. Then, when very light, airy curtain material is used and you have the brightness of a growing plant or two about the windows an ideal setting has been gained with the impression of brightness and cleanliness.

What is needed to complete the balance in such color schemes is a note of bright color in small area. Bright but greyed reds, blues, greens, oranges or yellows may be introduced in some form. Bright but small spots of color in plain colored curtains give the added balance. A brightly colored glass shade on the electric light may give the bright color note needed. It may be that a brightly colored linoleum will add all the contrast which the room calls for. The blues and greens are especially welcome in the kitchen because of their cool tones.

Some of the color schemes which will give a novel character to a kitchen, used principally for the curtains, are these: Blue, white and yellow-orange; yellowish-green with black and cream or ivory.

Color Schemes for a Library and Private Offices.—If there is any room in which the color treatment and furnishings should not call attention to themselves or clamor for notice it is in a library, a study or a private office in homes and business places. In such rooms the occupants want agreeable surroundings but they do not want active eye stimulations which will divert from the work in hand, whether it be study or the transaction of business. What is wanted is an atmosphere of comfort which is conducive to quiet and restfulness.

The color schemes for such rooms may be built up from medium dark greyed colors and the less intense tones. Receding rather than advancing colors are desirable and, above all, simplicity in color combination as well as pattern, texture and design are to be gained. Even the floor coverings, furniture and window drapes should be subdued and should harmonize in low values rather than to contrast greatly in value. If there are any art objects or accessories used they may be in bronze or dull polychrome.

Such a color scheme is likely to become a bit sombre and needs a note of contrasting color. This may be supplied by a central point of interest, or climax, which is in the form of a not too large, brightly colored picture or a vase containing flowers in well selected colors. If there are any decorative designs on the walls such as a frieze or stencil band it should be in simple, classic design and self-tone or colors related to the wall color.

Color Schemes for Bedrooms.—The atmosphere to be created by color schemes for sleeping rooms should be one of restfulness and relaxation. Light colors are much to be preferred to dark shades. Generally speaking, the colors should be warm unless the room happens to be of the low ceiling type on the south side of a home which actually becomes very warm during the summer; in which case the cool, blue-grays with a bit of contrasting orange, gold or pink are used. Cool bluish-greens and greenish-grays with pale lavender and black are useful in such rooms. For other bedrooms light grays which have yellow or red in their makeup for warmth, ivory with light olive green, dull blue or gold are good color combinations, as are also delicate blues, creams and light grays.

Mere common sense warns us also against the so-called spring greens, or even the too strong blues in bed rooms. But if the vivid hues are out of keeping, equally so are the sad and sombre colors. Sheer common sense again warns us against the depressing, melancholy tones, against blues of too great weight, against the solemn purples that have been called the "ashes of color," against certain dark reds which may be described as sullen.

There are left, then, for bedroom use, various shades of yellow, soft greens, soft blues and grays; and the possibilities for working out variations upon these, as well as for combining them into color chords, are infinite.

No color is more suited to the bedroom than grey, which has been called the peacemaker of colors. Nature, as we all know, uses grey and grey-browns lavishly when she wishes foils for her particular beauties. We realize this when we note her coloring of the ground, of rocks and of certain lichen vegetation.

Grey is a versatile color, almost a treacherous one, for in certain states—in that of steely tone, for instance, where it is a mean between black and white—it is far from friendly. Rather it is suggestive of mediaeval prisons and of stern limitations. On the other hand, when warmed with an admixture of yellow, or a small amount of red, grey will prove essentially fit for the restful room.

As sheer gray suggests limitation, blue, even in its heavy forms, suggests the illimitable. In its lightest tones a characteristic of the limitless sky, blue possesses the rare quality of allurement.

Color Schemes for the Hall.—The entrance hall is the first introduction visitors have to the home and is responsible for the first impressions gained. It ought to be decorated in warm cheerful colors ordinarily and also to harmonize with the living room.

Yellow tints or shades, tans, light browns and sometimes dull rose, buff, fawn, ivory and cream are desirable in this room.

For large halls fairly dark greens and dull red, drabs and browns are permissible but they are quite certain to cause a small hall to appear still smaller. The tints in small halls should be very light always.

Color Schemes for School, Church and Bank.—Quiet and dignified color plans are most suitable for these buildings. Neither color or stencil design should be strong enough to attract or divert attention. Dull, low tones of buff, drab, green, gray, blue, russet and brown serve the purpose admirably and offer a wide range of colors but they are likely to be dull and monotonous unless a certain amount of luminous or bright color is added such as in a stencil here and there to give the necessary amount of life and brightness without disturbing the dominant tone of the quiet, restful colors.

Color Schemes for Children.—A much better choice of decorations for a child's bedroom or nursery is more evident today than ever before, but there is still some tendency to force upon children color schemes which are appreciated more by grown-ups. A child's natural preference for colors tends towards bright, pure tones. It is possible to satisfy that preference without making a room too intensely stimulating to grown-ups.

When we attempt to force upon children a preference for quiet, subdued harmony very early in their lives nothing is really gained by it. In the beginning a child's preference is quite similar to the preferences of primitive peoples and savages. When children are allowed to exercise their preference at first they naturally become satiated with brilliant, pure colors and come naturally to a preference for true color harmony of greyed tones later in life.

The large surfaces such as walls and ceilings and floors in a child's room may well be given greyed, subdued colors but let there be considerable areas of the walls near the bottom which contain pictures or decorations done in pure, bright complementary colors. The pure intense reds, orange, yellow, blue, green and purple in moderate areas will satisfy and amuse the children without undue stimulation to mature persons.

The furniture of a child's room may well be colored with the greyed color hues, generally, but each piece of furniture should have its small area of pure, bright color. The toys will come naturally in bright colors, too. The bright colors and the grayed colors of the furniture should, of course, harmonize with the floor, walls, ceiling and wood trim colors.

Large Rooms.—Moderately large rooms offer greater latitude in choice of colors, textures and design than is possible in small rooms.

Here color schemes may be used which utilize greater contrasts of values, as between tints and shades of one color or as between light and dark colors; also colors may be used which constitute greater contrast of color hues, of related colors or complementary colors; and here also colors are permissible which show a greater contrast of intensity in pure, brilliant tone as between complementary colors and related colors.

In other words, stronger, brighter colors, those which have been grayed or neutralized to a lesser degree by mixing in white or complementary colors may be used in large rooms.

In moderately large rooms the advancing colors may be effectively used, not in their pure brilliant tones because that might produce too great a contrast of intensity, contrast of color hue and contrast of values as well.

But the advancing colors which are orange, reds, yellows, creams and light tans may be used in less greyed or less neutralized degrees.

Pure, intense tones of blues and greens are advancing colors as compared to greyed tints and shades of blues and greens. As compared to pure intense reds, orange and yellow, the pure bright blues and greens are, of course, receding colors.

Gloss and semi-gloss finishes may be used in large rooms but should not be used in small rooms, since they apparently emphasize the limits of vision and appear to make a room smaller. Flat finish is best for small rooms and may also be used in large rooms.

On the walls of large rooms very rough textures in special wall finishes like old English, Holland and Italian Travertine are fitting, as also are stronger designs in wall paper which contrast to a greater degree in values, hues and intensities of colors than should be permitted in small rooms.

Small Rooms.—A selection of color schemes for small rooms usually involves a consideration of ways and means to apparently increase the size of the room. Even when this is not especially desired the decorator must at least avoid a color treatment which will apparently shrink the size of a room.

Walls of a room limit the vision. Colors on walls emphasize or minimize this limitation according to their character.

Generally speaking, the receding colors are the blues, greens and the darker shades of other colors. Pure intense blues and greens are, however, receding colors only when compared to other pure, intense colors like orange, reds and yellows. Pure intense blues and greens are advancing colors compared to light tints and greyed hues of blues and greens when used in large areas.

Greens, blues and blue-greys which can be used on large wall areas to give a receding atmosphere are such as range from pale, pure tints of these colors to greyed, neutralized dark shades like olive shades and old blues.

