Color

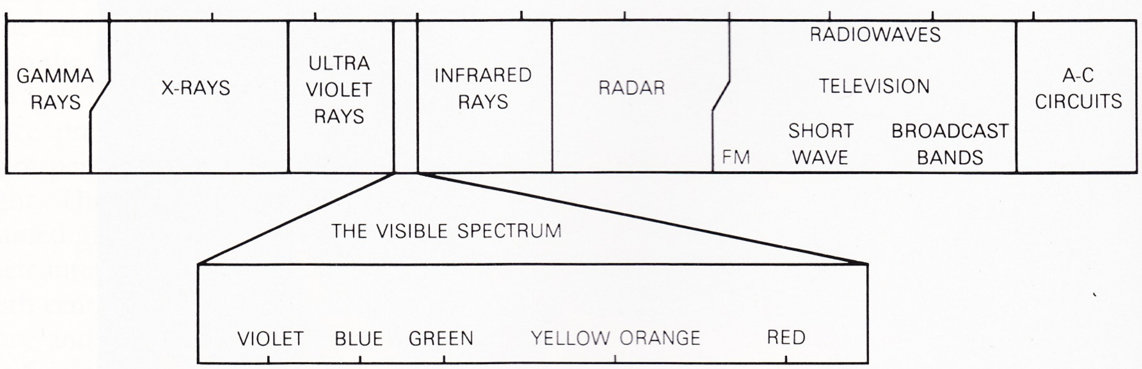
Color affects our emotions directly, modifying our thoughts, moods, actions, and even our health. Some painters of the past found color so dominating that they avoided pure unmixed colors to enable viewers to see the essence of the subject without being distracted. Early in the twentieth century, pure bright colors were used very little in everyday life in the United States. The French Impressionist painters and their followers led the way to the free use of color we enjoy today.

The Hindus, Greeks, Chinese, and certain American Indian tribes are known to have used colors for symbolic purposes. Each culture makes these associations in its own way. The Italian artist Leonardo da Vinci wrote, "We shall set down white for the representative of light, without which no color can be seen; yellow for earth; green for water; blue for air; red for fire; and black for total darkness."[5]

Evidently the human ability to see color continues to expand. Some scholars believe humans have only recently—that is, within the last two thousand years—developed the ability to see hues with the shortest wavelengths, like blue, indigo, and violet. The ancient Greek philosopher Aristotle (384–322 B.C.) named only three colors in the rainbow: red, yellow, and green.

When white light passes through a glass prism it is separated into the bands of color that make up the *visible spectrum*. Because each color has a different wavelength, each travels through the glass of the prism at a different speed. Red, which has the longest wavelength, travels more rapidly through the glass than blue, which has a shorter wavelength. Rainbows result when sunlight is refracted and dispersed by the spherical form of raindrops, producing a combined effect like the glass prism. In both cases the sequence of spectral colors is red, orange, yellow, green, blue, indigo, and violet.

Our common experience with color is pro-



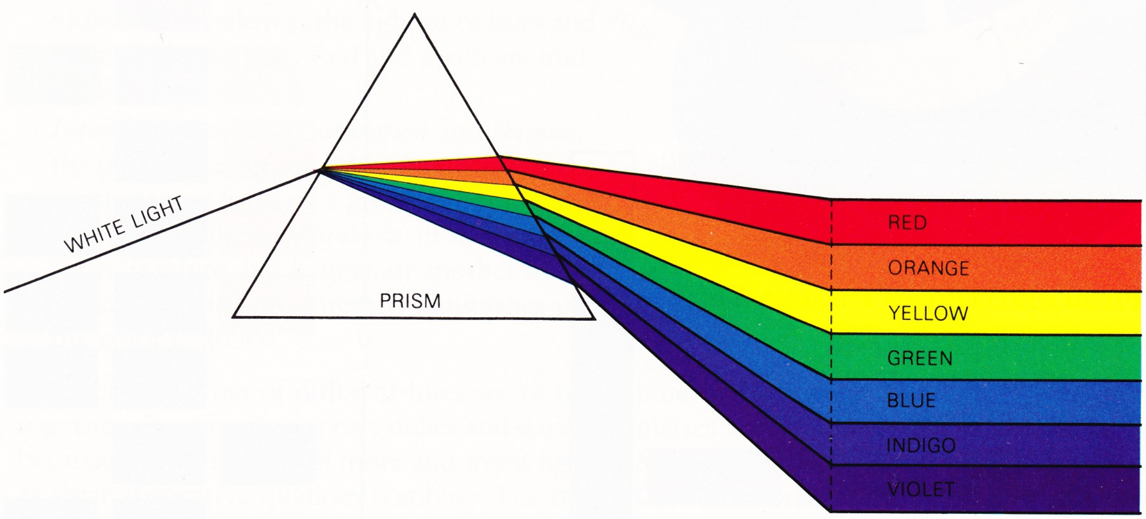
59 ELECTROMAGNETIC SPECTRUM.

vided by reflective surfaces, not by prismatic light. Therefore we shall look at color in terms of reflective surfaces and the changes on these surfaces caused by pigments and the light that illuminates them.

