THE USE OF BROKEN COLOR IN SCENIC DESIGN

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INTRODUCTION

The perceptive inventiveness generally ascribed to the painter can in no less way be assigned to the scenic designer. As the painter strives for a composition, working with color and light, emotional and intellectual responses and the illusions of the visual world, so too does the scenic designer. The designer's realm is one of continual change. Actors move in and through his composition changing the focus of attention and the balance of the stage, arbitrary lighting becomes a part of the illusion of color, form, space and time - all before the eyes of the audience. His design must be a working partner with the action of the play, yet in this role, it has the opportunity to be a vehicle of creative expression.

This writer as a novice, confronted with the problem of stage painting and designing, explored various techniques in search of those that would be most practical and satisfying to his method of expression. One which developed into general use was the application of paint with a natural sponge. Another was the large brush manipulated to throw or spatter the paint onto a surface. The handling of these tools, and the marks left by them, led rather naturally into the use of color and pigment in much the same manner developed in Impressionist and Neo-impressionist paintings.

The intent of this paper is to investigate to what extent the ideas and principles of broken color, as embodied in the Impressionist and the Neo-impressionist movements and as studied

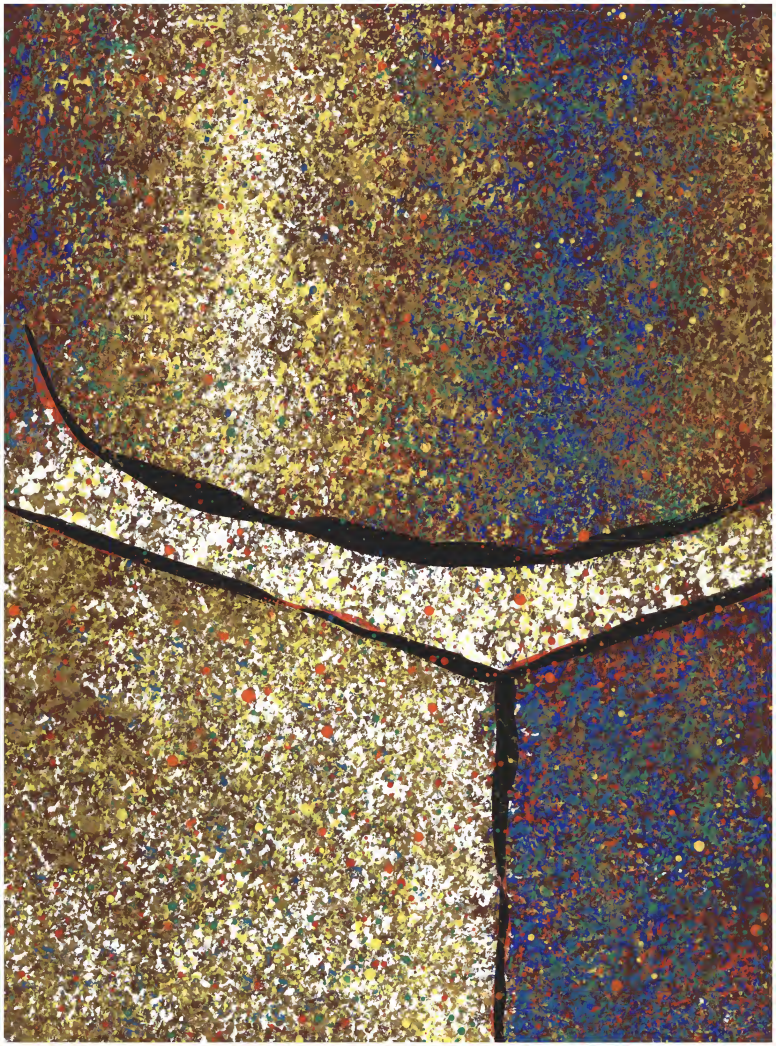
both physically and physiologically since then, might be applied to stage painting and design.

In the same manner that these movements in art were marriages of the intuitive workings of the painter and the objective observations of the scientist, so too must any attempt to use broken color on stage have the ingredients of both. In terms of human perception, light and color are relative as is the action on stage. If presented in a manner which possesses tonality, both may have great latitude and still be acceptable as plausible and as an art form to the audience. Therefore, this paper while dealing with the more technical aspects of broken color, recognizes that point where objective knowledge ends and the intuitions of the artist as a painter or scenic designer must begin.

PLATE I

Broken Color

Broken color is the juxtaposition of small areas of color, which when viewed from an appropriate distance will mix optically by simultaneous contrast. The resultant tone will be different both in hue and in apparent intensity from the original colors.



THE DEVELOPMENT OF BROKEN COLOR IN PAINTING

The term broken color refers to the perceptual or optical mixing of color. The observer stationed at an appropriate distance will see separate small areas of color, which have been laid side by side, resolve into a vibrating and luminous tone that is different both in hue and intensity from the original colors. This is a physiological phenomenon rather than a physical fact as in the material mixing of pigments, and the effect can not be duplicated by the latter.

The development of broken color in painting is correlated with the concept of color as light and paintings as visual sensations, coupled with research into the physiological aspects of color. The use of this optical mixture, began intuitively with the artist, and broken color was simply a means of making colors vibrate and suggest movement of sunlight. Later, a few artists applied formulas, and for them, intuition was replaced with precise scientific reasoning.

Credit for the discovery of broken color cannot go to one individual alone. The Impressionist painters, as a very independent and loosely organized group, used it to brighten their palettes as they attempted to make their canvases a source of light itself. Others had used it in varying degrees before them, and later the Neo-Impressionists claimed Delacroix as their immediate precursor. Charles Blanc called attention to the work of Delacroix with these words, "slashing green lines upon pink torsos, which produce exactly the effect of what we now call the optical mix-

ture".[1]

The effect Delacroix had used instinctively, was noted and formulated in a scientific treatise by Chevreul in 1838. In his "law of simultaneous contrast of colors" he stated the two fold phenomenon; calling the modification of intensity of the colors "contrast of tone", and the modification of hue, "contrast of color".[2] This has also been called the "law of complementary colors", as indeed the effects noted were usually limited to these combinations.

Monet, one of the leaders of the Impressionism movement, made use of situations in his paintings that invited contrasts of complementary colors. Orange reflections of sunlight shimmer on top of blue water, and yellow roads, walls and faces change into violet as light moves into shadow.[3] Broken color was not just applied where nature was most obvious, but became a means of adding what Monet termed "plein-airism" or a brilliant atmospheric light that penetrated all parts of his picture. To capture faithfully this effect, as in his painting Bridge on the Seine at Argenteuil, (Plate II), he insisted on painting out of doors, breaking his areas into decisive daubs of bright color.

