International Correspondence Schools, Scranton, Pa.

Painting

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"I find in life that most affairs that require serious handling are distasteful. For this reason, I have always believed that the successful man has the hardest battle with himself rather than with the other fellow. To bring one's self to a frame of mind and to the proper energy to accomplish things that require plain hard work continuously is the one big battle that everyone has. When this battle is won for all time, then everything is easy."

—Thomas A. Buckner

Architecture Home Study Course

Painting

V/O PART 3

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International Correspondence Schools
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What This Text Covers . . .

6227C

Painting

PART 3

Pigment Colors

Color Consciousness

1. Time was when most automobiles were black, home decorations were subdued, bathing suits were drab, and no respectable male wore a pink shirt. Today practically every phase of living is made more pleasant by the use of color.

In the design of a building, few factors are more important in creating a favorable impression for the building than the correct choice and application of color. In fact, color can accomplish more at less cost than any other factor in design. In recent years there has been an increased awareness of color, and there is a growing knowledge of the results that can be obtained by the use of color.

Purpose of This Text

2. With color many things are possible. Small rooms can be made to appear larger. Dark rooms can be made to look lighter. Rooms with a northern exposure can be given a feeling of warmth. The right color in hospitals can produce an atmosphere of well-being. In schools color can create an atmosphere of quiet that aids concentration. The correct use of colors in factories can raise morale and speed production.

Much has been written on the subject of color, and various theories of color – many of them confusing – have been expounded. However, it is not necessary for you to become steeped in color theory to be able to use color successfully. Knowledge of a few basic principles will enable you to solve most color problems.

A knowledge of color is important to the architect, designer, painter, interior decorator, homeowner, and realtor. The pur-

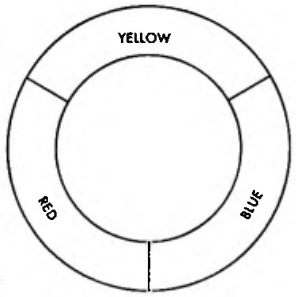

FIG. 1. PRIMARY COLORS

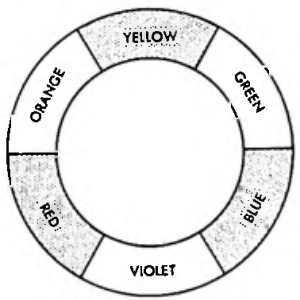

FIG. 2. PRIMARY AND SECONDARY COLORS

pose of this text is to give you an understanding of the use of color.

Primary Colors

3. The three primary colors in pigments are red, yellow, and blue. They are called primary colors because they cannot be broken up into component colors. All other colors can be produced by combinations of the primary colors. The primary colors are indicated in Fig. 1.

You might naturally expect to find black and white classed as primary colors. But although black and white are available as pigments, they are not generally classed as colors. No color can be seen in pure white, and black is so dark that no color is visible in it.

Secondary Colors

4. The mixing of two primary colors produces a secondary color. Since there are but three primaries, there can be only three secondary colors. Thus, red combined with yellow forms orange, red combined with blue produces violet, and yellow combined with blue gives green. The secondary colors are indicated by the unshaded areas in Fig. 2.

Tertiary Colors

5. By mixing equal parts of a primary color and a secondary color, a tertiary color is obtained. You can obtain six tertiary colors in this way. Thus, yellow and green produce yellow-green; green and blue produce blue-green; blue and violet produce blue-violet; violet and red produce red-violet; red and orange produce red-orange; and orange and yellow produce yellow-orange. The primary, secondary, and tertiary colors are shown together in Fig. 3; together they form a spectrum of twelve colors. You are already familiar with all these colors.

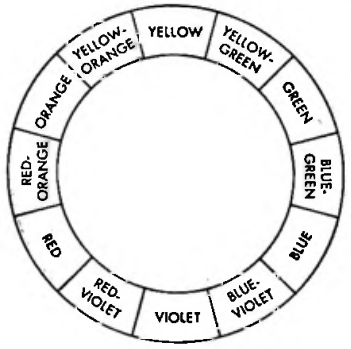

FIG. 3. TWELVE-COLOR SPECTRUM

Color Grays

6. When two or more tertiary colors are mixed together, the result is a color gray. Such a gray is to be distinguished from a neutral gray, which is a mixture of black and white pigments. Individual color names have not been given to the color grays, because the proportion of each tertiary color that is used in the mixture can vary widely.

Warm and Cool Colors

7. The twelve colors of the spectrum and the various color grays may be classed broadly as either warm or cool colors. Red, yellow, and orange, which give the effect of fire or heat, are warm colors. Blue, which is the color of ice, and its related colors, green and violet, are classed as cool colors. Similarly, a

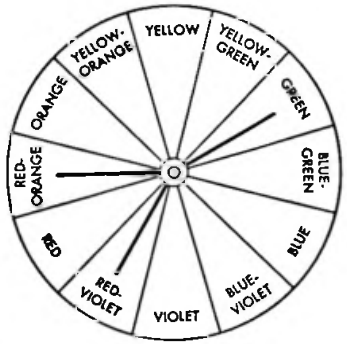

FIG. 4. SPLIT COMPLEMENTS

gray in which a warm color predominates can be called a warm gray; a gray in which a cool color predominates can be called a cool gray. Notice in the twelve-color spectrum in Fig. 3 that the warm colors are on the left side, and the cool colors are on the right.

Advancing and Receding Colors

8. Warm colors are commonly called advancing colors; that is, the warm colors attract your eye and appear more prominent and closer than do the cool, or receding, colors. The degree of advance or recession depends upon the value of the color. A dark red is less noticeable than a light red, for instance. Grayed or neutralized colors are the least noticeable of all colors.

Warm, advancing colors, particularly in the lighter variations of the hues, have a tendency to increase the apparent size of an object. A hue containing red or yellow is likely to add an appearance of greater bulk. Cool colors, particularly in the darker shades, make objects appear smaller and heavier in weight.

Complementary Colors

9. Complementary colors are those colors which, taken together, include all three primary colors. Thus the complement of red is green, which is made up of blue and yellow. The complement of yellow is violet, made up of blue and red. And the complement of blue is orange, made up of red and yellow.

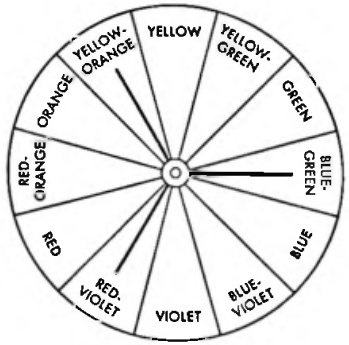

FIG. 5. COLOR TRIADS

You can readily determine complementary colors by referring to Fig. 3. The complement, or perfect contrast, of any color in the circle is found directly opposite that color. Split complements lie on either side of the complement, as shown in Fig. 4. Thus the split complements of yellow would be red-violet and blue-violet.

Analogous Colors

10. Analogous colors are related colors. Related colors share a common color. Thus, blue, blue-violet, and blue-green are all related colors, because they share the common color blue. Red-orange, orange, yellow-orange, yellow, yellow-green, and green are related colors that form a color analogy with the common color yellow. A color analogy may include any number of related colors from three to six, but three is usually the ideal number. By referring to the twelve-color spectrum, you can see that a color analogy cannot include seven colors, because a seventh color would be a complementary or contrasting color.