What we call "color" is the effect on our eyes of light waves of differing wavelengths or frequencies. Color is a property of light. The paradox of color is that, while it exists only in light, light itself seems colorless to the human eye. All objects that appear to have color are merely reflectors or transmitters of the color that must be present in the light that illuminates them.

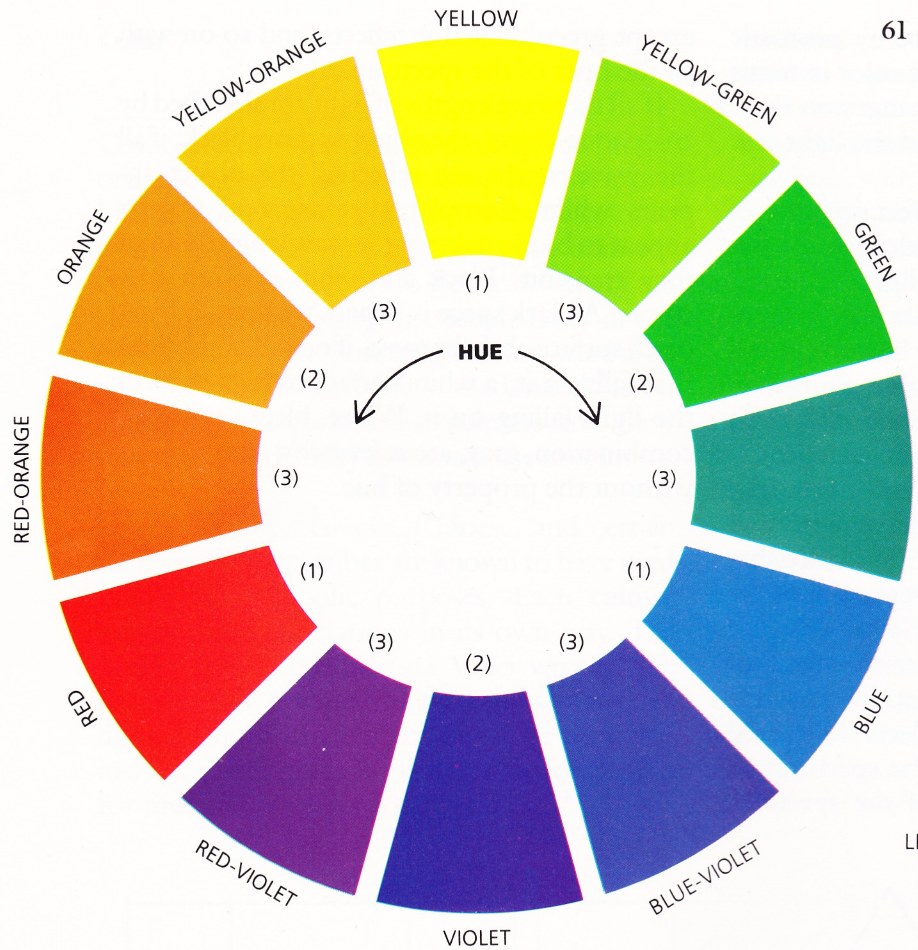
When light illuminates an object, some of the light is absorbed by the surface of the object and some is reflected or transmitted. The color that appears to our eyes as the apparent color of the object (called *object color* or *local color*) is determined by the wavelength or frequency of light being reflected. Thus a red surface in white light appears red because it reflects mostly red light and absorbs the rest of the spectrum. A green surface absorbs most of the spectrum except green, which it reflects, and so on with all the hues of the spectrum.

If all the wavelengths of light are absorbed by an opaque object, the object appears black; if all the wavelengths are reflected, the object appears white. Completely transparent objects appear to be the color of the wavelength of light they transmit. Black and white are not true colors. A black space is a space without light. A black surface absorbs most, if not all of the light that falls on it; a white surface reflects most of the light falling on it. White, black, and their combination, gray, are *achromatic,* or *neutral*—without the property of hue.