When you reduce the intensity of these pure blues and greens by mixing white with them, or neutralize them with their complementary colors orange and red you remove their insistent display strength, you make them as fully receding as possible, with the consequent effect of apparently increasing the size of the room.

The use of strong advancing colors like yellows, orange, reds and all tints which can be used to express sunlight the wall limitations are emphasized and made to appear nearer at hand—the room seems smaller with bright colors on the walls.

Gloss colors are more advancing than flat colors.

Spotty and strong patterns, stripes and designs in general which contrast sharply in values emphasize the limit of vision and should not be used in small rooms. Wall paper having large and prominent design which contrasts highly in value, hue or intensity is especially to be avoided in small rooms.

In nature's great color schemes the foreground is rough and broken but the distant hills and horizon are visible only as grey-greens, grey-blues and misty greys. In like manner we must construct color schemes for rooms to be given an apparently larger size.

To sum up, then, color schemes for small rooms and all decoration to give the effect of distance and recession should be composed of weak, light patterns, if design is attempted on the walls in the form of wall paper or as rough textures of special wall finishes. Patterns of rugs and linoleums for the floors in small rooms ought also to be small, light in form and color contrasts of values, hue and intensity ought to be low. In some rooms perfectly smooth walls without texture are needed.

Walls in small rooms should have a flat, not gloss, finish and the greyed blues and greens and cold greys are the colors to use for key colors. Self-tones and very closely related colors are especially useful in small rooms.

If the ceiling of a small room is low, increased height can be apparently given by the use of vertical stripes in wall paper or stencil designs on the walls. These should be in self-colors or very greyed tints of related colors having little contrast of values. Strong contrasts of values, hues or intensity will make the wall advancing in color and apparently decrease the size of the room.

Vertical panels using picture mouldings will also apparently increase the height of low ceilings.

A ceiling too high may be lowered apparently by use of darker color on it, by lowering the picture moulding to create a wide frieze at the top of the wall to be colored like the ceiling. Horizontal panels of picture mouldings will also decrease the height of ceilings.

Rooms with North Exposure.—Obviously rooms on the north side of the residence receive no direct sunlight and while they may be just as warm in fact, owing to an efficient heating plant, they often seem cold and lack the cheer of rooms receiving the direct rays of the sun. This condition then offers an opportunity to the decorator to add to the room a warm, cheerful atmosphere. For both walls and stencils tints and shades of the warm colors; red, yellow, orange and warm brown are in order for this purpose. Tan, cream, ivory, old rose, warm grey (has red or yellow in its makeup) and green which is toned with red, orange or yellow.

Often a wall color that is much too dull and cool for a north room can be brightened up materially by using quite strong, warm colors in the stencils. A fairly dark Cobalt Blue, for instance, on the upper side wall of a north exposure dining room may effectively he warmed up by stencil tints of Light Brown, Tan, Buff or Cream.

The woodwork would best be Fumed Oak or one of the brown oak shades, Mahogany, Natural Birch, Maple, Pine, Cherry, Cypress, Ivory or other warm colored Enamel.

Rooms with South Exposure.—The aim in decorating such rooms is diametrically opposite from that for north exposures. The colors ought to be such as will modify the glare of direct sunlight and to cause the rooms to appear cool. The cold colors; blue, green, grey, violet, purple and lavender, are now most useful. The grey ought not to contain red or yellow and the green should be one in which the blue, not yellow, predominates. In a room that is very light the greys may be most satisfactory; they do not fade so soon or as readily as the greens, blues, etc.

Blue-green and old blue made by tempering blue with black are much to be preferred to either color in its full or pure state.

Light and Dark Rooms.—When rooms to be decorated are lighter than average extra care ought to be taken to avoid the use of pure, intense colors and even bright but greyed colors in large areas. In such rooms the bright light causes colors to display their brightness to the greatest extent.

In light rooms it is equally important to avoid great contrast of values, hues and intensities of colors, also strong patterns in wall paper and all greatly contrasting design.

Useful colors in very light rooms are: French grey, warm grey, pearl greys, olive, old blue, dull reds, neutral greens.

Dark rooms, on the other hand, may well be decorated in rather a colorful manner. Strong contrasts of value, hue and intensity are permissible and are often urgently needed; especially are the sunshine colors needed—yellows, reds and orange tints.

In dark rooms, too, the wall patterns in paper and stencil design as well as rough textures of special wall finishes can be more prominent.

Colors used in dark rooms may be selected to add light to them. Yellow reflects more white light than any other color; so the yellows, cream, ivory and light tans and buff are useful colors in dark rooms.

Glaringly light rooms are made more restful by the selection of dull greens, greyed blues and greenish or bluish greys. These colors absorb more light than they reflect. Deeper, darker, though neutralized, greens and blues may be used in rooms which are possessed of strong natural light.

Colors for Wood Trim.—Having wood trim which is out of harmony with the decorative scheme preferred for a room it is always possible, obviously, to paint or enamel the trim a color which does fit in with wall colors wanted and the furnishings. That, in fact, is the English and European practice. In America where there is so much beautiful wood trim naturally finished, many are reluctant to enamel it and thus hide the grain. It is an outstanding fact, however, that a color harmonious interior as a whole is often not possible without changing the color of the wood trim. Often by staining natural colored trim, or restaining stained trim, its color can be made to harmonize with the balance of the scheme, at the same time preserving the beauty of the natural grain.

There is a much greater tendency today than ever to subordinate the wood trim, to paint it out, in order to make it a part of the color scheme in harmony with the whole unit. Often, in small rooms especially, it is painted or enameled the same color as the walls; or it may be a tint or shade of the wall color—a bit lighter or darker.

At times a related color or a complementary color in greyed or neutralized degree is needed. The amount or area of the wood trim is the determining factor. The greater the area of wood trim the less prominence and less contrast in the color are needed.

Many have the idea that Colonial architecture must invariably be enameled white. This is not in accord with the dictates of history or of color harmony. In these old homes the wood trim was also colored with greys, dull greens, yellowish browns and with other tints and shades.

In any discussion of colors to combine with different kinds of stained wood there is always the difficulty that the name of the wood is taken as expressing a color thought—while as a matter of fact it does nothing of the kind. It means nothing but a crude material which may alter in color according to how it is finished.

Wood, as a rule when finished for interior trim or for furniture, has a color, light or dark, produced by the finishing materials which must be considered alone. To say, therefore, that grey-blues combine with walnut or dark greens combine with mahogany is meaningless excepting that it refers in a general way to the colors in which these woods are commonly finished. It is unsafe to depend on such rules excepting as the most general of guides. A goodly number of shades of mahogany finish and oak used in interiors may be colored grey, green, black, yellow or brown.

If any degree of refinement is to be secured it is much better to get down to basic principles of color harmony and work out each problem independently with the color of the particular piece of wood as a starting point.

It is often a mistake in redecorating rooms to leave the woodwork in the color in which it is found. There has been for years a tradition among decorators that it is something akin to sacrilege to paint good woodwork.

The architect and the builder are accountable primarily. They build a house and put the dark-colored oak and mahogany trim in the hall-ways and the billiard-room, in the library and the study in the time-honored belief that these rooms call for dark shades in woodwork. Notwithstanding tradition, common sense dictates that if these rooms are in any degree lacking in natural light, as they often are, they should be treated in receding, light-reflecting colors—tones that make rooms look larger, lighter and more cheery.

Ceiling Colorings.—A lazy habit in our midst is largely responsible for the fact that most ceilings are thoughtlessly colored plain white, ivory or cream as a rule, giving an impression of a room without a roof; the walls seem to stand alone.

It is said that these tints reflect light and so they do but in most rooms that is of minor importance. Complete color harmony is often sacrificed by our indifference to ceiling colors.

Often on average jobs the contrast of values between ceiling and walls is too great; the ceilings, then, are not a continuation of the harmony of walls, trim, floor and furnishings, yet a ceiling is just as much a part of the room as these other elements.