In the beginning, the nature of the movement was one of complete spontaneity. The vital reality was the immediate sensations of color and light and the continual flux of appearances. Tech-

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1 Maurice Raynal, History of Modern Painting from Baudelaire to Bonnard, p. 54
2 M.E. Chevreul, The Principles of Harmony and Contrast of Colors, p. 7
3 Jean Leymarie, Impressionism Vol. 2, p. 14

PLATE II

CLAUDE MONET

Bridge on the Seine at Argenteuil

nique and execution were intuitive reflexes and at once unified with the emotions. Its realism was subjective and its appeal primary, without complicated reasoning or intellectualism.

By the end of 1873, this freely exchanged approach was established in the palettes of Monet, Manet, Pissarro, Renior, Degas, Sisley, Cezanne and others. This group, with the exception of Manet, formed the Société anonyme artistes peintres, sculpteurs et graveurs in order that their work might be publicly seen. The year 1874 marks their first public exhibit and the coming of age of the movement. From this showing, the term "Impressionism" was coined in ridicule by a journalist to note the whole collection of meaningless daubs.[4]

The unifying force of their approach to painting, and their common rejection from the academic norms of the Salon, held the group together for rather a brief period of time. Then various key artists began to drift away from the original nucleus. Some sought recognition on their own and away from the rebel group. Others worked to solidify their personal concepts of Impressionism while still others explored different methods of pictorial building or expression.

One of the new directions taken was the application of scientific reasoning and analysis to the division of tones as practiced by the Impressionists. The new innovators recognized their heritage and designated their movement, "Neo-Impressionism". This direction was in keeping with the general philosophy and

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4 Raymond Cogniat, The Impressionists, p. 25

trend of the day; that of placing the practice of the arts on a scientific basis. As a forecast, David Sutter wrote in 1880,

> Rules do not hamper the spontaneity of invention or execution. Science delivers us from every form of uncertainty and enables us to move freely within a wide circle; it would be an insult both to art and to science to believe that one necessarily excludes the other.[5]

One who practiced this marriage of painting and science was Georges Seurat. His ambition was to replace the empirical approach of the Impressionists with a scientific method of rational expression of light in terms of pure color.[6] He gained many followers to his "Pointillism" or "Divisionism" approach with Signac and Cross committing themselves completely, while painters like Monet, Pissarro, Van Gogh and Matisse eventually rejected the method as contrary to their nature.

Seurat and Signac were influenced by the work of the physicists of the day and of their research in analysis of light and color and of their delvings into psychology and the physiological nature of vision. As mentioned before, Chevreul had published in 1838 his treatise On the Nature of Simultaneous Contrast, and later investigations by Hermann Helmoltz and N. O. Rood completed these experiments. These and other writings were studied by both painters. Signac confined his investigation to the phenomena of color, while Seurat was able to also synthesis geometry into his theories.[7]

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5 Jean Leymarie, Impressionism Vol. 2, p. 90
6 Ibid., p. 94
7 Maurice Raynal, History of Modern Painting from Baudelaire to Bonnard, p. 58

Primarily, the principles of Divisionism were based on this law of simultaneous contrast. The optical mixture of color was substituted for the physical mixture of pigments through the technique of laying down small dots or points of pure color side by side. The tone produced was more luminous and intense than the original colors, and the resulting hue was also found to be different as the juxtapositioned dots influenced one another.

Seurat summed up his theories this way in a letter to Maurice Beaubourd:

> Aesthetic. Art is harmony. Harmony implies an analogy of contraries, and also an analogy of similarities of tone, hue and line, disposed in relation to their dominants and under the influence of light, in gay, calm or sad combinations. The contraries are:
>
> For a tone, a more luminous or pale tone as against a darker.
>
> For the hue, the complementaries; as when a certain hue of red is opposed to its complementary colour (e.g. red-green; orange-blue; yellow-violet).
>
> For the line, lines forming a right angle.
>
> Gaiety of tone is given by the luminous dominant; of hue, by its warm dominant; of line, by lines ascending from the horizontal.
>
> Calm of tone is equality of dark and light; of hue, equality of warm and cool; of line, the horizontal line.
>
> Sadness of tone is given by the dark dominant; of hue, by the cool dominant; of line, by lines descending from the horizontal.
>
> Technique. In view of the phenomenon of the duration of a light-impression on the retina, a synthesis necessarily ensues. The means of expression if the optical mixture of the tones and hues (local colour and that resulting from illumination, by the sun, by an oil-lamp, by gas and so forth); that is to say, of light elements and their reactions (shadows), according to the laws of contrast, gradation, and irradiation.
>
> The frame should be in a harmony opposed to that of the tones, hues and lines of the picture.[8]

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8 Maurice Raynal, History of Modern Painting from Baudelaire to Bonnard, p. 54

PLATE III

GEORGES SEURAT

Sunday Afternoon on the Island of La Grande Jatte

HE ART INSTITUTE OF CHICAGO

HELEN BIRCH BARTLETT MEMORIAL COLLECTIO

It is also noted that Seurat limited his palette to Chevreul's circle of four fundamental colors and their immediate tones: blue, blue-violet, violet, violet-red, red, red-orange, orange, orange-yellow, yellow, yellow-green, green, green-blue and blue again. To these colors he would add white, but would not mix them among themselves.[9]

With this highly organized Divisionism, Seurat replaced the disorder of Impressionism. His execution became the methodical brushing of tiny dots which soon became known as "Pointillism". His painting A Sunday Afternoon on the Island of La Grande Jatte (Plate III) is a well known example of this method, and also indicates his competent handling of the architectural features of pictorial structure. Indeed, history has shown that this movement would have had less importance as art, and would have only been of scientific interest, had it not been that those involved were better artists than theorists.

Few accepted the Neo-Impressionist approach in its entirety, as its rigorous formula was not of their nature. The aftermath of the two movements was one of trends and counter-trends. The conflict that arose is still present with the painters of today. On the one hand is the subjective painter, with his intuitions as his only guide. On the other is the intellectualist who demands reasoning in his art expression. Significantly, today both are abstract in character and bear little resemblance to either movement.

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9 John Rewald, The History of Impressionism, p. 382

The legacy of broken color in contemporary painting is found in various forms and degrees of application. Pollack and DeKooning represent an emotional use of color interplay and visual sensations. Albers contemplates with geometrical precision the interaction of light and color. These are further explorations into the physiological effects of color, some intuitively and some objectively, but both are contributions to the enrichment of man's visual and spiritual worlds.