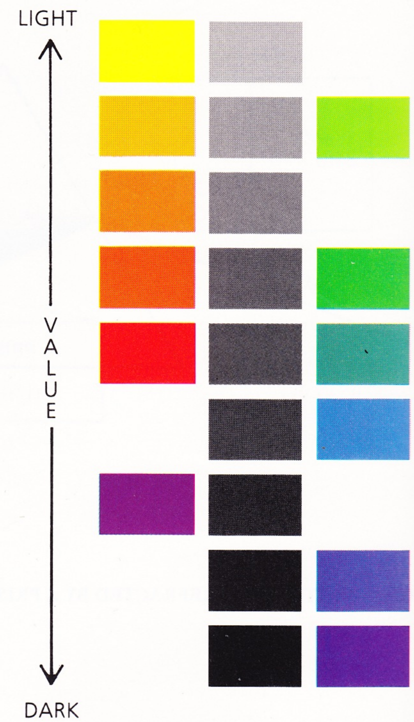
60 WHITE LIGHT REFRACTED BY A PRISM.

61 THE THREE DIMENSIONS OF COLOR.

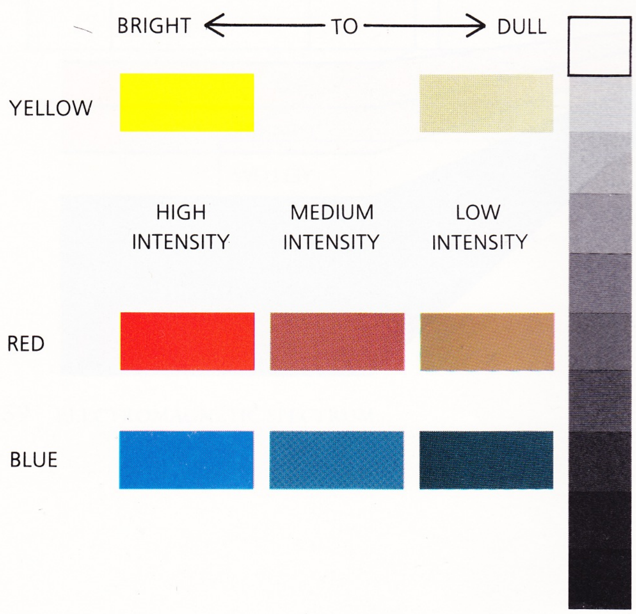


COLOR WHEEL (HUE)

VALUE OF EACH HUE



INTENSITY SCALE



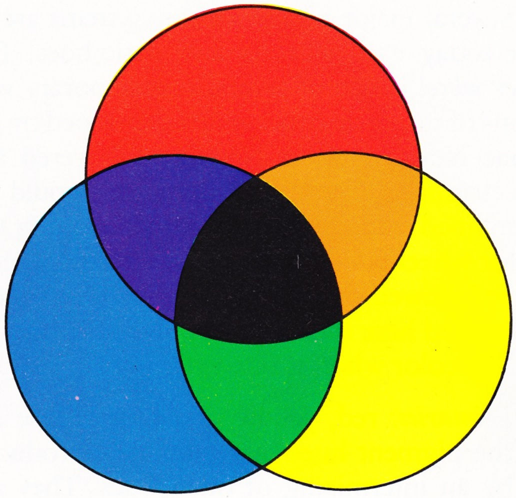
Color has three major dimensions: hue, value, and intensity.

- □ *Hue*: the particular wavelength of spectrum color to which we give a name (see the prism diagram, page 65). Hue is what we commonly call color. Spectrum-intensity red is spoken of as the hue red, as distinguished from the hue orange, its neighbor on the spectrum, and so forth.
- □ *Value*: the relative lightness or darkness of a color (see the value scale, page 59). Black and white pigments can be important ingredients in changing color values. Black added to a hue produces *shades* of that hue. For example, when black is added to orange, the result is a brown; and when black is mixed with yellow the resulting dark yellow has a greenish cast due to the imperfect nature of pigment blacks. White added to a hue produces a *tint*. Lavender is a tint of violet. Pink is a tint of red.