It is true that dark colors are not permissible on ceilings, unless they are unusually high and there is a wish to apparently lower them by decorative treatment. But more color can be carried to ceilings without lowering them and greater unity in the harmony of interiors will result. Related colors, or complementary colors much greyed and in light tints, are quite as suitable as the self-tints usually used. For example, in a color scheme the key color of which is brown with climax color of rather pure, intense orange and subordinate shades of greyed blues, a selection for a ceiling color could be a light tint or greyed orange or a light greyed blue tint.

And when self-tints are used they may well be a bit more colorful, since as a rule now the contrast of values between ceiling and walls is too high, too great.

Colors of pure intensity must not be used on ceilings. Strong contrasts of value, hue or intensity of ceiling color makes a ceiling too prominent, too advancing.

Floor Colors and Designs.—If we would gain harmony in a room as a whole and center attention on a climax consisting of a single display of bright color or a concentrated group of color, then strongly contrasting color and design in rugs, tile or linoleums must not be allowed.

It is best to have floor colors and designs subdued and quietly harmonious with the room as a whole. The floor is the foundation, it should be a darker tone than walls and should not be so strong in color or design as to compete with the climax point of the room. Self-tones and related colors low in contrast of value, hue and intensity are essential. When complementary colors appear they must be much subdued and greyed.

Colors in Pictures, Frames, Mats.—The selection of pictures for a home is nearly always an exceedingly personal affair. Decorators have little opportunity to advise concerning the character of pictures which come into a home, but they can as a rule have a voice in allotting certain pictures to appropriate rooms. Personal preferences of the occupants will be asserted, in some instances, regardless of what their choice of pictures does to a color scheme, but a decorator who can point out good reasons for his preference usually has his way.

Pictures which are very colorful displaying pure, intense colors in large area should be used only as a climax or central point of interest in a color scheme. One to the average room is quite enough; more than one picture like the brilliant red English coaching scenes and such as have strong contrasts like the poster style is likely to set up competition for attention. Also too much eye stimulation will result, with attendant fatigue and restlessness.

Picture frames should tone-in with the pictures, the wall color, furniture and wood trim. Well framed pictures as a rule have frames which repeat the key color of the picture in self tints or shades; sometimes a greyed, related color or a much greyed complementary color is used on the picture frame.

Mats are quite useless on many pictures and are often very bad for a color scheme. White and very light colored mats give the effect of a hole in the wall; they clamor for attention and irritate the eye nerves. White is more advancing than many colors and is quite as likely to be a note of discord in a color scheme as a vivid color which is out of harmony. In fact pure white areas like picture mats, table covers, scarfs and lace curtains are likely to separate from the color scheme and jump out at you, especially when the wall color and the whole scheme is low in contrast of values or rather dark.

A white area in a room is usually the first element noticed on entering and it competes for attention always.

If mats are used they should be subdued by coloring to harmonize in low value with the frames and pictures. Self-tones repeating the frame colors are usually safest to use. Sometimes a mat may be covered with a fabric of just the right related color or greyed complementary color, but extreme care must be taken to avoid making the mat more prominent and advancing than the picture itself.

Drapes and Window Shades.—Window hangings are often made the color climax of a room, rather unconsciously, to be sure, but sometimes with good effect.

If the windows are not too large and too numerous and other centers of interest are lacking a note of cheer may well be given by using pure, intensely colored drapes.

The tendency now is to build more and larger windows in homes and there is considerable likelihood that brightly colored drapes in such homes will be a jarring note, because of the large areas.

In those cases where large areas of drapes are needed the color should be of a very much greyed and subdued character and of plain colors, rather than strong figures and patterns of design like cretonne.

As a general rule where the color climax of a room is at some point of interest other than the windows, the drapes should be in subdued colors. The dominant color note of the walls and the color scheme in general is the key to correct and easy selection of the drapes and shades.

When wall paper is used the drapes may repeat one of the color notes of the paper, matching it in self tint or shade, and in the case of drapes of silk or other fabrics with a sheen, the dominant hue of the wall color is also repeated in the drapes.

When the wallpaper or all-over stencil designs are rather prominent the drapes ought to be of plain, subdued color fabrics.

Drapes, in general, may be a harmony self-tones with the wall colors, they may be related colors or complementary colors subdued by having been greyed or neutralized. And the contrasts of values should not be great—a scheme of low tones is best.

Many textiles and objects of nature reflect a series of related colors. Red velvet drapes in sunlight show orange, where light strikes directly, shading to orange-red, red and red-violet in the shadows. A green leaf on a tree reflects yellow-green, green, blue-green and dark blue in shadows. Such surfaces displaying a play of light and shadow make charming drapes.

Effect of Panels and Stripes.—Although walls should remain always as the background, the foil against which the furnishings are displayed, it is, nevertheless, possible for a wall to be too flat, uninteresting and monotonous.

Walls of large area may be broken up in many ways. The rough textures of special wall finishes like Italian Travertine, Old English, Holland, Sand-Float and Tiffany Mottling and Blending accomplish this artistically. Well selected wall papers serve the purpose.

Panels formed of picture mouldings and proportioned with a good sense of balance are excellent. Vertical panels apparently increase the height of a ceiling. Horizontal panels lower a ceiling, apparently.

Vertical stripes in wall paper or applied by stencils or the vertical textures of rough special wall finishes give apparent increased height.

All-over patterns of wall paper break up an uninteresting wall and the all-over diaper stencil patterns so much used in England give a very interesting note of design and self-tones or related colors. Strong contrasts of values, of color hues and of intensity of colors must be avoided in all-over designs.

A flat, uninteresting wall may also be relieved by slight changes architecturally; the addition of vertical pilasters or columns against the walls reaching about two-thirds or three-fourths of the way up to the ceiling. These may be built in pairs or singly on all walls of the room, being careful to balance them. With a projecting cap at the top or cornice of mouldings, a finish is gained and an opportunity offered for a decorative effect by placing a vase, lamp, bit of pottery or a growing plant on top.

A Suggested Experiment.—While it is always useful to have a set of color cards handy showing individual colors this usually confuses the average customer. It will be much more useful if you will make up a set of color cards which is composed of perfect combinations of colors. A search for such color combinations and the habit of making note of them is a profitable enterprise.

In your search for useful color groups it is well to take particular note of the impression given by each type of color combination. Note the simplicity, dignity and attractiveness of the self-tone color schemes. Make a search for these not only in the color schemes used on the interior of homes, public buildings, show windows and in merchants' shops, but also, such color schemes in nature. In your scrap-book make up half a dozen color schemes after this principle, by mixing colors in the ordinary manner and spreading them on to sheets of heavy water color paper, in two or three coats. When the paint is dry cut out color chips two or three inches square and paste them in your scrap-book. If you will do this for each of the tints or shades used in a self-tone color scheme you will have a group of harmonizing colors which will be useful for a long time and for many jobs.

In this first group you should have color schemes each one of which is made up of self-tones of one color and which illustrate how contrasts in values—contrast of light and dark colors, add life to the scheme. Then, this group should include color schemes which are warm, those which are cold and those which are composed of greyed or neutral colors.

In this same scrap-book, but in another section, begin a collection of color schemes which harmonize by the principle of related colors-analogy. Note how the addition of related color adds life to a self-tone color scheme. In this group divide the color schemes into three classes, too,—color schemes which are warm, some which are cold and some which are greyed or neutralized.

In still another section of your scrap-book start a collection of color schemes which are constructed after the principle of complementary colors and noting, particularly, how much more perfectly they balance and satisfy than either of the other two groups.

In searching for groups of colors which harmonize there are many fields which offer both pleasure and profitable returns. Public buildings and homes which have been decorated according to the plans of professional decorators who are capable offer much material for study. In museums and art galleries the paintings, textiles, pottery and art objects of many kinds offer numerous illustrations of color harmony by one principle or another. In nature, illustrations of color harmony are limitless.

In all your observations following these suggestions you will find great variety; there are color schemes of greys alone, of several values of one color, of greys and one other color, of black and one other color, of greys and two other colors, of black and two other colors and of three or more colors with the addition of grey or black.