PREVIOUS USE OF BROKEN COLOR ON STAGE

Most references written on producing the play, are either vague or elementary in dealing with scene painting and the use of color as pigment or light. This may be due to several reasons. The principle reason seems to be that the writer is generally encompassing the whole theatre field, and is not sufficiently knowledgeable in this specific area. Another reason may be the inability of those practicing this art to communicate the subtleties of technique that have been gained through personal inventiveness and experience.

Against the scene designer or painter as a source, is the fact that scene painting, in contrast to easel painting, is not generally subject to critical examination for itself. The painted set, as is the play, is a part of a fleeting experience for the observer. Most contemplations about the technical aspects would be in retrospect and therefore not as susceptible to analytical review. It is difficult then to find material in depth about the interaction of color on stage.

Some use of broken color in stage painting has been mentioned and it is to be expected that other methods have been tried or are in use. The most common usage is the application of small dots of color to break up the effect produced by a large monochromatic surface. If the area is of any appreciable size, the surface becomes a monotonous attraction, moving forward in space and overpowering the action on stage. Its subsequent spattering with various colors, will cause the eye to vibrate on the surface and the

offending area will move back into acceptable space.

Lee Simonson records the use of a fairly dry brush to drag or scumble broken colors on the surface for the same effect. The colors are close in value, and he suggests the use of gray, violet or blue on warm ground tones, and warm colors on a cool background.[1]

Another technique as noted by Simonson, is one perfected by Robert Bergman and is known as the Bergman Bath. This method is a succession of thin washes of paint, floated over a ground tone as the scenery lies on the floor. Colors in close values of grays, blues, violets, ocher and occasionally silver or gold, are used to produce a surface rich in texture and responsiveness to light.[2]

A secondary effect of the spattering or scumble technique is the effectiveness in hiding flaws in painting or in the structure of the scenery. In general practice this often becomes the main purpose for its use, and the spattering applied is more in the nature of value than color.

A variation, which in the total scope of the use of broken color on stage can only be considered as different in degree, is the method called Permanent Painting. The effects of broken color as in Impressionism painting is primarily physiological, with the assumption, more or less, that ideal or natural light is used in viewing. Of course this is not always the case, and in applying broken color for the stage, extreme variations in lighting will

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1 Lee Simonson, The Art of Scenic Design, p. 38
2 Loc. cit.

be arbitrarily made. The effects noted in this method are physical and are a part of the total consideration of broken color viewed under varying lighting situations.

The term Permanent Painting is one Herbert Hake has given to a unit that has been painted in such a manner as to reflect a succession of colors upon proper stimulus. Conceivably, the same unit could be used in many scenes, changing color and mood under a latitude of lighting conditions. To what extent it has been used is not known to this writer, but appears worthy of exploration. Hake's description of his method is as follows:

> In order to obtain a reflected color which will correspond to the color of light used in every case, it is necessary to use a combination of three colors of paint which will correspond to the three primary colors of light. The three colors which will satisfactorily reflect these three primaries are burnt sienna (a neutralized red), chrome green and ultramarine blue.
>
> The scene units are first given a solid coat of burnt sienna. When this is dry, the entire surface is spattered (or sprayed) with chrome green. The surface will then have a broken texture in which both red and green will be represented. When the green paint has dried, the surface is finally spattered with ultramarine blue, and three colors will be in evidence. Although the undercoat has been spattered twice, some of the red will still be visible, and enough of it will be available for reflecting red light.
>
> These units will now reflect any color of light that is thrown on them. When only red light is used, the green and blue paint will be neutralized, and then the red paint will give the effect of color to the set. When green light is used, the red and blue paint will be neutralized and only the green will be reflected. When blue light is used, the red and green paint will be neutralized, and the set will appear to be blue. Further variation is possible; when yellow light is used, the blue paint will be neutralized and the red and green paint, in combination, will reflect the light and give the set a yellow appearance. Blue-green light will be reflected by the blue and green paint, while the red is neutralized; and magenta or purple light will be reflected by the red and blue paint, while the green is

neutralized.

> Many transformations can be effected in this way. It would seem that the neutralizing of a part of the painted surface in each case would result in a visible mottling of tone. The contrary is true, however. The individual spots of color are so small, and their distribution is so uniform, that there is no evidence of omission when one or the other color is not reflected.[3]

In visiting the scene shop at the University of Kansas in Lawrence, a direct example of broken color on stage was observed by this writer. The scenery flats for a garden scene had just been painted, and the finished product in style and technique was reminiscent of the paintings by Monet. The painters had used sparkling colors over a dark background, and for the most part, it appeared they had employed 1" to 2" brushes. The effect was quite fluid and spontaneous. Though not knowing the temper of the play or how it was to be lighted, the audience should have found it to be a delightful experience. While exciting as a garden, the same techniques were not employed in painting the other architectural scenes and it is difficult to see how they could have been treated in quite the same manner.

It can be seen from these examples that broken color has been used on stage in varying degrees. In a few instances, it can be noted there were direct references to the Impressionism movement in painting.

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3 Herbert V. Hake, Here's How, A Guide to Economy in Stagecraft, p.87

THEORETICAL ASPECTS OF BROKEN COLOR ON STAGE

The perception of color is complex and highly personal, and any consideration of the nature of color must be in terms of the physical cause, the physiological process of the eye and the psychological elements of human experience. When analyzing broken color as it might be used in the theatre, all of these elements must be noted in the usual sense of perception and application with the added dimension of the arbitrary lighting of the stage.

In theory, the mixing of broken color is an optical mixture, or mixture by addition. In practice, the effects might be a combination of the two, mixture by addition with some elements contributed by subtraction. In some areas of color mixing, the results are similar with both methods, while with others the areas differ greatly.

A total analysis of the effects must include the study of three different color circles. Each of these wheels is an arbitrary illustration of a particular element or phenomenon of color, and cannot be used as a dogmatic entity. The terms of color notation are also relative, as each system employs a slightly different meaning for the same name.

Credit for first placing color in the form of a circle is given to Sir Isaac Newton. In studying the spectrum, he noted the similarity of the red on one end of the scale, and violet on the other. Placing the spectrum in a circle left a void segment, which he filled with hues of purple, or mixtures of the two end

colors, red and violet. His color wheel contained seven basic colors; red, orange, yellow, green, blue, indigo and violet in unequal spacing according to the spectrum.[1]

The eye always tends towards simplification in form or in identification of colors. The accepted grouping of identifiable colors of today are red, yellow, green, blue and violet. In general, color theories use these five or add orange and use six as basic colors. Those colors that are fundamental to the formation of other hues are called primaries, and differ according to the manner in which they are considered.