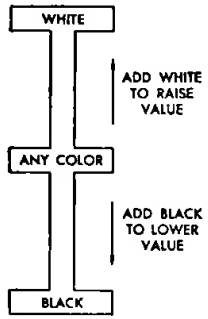

FIG. 6. VALUE OF A COLOR IN RELATION TO WHITE OR BLACK

Color Triads

11. Any three colors that are equidistant on the color spectrum form a color triad and provide favorable contrast. Various triads can be picked out by referring to Fig. 5. Thus red, blue, and yellow form a color triad. Colors of full intensity, however, seldom form a desirable combination. A preferable triad would consist of yellow-orange, red-violet, and blue-green, as indicated by the heavy lines in Fig. 5.

Measuring Color

12. If you wish to use colors effectively, you must first learn how to measure colors. A color has definite measurements in the same way that a building has measurements of height, length, and width. The color measurements are called hue, value, and intensity.

Hue is just another name for color; hue means color. Hue distinguishes one color from another, for instance, red from yellow, and purple from green. A hue may be darkened with black or lightened with white, but it is still the same hue. Thus, a light red and a dark red are still the same hue, namely, red.

Each hue or color has a definite value. The value of a color is its degree of lightness or darkness in relation to white and black. This is shown in Fig. 6. We can say that pure white has

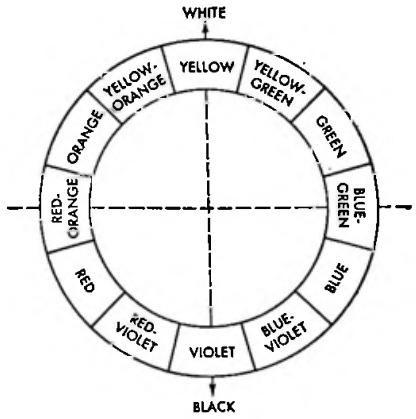

FIG. 7. RELATIVE VALUES OF COLORS OF SPECTRUM

the highest value and that black has the lowest value. Yellow, for example, is closer to white than to black, and so it has a high value; blue-violet, on the other hand, is closer to black than to white, and so it is said to have a low value. However, we can change the value of a hue by darkening the hue with black or lightening it with white, as shown in Fig. 6.

13. If we refer to Fig. 7, we can see the relative value of various colors starting with yellow, which is the lightest color in the spectrum. The colors on either side of yellow become progressively darker as they approach violet, the darkest of the spectrum colors.

The diagram in Fig. 7 is important because it shows the relationship in value that exists between two colors that may be used together. For example, if you decide to use blue and orange in a color scheme, you must remember that the blue will normally be considered lower in value than the orange. If, however, you lighten the blue to the same value as the orange, a discordant relationship will result, because you have violated the normal spectrum relationship of the two colors. For this

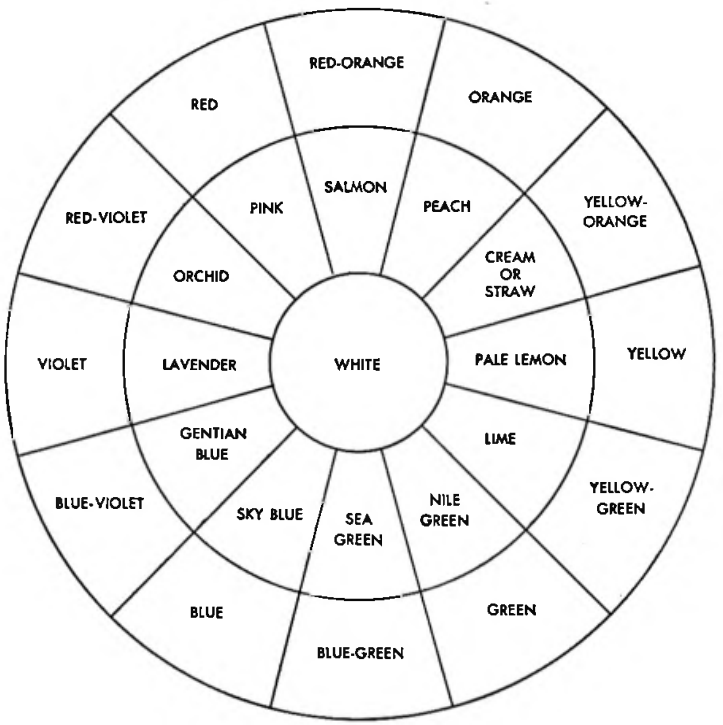

FIG. 8. RAISING VALUES OF SPECTRUM BY ADDING WHITE

combination, if you wish a lighter blue, you should lighten the orange correspondingly. In fact, you can lighten the entire spectrum in value by adding proportionate amounts of white to each color. This will produce a spectrum including peach, salmon, orchid, and similar colors, as shown in Fig. 8. On the other hand, a spectrum can be lowered in value by adding black to each color, as shown in Fig. 9.

14. If you add white to any color of the spectrum, the result is a tint which has a higher value than the original color. The more white you use, the lighter will be the tint and the higher its value. If you add black to a color, the result is a

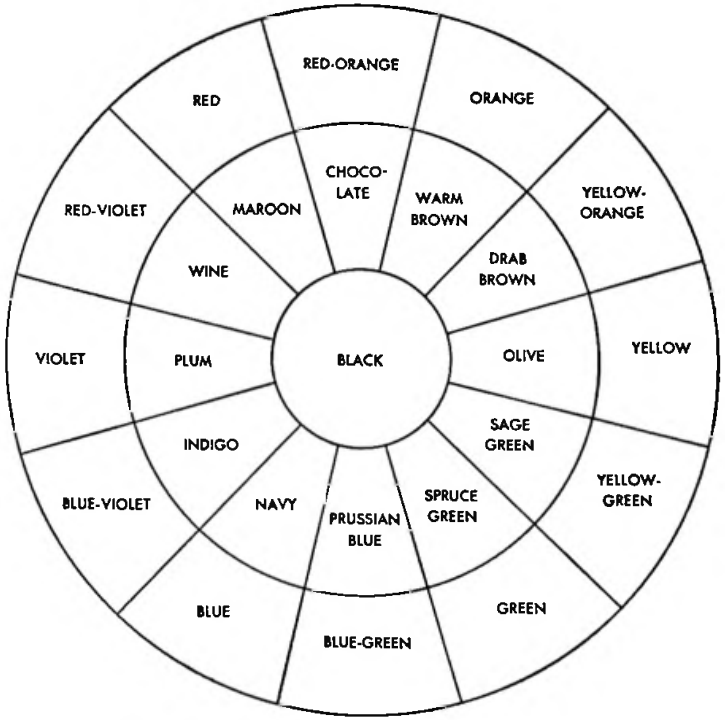

FIG. 9. LOWERING VALUES OF SPECTRUM BY ADDING BLACK

shade which is lower in value than the original color. Shades are known as low values; tints are known as high values. In Fig. 10 is shown how any color of the spectrum can range from a low-value color to a high-value color.

The intensity of a color, sometimes called its chroma, denotes the strength of the color. A primary color, for instance, without the addition of another color, is said to be of full intensity; it is a strong color. When a color is grayed by adding

FIG. 10. RANGE OF VALUES FOR ANY SINGLE COLOR

either black or white, or by adding the color's opposite on the spectrum, the color is reduced in intensity. It is then said to be a soft color, or a dull color. If a color is reduced far enough in intensity, it becomes a color gray.

Two paints may be of the same hue, let us say red, and of the same value, with neither paint being lighter or darker than the other. Yet the two paints may be quite different in appearance because the one red may be a bright red high in intensity, while the other red may be a grayed red of low intensity.

Light and Color

15. Regardless of its intensity, a color does not register on the eye unless there is light. In selecting colors, light is of prime importance.

Light often does unexpected things to color. Strange as it may seem, the intensity of a color is lowered both by bright sunshine and by reduced light.