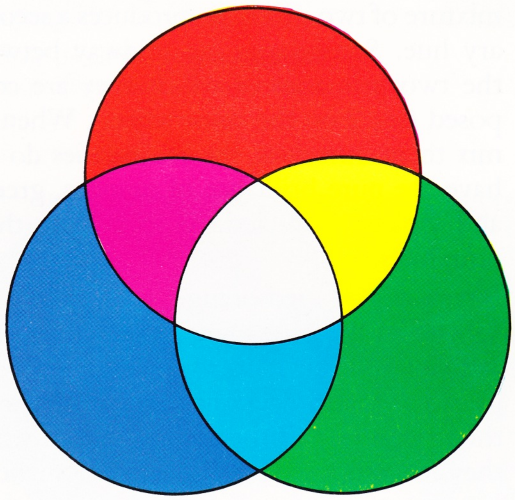
  Hues in their purest form are also at their normal value. For example, the value of pure yellow is much lighter than the value of pure violet. Pure yellow is the lightest of hues and violet is the darkest. Red and green are middle value hues.
- □ *Intensity* (also called *saturation* and *chroma*): the purity of a hue, or color. A pure hue is the most intense form of a given color; it is the hue at its highest saturation, in its brightest form. If white, black, gray, or another hue is added to a pure hue, intensity diminishes and the color is dulled.

When pigments of different hues are mixed together, the mixture appears duller and darker because pigments absorb more and more light as their absorptive qualities combine. For this reason pigment mixture is called *subtractive color mixture*. Mixing red, blue, and yellow will produce a dark gray, almost black, depending on the proportions and the type of pigment used.

Most people are familiar with the three pigment primaries: red, yellow, and blue. There are also three light primaries: red, green, and blue or blue-violet. When the three light primaries are combined, the result is white light. Such a mixture is called *additive color mixture*. Combinations of these light primaries produce lighter colors. Red and green light when mixed make yellow light, and so forth. Color television employs additive color mixture. A working knowledge of the character and mixing properties of light colors is essential to anyone working with light as an art form.



62 PIGMENT PRIMARIES: SUBTRACTIVE COLOR MIXTURE.



63 LIGHT PRIMARIES: ADDITIVE COLOR MIXTURE.

Several major pigment color systems are in use today, each with its own basic hues. The *color wheel* is one of several contemporary versions of the circle concept first developed by Sir Isaac Newton. After Newton discovered the spectrum, he found that both ends could be combined into the hue red-violet, making the color wheel possible. Numerous color systems have followed since that time. The color system presented here is based on twelve pure hues.

The color wheel is divided into:

- □ *Primaries:* red, yellow, and blue. These are the pigment hues that cannot be produced by an intermixing of other hues. They are also referred to as primary colors (see 1 on the color wheel on page 66).
- □ *Secondaries:* orange, green, and violet. The mixture of two primaries produces a secondary hue. Secondaries are midway between the two primaries of which they are composed (see 2 on the color wheel). When we mix them ourselves, the secondaries do not have the pure brilliance of oranges, greens, and violets manufactured to achieve those pure hues.
- □ *Intermediates:* red-orange, yellow-orange, yellow-green, blue-green, blue-violet, and red-violet. Their names indicate their components. Intermediates are located between the primaries and the secondaries of which they are composed (see 3 on the color wheel).

The blue-green side of the wheel is called *cool* in visual temperature, and the red-orange side is called *warm.* Yellow-green and red-violet are the poles dividing the color wheel into warm and cool hues. The difference between warm and cool colors is partly due to association. Relative warm and cool qualities can be seen in any combination of hues. A room painted a warm color becomes warm psychologically. Color affects our feelings about size as well as temperature. Cool colors appear to recede and warm colors appear to advance.

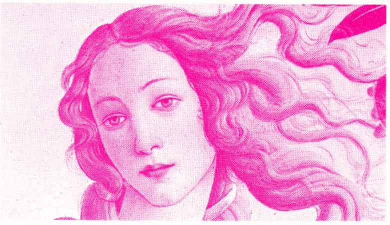
Malevich's WHITE ON WHITE (see page 61) is based on a subtle warm/cool difference. The diagonally placed square is painted a cool blue-white, which sets it apart from the warm yellow-white background.

Color sensations more vibrant than those achieved with actual pigment mixture are obtained when dots of pure color are placed together so that they blend in the eye, creating the appearance of other hues. This is called *optical color mixture.* For example, rich greens appear when many tiny dots or strokes of yellow-green and blue-green are placed close together.