The Pigment Color Circle

The first color circle to note is the pigment color wheel (Fig. 1). This is color by subtraction. The reflecting surface subtracts or absorbs part of the wavelengths of the light, reflecting a certain few. While the pigment may be quite selective in the color it reflects, all pigments give off some traces of other colors and can never equal in intensity a spectrum color.

The primaries of the pigment wheel are red, yellow and blue. Secondary colors are produced by combining any two such as red and yellow for orange, blue and red for purple and yellow and blue for green. By mixing adjacent colors the intermediate hues may be formed. The mixing together of all three primaries, subtracts all of the wave lengths producing black, which is considered the absence of light.

In the Ives color circle, the primaries are listed as mag-

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1 Faber Birren, Creative Color, p. 19

Fig. 1
The Pigment Color Circle

The pigment circle is mixture by subtraction and has primaries of red, yellow and blue with secondaries of orange, green and violet. The Ives color circle has primaries of magenta, yellow and turquoise-blue. A mixture of the primaries or complementaries would produce, in theory, black.

Fig. 2
The Light Color Circle

The light color circle is mixture by addition with primaries of red, green and blue-violet and secondaries of yellow, magenta and turquoise. The mixture of all three primaries produces white which is the presence of all hues in balance.

Fig. 3
The Vision Color Circle

The vision circle has four primaries, yellow, red, blue and green. The secondaries are orange, violet, blue-green and yellow-green, with the center of the circle as gray. When used as an illustration for the mixture of broken color, the secondaries are formed by addition.

enta, yellow and turquoise blue.[2] This would appear to be a closer description of true primaries in pigment for a full mixture of secondary and intermediate hues. It coincides with the primary colors used in color printing which must rely on these three to form a multitude of color variations.

A method of illustrating the change in chroma as a result of mixing two colors in pigment, involves the use of the color circle with gray in the center. All of the hues placed on the rim of the circle are thought to be spectrum colors or at maximum intensity. Any line drawn then between two colors will cut across the circle coming closer to the center or gray. If the colors are mixed in equal proportions, the mid point of the line will show its position in relation to hue and intensity. As can be seen, neighboring colors will lose some intensity when mixed, and as the colors become farther apart or complementary, the position of the line moves closer towards center and the resultant color decreases in intensity.

The Light Color Circle

The second color wheel for consideration relates to the mixing of color as filtered light (Fig. 2). This is mixture by addition, as the wavelength of one color is added to the wavelength of another and seen as a secondary color. The primaries of light are red, green and blue-violet. The secondaries are turquoise blue (a mixture of blue-violet and green), purplish magenta (red added to blue-violet), and yellow (a mixing of red and green).

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2 Faber Birren, Creative Color, p. 20

The mixture of all three primaries produces white light, which is the presence of all the colors in balance.

The Vision Color Circle

Theories have been advanced on the means of color perception in human vision, and many are based on the agreement that the human eye responds to four elementary hues; red, yellow, blue and green and two hueless sensations white and black. These have been considered as pairs of primaries which are complementary in nature and whose interactions would correspond to the known facts of color mixing, color circles, complementary colors, aftersensations and simultaneous contrasts.[3] These pairs are red and green, yellow and blue, and white and black. White and black are perceived not necessarily as the presence or absence of light and color, but as separate sensations.

The third system of color arrangement in a circle, relates to this physiological and phychological perception and can be called the vision circle.[4] Here the primaries are four in number; red, yellow, green and blue with secondaries of orange, yellow-green, blue-green and violet. A mixture of the primaries at the center would result in gray (Fig. 3).

The Color Solid

The discussion to this point has been primarily about color as a hue or as a differentiated segment of the spectrum. As indicated, white and black are perceived as separate sensations.

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3 Ralph Pickford, Individual Differences in Colour Vision, p. 35

4 Faber Birren, Creative Color, p. 18

Fig. 4
The Color Solid

The color solid has an axis of value with the spectrum hues located on the equator of the sphere. Chroma or intensity is the perpendicular movement from the axis to the surface.

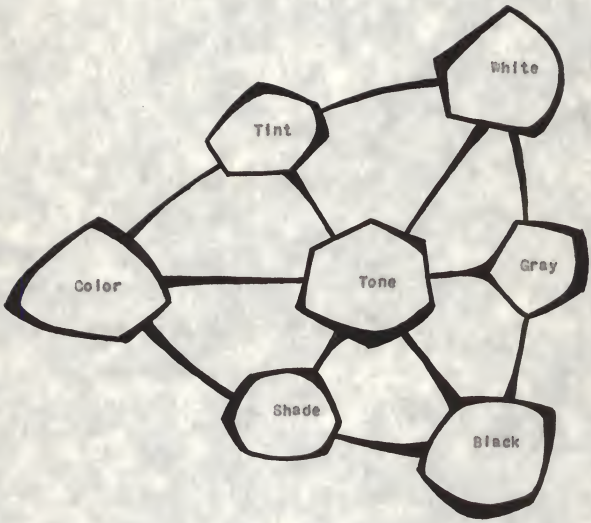

Fig. 5
The Color Triangle

All colors are perceived as being one of the seven forms noted in the color triangle. The triangle might also be considered a leaf or segment of the color solid. If color is designated as a particular hue, the tints, shades and tones will be mixtures of that hue with white and black.

They are unlike the spectrum colors, but as the other primary sensations mix and form intermediates, so too do white and black combine with themselves and with those containing hue. This expands the color circle into a solid (Fig. 4).

The term hue has been noted before as a particular segment of the spectrum and refers to the name commonly given that part such as red, yellow or blue. This is the first dimension of color as a solid. The second is value and relates to the lightness or darkness of a color. The basic unit of value is a scale of white and black and the mixtures of these two in various degrees of gray. The third dimension is an interaction of the sensations of hue and value. This is called chroma or intensity and is the movement from a like value of gray (which is neutral or lacking in chroma), towards the spectrum color which contains no other elements except of that particular hue. The dimensions used in describing color as a solid (Fig. 4) is the same for color as pigment or as light, although the steps or the latitude of these dimensions will differ greatly between the two.

Figure 5 shows a hue segment of the color solid and the additional dimensions of color and color mixing. This has been referred to by Birren as the Color Triangle, and indicates the seven forms in which color is experienced.[5] In addition to the directions already noted, is the mixture of hue and white for a tint, hue and black for a shade and the mixture of any of the diagonals (tint and black, shade and white, hue and gray) for a

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5 Faber Birren, Color, Form and Space, p. 37

tone. These terms are further notations of color positions or movements within the solid.