If we assume that colors are seen most correctly under a north light on a clear day, we might also assume that these same colors viewed in bright sunshine will appear more intense. *But bright sunshine actually lightens a color.* That is why intense colors can be used, without seeming too strong, in southern climates where there is an abundance of sunlight.

As the sunlight disappears with the approach of darkness, the bright colors in a room begin to fade. As the light grows steadily less, the bright colors seem to become darker and darker. But when the daylight fades into twilight, the darker colors of the spectrum appear to become lighter.

Artificial light also presents problems. Incandescent light has a tendency to yellow a color. Peach, for instance, becomes more orange in incandescent light. Ordinary fluorescent light, on the other hand, is colder than incandescent lighting, and it often gives colors a bluish cast.

The effects of natural and artificial light on color can be very confusing. In selecting colors, it is wise to plan your color scheme for the time of day or night when the space is used to the greatest extent. Before a color is approved, it should be viewed under the kind and amount of light that will be in use.

16. If you must match the same color on two different occasions, be sure to use the same kind of lighting. Don't try to match under incandescent light a color which was first mixed in daylight.

When mixing colors, consider the tinting strength of the various colorants. Suppose you are mixing white oil color with red to get a medium pink. It would seem logical to mix one part of white with one part of red. However, this actually gives a deep pink, because the red pigment in oil color is a stronger colorant than white is. The proportion would have to be about eight parts of white to one part of red to give the proper value.

It is a good practice to add color to white in very small amounts, little by little, when mixing pale colors. To lighten dark tones, add the lighter color to the darker one in fairly small amounts.

Finally, keep in mind that most paint colors look different in the wet state than in the dry state. Whenever possible, make it a practice to brush out a sample and let it dry thoroughly before checking the color match.

Phosphorescent and Fluorescent Pigments

17. Outstanding examples of new developments in colorants are the phosphorescent and the fluorescent pigments. In many fields their possible uses are only now being explored.

These pigments have several unusual characteristics. A phosphorescent pigment, or color, will glow when exposed to invisible ultraviolet light rays, and it will continue to glow some time after the ultraviolet rays are cut off. Such colors contain phosphor compounds which have the property of being able to trap light energy and emit it later, after the source of

activation has been discontinued. How much later this can be done varies from millionths of a second to days, depending on the compound. What we see as "color that glows in the dark" is actually stored-up light energy being emitted by the phosphor compounds which at some previous time have been exposed to light.

After thorough exposure to ultraviolet light, or black light, most phosphorescent pigments have a sufficiently high initial brightness in the dark to be viewed by the eye as distinctive colors. The range of colors available, however, is limited to blue, blue-green, green, yellow, yellow-orange, and variations of these colors.

18. Fluorescent pigments, on the others hand, actually capture and transmute absorbed visible and invisible rays into the dominant color visible to the eye. This makes the pigments appear to glow, or emit light themselves, when seen under normal light conditions.

Fluorescent pigments, available in a full range of very intense fluorescent colors from red to blue, make it possible to produce very brilliant color effects such as Day-Glo. "Daylight" fluorescent products retain their visibility and color effect at distances up to four times as great as the brightest of ordinary materials. However, fluorescent brightness is controlled by the intensity of the exciting light and by the nature and amount of fluorescent pigments used in the finished material. Glowing color at present has one shortcoming; it fades under strong sunlight and loses its fluorescent quality quite rapidly. Artificial light does not cause fading. The major difference between the fluorescent and the phosphorescent pigments is that the fluorescent pigments are not visible in the dark.

How Colors Are Prepared

19. A multitude of colored paints can be obtained in containers ready for application. When desired, these colored

paints can be modified on the job by the addition of colors. And colored paints can be mixed on the job by adding colors to white paint; the colors are prepared as a thick paste. The colors are sold in containers of various sizes.

Although there are several grades of tinting colors, it pays to buy the best. The best colors are brighter, clearer, and have greater tinting strength. A smaller amount of the best color will be required to obtain the desired tint when added to a white paint. The cheaper grades lack tinting strength and are apt to be cloudy or muddy.

Some manufacturers give special names to certain grades of standard colors, but the principal colors ground in oil are those listed in the following table.

Reds	Indian red	Permanent red
	Tuscan red	Scarlet vermilion
	Turkey red	Unfading vermilion
	Venetian red	English vermilion
Blues	Chinese blue	Prussian blue
	Cobalt blue	Ultramarine blue
Yellows	Chrome yellows:	Dutch pink
	Light, or canary	Golden ochre
	Medium	Yellow ochre
	Orange	French yellow ochre
Greens	Light chrome green	Forest green:
	Medium chrome green	Light
	Bottle green	Medium
	Bronze green	Dark
	Olive green	
Browns	Raw sienna	Burnt umber
	Burnt sienna	Vandyke brown
	Raw umber	Brunswick brown
Blacks	Carbon black	Ivory black
	Coach black	Lampblack
	English blue-black	Black iron oxide

20. A finer-ground, brighter, and clearer-toned grade of color in oil is used by decorators, artists, and furniture finishers. Colors of this grade are best for stencils, pictorial and mural paintings, and theater scenes. High-grade colors are put up in tubes and one-pound press-top cans.

Summary

21. There are three primary colors, yellow, red, and blue; three secondary colors, orange, green, and violet; and six tertiary colors, yellow-orange, yellow-green, blue-green, blue-violet, red-violet, and red-orange. These twelve colors constitute the commonly used color wheel but, by varying the combinations, an infinite number of other colors may be obtained.

Without light, color does not exist. Color varies with the amount and the kind of light. When selecting a color for a room you should always view it under the same kind of light under which the room will appear when in use.

Color intensifies when either area or reflectance is increased. The usual inclination is to select colors that are too bright. Bright colors, as a rule, are best used in small areas as accents. For large areas, such as backgrounds, you will generally find that colors which have been neutralized are most satisfactory.

Colors can be measured by their hue, value, and intensity. Hue is another name for color. Value is the degree of lightness of a color in relation to white or black. The intensity of a color indicates its strength. Both intensity and value exist in all colors at the same time. Tints are obtained by adding white to a color. Shades are obtained by adding black to a color.

Effects of Color

Balance and Proportion

22. Numberless combinations and adaptations are possible when color is used – as it can be used – to create an impression of balance and proportion. Much of the knowledge that you need for an understanding of how to use color in this way can come only with practice. Your progress, however, will be more rapid if you first master a few principles that underlie the use of color.

Several mistakes are commonly made in the use of contrasting colors. One mistake is to forget that equal areas of contrasting color are not pleasing. For instance, a room with a red wainscot 4 feet high and upper walls of green would not be pleasing because the areas would be approximately equal. An all-green room with contrasting red accents would be more effective.

Furthermore, the size of a contrasting area will govern the intensity of the colors used. In an all-green bathroom, accessories of primary red would be acceptable. Primary red, however, would be too strong for the bath curtain; in an all-green bathroom the bath curtain might be a grayed red, possibly a salmon color. The smaller the contrasting area, the more brilliant the contrasting color may be; conversely, the larger the contrasting area, the less brilliant, or more neutral, the color should be.

23. Equal areas of the same value and intensity, even though they are of contrasting colors, are monotonous. A bedroom, for instance, with walls, curtains, spreads, and so forth carried out in light tints such as peach and turquoise would appear to lack something. Here a color of low value and high intensity would be needed to provide a counterbalancing punch. A dark plum-colored rug, for example, would supply the necessary balance and strength.

Equal areas of dark colors are also apt to become tiresome.

A room painted in dark green, with the furnishings in deep reds and blues, would actually be depressing. Relief from the dark areas could be provided by white trim, blond furniture, and gay fabrics.