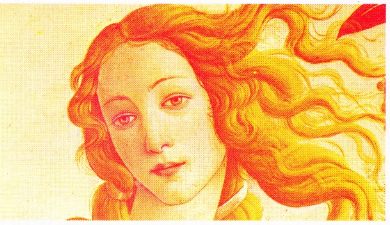
This concept was developed in the 1880s by painter Georges Seurat as a result of his studies of Impressionist painting and scientific theories of light and color. His method, divisionism, popularly called *pointillism,* is related to the development of modern four-color printing in which tiny dots of printers' primaries—magenta (a red), yellow, and cyan (turquoise blue)—are printed together in various amounts with black on white paper to achieve the effect of full color. Seurat, however, used no black. Compare the detail of Seurat's SUNDAY AFTERNOON ON THE ISLAND OF LA GRANDE JATTE with the color separations and the enlarged detail of the reproduction of Botticelli's BIRTH OF VENUS (see the complete paintings on pages 332 and 300).

64 COLOR PRINTING.

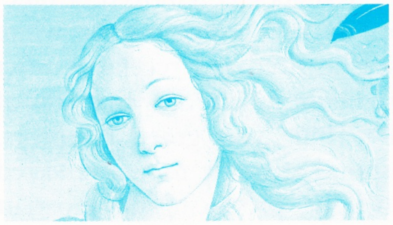
a Yellow.



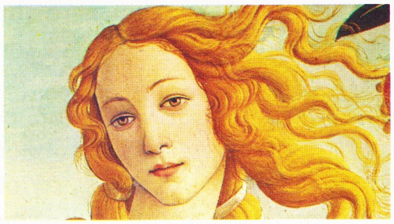
b Magenta.



c Yellow and magenta.

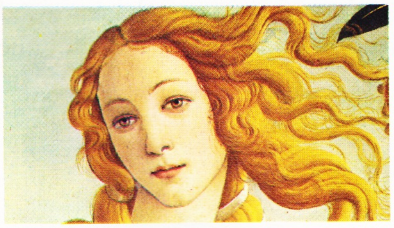


d Cyan.

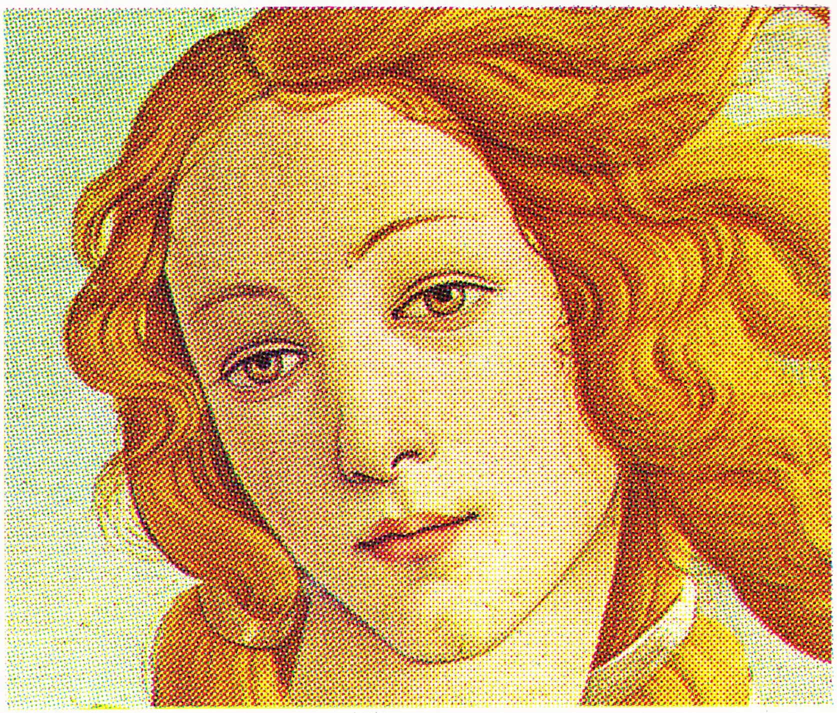


e Yellow, magenta, and cyan.

f Black.



g Yellow, magenta, cyan, and black.



h Color printing detail showing mechanical dot pattern of offset photo-lithography.

65 OPTICAL COLOR MIXTURE.
Detail showing divisionist technique developed by Seurat.
(See complete painting on page 332.)

Color groupings that provide certain kinds of color harmonies are called *color schemes*. The most common of these are:

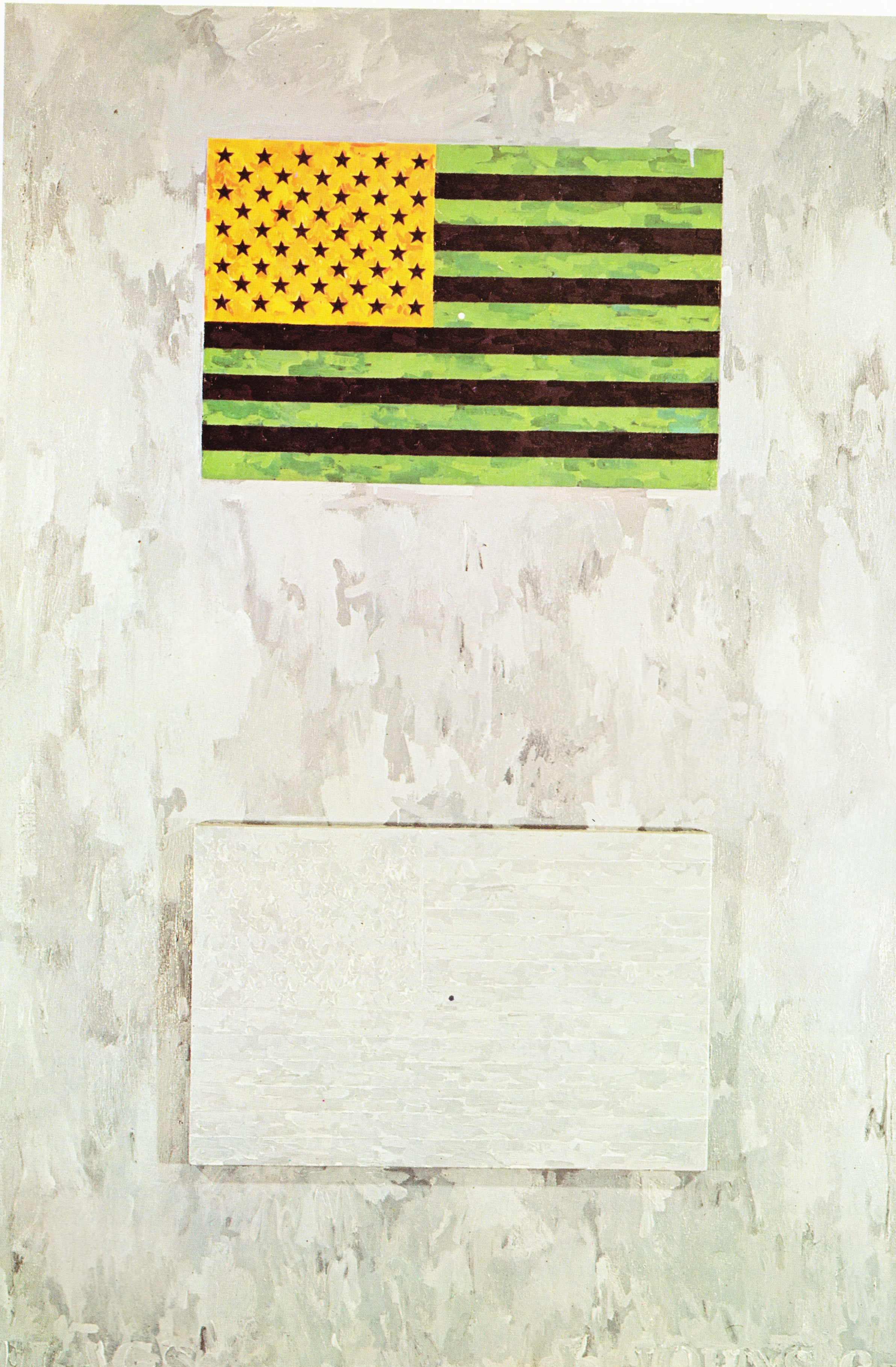
- *Monochromatic:* variations on one hue only. In this color scheme a pure hue is used alone with black and/or white or mixed with black and/or white. The hue can be combined with varying amounts of white (tints) or varying amounts of black (shades). The result is a monochromatic scheme based on that hue. For example, a scheme based on red (pure hue) with pink (tint of red) and maroon (shade of red) would be called monochromatic. Victor Vasarely's untitled screen print (see page 150) is a monochromatic work that employs a pure blue and its tints and shades.
- *Analogous:* hues adjacent to one another on the color wheel, each containing the same hue—for example, yellow-green, green, and blue-green, which all contain the hue green. Analogous color is used in Ben Cunningham's CORNER PAINTING (see page 407). Tints and shades of each analogous hue may be used to add variations to this color scheme.
- *Complementary:* two hues directly opposite one another on the color wheel. When mixed together in almost equal amounts, complementary hues form neutrals or grays; but when placed side by side as pure hues, they contrast strongly, and intensify each other. Because they can be identical in value, the complementary hues red-orange and blue-green tend to "vibrate" more when placed next to each other than do other complements. The complements yellow and violet provide the strongest value contrasts possible with pure hues. The complement of a primary is the opposite secondary, which can be obtained by mixing the other two primaries. For example, the complement of yellow is violet. The complementary hues blue-green and red-orange are used in the child's painting TREE, on page 24.
- *Polychromatic:* use of many hues and their variations. When painters choose their palettes, they visualize color combinations in terms of their familiarity with certain available pigment colors. Most artists work intuitively when determining color choices for a particular composition.