Simultaneous Contrast

The heart of broken color is the phenomenon of simultaneous contrast. Two colors are shown as separates in Fig. 6, they are mixed as pigments in Fig. 7 and mixed optically in Fig. 8. The effect as perceived in the last figure, was defined originally by Chevreul in his statement on simultaneous contrast:

> If we look simultaneously upon two stripes of different tones of the same colour, or upon two stripes of the same tone of different colours placed side by side, if the stripes are not too wide, the eye perceives certain modifications which in the first place influences the intensity of colour, and in the second, the optical composition of the two juxtaposed colours respectively.[6]

The small stripes of red and blue have become a shimmering magenta which is more intense than either of the parent colors. This is a spreading or irradiation of the two colors, as the eye at a distance loses the ability to discriminate the colors as separate areas.

When viewed separately, the stronger the contrast in hue, the weaker the effect of increased intensity will be when diffused optically. The weaker the contrast, the stronger the effect will be of increased vividness. Thus when two colors are analogous or close together in hue, their fusing by the eye will produce a vivid vibrating tone. As the colors move farther apart towards complementary positions, this effect will decrease in nature.

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6 M.E. Chevreul, The Principles of Harmony and Contrast of Colours, p. 7

Fig. 6 The original colors as they appear before mixing.

Fig. 8 Mixture of the colors by simultaneous contrast or by addition.

Fig. 7 Mixture of the colors as pigment or by subtraction.

Fig. 9
The Effect of Contrast of Hue

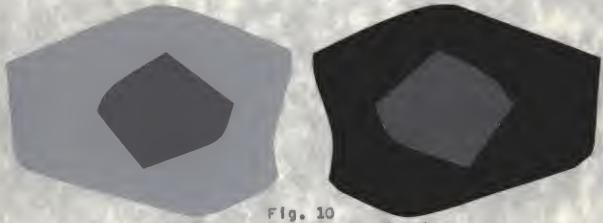

Fig. 10
The Effect of Contrast of Value

Fig. 11
The Effect of Contrast of Intensity

The same effects will be noted in relation to the degree of value contrast. Those colors close in value will produce a stronger effect than those with more contrast. Hence, the degree of this increase in intensity is altered by both hue and value.

Viewed simultaneously as large areas, colors in proximity influence the appearances of each other. Figure 9 shows how a surrounding area will change the appearance of hue in a given color. In both cases the small shape is the same green, but viewed against different backgrounds the hue seems to change. In Fig. 10 a like situation illustrates the change in apparent value as the same value gray is placed against different grounds. An apparent change in intensity is made in Fig. 11 through the use of a medium intense red against areas of higher and lower chroma.

Mixing by Simultaneous Contrast/Broken Color

The first assumption when laying pigments down as broken color and to be viewed as the effects of simultaneous contrast, is that the resultant hues will be formed according to the pigment or subtractive color circle. This is not true, in that the mixing is optical in nature and therefore by addition or the adding of one color sensation to another. Yet, as the results are within the limitations of pigment reflections, neither can the effects be fully exploited if only the light primary colors are used as pigment.

In both the light and pigment color circles, the results of mixing secondaries in the areas of violet and blue-green are alike in some respects. In the light circle, blue-violet mixes with green to form turquoise. This is similar to the results expect-

ed in pigment mixing. Blue-violet mixed with red for magenta would also be similar. Still, there are noticeable differences in hue and intensities.

The area of most difference is in the region of yellow. While a primary in the pigment circle, it is a secondary mixed by red and green in the light circle. As pigments, these two are complementary and a mixture would give a muddy gray. At best, an area of these two as juxtapositioned dots or stripes would only appear as slightly different in either mixture. This can be explained in terms of changes in value and intensity. Red and green at maximum intensity are in the middle of a value scale. To bring these colors up in value to match yellow at its point of maximum intensity, would be to dilute almost all of the chroma from these two colors. Hence, the effect of yellow as a secondary by the additive method cannot be obtained in paints. This necessitates the adding of yellow to the basic palette for a full range in broken color.

As noted before, Seurat used Chevreul's four fundamental colors and their intermediate tones. Further reference to this could not be found, but the coincidence would suggest that Chevreul was aware of this visual psychological discrimination and that Seurat incorporated at least part of it into his theories. How closely he may have followed the idea of these four as basics would speculative, and the colors then listed are inconsistant to the statement in that it includes violet and an intermediate. This makes five basic colors in his palette. Still, the manner and degree in which these were applied, would not necessarily

change the means by which the broken color is perceived optically by the viewer.

These colors were not mixed among themselves as pigment, however white was added for tints. Tones or shades by the mixing of paint was not a part of Seurat's palette, and no mention is made of black even as an accent. His palette then, consisted of spectrum colors and their tints. This is only a segment of the colors available, but optically he produced or suggested whatever else he needed.

Modeling Around the Hue Circuit

The hue circuit can be divided into two groups that possess the properties of either warmth or coolness. Red, orange and yellow are warm in feeling and are also known as advancing, luminous or hard; all of which describes the characteristics of these hues against a neutral background. Green, blue and violet are cool and receding in nature, and also thought of as somber or soft. Yellow-green and red-violet remain rather neutral against gray, or could be used in either group. White is considered to be hard, though not warm, and black is soft and receding.

These characteristics have been employed by artists in many ways to suggest space or distance. One example is aerial perspective, with the use of cool colors, generally with white added in the distance and warm colors in the foreground.

Another method is the modeling by the hue circuit rather than by value, although a degree of value change is involved. Modeling of light and shade can be indicated by the shifting of a tone around the color wheel towards an advancing and then a reced-

ing color. Warm colors suggest sunlight, and shadows are generally cool; this coupled with the advancing and receding characteristics of each create an illusion of modeling on a flat surface. This shift of a tone is towards orange as advancing, and towards blue for receding. This is not necessarily a complete movement to these colors but only towards them, depending upon the position of the original tone and the degree to which the modeling is forced.

Visual Acuity

The last three areas for consideration in this chapter assume added importance because of the extreme range of lighting conditions practiced on stage. The sensitivity of the eye in visual acuity varies under different degrees of illumination. In bright light, the spectrum will be most intense in the area of yellow and yellow-green. As the illumination dims, there is a definite shift to green and in darkness, blue-green is the hue of highest intensity.

In illumination as filtered light, yellow has been found to be almost as satisfactory as balanced light in the ability of the eye to distinguish objects clearly. Orange-yellow, yellow-green, and green follow in that order of maintaining visual acuity. Deep red and violet are increasingly difficult, and blue as illumination causes blurring and creates halo effects. Under extreme dark conditions red has been found to have excellent acuity.[7]

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7 Faber Birren, Color, Form and Space, p. 46

Filtered Light

To be perceived, a color must be present in both the surface that is reflecting the light, and in the source of the illumination. Sunlight, the ultimate in illumination, contains all of the colors that the human eye experiences. Any other source is generally noticeably deficient. When light is produced by a heated element, the illumination may be strong in warm colors and weak in cool, specifically blue. Some lamps, notably those filled with a gaseous matter, are stronger in the cool colors and weak in reds. Knowledge of the strengths and weaknesses of your illumination is vital to planning a pigment palette that will reflect the desired effect.