On the other hand, excessively figured areas produce undue excitement. If figured wall areas are used in decoration, they should be balanced by compensating areas of plain colors in the accessories. For the same reason, plain wall areas can be made more interesting by the use of figured accessories. It is always a good idea to repeat one or more of the basic colors of the plain areas in the accessories.

24. Color can be a means of changing the apparent proportions of a room. A high ceiling can be lowered in appearance by using light colors on the walls and a dark color on the ceiling. The darker the ceiling, the greater will be the illusion of lowness. As a rule, the dark color selected for a ceiling should be of high intensity, because pastel shades usually look insipid on a ceiling. The advancing colors, which are the warm colors found in the left half of the spectrum, Fig. 3, tend to lower a ceiling more than the receding or cool colors in the right half of the spectrum.

The ceiling may also be lowered in effect by lowering the apparent height of the side walls. You can accomplish this by the use of horizontal lines or bands of color. Sometimes a single band will achieve the desired effect.

25. A more difficult job than lowering the height of a ceiling is to give the illusion of height to a ceiling that is actually low. Painting the ceiling white and using vertical lines and warm colors on the side walls will help give the illusion of a higher ceiling.

If a room is extremely long in relation to its width, the length of the room may be apparently reduced by painting the two end walls in a warm color, fairly deep in value, and using a light tint of the same color on the side walls. Complementary colors can be used on the side walls if the rule for equal contrasting areas is not violated.

Generally, the warm, dark values of colors make a room appear smaller. Cool colors tend to make a room look larger. The maximum apparent size is obtained by using light tints.

Psychology of Color

26. Although the psychology of color is not yet an exact science, enough about it is known to serve a number of practical purposes. It has been well established, for instance, that the response to color is emotional. Although the response to color may differ somewhat from person to person, most of us find that certain hues seem quiet and subdued and give rise to corresponding emotions. Other hues that are more intense produce a cheerful or excited response. Accordingly, color can animate or tranquilize, excite or depress, soothe or irritate, delight or annoy, depending upon the colors used.

Yellow is the most cheerful of all colors; it is the color that comes the nearest to sunshine. Like yellow, red is a "warm" color, and it inspires warmth and happiness. Orange, which is produced by combining red and yellow, is also a cheerful color. Buffs, tans, and creams, which are tints of orange or yellow-orange, are safe background colors. The present trend, however, is to more lively colors.

Blue is a "cold" color, and it is true that certain blues may be depressing. Other blues, however, suggest a dignity and serenity that make them admirable for creating a formal and sometimes even a spiritual atmosphere.

Green shares the qualities of both yellow and blue, that is, the qualities of sunshine yellow and cold, sedate blue. It is one of the most restful and pleasing of colors. Green, as you know, occurs abundantly in nature, and yellow-green, which is the color of young grass and leaves, suggests springtime. Grayed tints of green are extremely restful and are therefore especially suitable for backgrounds. As a result grayed greens

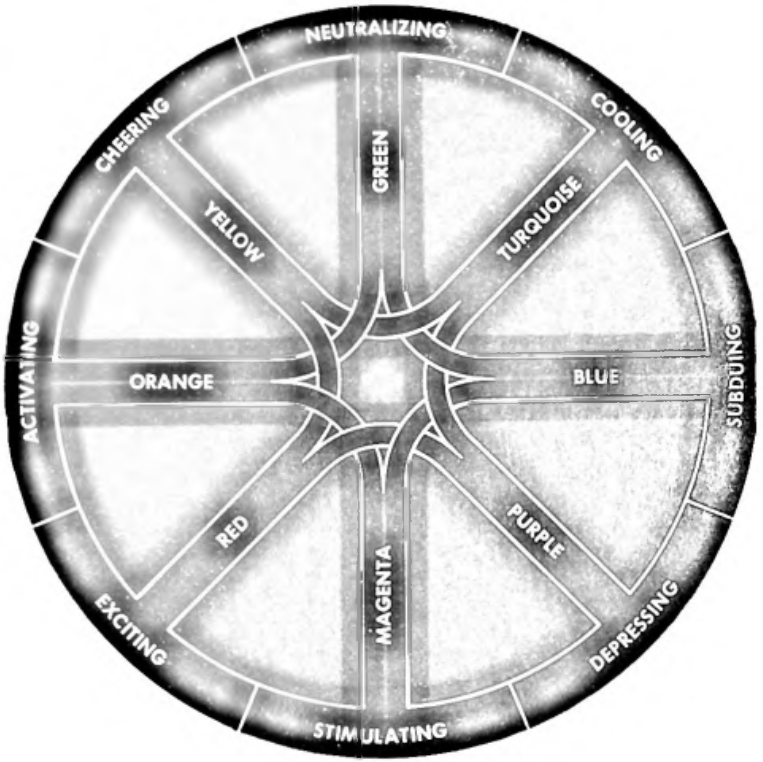

FIG. 11. EFFECTS OF COLOR ON EMOTIONS

are widely used for workrooms, schools, and offices. A grayed green, for instance, is often used in hospital operating rooms. Here it not only promotes accurate vision, since it is easy on the eyes, but also restores eye stability to the surgeon as he looks away from areas of red to the green walls.

27. Purples and violets are depressing to some people. But if they are shaded with black or gray to produce a raisin or plum color, they can provide a pleasing background for an attractive color scheme. They may also be used as accent colors for draperies, furniture, and accessories. It is a good

rule, however, to avoid large areas of light tints of lavender or orchid, since such colors violate the normal spectrum order and thus create a discordant relationship with other colors.

We are now ready to summarize what has just been said about the general psychological reactions to color. We can start with red as the most exciting of colors. Then, in passing from red-orange to yellow-orange, we pass from exciting colors to stimulating colors. Although yellow is less stimulating than yellow-orange, it is the most cheerful of colors. After leaving yellow we come to the greens (yellow-green, green, and blue-green), which are more tranquilizing than yellow, and after the greens we come to the serenity of blue. From blue we go on to colors that are often depressing, the purples and violets. The usual emotional responses to various colors are indicated in Fig. 11.

We have now learned that certain colors produce certain psychological reactions. But at the same time we must keep in mind that the reaction to a given color depends upon the area of the color, the degree of brightness or dullness of that color, and the characteristics of the colors nearby.

Applications of Color Psychology

28. Today, the known psychological responses to given colors are an important factor in color selection. We have learned, for instance, that brilliant colors are the most stimulating ones and that red and orange are the most stimulating of all. Such colors are well suited for the theater, for the cocktail lounge, and for recreational enterprises.

Brilliant colors, however, are tiring. In areas in which we spend most of our working hours, the colors should not be ones that fatigue us. We need restful colors instead. Grayed greens and blues are particularly restful, and they promote thought and concentration. They are widely used for offices and schools. Kindergarten rooms, of course, are an exception; they should be decorated in bright colors.

Until recent years, hospital interiors were painted white to emphasize their hygienic aspect. Today you seldom see white walls in a hospital; they have given way to subdued colors for nervous patients and to more cheerful colors for patients who can benefit from mild stimulation.

To make the kitchen attractive to the modern woman, the colors should be as cheerful as possible. Since yellow is the most cheerful color in the spectrum, it is ideally suited to kitchens.

In the living room most families prefer the restful atmosphere that results from restrained colors. More stimulating colors are desirable in the dining room to promote a cheerful atmosphere in which to enjoy food and conversation.

Cheerful colors are also suitable in bedrooms that are in use during only a few of the waking hours. Today, however, there is a trend to large bedrooms equipped with built-in bookcases, television sets, and so forth. Since such rooms are really combination bedrooms and studies, they are best decorated in the restful colors.