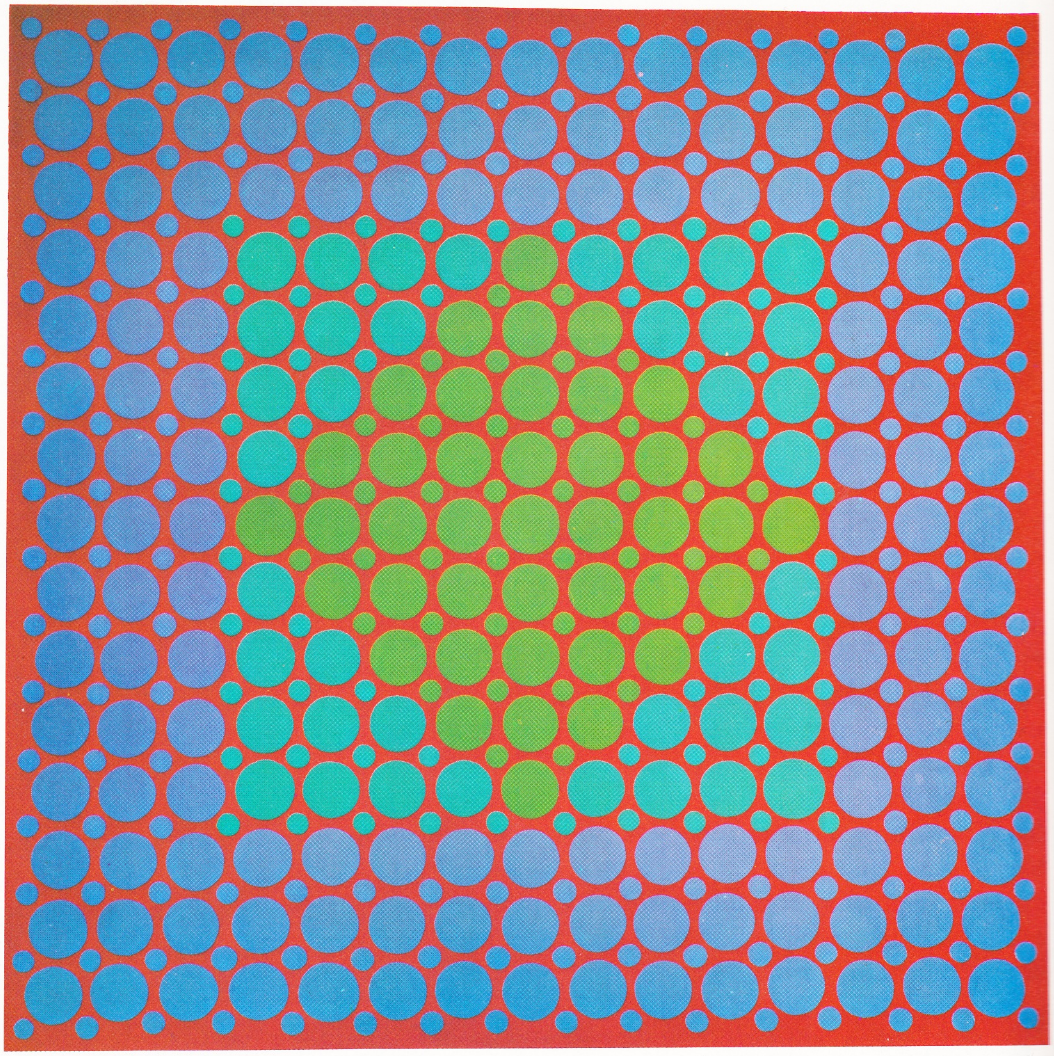
An *afterimage* appears to the eye when prolonged exposure to a visual form causes excitation and subsequent fatigue of the retina. Color afterimages are caused by partial color blindness temporarily induced in the normal eye by desensitizing some of its color receptors. For example, staring at a red spot for thirty seconds under a bright white light will tire the red receptors in that segment of the retina on which the red spot is focused and make them less sensitive to red light, or partially red-blind. Thus, when the red spot is removed, a blue-green spot appears to the eye on the white surface because the tired red receptors react weakly to the red light reflected by that area of the surface. The blue and green receptors, meanwhile, respond strongly to the reflected blue and green light, producing an apparent blue-green dot that is not actually present on the surface. On a neutral surface, therefore, the hue of the afterimage is complementary to the hue of the image or stimulus.