When the light beam is filtered by a gelatine, the material allows certain lightwaves to go through and stops the passage of others. If the filtered beam is a primary light color, the gelatine has blocked the other two primaries from passing. As an example, a blue filter subtracts both red and green, and only blue light passes. Conversely, a yellow filter will subtract only its complement blue, passing both red and green, as yellow is a secondary in light and therefore a mixture of the two other colors.

When two filtered beams overlap, the resulting mixture of their hues will be by addition and according to the light circle. Thus the overlapping of red and blue would produce magenta, red and green would give yellow, and green and blue would be turquoise. If all three primary light beams were to overlap, the result would be white, as white is the balanced presence of all hues.

Filtered Light on Pigment

To be perceived as a reflected color, the hue must be present in the surface as well as in the illumination. All colors present in the surface, that are not in the filtered light, will be seen as gray. The existence of a color as illumination will be noted in relation to the light primaries, and the presence or absence of a color on the surface will be according to the pigment primaries.

A pure blue surface color in a blue illumination will reflect as an intense light valued blue. Green and violet contain some blue as pigments, and would reflect in the same light as a grayed blue. The same kind of experience will result relative to the use of either of the other light primaries, red or green.

If a secondary colored filter is used, it will reflect not only that same color in pigment, but also the hues of the parent primaries. Thus a yellow illumination would reflect yellow, and also red and green. Any other variations of colored lighting must be considered in the same manner.

When two different colored beams overlap, the colored illumination is a total of the wavelengths present in each. Thus the range of colors that can be reflected has been extended. If the primaries of red and green as filters were used, the pigments of violet, red, orange, yellow, green and blue-green would reflect. The first and last pigments would appear as grayed red and grayed green rather than violet or blue-green, as blue is missing in the illumination.

A full range of reflected light can be achieved with the use

of all three primaries, or any two of the light complimentaries. The center of the light circle is white light or the presence of all colors, making possible the reflection of all the colors of the surface.

Color Constancy

The phenomenon of color constancy is considered as one of the most curious of visual perceptions. A color may be experienced as the same tone even though viewed under a variety of lighting conditions in terms of brightness or filtered color. A white cardboard, viewed first out of doors in the sunlight, then in the shadow of a room, then under the colored lights of the stage, might be experienced by the viewer as the same white though a camera would record three different tones. Birren quotes David Katz on this phenomenon:

> The way in which we see the color of a surface is in large measure independent of the intensity and wavelength of the light it reflects, and at the same time definitely dependent upon the nature and intensity of the illumination in which it appears.[8]

The distinction between light and illumination becomes all important in understanding this statement. It is the surroundings in which a particular color is seen that determines how it is recognized. If all other parts are illuminated by the same degree of brightness or color, the viewer is not likely to sense that particular reflecting area has noticeably changed.

This phenomenon, with all of the other aspects of color and vision discussed in this chapter, has decided implications in

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8 Faber Birren, Color, Form and Space, p. 93

the use of broken color on stage. The mixing of pigments themselves for a painting has many ramifications. When this is compounded by the physiological and psychological overtones of broken color, and then placed under extreme changes in degree and kind of illumination for viewing, the understanding of the process at best becomes quite complex.

THE USE OF BROKEN COLOR ON STAGE

The research for this paper was to find to what extent broken color could be used in stage design. The discussion of the findings to this point, have been in relation to broken color as used by the Impressionist painters, any previous application on stage, and notations on the phenomenon and theories accompanying its use.

As noted before, the interest in this area for the writer began in the need to explore various methods of painting stage scenery in lieu of previous training. The author's experiences to be noted here were limited to one type of drama, that of the musical play. However, as the basic approach of broken color has been used in six major high school productions, some conclusions and statements can be made concerning the use of broken color on stage.

Musical plays usually require a large amount of scenery and many scene changes. The designer's first problem was to become aware of the movements of the actors and their particular needs for visual support in terms of scenery. Then within the facilities and dimensions of the stage, the movement of the scenery changes and storage was planned. All other technical demands were considered and became a part of the final decision as to the amount, the appearance and construction of the sets. In general, any scenery that did not have to be three dimensional and played upon or used by the actors, was made as a two dimensional piece for ease in handling and storage.

A complete chapter could be written about the role of the

designer in his interaction with the story, director and players in presenting a total experience to the audience. For the specific purposes of this paper, only a notation will be made as to the awareness by this writer of the nature of this responsibility.

Partly because of the lack of facilities to fly painted drops and the availability of a versatile light blue skydrop, most of the scenery pieces used in the productions were self-supporting cutouts. Being able to see past parts of the scenery added to the feeling of space and distance on the stage, and a change of lighting situations on the skydrop suggested various types of illuminations.

The painting of the stage set cannot be approached in the same manner and spirit as an easel painting. The area to be covered was many times larger in size and rarely was the work in a position that progress could be checked as to how it would be seen in final form. The lighting was seldom right, and the amount of time allowed did not give opportunity for great care or detail.

The application of broken color by the author usually followed this procedure. First, a general color tone was applied in stage paints. Then any drawing or defining of the areas as form was made with a small brush. An animal sponge was then used to lay in one color at a time, modeling around the hue circuit on those parts that were to have dimension. After the modeling or modification of the base coat was complete, the drawing was checked for any parts that needed revision or strengthening. The final step was to spatter the entire set with spectrum colors for

a unifying effect.

Where Seurat may have built up a tone by completely covering an area with small dots of color, the procedure here was to start with the flat painting of a tone, adding the effects of vibration and intensity of broken color that many times was more of a suggestion than a complete coverage. As can be seen, it generally produced the desired effect and the rapid application was within the limitations of time.

The base tone was often an earth color or at least very neutral, and as mentioned, stage paint was used for economy. The drawing was usually done in black, but many times was a complementary color to the base tone. It might be noted here, that the drawing served to give additional definition to the forms, but also contributed to the realization that the set was an art form and not an attempt to produce naturalistic objects.

The broken color applied was usually tempera paints for ease of handling. Only spectrum colors were used, with reliance primarily upon yellow, red, green and blue. Tinted mixtures were not used with the exception of violet. Violet would appear as dark gray under most lighting unless tinted and was seldom used in favor of red and blue juxtapositioned. Tinting was usually simplified to the use of white laid alongside the other colors. Black was used only once or twice in sponging but was abandoned as not necessary or contributing.