You are already familiar with the intelligent way in which the modern store uses color to stimulate buying. The dismal, colorless store is a thing of the past. The modern store, with its wide range of both brilliant and subdued colors, has become a housewife's paradise.

Most persons are not students of color, and few have the ability to create outstanding color combinations. But any person, unless he is color-blind, can be favorably influenced by the proper use of color.

Color in Industry

29. In industry you can use color and lighting not merely to make working places clean and orderly but also to improve the health, comfort, and well-being of the workers. The selection of the correct colors for different surfaces needs careful consideration. Distinctive colors can be used to help the eye

to register properly on the moving parts of machinery. Neutral gray backgrounds serve to eliminate distraction from the field of vision. Better vision, greater accuracy, less eyestrain, and fewer accidents result from careful color planning.

The color treatment that you select should be determined by a study of the plant, its location, the location of the various departments, the kind of work being performed, and the type of equipment being used. In factories where temperatures are relatively high, cool light tones of blue and green are advisable. Soft, warm buffs and sun-tone creams add apparent warmth to cool locations.

30. Pipelines running along walls and ceilings may be made inconspicuous by painting them the same color as adjacent walls and ceilings. This also applies to steel bracings and masonry and steel columns.

Ceilings, together with overhead steel work, beams, cross-bracing wires, and pipes, should be painted in light tones, which are receding colors. The ceilings thus become inconspicuous and do not "bear down" on the worker.

When a machine is so located that a wall of the room is constantly in the operator's field of vision, you should use colors that rest the eyes rather than stimulate them. The wall, which is glanced at frequently for eye rest or change, should have approximately the same brightness as the working surface.

31. High-visibility colors can be used to draw attention to danger areas. Bands of "safety yellow" along the sides of aisles will help to keep workers from drifting into dangerous traffic zones. Black-and-yellow striping is used as a warning on obstacles either on the floor or overhead.

Heavy machinery can be made less bulky looking by using gray-greens, bluish grays, and medium grays in the particular shade most suitable to the interior color plan of the plant. Where soilage is a problem, the need for cleanliness and care can be emphasized by the proper use of color for ma-

chinery. Color guides can identify oiling and other maintenance areas by providing contrast at lubrication points.

Summary

32. Color creates an emotional response in the beholder. It can be used to make a room seem gay or restful, warm or cool. The emotional response to a given color depends upon the degree of brightness or dullness of that color.

Color can be used to create architectural illusions: it can make a large room appear smaller or a small room, larger. The use of proper colors may make a high ceiling appear lower or a low ceiling, higher.

In industry, the proper use of color can contribute to the comfort, efficiency, and safety of workers.

Color Schemes

Selecting the Color Scheme

33. In selecting a color scheme, it is necessary for you to take into consideration the kind of light, the size and proportions of the room, and the emotional response desired.

Usually, colors are selected from color cards or by painting small wall areas. Such small areas, however, are deceiving even to experienced colorists because they fail to show a definite color fact, which is that *color intensifies with area and reflectance.* This intensification of color is greater in a small room than in a large room, but it is always present.

A common error is to select colors that are too bright. This is especially true of background colors when the colors are used in large areas and the intensification of color is multiplied. Grayed colors are generally best for backgrounds. Any color can be grayed by adding black, white, or, better still, a small amount of the complementary color.

In using colors, as in any form of design, interest is developed through contrast. In Fig. 12, in which various groups of colors are placed on a white background, the dark colors

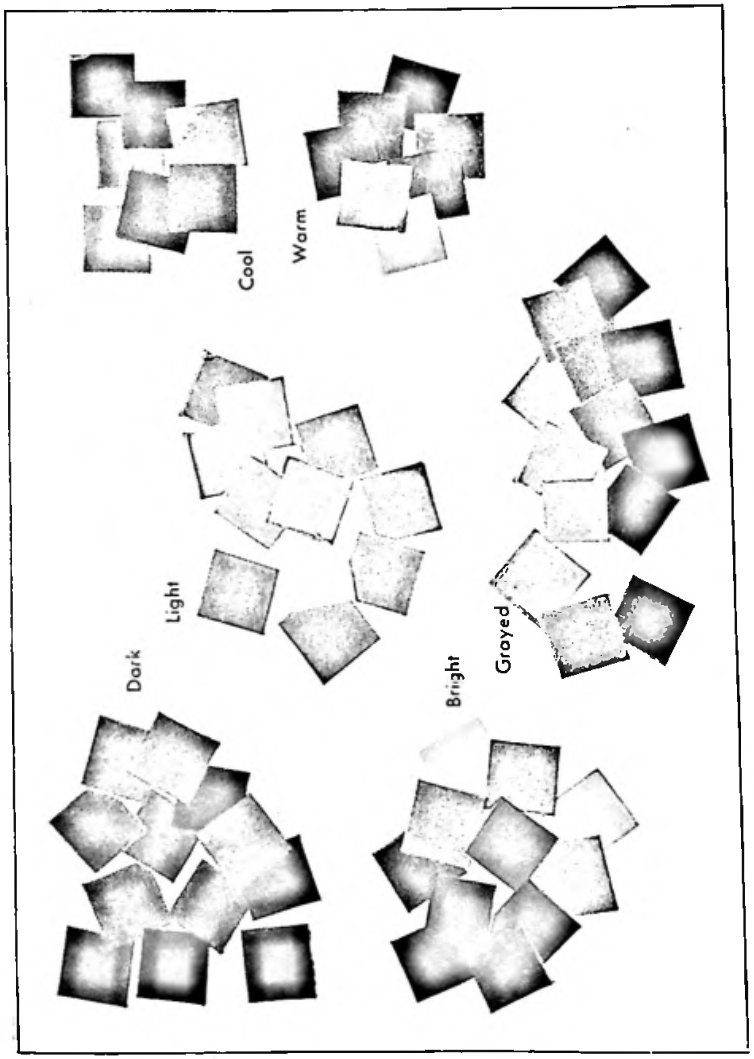

FIG. 12. GROUPS OF COLORS AGAINST WHITE BACKGROUND

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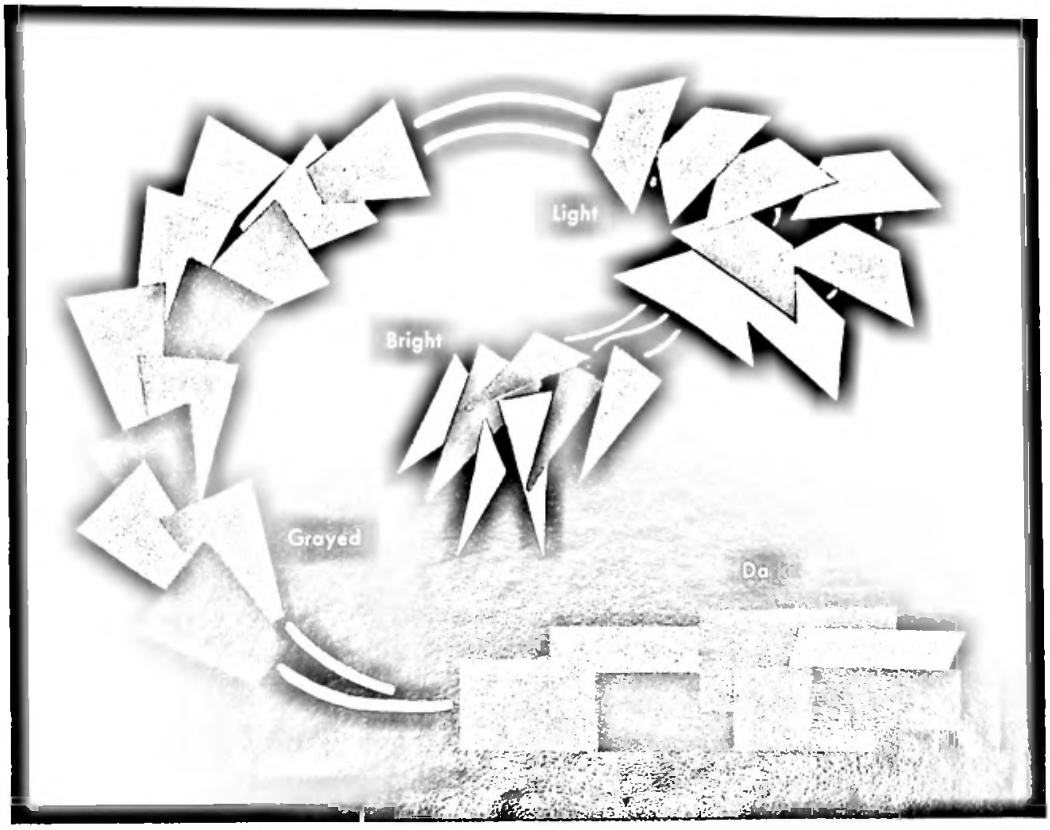