A more complex example of this phenomenon can be experienced by staring for about thirty seconds at the white dot in the center of the flag at the top of Jasper Johns's painting FLAGS, then looking down at the black dot in the gray flag below.

The appearance of a given color in objects around us is always relative to adjacent colors and light conditions. A hue can appear to change as colors around it change. In INJURED BY GREEN (page 72), Richard Anuszkiewicz painted a uniform pattern of dots in two sizes. Behind these, the red-orange background appears to change, but it is the same hue throughout.

66 Jasper Johns.
FLAGS. 1965.
Oil on canvas with raised canvas.
72″ x 48″.
Private collection.


FLAGS
J. JOHNS 65



67 Richard Anuszkiewicz.
INJURED BY GREEN. 1963.
Acrylic on board. 36″ x 36″.
Collection of Janet S. Fleisher, Philadelphia.

Intensity builds from the outer edges of the painting toward the center, where we are "injured"—or temporarily color-blinded—by a diamond-shaped area containing yellow-green dots of the same value as the red background, which are surrounded by a square of blue-green dots. These two hues are on either side of green on the color wheel—and green is the complement of red. The yellow-green and blue-green form the split complements of red. Anuszkiewicz used split complements of matching value to give this central area its pulsing energy.

My work is of an experimental nature and has centered on an investigation into the effects of complementary colors of full intensity when juxtaposed and the optical changes that occur as a result.

Anuszkiewicz[6]

Surface color is modified by its association with surrounding colors and by such factors as intensity, angle, and warm or cool properties of the light. As light decreases, individual colors become less distinct. In bright light, colors reflect on one another, causing changes in the appearance of local color. In his painting THE BREAKFAST ROOM Pierre Bonnard emphasized these shifts in local color and added many personal poetic color relationships of his own invention.

68 Pierre Bonnard.
THE BREAKFAST ROOM. c. 1930–1931.
Oil on canvas. $62^{7}/_{8}$″ x $44^{7}/_{8}$″.
The Museum of Modern Art, New York.
Anonymous gift.


Bonnard

Color is central to Bonnard's art. He began with a somewhat ordinary scene and intensified its effect on us by concentrating on the magical qualities of light and color on a sunny day. The painting portrays Bonnard's feelings about the mood of that day, using color that could not have been recorded with a camera.

Bonnard's color is the result of a personal search. During the 1890s he worked with subdued color. About 1900 he began to use brighter colors in what he described as a personal version of Impressionism. As his color sense matured, his paintings became filled with rich harmonies of warm and cool colors, subtly played off against each other. In these paintings the surfaces seem to shimmer with a light of their own.

69 Meret Oppenheim.
OBJECT. 1936.
Fur-covered cup, saucer, and spoon.
Cup, diameter 4 3/8";
saucer, diameter 9 3/8";
spoon, length 8".
The Museum of Modern Art, New York. Purchase.

Texture

Texture refers to the tactile qualities of surfaces, or to the visual representation of such surface qualities. Texture may be experienced by touching, or through suggestion by sight alone. All surfaces have texture. Sculptors and architects, who work with three-dimensional materials, work with the inherent textures of their materials and can also create textures by the way they develop surfaces. Printmakers, painters, and other artists working on flat surfaces use the textures of their materials and may also simulate or visually suggest textures that cannot be experienced through touch. Such textures can be referred to as ***visual, simulated,*** or ***implied***. Sometimes actual (tactile) and implied (visual) textures are combined in a single work of art.

The notorious fur-lined teacup was constructed in 1935 by Meret Oppenheim. She presented an intentionally contradictory object designed to evoke strong responses ranging from revulsion to amusement. The actual texture of fur is pleasant, as is the smooth texture of a teacup, but the combination makes the tongue "crawl." Social and psychological implications are abundant and intended.

Used expressively, texture adds an important dimension to our sensory experience. Compare the eroding surfaces of Alberto Giacometti's figure on page 77 with the youthful skinlike textures of the figures in Rodin's THE KISS (see page 42), which in itself has strong textural contrast. Each artist used texture to heighten emotional impact.

In Le Corbusier's chapel at Ronchamp, NOTRE-DAME-DU-HAUT, rough and smooth concrete and wooden furnishings are contrasted to produce textural variations (see page 388). In contrast, buildings like Lever House