Because of the inherent weakness of stage lighting in the region of cool colors, a larger proportion of blues and greens were generally needed. Often an Italian blue was used as an in-

termediate color to supplement ultramarine blue.

Figure 12 shows the modeling around the hue circuit of a cardboard cutout, achieving a feeling of three dimensional form with an indication of a single light source. Figure 13 is a detail of the same piece and is truer to the colors of the original. The piece was painted first with a flat coat of burnt sienna, then the sponging of the sunlit areas was begun with yellow ocher. Most of the ocher was covered in subsequent layers of color, but served as a light-dark pattern in which to work. The white was used separately, rather than mixed as tints. The base coat of burnt sienna served as a subdued red and when sponged with blue gave a purple shadow. This was generally neutralized to a degree with green and orange. As the use of broken color developed, it became a common practice to use a color in all parts of the area in varying proportions, rather than a sharp division of warm colors for the light side and cool for the shadow. The photograph also shows the use of red lines as part of the drawing. Colored lines were not unusual, especially in the shadows as a means of adding more color and light to that area.

Often the two dimensional pieces appeared to have more form than those with constructed dimension. To correct this appearance, shadows and highlights were painted on them also. This kept a sameness in treatment and contributed to the feeling of a tonality in the stage picture. Figure 14 shows a three dimensional set with a practical door, and with a window, porch posts, lantern and pane in two dimensions and modeled in broken color.

The general illumination of the stage is unidirectional and

Fig. 12
Ground row barn from Oklahoma1. A self supporting cardboard cutout, modeled in broken color.

Fig. 13
Detail from the barn above, showing colors as applied by sponge and brush.

Fig. 14
Aunt Ellen's back porch from Oklahoma!. A combination of two and three dimensional pieces painted in a like manner for tonality.

three dimensional shapes lose their form in such light. This is one argument for the stressing of color on stage, in that both illumination and form can be suggested through a knowledgeable use of color. Form invites critical judgement on the part of the viewer, whereas color is more direct or elementary in its appeal to the senses. Color becomes a more acceptable medium for an arbitrary use. Since the stage setting is a direct means of conveying the temperament of the play itself, color can prepare the audience and then supplement the elaborations and completion of the story by the players.

Seldom does the play or the audience demand a completely naturalistic setting. Musicals, and for that matter many other types of plays, are usually realism or suggested realism. In spite of the tendency for a higher degree of empathy in the theatre art form, the audience recognizes that the situation of viewing a play is, after all, unreal. A wide latitude of situations in story, acting or setting will be accepted as plausible if the forms have continuity and tonality.

The Show Boat in Fig. 16 would not stand the critical eye of a river boatman, as proportions and placement of vital parts have been altered for the demands of the stage. What was a barge in the novel and original play, a stern wheeler in the motion picture, became a sidewheeler in this production in order that a distinctive part of the riverboat could be seen on the stage. Within limitations, such changes are possible, as the audience recognizes the settings as a suggested environment rather than a real one.

Fig. 15 A cutout tree for the Levee in Show Boat, sponged and spattered for suggested form.

Fig. 16 Opening scene of Show Boat on the Levee at Natchez on the Mississippi River.

The photograph in Fig. 17 shows the main characters from the Wizard of Oz in front of a section of the Emerald City set. This was taken at a rehearsal, and the painting of the set was incomplete. It might be injected here, that much scenery painting today rarely progresses beyond this point; relying upon flat areas of color and some drawing. This may be sufficient in some instances, but in many cases it looks as if it were only a beginning.

The Emerald City was a particularly special place in this story of fantasy. The name of the city leaves no doubt as to the color of the city nor the implication that it should be bright and luminous. The discussion of broken color as applied before was in relation to modeling around the hue circuit. Here the effects of broken color or simultaneous contrast are used to produce the intense luminous quality needed in this particular scene.

A tone was established first of all by the application of a gray-green base coat. It could not be too intense because of the large areas involved. Next came the brush drawing of the mortar and architectural forms. The sponging of broken colors was limited to analagous or neighboring colors of green, using yellow-green and an Italian blue. The complementary colors of red, orange and yellow were then spattered over the entire set. As not enough was used to neutralize the mixture optically, it only served to heighten the effect. Figure 18 and Fig. 19, though not accurate in color, will give some indication of the final results. A truer illustration of the colors actually used can be found in Fig. 20.

Fig. 17
Dorothy, Tinman, Scarecrow and Lion from The Wizard of Oz in front of the incomplete set of Emerald City.

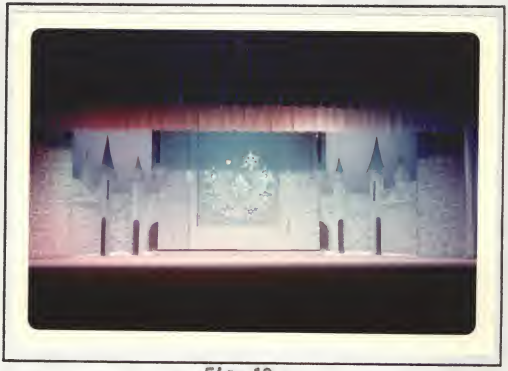

Fig. 18
Full stage set of Emerald City in The Wizard of Oz, using the effects of simultaneous contrast for luminosity.

Fig. 19
Detail of Emerald City set.

Fig. 20 Illustration of broken color as used in the Emerald City. The effect of apparent increased intensity was achieved through the use of analagous colors in simultaneous contrast.

In the forest scene for the same show (Fig. 21 and Fig. 22), an attempt to model with a sponge on the loose muslin cutout drop was not successful. A switch to the use of a two inch brush to indicate the rough texture of bark met with limited success. This approach has much merit for broken color, but too much time was needed to bring such a large area to a satisfactory completion.

The face of Oz in Fig. 23 and Fig. 24 was another method of application of broken color, only this time the problem was the exploration as to what extent a three dimensional form should be modeled. Various attempts were made using a sponge again, but the results seemed very unsatisfactory and any forced modeling seemed unnecessary. Earlier attempts were painted out with a pale green base color and the return to spattering the form with the usual basic colors was decided upon. The brush was manipulated to spatter according to the hue circuit. The effect was not forced modeling, and this proved sufficient as the face was lighted with directional light.

The element of distance, so necessary for the optical mixing of broken color, is a built-in physical feature of the theatre. The areas of juxtapositioned dots of color can be relatively large and free in handling, and still be acceptable to the eye of the viewer. With study the viewer might discern the method of application and the color break-up. However, if the whole scene is unified with the same treatment, as perhaps a sponge and the resultant build-up of paint, and then bathed in a film of spattered broken color, the effect of the vibrations on the eye will be the same as a soft focusing of the scene.