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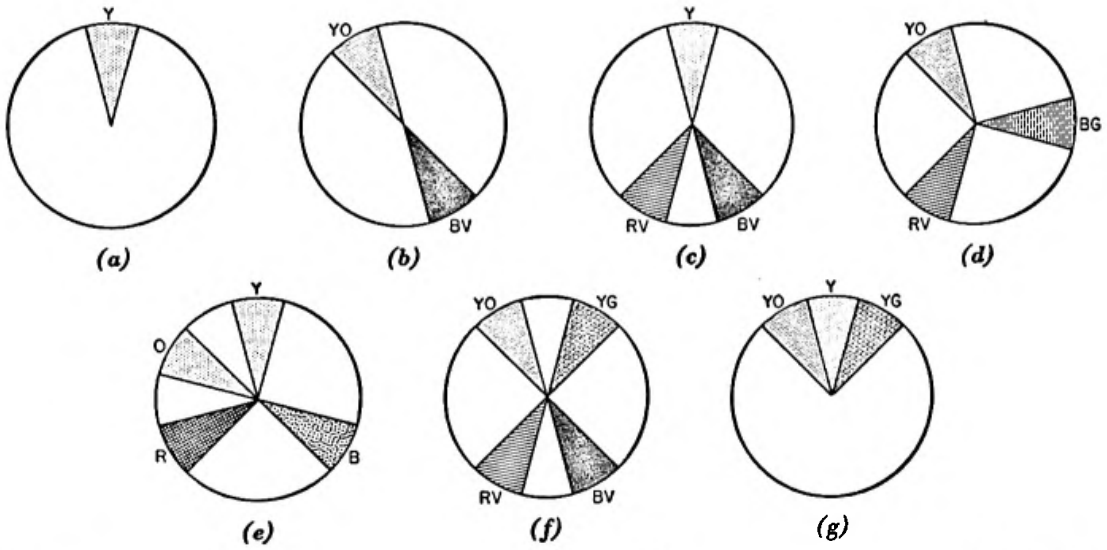
FIG. 13. GROUPS OF COLORS AGAINST DARK BACKGROUND



Y. yellow
YG. yellow-green
G. green
BG. blue-green
B. blue
BV. blue-violet
V. violet
RV. red-violet
R. red
RO. red-orange
O. orange
YO. yellow-orange

(a) Monochromatic
(b) Direct complement
(c) Split complement
(d) Triad
(e) Alternate complement
(f) Double complement
(g) Analogous

FIG. 14. EXAMPLES OF COLOR SCHEMES

stand out in strongest contrast to the background. The light colors provide the weakest contrast.

34. In Fig. 13, in which the colors are placed on a dark background, the effect is the opposite of the effect of Fig. 12. Here the light colors stand out strongly against the dark background.

Both Fig. 12 and Fig. 13 are interesting as illustrations of cool, warm, bright, and grayed colors. In Fig. 12 notice that dark colors can also be bright, as is shown by the bright red block in the dark group. In Fig. 13 notice the dark blue included in the bright group.

While innumerable variations are possible in selecting colors, the various color schemes may be grouped according to a few general types that are discussed in the following sections.

Monochromatic Color Schemes

35. We have learned that a color may vary in lightness or darkness, or in brightness or grayness, and still remain the same color. The tints, shades, and graduations of a color are said to be in monochromatic relationship to each other. A monochromatic color scheme is based on the variations in value and intensity that may be had by the proper treatment of a single color as indicated in Fig. 14, view (*a*).

For instance, you might design a room with a rich oak floor, a walnut wainscot, side walls of Vandyke brown, and a light-brown ceiling, and in this way develop an ideal monochromatic relationship. Such a room could be enlivened with contrasting accents in complementary colors.

Complementary Color Schemes

36. You are familiar with complementary colors. You know that they are opposite each other on the color spectrum, as in Fig. 14, view (*b*), and that they provide the greatest contrasts in color. Split complements lie on either side of a complement.

Thus the split complements of yellow would be red-violet and blue-violet, as indicated in view (*c*).

The interest provided by the complementary color scheme is the interest afforded by unlike colors. As in any color scheme one color should be picked as the dominant one. This color should be the one that best meets the requirements of the room. For example, if green is selected as the dominant color, red will be the complement, and it will be used to accent the green. If split complements are used, they will be red-orange and red-violet.

Theoretically, the use of complementary colors should result in a pleasurable visual sensation. In practice, however, the use of strong, pure colors, even though they are in perfect contrast, will tire the eyes, just as too much excitement will tire the body. To avoid color fatigue, bright colors should be used only on small areas, with the use of large areas of neutral colors to offset the brightness.

There is another way of making strong complementary colors less tiring. Let us assume, for example, that your complementary color scheme calls for blue and orange and that both colors are to be used in large areas. Then both colors may be neutralized by mixing a little of each with the other, thus lessening the contrasts in values and intensity.

Color Triad Schemes

37. The color triad scheme employs three colors that are equidistant on the color spectrum, as indicated in Fig. 14, view (*d*). An example of a color triad would be a room having walls of yellow-orange, drapes of red-violet, and a blue-green rug. Here the wall color would probably occupy the greatest area and so would be the dominant color. However, since all the areas are large, all colors would be grayed.

Four-Color Schemes

38. Four colors can be used harmoniously in a room by employing alternate complements, as shown in Fig. 14, view

(*e*). By this plan you use any three colors equidistant from each other in the color wheel and, in addition, the direct complement of any one of the three colors. The four-color plan permits the use of many colors in a small room. However, you should limit the bright colors to small areas.

Another plan for four colors is called the double-complement scheme, in which you choose any two sets of complementary colors from the color wheel according to the pattern shown in Fig. 14, view (*f*).

Analogous Color Schemes

39. The analogous color scheme uses analogous or related colors. One such group of related colors is shown in Fig. 14, view (*g*).

When related colors are used, one color should be selected as the principal or dominant color. A second related color can be used in a fairly large but subordinate area; it may be advisable to gray this color. Other related colors can be used in small areas in pure and bright hues. The interest provided by the related color scheme is the interest that like colors afford. Like colors enhance each other by emphasizing a common hue. Thus, in a group of hues related to blue we notice the blueness; in a group of colors related to yellow, we notice the yellowness; and so on.