Combinations of Colors in Harmony.—

Black, white and yellow, orange or gold.
Black, white and red, vermilion, crimson.
Black, blue-green, silver and lemon yellow.
Black, silver and light blue.
Blue and gold.
Blue and orange and gray.
Blue and salmon.
Blue and maize.
Blue and brown.
Blue and black.
Blue, scarlet and lilac.
Blue, orange and black.
Blue, brown, crimson and gold.
Blue, orange, black and white.
Blue (deep) and pink or maroon.
Buff and violet, yellow, straw or claret.
Crimson and medium green.
Crimson and orange.
Gray and orange, pink, lavender or brown.
Green, olive and red, russet, maroon or chocolate.
Green and gold.
Green, crimson, turquoise and gold.
Green, orange and red.
Green (light) and Ivory White.
Lavender and warm gray or pale green.
Lilac and gold.
Lilac, scarlet and black or white.
Lilac, gold, scarlet and white.
Lilac and black and crimson.
Maroon and warm green or deep blue.
Old rose and green.
Pink and black.
Purple and golden yellow.
Purple and green or citron.
Purple and gold.

Purple, scarlet and gold.
Red and gold.
Red, gold and black.
Red and olive or brown.
Red, deep and grey.
Red, normal, and blue-green.
Red, purple and greenish yellow.
Russet and green or olive.
Scarlet, black and white.
Scarlet and purple.
Scarlet and turquoise blue.
Straw and violet.
Violet and reddish orange.
Violet and yellow, straw color or buff.
Yellow and purple, lavender or violet.
Yellow and purple.

COLOR MIXING FORMULAS

There are no standard names for colors. Perhaps it ought to be stated the other way—there are no standard colors for color names. Lay out a certain medium shade of warm yellow and ask several people what is it. One will say buff, another fawn, others goldenrod, russet, pumpkin color and so on. So it is with most colors. Perhaps some day our government will establish color standards, as it has already declared how much weight constitutes a pound, how much of any liquid equals a gallon, etc.

The colors produced by the formulas given here are considered correct by the average decorator for the names attached to them. You must, however, mix any one of them lighter, darker, or a little differently if necessary to produce what your customer thinks is a better color for the name given.

The tinting strength of different brands of colors varies considerably. Some brands of tinting colors are greatly extended by inert pigments, because some people want cheap colors. The high class, strong colors are cheapest in the end and far better and clearer tints are produced with them. In mixing the colors to test these formulas, first-class colors of a standard advertised brand were used.

Amber.—Burnt umber, 3 parts; medium chrome yellow, 3 parts; orange chrome yellow, 8 parts.

Argent (*Grey*).—Black, 9 parts; white lead, 16 parts; red, 1 part; trace of orange chrome yellow.

Ash.—White lead, 50 parts; raw umber, 5 parts; yellow ochre, 1 part.

Bay.—Black, 3 parts; Venetian red, 3 parts; a trace of orange chrome yellow.

Black (*Jet*).—Ivory black, 10 parts; raw umber, 1 part; Prussian blue, 1 part.

Black (*Olive*).—Vine-black, 20 parts; yellow ochre, 1 part.

Black (*Purple*).—Lampblack, 5 parts; rose pink, 1 part.

Blue (*Antwerp*).—Antwerp blue. Or compound with bright green, 1 part; ultramarine, 2 parts; trace of zinc white.

Blue (*Azure*).—Azure blue. Or compound with: Ultramarine blue, 1 part; zinc white, 40 parts.

Blue black.—Ivory black, 40 parts; Prussian blue, 3 parts.

Blue (*Bronze*).—Black, 3 parts; Prussian blue, 1 part.

Blue (*Dark*).—White lead, 1 part; chrome green, 2 parts; Prussian blue, 7 parts.

Blue (*Delft*).—Tint white lead with cobalt blue and a touch of lamp black.

Blue (*Deep*).—Prussian or ultramarine blue.

Blue (*Gobelin*).—Ivory black, 4 parts; white lead, 2 parts; chrome green, 1 part; Prussian blue, 3 parts.

Blue (*Granite*).—Black, 2 parts; white, 6 parts; ultramarine blue, 1 part.

Blue (*Grayish*).—White lead, 20 parts; Prussian blue, 2 parts; ivory black, 1 part.

Blue (*Indigo*).—Indigo, or compound with: Black, 9 parts; Prussian blue, 4 parts.

Blue (*Light Prussian*).—White lead with a touch of Prussian blue.

Blue (*Light Gray*).—White lead with a touch of lamp-black and of raw umber.

Blue (*Marine*).—Ultramarine blue, 1 part; ivory black, 9 parts.

Blue (*Methyl*).—Green, 1 part; blue, 12 parts; trace of red.

Blue (*Misty*).—White lead, 50 parts; ultramarine, 10 parts; burnt umber, 1 part.

Blue (*Mountain*).—Mountain blue. Or compound with: Ivory black, 1 part; cobalt blue, 3 parts; rose madder, 2 parts; white lead, 4 parts.

Blue (*Old*).—Mix from Prussian blue and a touch of lampblack or ivory black.

Blue (*Opaque*).—Zinc white, 1 part; French ultramarine, 1 part.

Blue (*Oriental*).—White lead, 100 parts; Prussian blue, 9 parts; lemon chrome, 1 part.

Blue (*Pale*).—White lead, 30 parts; Brunswick blue, 1 part.

Blue (*Pure*).—Zinc white, 20 parts; English ultramarine, or cobalt blue, 2 parts.

Blue (*Royal*).—White lead, 1 part; ultramarine, 15 parts.

Blue (*Sapphire*).—Zinc white, 4 parts; Chinese blue, 1 part.

Blue (*Sea*).—White lead, 16 parts; ultramarine, 3 parts; raw sienna, 2 parts.

Blue (*Pale Sky*).—White lead, tinted with cobalt blue.

Blue (*Sky*).—White lead, 300 parts; cobalt blue, 1 part; Prussian blue, 1 part.

Blue (*Turquoise*).—White lead, 20 parts; ultramarine, 2 parts; light green, 1 part.

Brass Yellow.—White lead, 40 parts; light chrome yellow, 12 parts; raw umber, 1 part; burnt umber, 1 part.

Brick.—Venetian red, 2 parts; white lead, 1 part.

Bronze.—Black, 14 parts; yellow, 1 part; green, 2 parts.

Bronze (*Asiatic*).—Medium chrome yellow, 1 part; raw umber, 2 parts; very little white lead.

Bronze Green.—Middle chrome, 2 parts; raw umber, 5 parts; burnt sienna, 1 part; black, 1 part.

Bronze Yellow.—White lead, 10 parts; lemon chrome, 4 parts; raw umber, 5 parts.

Brown (*Alderney*).—Yellow, 3 parts; black, 14 parts; white lead, 1 part; orange, 2 parts.

Brown (*Amber*).—Burnt umber, 9 parts; middle chrome, 5 parts; Venetian red, 3 parts.

Brown (*Chestnut*).—Medium chrome yellow, 4 parts; Venetian red, 2 parts.

Brown (*Coach*).—Indian red, 5 parts; ivory black, 2 parts.

Brown (*Cocoanut*).—Burnt umber, 4 parts; yellow ochre, 1 part; white lead, 1 part.

Brown (*Coffee*).—Burnt umber, 9 parts; yellow ochre, 4 parts; Venetian red, 1 part.

Brown (*Foliage*).—Vandyke brown, 2 parts; burnt sienna, 1 part.

Brown (*Golden*).—White lead, 20 parts; yellow ochre, 3 parts; burnt sienna, 1 part.

Brown (*Italian*).—Vandyke brown, 4 parts; raw sienna, 1 part.

Brown (*Leather*).—Yellow ochre, 4 parts; Venetian red, 3 parts; white lead, 2 parts; blue black, 1 part.

Brown (*Olive*).—Burnt umber, 3 parts; lemon chrome yellow, 1 part.