The analogous color scheme is less likely to become tiresome after long use than is the monochromatic color scheme. Nevertheless, like the monochromatic color scheme, it presents the danger of too much uniformity, since there is often little contrast of hues. Variety can be obtained in an analogous color scheme by contrasts of tints and shades, gloss and flat surfaces, and intensity and dullness.

Summary

40. You have now come to the end of Part 3 of *Painting*. In this text you have learned important facts about color. You are now familiar with such color terms as primary, secondary, tertiary, warm color, cool color, tint, shade, spectrum, complement, and triad.

Each kind of color scheme — monochromatic, analogous, color triad, or complementary — can be used successfully. Each scheme has certain advantages and is best suited to the solution of a particular color problem.

In any color scheme it is necessary to have contrast in order to create interest. Contrast can be obtained by using different colors; this is a contrast in hues. Contrast can also be obtained in values and intensities. To avoid monotony, the color scheme should have considerable contrast in all three factors. In selecting your color scheme, remember that color loves company. Putting complementary colors side by side makes each color appear stronger and brighter.

Paint is not the only source of color. Everything in a room has color — either natural color or applied color. In selecting a color scheme, collect color samples of wallpaper, paint, upholstery, wainscoting, and floor finish. Include every color you intend to use.

Do not expect to obtain successful results in color by an exact adherance to color charts or wheels. There can be no hard and fast rules for securing sensitive color combinations. Your first problem in using color is to develop a "color sense." This will come as you acquire familiarity with various colors through actual use. As you use colors, you will notice how they change in character and appearance as they are employed in different combinations.

In selecting colors, pick out the ones that seem to you to best represent the mood or atmosphere that you wish to express. Consider them carefully. Take your time. If they still look good after you have considered them for a few days, go ahead.

Glossary

For your use, various terms referred to in painting are defined in the balance of this text. Because the primary purpose is to define terms rather than words, the definitions are arranged alphabetically according to the first word of the term.

acid number A value obtained in analysis of oils and fats; it is the number of milligrams of potassium hydroxide required to neutralize the free fatty acid in a gram of the substance.

alkali-refined oil A drying oil refined with alkali to reduce its acid number.

alkyd resin One of a group of synthetic resins made by reacting polyhydric alcohols, such as glycerin and the glycols, with dibasic organic acids, such as phthaltic, maleic, succinic, and sebacic acids. A modifying agent is generally present to impart certain properties. Some of these agents are drying, semidrying, and nondrying oils; fatty acids of the oils; natural resins such as rosin; synthetic resins; and other substances. An average alkyd resin may contain, by weight, about 50 per cent of modifier such as linseed oil fatty acids, 30 per cent of dibasic acid, and 20 per cent of polyhydric alcohol (see glyceryl phthalate).

antifoaming agent A substance added to latex paint to reduce its tendency to foam. Also called defoamer.

binder The nonvolatile portion of a paint vehicle.

bleeding The effect when coloring material from either the wood or an undercoat works up into succeeding coats and imparts to them a certain amount of color.

blistering Forming of bubbles on the surface of paint film. Blistering is caused by gas or liquid pressure behind the film.

bloom Haze or bluish-white clouded effect that appears on the surface of dried enamel or varnish and affects the gloss of the film. Bloom is caused by dampness or frost, by too much drier in the varnish, and sometimes by ammonia or coal gas fumes.

bodied linseed oil Linseed oil that has been thickened by heat treating or blowing, thus increasing the body or consistency. It may be obtained in various degrees of body or viscosity.

body coat Intermediate coat of paint between the priming, or first, coat and the finishing, or last, coat.

boiled linseed oil Raw linseed oil that has been heated in the presence of metallic drying compounds.

boot-topping paint A water- and weather-resistant marine paint used on the boot-topping area of vessels. The boot-topping area is the area on the exterior of the vessel that extends from the light-load water line to 6 inches above the full-load water line.

broken color A color changed by the addition of black, white, or gray.

calcimine A wash consisting of a mixture of whiting, glue, china clay, and water.

colorant A dye or pigment which gives color to a material.

chalking A phenomenon of paint coatings manifested by loose pigment in the form of powder coming from the film itself. After several years of moderate chalking, the thickness of the paint film is reduced and the surface is in good condition for repainting.

chroma See INTENSITY.

consistency Relative firmness, limpidity, body, or restistance to agitation or deformation of a coating material in bulk.

copals A group of resinous substances that exude or have exuded from various tropical trees. Copal is collected from living trees or is dug from the ground as a fossil. The main sources are East India, New Zealand, and Africa. Some of the resins are amber, congo, kauri, manila, pontianak, West India gum, and Zanzibar.

crazing A type of paint failure consisting of minute interlacing cracks on the surface of a finish. Crazing is caused by unequal contraction while drying.

cut The dispersion of a certain number of pounds of shellac or resin per gallon of volatile liquid. For example, a 4-pound cut of shellac varnish contains 4 pounds of dry shellac and 1 gallon of alcohol.

dispersing agent A substance added to latex paint which helps the vehicle to wet the pigment particles.

dominant hue (or value) The value which is most conspicuous in the range of values of any single color.

drier A composition that accelerates the drying of oil, paint, or varnish. Driers, usually compounds of metals, are available in solid, paste, and liquid form.

drying oil An oil which possesses to a marked degree the property of readily taking up oxygen from the air and thereby chang-

ing to a relatively hard, tough, elastic substance when exposed in a thin film to the air.

earth colors Colors of pigments which were originally obtained from natural deposits of colored earth.

efflorescence A white powdery substance exuding from brick walls and similar masonry surfaces. Efflorescence should be removed before the surface is painted.

emulsifier, or emulsifying agent A substance of such chemical nature that it intimately mixes and disperses dissimilar materials ordinarily incapable of being mixed, such as oil and water, to produce a stable finished emulsion. The emulsifier has the double task of promoting the emulsification and stabilizing the finished product.

enamel A paint that employs varnish instead of oil as a vehicle; a pigmented varnish that is characterized by its ability to dry to an especially smooth, hard, glossy, or semiglossy finish.

film integrity The serviceability of a paint coating against cracking, slitting, flaking, and scaling of the film or discontinuities in the film that lay bare the underlying surface.

filmogens Film-forming materials such as linseed oil and varnish resins.

flake white Pure carbonate of lead (white lead) pigment of very fine texture.

foots Slimy mucilaginous matter that separates from some oils when they stand for a long period of time.

form lacquer Thin varnish or lacquer used to coat concrete forms to prevent the concrete from adhering to the forms.

fungicide A chemical added to paint in very small quantities to prevent the minute fungus growth called mildew.

garnet paper An abrasive sheet similar to sandpaper, except that the garnet sand used for making it is the same red mineral that is used for jewelry but of more impure form and usually dark claret in color.

glazing Operation of setting window glass with putty. Also, the process of obtaining antique decorative effects on walls by the application of translucent pigment colors-in-oil, such as sienna, umber, and Vandyke brown, thinned with flatting oil.

gloss (luster, sheen) The property by which a surface reflects light. Painters use the terms high, enamel, or mirror to indicate the highest gloss or luster, and semigloss, eggshell, and flat to indicate decreasing degrees of gloss in the order given.

glyceryl phthalate resin (alkyd) A synthetic resin of the alkyd group, used principally in paints, varnishes, and lacquers, and sometimes called phthalic alkyd resin. It is made by reacting glycerin and phthalic anhydride.

gum A viscous vegetable secretion that hardens but, unlike resin, is water-soluble. The name is often applied in the varnish industry to natural resins, as, for example, kauri gum. A more appropriate term is "gum resin."

hiding power The power of a paint or paint material to obscure the surface to which it is applied. In Federal specifications this property is expressed in terms of square feet per gallon.

intensity The intensity of a color, sometimes called its chroma, denotes the strength of the color. A primary color without the addition of another color is said to be of full intensity.

ivory black A black pigment made from the charring of ivory chips.

lacquer—A cellulose coating that dries rapidly by solvent evaporation. Lacquers are either transparent or pigmented and are used for both exterior and interior finishes.

lamp black A black pigment obtained from the soot resulting from burning resinous wood, tar, or pitch. It is composed almost entirely of carbon.

mil A unit of thickness, equal to 1/1000 inch, used to measure the thickness of paint coats.

nonvolatile vehicle Liquid portion of paint with the exception of volatile thinner and water.

oil length of varnish The number of gallons of drying oil with which 100 pounds of resin, or gum, is heated.

oil varnish Varnish that contains resin and drying oil as the basic film-forming ingredients and is converted to a solid film primarily by chemical reaction.

opaque color A pigment which causes the paint to hide the surface to which it is applied.

paint A mixture of pigment with vehicle intended to be spread in thin coats for decoration, protection, or both.

pastel tints Any of various pale colors of high brilliance and low or medium intensity.

pigment Fine solid particles that are used in the preparation of paint and are substantially insoluble in the vehicle.

pigment volume The percentage by volume of pigment in the nonvolatile portion of a paint as calculated from bulking value and composition data. The letters PV are commonly used as an abbreviation.

plasticizer An ingredient added to a paint or lacquer to increase the toughness and elasticity of the film.

plastic wood A mixture designed for the repair of woodwork. It consists of wood flour, resins, volatile solvents, and plastic binding material such as cellulose nitrate.

polymerization A reaction in which two or more molecules of the same substance combine to form a product of higher molecular weight without changing the chemical composition of the original material. In the protective-coating field the term is applied to various materials including drying oils, such as linseed oil and tung oil, and resins, such as rosin. In most varnishes, the oil is polymerized by careful heating. The presence of phenolic resin along with the oil, during the varnish cooking, greatly accelerates polymerization. Such varnishes dry largely by polymerization rather than by oxidation. Varnish films produced mainly by polymerization are characterized by improved water resistance and resistance to sunlight and weathering. A tung-oil, pure phenolic-resin spar varnish is a good example.

primer The paint or analogous substance applied next to the surface of the material being painted; a paint used for a first coat.

prismatic colors One of the colors produced when a ray of light is passed through a prism.

putty A kind of cement used for fastening glass in sashes, stopping crevices, and similar purposes.

resin A semisolid, or solid, complex amorphous mixture of organic compounds with no definite melting point, insoluble in water. Resins are usually either partly soluble in alcohols, ethers, and other organic solvents or can be made so by heating. On heating, resins soften, melt, and burn with a smoky flame.

rosin The solid resin obtained as the residue from the preparation of turpentine from the crude resin of the pine tree.

saponify To convert a fat or oil into soap by the action of an alkali. When esters are boiled with strong bases, soaps are formed. Linseed oil contains the glyceryl ester of linoleic acid. Thus, when a linseed-oil paint comes in contact with a surface that contains strong alkali and water, such as a damp concrete basement floor, the oil is saponified and thus loses its bonding properties.

sealer (size) A transparent liquid, such as varnish, that also contains pigment for sealing porous surfaces, especially plaster, preparatory to application of finish coats.

shade A color to which black has been added.

shellac A spirit varnish made by distilling gum lac in alcohol. Shellac is obtainable in two forms, orange and white.

spackle A putty-like material used for filling cracks and holes in plaster, and sometimes in wood, to prepare a smooth surface for further finishing. Unlike putties, spackling compounds are mixed with water and harden rapidly.

spar varnish A durable, water-resistant varnish especially adapted for severe service on exterior exposure. It consists of one or more drying oils, for example, linseed, tung, or dehydrated castor; one or more resins, for example, rosin, ester gum, 100 per cent phenolic resin, or modified phenolic resin; one or more volatile thinners, for example, turpentine, or petroleum spirits; and driers, for example, linoleates, resinates, or naphthanates of lead, manganese, and cobalt. It is classed as long-oil varnish (see "oil length of varnish") and generally consists of 45 to 50 gallons of oil to each 100 pounds of resin.

spirit varnish A varnish which is converted to a solid film by solvent evaporation. Damar varnish and shellac varnish are spirit varnishes.

spreading rate The amount of surface or area over which a given volume of paint can be spread by brushing, spraying, or rolling. It is usually expressed in square feet covered per gallon.

thixotropic paint A gel-like paint that becomes fluid when shaken, stirred, or otherwise manipulated. The change is reversible. Thixotropic paint is used particularly as an interior flat wall paint. Many paints of this type possess marked rigidity, like the texture of whipped cream, when not disturbed but become highly fluid when stirred and remain so for an appreciable time. After cessation of a mechanical disturbance, such as stirring the paint or putting a brush into it, rigidity slowly develops again. The thixotropic property is of practical significance as regards storage, application, and film properties of the paint.

tint A color to which white has been added.

titanox The trade name for titanium dioxide, a white paint pigment.

transparent color A pigment that does not hide the surface on which it is used.

trim enamel paint A subdivision of surface coatings that are known as house paints but differ from ordinary house paint body colors by faster drying, having more gloss, and showing fewer brush marks. This type of paint is principally designed for use on trim, screens, and shutters.

varnish A homogeneous liquid generally composed of resin, drying oil, volatile thinner, and drier. When applied in a thin layer and exposed to air, it is converted to a hard transparent or translucent film.

vehicle The liquid portion of a paint.

viscosity Internal friction of a fluid; resistance to flow; opposite of fluidity. For example, linseed oil is more viscous than turpentine; bodied linseed oil is more viscous than raw linseed oil. An important physical property of oil, varnish, and lacquer.

volatile thinner The liquid portion of a paint, except water, which is volatile in a current of steam at atmospheric pressure.

zinc oxide, leaded zinc oxide White pigments that differ in lead content. Zinc oxide contains practically no lead; leaded zinc oxide is produced from impure ores and may contain from 7 to 40 per cent of material other than zinc oxide. Leaded zinc oxide is really a mixture of zinc oxide and basic sulfate white lead.

Painting

Serial 6227C PART 3 Edition 1

Examination Questions

Notice to Students.—Study this instruction text thoroughly before you answer the following questions. Read each question carefully and be sure you understand it; then write the best answer you can. You will profit most if you answer the questions in your own words. When you complete your work, examine it closely, correct all the errors you can find, and see that every question is answered; then mail your work to us. DO NOT HOLD IT until another examination is ready.

1. Explain briefly the following terms: tint, hue, chroma, value, shade, split complement, soft color, primary, secondary.

2. What value of color would you use to make a high ceiling seem lower?

3. Before final selection of a color, how should the color be viewed?

4. What pigment colors would you mix together to produce
   a) a green hue?
   b) an orange hue?

5. You are required to select the colors for a large living room. Explain briefly the colors that you would use for
   a) a monochromatic color scheme.
   b) an analogous color scheme.
   c) a complementary color scheme.
   d) a color triad scheme.

6. Explain the difference between a neutral gray and a color gray.

7. With regard to intensity, what kind of colors are generally best for backgrounds?

8. *a*) List two advancing colors.
   b) List two receding colors.
   c) You are required to select the colors for the auditorium of a small church. What colors would you use to make the auditorium appear larger?

9. *a*) Which color is the most exciting?
   b) Which color is the most cheerful?

10. *a*) How do colors appear when viewed under bright sunlight?
    b) How do colors appear when viewed under incandescent light?
    c) How do colors appear when viewed under fluorescent light?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