Brown (*Orange*).—Burnt sienna, 5 parts; orange chrome, 4 parts.

Brown (*Pale*).—White lead, 4 parts; burnt umber, 1 part.

Brown (*Purple*).—Indian red, 8 parts; burnt umber, 1 part; black, 1 part.

Brown (*Seal*).—Burnt umber, 4 parts; golden ochre, 1 part.

Brown (*Snuff*).—White lead, 9 parts; orange chrome, 1 part; burnt umber, 2 parts.

Brown (*Stone*).—Burnt umber, 10 parts; golden ochre, 1 part; burnt sienna, 2 parts.

Brown (*Thrush*).—Yellow ochre, 1 part; burnt umber, 3 parts; white lead, 12 parts.

Brown (*Walnut*).—Burnt umber, 5 parts; raw sienna, 1 part.

Buff.—White lead, 100 parts; yellow ochre, 7 parts; middle chrome, 1 part.

Buttercup Yellow.—Middle chrome.

Canary.—White lead, 10 parts; lemon chrome, 1 part.

Chamois Yellow.—White, 4 parts; yellow ochre, 5 parts; green, 1 part.

Chamoline (*Yellow*).—Raw sienna, 3 parts; lemon yellow, 1 part; white lead, 5 parts.

Chocolate.—Burnt sienna, 5 parts; carmine, 1 part.

Cinnamon.—Golden ochre, 1 part; burnt sienna, 2 parts; white lead, 6 parts.

Citron (*Yellow*).—Raw umber, 2 parts; lemon chrome 5 parts.

Claret.—Carmine, 2 parts; ultramarine blue, 1 part.

Copper.—White lead, 100 parts; middle chrome, 19 parts; Venetian red, umber, and green, 3 parts each.

Cream.—White lead, 100 parts; raw sienna, 3 parts.

Cream.—White lead, 100 parts; Italian ochre, 3 parts.

Crimson (*Amaranthine*).—Vermilionette, 3 parts; Prussian blue, 1 part.

Drab.—Burnt umber, 1 part; white lead, 10 parts.

Drab (*Deep*).—White lead, 20 parts; burnt umber, 14 parts; ochre, 2 parts.

Drab (*Light*).—White lead, 50 parts; burnt umber, 12 parts; ochre, 1 part.

Drab (*Medium*).—White lead, 100 lbs.; raw umber, 4 lbs.; French ochre, enough to tone to tint wanted.

Drab (*Warm*).—White lead, 100 lbs.; raw umber, 1½ lbs.; French ochre, 2 to 3 lbs.

Ecru.—Brunswick green, 1 part; medium chrome yellow, 3 parts; white lead, 8 parts; black, 3 parts.

Fawn.—White lead, 60 parts; burnt umber, 5 parts; yellow ochre, 3 parts.

Fawn (*Deep*).—White lead, 10 parts; burnt umber, 4 parts; ochre, 1 part.

Flesh.—White lead, 50 parts; yellow ochre, 2 parts; burnt sienna, 1 part.

Gold.—Color white lead with yellow ochre, raw sienna, or chrome yellow, 5 parts; vermilion, 1 part.

Granite (*Blue*).—Black, 2 parts; white, 6 parts; ultramarine blue, 1 part.

Green (*Aloes*).—Black, 6 parts; white lead, 3 parts; chrome yellow, 1 part; Brunswick green, 3 parts.

Green (*Apple*).—Medium chrome green, 1 part; white lead, 30 parts.

Green (*Autumn*).—Emerald green, 2 parts; black, 7 parts; chrome yellow, 1 part.

Green (*Blue*).—Deep green, 7 parts; Prussian blue, 1 part.

Green (*Bottle*).—Light green, 6 parts; lampblack, 1 part.

Green (*Chartreuse*).—Chrome yellow, 4 parts; chrome green, 5 parts; tint with white.

Green (*Chrome*).—Chrome green. Or compound with Prussian blue, 1 part; lemon chrome yellow, 8 parts.

Green (*Citron*).—White lead, 40 parts; middle chrome, 3 parts; ivory black, 1 part.

Green (*Emerald*).—Emerald green. Or compound with white lead, 8 parts; medium chrome green, 1 part.

Green (*Foliage*).—Blue black, 1 part; lemon chrome, 4 parts.

Green (*Gray*).—Terre verte, 10 parts; raw umber, 1 part; white lead, 1 part.

Green (*Invisible*).—Black, 9 parts; bright green, 1 part.

Green (*Light Olive*).—Middle chrome, 3 parts; black, 2 parts; burnt sienna, 1 part; trace of white lead.

Green (*Marine*).—Black, 4 parts; middle chrome green, 1 part.

Green (*Middle Chrome*).—Lemon chrome, 1 part; middle chrome, 1 part;

Prussian blue, 2 parts.

Green (*Mignonette*).—Chrome green, 3 parts; black, 15 parts; Prussian blue, 1 part; chrome yellow, 1 part.

Green (*Moss*).—Medium chrome green, 30 lbs.; raw umber, 12½ lbs.; medium chrome yellow, 6 lbs.

Green (*Moss Rose*).—Brunswick green, 1 part; yellow, 4 parts; white lead, 3 parts.

Green (*Muscovite*).—Prussian blue, 6 parts; chrome green, 13 parts; orange chrome, 3 parts; white lead, 8 parts; black, 20 parts.

Green (*Myrtle*).—White lead, 20 parts; middle chrome, 7 parts; ivory black, 1 part.

Green (*Nile*).—Prussian blue, 6 parts; emerald green, 9 parts; white lead, 5 parts.

Green (*Olive*).—White lead, 12 parts; yellow ochre, 4 parts; umber, 1 part.

Green (*Oriental*).—White lead, 2 parts; lemon chrome, 2 parts; umber, 1 part.

Green (*Pale*).—Zinc green, 4 parts; zinc white, 5 parts.

Green (*Pale Emerald*).—White lead, 2 parts; emerald green, 1 part.

Green (*Pea*).—White lead, 100 parts; lemon chrome, 1 part; light green, 13 parts.

Green (*Peacock*).—White lead, 7 parts; emerald green, 50 parts; Prussian blue, 43 parts.

Green (*Pistache*).—Black, 7 parts; yellow ochre, 1 part; chrome green, 1½ parts.

Green (*Prussian*).—Prussian green. Or compound with emerald or medium chrome green, 12 parts; chrome yellow, 3 parts; black, 5 parts.

Green (*Sage*).—White lead, 30 parts; chrome green, light, 2 parts; burnt sienna, 1 part.

Green (*Sea*).—White lead, 100 parts; deep green, 4 parts.

Green (*Slate*).—White lead, 16 parts; black, 5 parts; raw turkey umber, 1 part; deep green, 3 parts; blue, 1 part.

Green (*Velvet*).—Burnt sienna, 3 parts; light chrome green, 5 parts; white lead, 8 parts.

Green (*Water*).—White lead, 25 parts; deep green, 1 part; yellow ochre, 5 parts.

Gray (*Argent*).—Black, 9 parts; white lead, 16 parts; red, 1 part; trace of orange.

Gray (*Ash*).—Burnt sienna, 2 parts; ultramarine blue, 3 parts; zinc white, 60 parts.

Gray (*Dove*).—White lead, 50 parts; ultramarine, 4 parts; ivory black, 1 part.

Gray (*Greenish*).—White lead, 100 lbs.; medium chrome yellow, 8 oz.; medium chrome green, 1 lb.; lampblack, 1 oz.

Gray (*Jasper*).—Black, 9 parts; white, 2 parts; trace of deep chrome.

Gray (*Light*).—Prussian blue, 1 part; lampblack, 1 part; white lead, 10 parts.

Gray (*Light*).—Tint white lead with a little each of lampblack, raw umber, and Prussian blue.

Gray (*Light French*).—White lead, 200 parts; ivory black, 2 parts; blue, 1 part.

Gray (*Opal*).—Burnt sienna, 1 part; zinc white, 30 parts; cobalt blue, 2 parts.

Gray (*Pearl*).—White lead, 50 parts; Venetian red, 2 parts; deep green, 2 parts.

Gray (*Pure*).—Raw turkey umber, 1 part; ivory black, 1 part; white lead, 40 parts.

Gray (*Silver*).—White lead, tinted slightly with a touch of lampblack and raw umber.

Gray (*Warm*).—White lead, 100 lbs.; French ochre, 4 to 6 lbs.; lampblack, 2 oz.; Venetian red, 2 oz.

Hay.—White lead, 100 parts; yellow ochre, 4 parts; raw umber 4 parts; deep green, 1 part.

Heliotrope.—Zinc white, 2 parts; red, 3 parts; ultramarine blue, 4 parts.

Indigo.—Indigo. Or compound with black, 9 parts; Prussian blue, 4 parts.

Ivory.—White lead, 56 parts; yellow ochre, 2 parts; Venetian red, 1 part.

Ivory.—Tint white lead with raw sienna and a touch of American vermilion.

Lavender.—White lead, 100 parts; ultramarine, 3 parts; madder lake, 1 part.

Lead.—White lead, 100 parts; ivory black, 8 parts.

Leather.—White lead, 20 parts; yellow ochre 4 parts; Venetian red, 2 parts.

Lemon.—Lemon chrome. Or compound with chrome 5 parts; white lead, 2 parts; very little green.

Lilac.—White lead, 100 parts; ultramarine, 1 part; rose madder, 1 part.

Limestone.—White lead, 100 parts; yellow ochre, 1 part; raw umber, 1 part.

Mahogony.—Orange chrome, 10 parts; burnt sienna, 3 parts; white lead, 1 part.

Maple.—White lead, 100 parts; yellow ochre, 3 parts; raw umber, 1 part.

Maroon.—Venetian red, 2 parts; Indian red, 4 parts; lampblack, 1 part.

Maroon (*Acacia*).—Black, 4 or 5 parts; Indian red, 3 parts; Prussian blue, 1 part.

Maroon (*Black*).—Black, 4 parts; bright red, 1 part; trace of Prussian blue.

Mascot (*Blue*).—Black, 7 parts; blue, 1 part; trace of green.

Mauve.—White lead, 6 parts; Prussian blue, 2 parts; madder red, 1 part. Or add blue to brown.

Mouse Color.—Lampblack, 3 parts; Prussian blue, 1 part; white lead, 16 parts.

Oak (*Dark*).—White lead, 2 parts; yellow ochre, 3 parts; Venetian red, 1 part; umber, 3 parts.

Oak (*Light*).—White lead, 6 parts; yellow ochre, 6 parts; Venetian red, 2 parts; umber, 1 part.

Ochre (*Golden*).—Yellow ochre, 5 parts; lemon chrome, 2 parts.

Ochre (*Roman*).—Yellow ochre, 50 parts; turkey umber, 3 parts.

Old Gold.—White lead, 6 parts; ochre, 12 parts; middle chrome, 3 parts.

Olive.—White lead, 12 parts; yellow ochre, 4 parts; ivory black, 1 part.

Olive (*Gray*).—Chrome green, 1 part; lampblack, 3 parts; white lead, 40 parts.

Olive (*Light*).—Middle chrome, 3 parts; black, 2 parts; burnt sienna, 1 part; trace of white lead.

Olive (*Yellow*).—Burnt umber, 3 parts; lemon chrome yellow, 1 part.

Orange.—Orange chrome, 18 parts; white lead, 1 part; yellow, 1 part.

Orange (*Bright*).—Orange chrome, 1 part; orange lead, 2 parts.

Orange (*Scarlet*).—Orange lead, 2 parts; white lead, 1 part.

Orange (*Persian*).—Orange chrome, 14 parts; white lead, 1 part; yellow ochre, 5 parts.

Peach Bloom.—Indian red, 3 parts; white lead, 17 parts.

Pink.—White lead tinted with American vermilion.

Pink (*Aurore*).—Indian red, 1 part; orange chrome, 2 parts; blue, 2 parts; trace of lemon chrome; tint with white.

Pink (*Coral*).—Vermilion, 5 parts; white lead, 2 parts; chrome yellow, 1 part.

Pink (*Indian*).—White lead, 100 parts; Indian red, 3 parts; rose madder, 1 part.

Pink (*Light*).—White lead, 100 parts; rose madder, 4 parts; vermilion, 1 part.

Pink (*Royal*).—Zinc white, 2 parts; carmine lake, 2 parts.

Pink (*Venetian*).—White lead tinted with trace of Venetian red.

Porcelain (*Blue*).—Zinc white, 1 part; chrome green, 1 part; ultramarine blue, 4 parts; trace of black.

Primrose.—Pale zinc chrome. Or compound with: White lead, 10 parts; green, 3 parts; yellow, 4 parts.

Purple.—White lead, 1 part; ultramarine, 1 part; Indian red, 1 part.

Purple (*Anemone*).—Black, 2 parts; white lead, 1 part; bright red, 6 parts; Prussian blue, 6 parts.

Purple (*Begonia*).—Lampblack, 4 parts; bright red, 5 parts; Prussian blue, 4 parts.

Purple (*Royal*).—Royal purple. Or compound with: Vegetable black, 2 parts; red, 3 parts; Prussian blue, 14 parts.

Red (*Armenian*).—Yellow ochre, 1 part; Venetian red, 2 parts.

Red (*Bordeaux*).—Black, 1 part; orange chrome, 2 parts; Prussian blue, 1 part.

Red (*Carnation*).—Carmine lake, 3 parts; white lead, 1 part.

Red (*Cherry*).—Rose madder, 1 part; vermilion, 2 parts.

Red (*Deep Indian*).—Indian red, 5 parts; lampblack, 1 part.

Red (*Egyptian*).—Black, 10 parts; white, 3 parts; orange, 4 parts; blue, 2 parts; trace of red.

Red (*Geranium*).—Bright red, 9 parts; blue, 1 part.

Red/i> (Light Indian/i>).—Venetian red, 1 part; Indian red, 3 parts.

Red (*Mexican*).—Red lead, 1 part; Venetian red, 4 parts.

Red (*Mikado*).—Blue, 3 parts; red, 7 parts; small quantity of white.

Red (*Moorish*).—Vermilion, 3 parts; rose pink, 1 part.

Red (*Orange*).—Orange chrome.

Red (*Oriental*).—Rose madder, 2 parts; orange lead, 1 part.

Red (*Poppy*).—Blue, 1 part; vermilion, 24 parts.

Red (*Turkish*).—Pale vermilion, 4 parts; mahogany lake, 1 part.

Red (*Tuscan*).—Rose pink, 2 parts; Indian red, 4 parts.

Rose (*Carnation*).—Rose madder, 1 part; zinc oxide, 8 parts.

Rose (*Light*).—White lead tinted lightly with rose lake, turkey red, or vermilion.

Rose (*Old*).—White lead, 16 parts; crimson madder, 1 part.

Rosewood.—Bright red, 1 part; black, 6 parts; trace of green.

Russet (*Dull*).—White lead tinted to desired shade with raw sienna and a touch of vermilion or Indian red.

Salmon.—White lead, 40 parts; golden ochre, 5 parts; Venetian red, 1 part.

Sapphire.—Zine white, 4 parts; Chinese blue, 1 part.

Scarlet (*Bright*).—Vermilion, 20 parts; pale chrome, 7 parts; golden ochre, 1 part.

Scarlet (*Orange*).—Orange lead, 2 parts; white lead, 1 part.

Slate.—White lead, 100 parts; ivory black, 3 parts; ultramarine, 1 part.

Snuff.—White lead, 9 parts; orange chrome, 1 part; burnt umber, 2 parts.

Stone.—Burnt umber, 1 part; French yellow ochre, 2 parts; white lead, 5 parts.

Stone (*Bradford*).—White lead, 100 lbs.; raw sienna, 3 lbs.; shade with lampblack.

Stone (*Brown*).—Burnt umber, 10 parts; golden ochre, 1 part; burnt sienna, 2 parts.

Stone (*Dark*).—White lead, 20 parts; yellow ochre, 12 parts; raw umber, 4 parts; Venetian red, 1 part.

Stone (*Light*).—White lead, 100 parts; and either Italian ochre, 5 parts, or yellow ochre, 6 parts.

Stone (*Middle*).—White lead, 100 parts; yellow ochre, 12 parts.

Tan.—White lead, 20 parts; burnt umber, 6 parts; burnt sienna, 3 parts; yellow ochre, 2 parts.

Tan (*Auburn*).—Burnt umber, 1 part; golden ochre, 3 parts; white lead, 20 parts.

Tan (*Coffee*).—White lead tinted with burnt umber.

Tan (*Soft*).—Tint white lead with raw sienna.

Tan (*Warm*).—Tint white lead with raw sienna, chrome yellow, and vermilion.

Terra Cotta.—White lead, 2 parts; burnt sienna, 1 part.

Terra Cotta.—White lead, 2 parts; Venetian red, 1 part; burnt sienna, 1 part.

Turquoise.—White lead, 20 parts; ultramarine, 2 parts; light green, 1 part.

Violet.—French ultramarine, 14 parts; Crimson lake, 3 parts.

Violet (*Transparent*).—ultramarine blue, 4 parts; crimson lake, 1 part.

Walnut.—Burnt umber, 5 parts; raw sienna, 1 part.

White (*Clear*).—White lead, 300 parts; ultramarine, 1 part.

White (*Flake*).—Pure English white lead.

White (*Cremnitz*).—Pure zinc oxide, 100 parts; ultramarine, 1 part.

White (*Permanent*).—Finest barytes, 200 parts; blue, 1 part.

White (*Pure*).—Equal parts white lead and zinc white.

White (*Translucent*).—White lead, 1 part; barytes, 10 parts.

White (*Transparent*).—Zinc white, 1 part; barytes, 20 parts.

Yellow (*Alabaster*).—White, 4 parts; middle chrome yellow, 1 part.

Yellow (*Light Colonial*).—White lead, 100 lbs.; medium chrome yellow, 1 to 2 lbs.; raw sienna, 1 lb.

Yellow (*Orange Chrome*).—Use orange chrome yellow or same plus a touch of vermilion.

Yellow (*Light Orange Chrome*).—Use orange chrome yellow and a little white lead.

Yellow (*Brass*).—White lead, 40 parts; light chrome yellow, 12 parts; raw umber, 1 part; burnt umber, 1 part.

Yellow (*Bronze*).—White lead, 10 parts; lemon chrome, 4 parts; raw umber, 5 parts.

Yellow (*Buttercup*).—Middle chrome.

Yellow (*Canary*).—White lead, 10 parts; lemon chrome, 1 part.

Yellow (*Chamoline*).—Raw sienna, 3 parts; lemon yellow, 1 part; white lead, 5 parts.

Yellow (*Chamois*).—White, 4 parts; yellow ochre, 5 parts; green, 1 part.

Yellow (*Citrine*).—Raw umber, 2 parts; lemon chrome yellow, 5 parts.

Yellow (*Golden*).—Middle chrome, 16 parts; yellow ochre, 1 part.

Yellow (*Italian*).—Yellow ochre, 14 parts; burnt umber, 1 part.

Yellow (*Jonquil*).—Indigo, 1 part; light red, 2 parts; white lead, 16 parts; tint with chrome yellow.

Yellow (*Lemon*).—Lemon chrome.

Yellow (*Olive*).—Burnt umber, 3 parts; lemon chrome yellow, 1 part.

Yellow (*Primrose*).—Pale zinc chrome.

Yellow (*Transparent*).—Yellow ochre, 1 part; barytes, 10 parts.

CHAPTER XIV
PRINTING INKS

The advent and early history of printing inks is of little practical use to the printer seeking knowledge about present day problems, yet there is much of interest in them. Through the courtesy of Philip Ruxton, Incorporated, the author is able to present this brief history.

Very early in the history of every race printing was done first upon skins and fabrics and later upon linen, papyrus, parchment and hand-made papers. The stamping of designs and patterns upon textiles was common in India and China even before available records place definite dates on such arts and crafts. In China the classics were cut into tablets which were printed from by hand in 175 A. D. In the sixth century classical books were engraved into wood by the command of the Suy Dynasty and hand prints made therefrom. And as early as the ninth century books were engraved in stone; ink was spread upon these forms and rough prints taken by hand from them.

The printing of textiles from blocks of wood, stone and clay was indulged in by many of the historic peoples of India, Egypt, Greece, Rome and the ancient Incas of South America, as well as by North American Indians.

At later periods the mediaeval kings and nobles used wood block monograms and printing inks to stamp their approving mark on charters and other official papers.

The date of the invention of paper is lost in antiquity. Paper was made and used for hand writing long before the advent of block or type printing. There were paper mills in Toledo as early as the tenth century. In 1102 the king of Sicily paid marked attention to paper making. Copyists or letterers of his time used vellum in preference to the rough hand made papers.

Books at first were lettered by hand. Next came the first printed book made by cutting the letters or characters upon wood blocks, covering the blocks with ink and making a rough impression by hand;—a slow and tedious job, indeed. Such block plates were known as Xylographs.

The very early block printed books have been lost or destroyed but one bearing the date of 1470 is still in existence today. The use of type for printing, however, began some forty years previous to this date.

The making of printing ink evidently was of little importance until the invention of the printing press by Gutenberg and, of course, the quantity used was insignificant.

From the records it appears that the first printing press operated in Venice was in 1469, but by 1470 there were about eighty German printers at work in Rome. By the first year of the 15th century there were over two hundred presses at work in Venice. By the early part of the sixteenth century printing as an art was well established and well patronized. The makers of playing cards, especially, made use of printing.

Only black ink was used for many years. When a color was wanted for initials or for ornamentation it was hand lettered. Ink was made by the printers in rather a simple way. A fire was built in the open and a huge kettle was suspended over the fire. In the kettle linseed oil was boiled until it was reduced to a thick varnish. Bread was put into the hot oil to soak up excess grease. The bread was eaten and relished; thus a feast was enjoyed by the printers at this work.

Having the linseed oil reduced to a thick varnish, the printers then mixed a black pigment, carbon black or lamp black, as a rule, with the varnish. This was a slow process calling for a great expenditure of labor. Power mills were unknown then, so a large stone and muller were used to grind the black pigment and varnish together.

In making the linseed oil varnish a gum of one kind or another was usually cooked with the oil; this to give a binder or adhesive which would make the ink stick to the paper.

As greater use was made of the printing press up through the sixteenth and seventeenth centuries, printers continued to make their own ink, using the same basic materials—linseed oil, juniper gum or rosin and carbon black. Good quality inks from the viewpoint of permanence were made. The first edition of Virgil printed in 1502 by the Germans was done with good quality of ink, permanently black; although a bit slow to dry, perhaps, since the pages are offset a little. The inks used on ancient Italian and Dutch books apparently contained a black charcoal pigment made from twigs or burned peat; they faded to a brown tone.

The development of colored inks probably occurred during the latter part of the seventeenth and early part of the eighteenth centuries, about the time cylinder and power printing presses were introduced.

Previous to the nineteenth century the manufacture of printing inks was accomplished by haphazard rule-of-thumb methods. But from this time on down to our day the industry has been one in which chemistry has taken hold and developed ink making into a highly technical science.

The invention of coal tar colors has been especially influential upon the manufacture of a more extensive line of colors and inks of higher quality. Many brilliant color pigments were made available to the ink maker by the coal tar industry development. Many such colors faded greatly as made at first, but constant improvement in their permanency of color has been made until today some of the coal tar colors are the most permanent known. From about forty colors commonly sold in 1870 the list of available colored inks now numbers in the hundreds or thousands;—practically any color wanted may be secured.

The manufacture of dyestuffs from coal tar originated in England. France took up the manufacture next and then both Switzerland and Germany began to make such colors. Germany soon developed this industry to a point after 1870 where almost a monopoly of the world business was in her possession. From that time most of the improvements and valuable discoveries in the coal tar industry have been made by Germans.

In 1875 the important discoveries were made which led to the manufacture of Malachite green, methylene blue, eosine and chrysoidine. Between 1880 and 1890 vast improvements and many important discoveries occurred. Such dyestuffs as auramine, tartrazine, congo red and rhodamine were then introduced. A little later para red and lithol were produced.

Germany supplied America with about eighty per cent of the dyestuffs used in 1913. Estimates indicate that the German investment in dyestuffs manufacture before the world war was in the neighborhood of four hundred million dollars. During the war America was thrown on her own resources for the manufacture of dyestuffs and while the first dyestuffs made were not equal in quality to the imported colors, great improvements have been made continuously. All of the pre-war colors are not made, but a sufficient number of high quality is made to serve all practical purposes.

ESSENTIAL CONSTITUENTS

Printing ink is composed of color pigment, liquid vehicle and drier. There are about five hundred basic materials used in the manufacture of inks today which include oils, resins, color pigments, white pigments, waxes, dyes and various acids and other chemicals.

Color Pigments and Dyes.—The principal colors now used for the manufacture of printing inks are those made by chemical processes and to some extent earth pigments such as raw and burnt sienna, raw and burnt umber and yellow ochre. For descriptions of these see Chapter II. Generally earth colors are not used except for certain shades; they are apt to be gritty and to cause excessive wear on type, half tones, zincs and electros.

Such chemical colors as the iron blues like Prussian, Chinese, bronze and Milori blue are extensively used in the manufacture of modern inks. Chrome yellows, light, lemon, medium and orange, are used a great deal as are also such colors as ultramarine blue and vermilion. For descriptions of these colors see Chapters II and III.

The basic white pigments used in printing inks are white lead, zinc oxide, lithopone, blanc fixe and magnesia. See Chapter V.

Black pigments used are carbon black, lamp black, bone or ivory black, aniline black and mineral black oxide of iron.

Extreme care must be exercised in selecting carbon blacks from which all grit and crystalline particles have been removed by the air-floating process. Should such impurities as crystallized carbon, small particles of iron rust or other grit be allowed to remain in the carbon black, the ink will cause fill-ups in half-tone screens and fine lines of zincs. Also excessive wear of plates and ink rollers will result from the use of such ink.

Coal tar colors used in modern ink making are these: Para red, lithol red, eosine, madder lake, red for lake C, toluidine, lithol rubeine, scarlet, methyl violet, alkali blue, peacock blue, auramine yellow, tartrazine yellow, Malachite green, fuchine, Victoria green, rhodamine, scarlet 2R, permanent red 4B, orange Y and chrysoidine. All of these colors belong to the transparent lake class except para red and toluidine red. The lake colors are made by precipitating the coal tar dyestuff as an insoluble salt on an inert, transparent base such as alumina hydrate.

The ink manufacturer differentiates between color pigments and dyes. The former are such colors as are not soluble in water or oil, whereas the dyes are soluble.

Oils and Varnishes.—Pure linseed oil is the principal liquid constituent of printing ink just as it is of paint. See Chapter VI.

The linseed oil is reduced to a thick varnish by boiling after it is refined and purified by chemical processes. The product resulting from this treatment is called lithographic varnish. It is produced in several grades classified according to body or viscosity, varying from a very thin varnish to one as thick as molasses. These thick and thin varnishes are usually blended in making ink to gain just the right body and working qualities.

While linseed oil varnish is the chief one used in the making of high quality printing ink, there are other varnishes which are also used in inks for certain specific purposes. Such special purpose varnishes are compounded of various gums and resins with linseed or mineral oil. To a large extent the same materials are used for ink varnishes as are made for general house and cabinet varnishing purposes.

The gums and resins in common use for ink making varnishes are these:

Rosin, which is the residue left from the distillation of turpentine;

Copal gum, a soft gum taken from live trees in Java, Sumatra, the Philippines, Australia and New Zealand. The hard copal gum is a better quality and is dug out of the ground in South America, West Africa, Madagascar and the East Indies. It is a fossil formation from the buried trees of past ages;

Damar gum is a resin exuded by a certain coniferous tree in the Moluccas;

Kauri is a resin secured from New Zealand. Some of it is in the fossil state;

Rosin oil, obtained by the distillation of rosin. It is used for special purposes in ink making.

Waxes for Ink Making.—In the manufacture of some inks waxes are used to gain certain desirable qualities.

Bees-wax, secured from the honeycomb of bees, is a common ingredient of ink.

Carnauba wax, made from the Brazilian palm tree, is another inkmaker's wax.

Wool-grease, a product secured by scouring sheep wool, is commonly used in printing ink.

Petrolatum and paraffin are wax products secured from petroleum and they are useful for some kinds of ink.

Ink Driers.—These are such liquids or pastes as will naturally hasten the drying of inks. They are added to the varnish or to the ink. They are compounded chiefly from soaps of the three drying metals—lead, manganese and cobalt. The linoleates and resinates are usually used but borate of manganese and lead acetate are commonly used too. Each type of drier has its own peculiar reaction and is used to gain certain qualities. And all are used to speed the drying of printing inks. See Chapter VII.

The drying of ink on paper is a process which accomplishes its aim by oxidation (taking up oxygen from the air), by absorption or by evaporation. All three methods may occur with the same ink. At any rate the ink must dry within certain time limits to allow handling of the paper for further printing, for cutting and binding.

Inks which dry by oxidation depend upon the varnish and drier added; inks which dry by absorption depend upon the paper partly and partly upon the varnish vehicle; inks made to dry by evaporation depend upon the rapid volatilization of the vehicle which may be xylol, gasoline or alcohol.

Some colors are naturally rapid in drying while others dry slowly. Quick drying varnishes are added to slow drying colors to make the ink dry normally rapid.

Driers are added to ink varnish by the manufacturers, but sometimes the printer must add more to the ink in the fountain when the weather is humid or when the paper contains too much humidity.

Driers should be added to ink with the greatest of care. They constitute a stimulant and if an overdose is added to ink the drying may be retarded instead of speeded up.

Characteristics of Ink.—The requirements which must be met by the inkmaker of today are complex as compared to the simple needs of hand block printing and early printing presses.

Since that ancient day the introduction of lithography by Senefelder in 1796 called for the production of colored inks while black sufficed before.

And from then until now has followed a continuous procession of inventions and improvements, each presenting problems for the inkmaker, until now we have inks for lithography, letterpress, gravure and offset; for job press, cylinder and rotary; for steel and copperplate engraving and embossing.

Changes and improvements in press speeds and in paper qualities require modification or adjustment of printing inks to fit the condition.

The introduction of photo-engraving to supercede wood-cut plates again set up a problem for inkmakers; and today the constant refinement in color process printing and betterment of paper constantly calls for vigilance and understanding on the part of the printer.

Standardization of raw materials and uniform quality are absolutely essential to successful adjustment and tempering of inks to fit every purpose, where color, body, drying ability, penetration of paper, adhesiveness, fineness of pigment, transparency and opaqueness all are vital factors in the making and mixing of printing inks.

Printing inks today are made for use on paper of many grades, on wood, burlap bags, waxed paper, glassine, fibre board, tin and iron.

The mixing of printing inks to match any given sample is done by substantially the same working methods as were outlined in Chapters VIII, X and XI. The principal difference to be noted is that instead of adding a little color to a quantity of white basic pigment, as painters and decorators do, the printer selects an ink which is near the color wanted and adds a little white or other color to correct it.

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Transcriber's Notes

A section of the Index had been printed out of alphabetical order, and it has been repositioned. The punctuation in the Index was modified substantially to achieve consistency.

The author assigns the words grey and gray different meanings, as described in the text. Every attempt has been made to retain the original spellings as they occurred in the printed book.

A modest number of spelling and punctuation changes were made to the text to achieve consistency.

[The end of *The Mixing of Colours and Paints* by F.N. Vanderwalker]