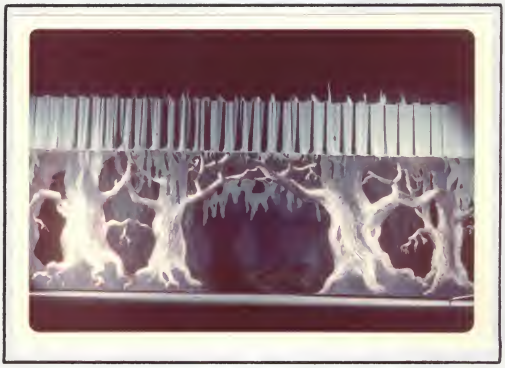

Fig. 21
Forest scene from The Wizard of Oz.

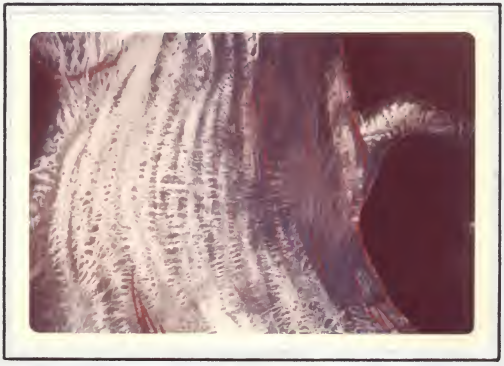

Fig. 22
Detail of above, showing broken color as applied only with a brush.

Fig. 23
The face of Oz, using broken color on three dimensional forms.

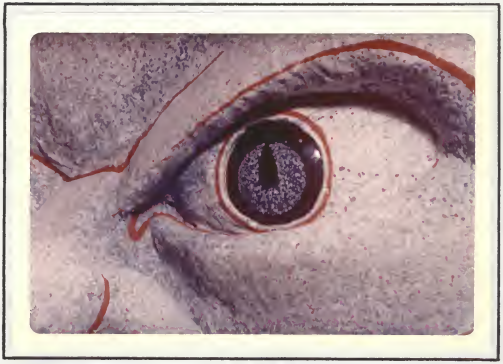

Fig. 24
Detail of above.

As one of the effects of simultaneous contrast is the apparent increase of intensity, broken color offers the possibilities of suggesting a higher degree of illumination without the washing out of colors so often accompanying a brightning of the stage lighting. This suggestion of bright illumination should work no less for the stage than it did for the Impressionist painters, if applied in a like manner.

The area that cannot be properly covered in this paper, is the reaction of broken color as reflected light under the filtered stage lights. It is one of the regrets of this writer, that at the time of the productions and before the sets were struck, and usually destroyed, that experiments could not have been made along this line. The lighting of the sets was delegated to another group as this task alone requires considerable time and effort for the performances.

As noted in the previous chapter, the results could be calculated with a knowledge of the light and the pigment circles. There will be variations in the actual results according to the available color in the lights, and the filters used. Any method of testing would need to include specific designations of the type of light fixture used, its spectrum range, and the measured steps of degree of illumination. Since there are a multitude of filters, certain ones would have to be decided upon for particular qualities, and these might not be the hues corresponding to the light color primaries. An attempt to use filters that would produce a balanced white light is not a common practice on most stages. Such investigations, if carried out to any extent,

might have some contributions to the actual practice of the art, but in general would be more of a scientific curiosity.

One of the most intriguing aspects of vision is that of color constancy. Within the enclosure of the theatre and with no other point of reference, the perception of color is quite independent of physical facts. This phenomenon alone negates some manipulations of colored lighting on stage. Unless the degree or color of illumination is changed considerably or abruptly, color retains its stability to the viewer.

In spite of knowledge of this phenomenon, photographing on stage with stage lighting can be quite frustrating and illustrates the range of the effects. Unless an accurate measurement of the color temperature can be made, any attempts to rely upon the perceptions of the eye and previous experience, will prove how far from physical fact such judgements might be.

SUMMARY

Reference to broken color is usually in relation to painting and the Impressionists. This is as it should be, for this phenomenon of light and color was explored to the fullest by this particular art form. Evidence would indicate also, that broken color has been applied to the stage more than generally realized.

The knowledge gained from the study of written material for this research, and the accumulated experiences of six musical productions, has convinced this writer that the use of broken color on stage has many possibilities and can be a contributing innovation.

The investigation and understanding of the phenomenon and problems involved need not hamper any free and creative approach. Techniques can be developed without rigid methodology. It is recognized though, that as the full ramifications of the complexities of broken color are known, that it will be of limited use for many, in favor of a simpler method.

The total effect created on stage by broken color, is in general quite satisfactory. Many times the effect is a vast improvement over other techniques. The unity achieved with a like treatment of the three and two dimensional surfaces with broken color, including a final spattering of the entire set, gives the scene an atmosphere and illumination of its own. This plays best under a balanced light, though coupled with the stability of color constancy is acceptable over a wide range of lighting conditions. The more elaborate and refined the scheme becomes, the more sensitive it is to change.

Further research is needed to determine the range of stage lighting and what variations in the palette would extend the capabilities and use of broken color. It is evident that broken color can be planned for an extreme lighting situation, and need not be considered usable only for theatre productions that tend to be decorative or light in nature.

In any form of application or theory, the problem is easiest to understand when the components have been reduced to the fundamental elements. In mixing color this becomes the reduction of the available colors to the least number from which all of the others can be mixed.

The mixing of hues in broken color is by simultaneous contrast, therefore by addition and according to the color circle for light. Since the medium used is pigment, this becomes the mixing of one medium according to the laws of another. The complexity of this interaction of the effect and the medium are at odds with the advantages of simplification for a freedom of expression. A different means of illustration that might embody the essential characteristics of each could be of value in application.

Perhaps more than by just coincidence, the vision color circle seems a satisfactory way of arranging the hues of pigment that are fundamental to the optical mixing of a complete range of color. As yellow in pigment cannot be produced effectively as a secondary for the light circle, it becomes necessary as a primary color. The vision circle uses the light primary colors; red, green and blue (blue-violet), and yellow; and

provides a basic palette for broken color. The addition of white produces tints and contributes to the completion of the color solid. Black is used only as accents in arbitrary drawing. As it is perceived as a separate color it becomes important to the total effect.

One of the qualities of simultaneous contrast is the increase of apparent intensity. On stage, this must be used with a degree of restraint. This allows for simplification in the method of applying broken color. The application of a flat base tone as a ground simplifies the amount of broken areas to be added without considerable loss of effect. The nature of the sponge as a means of building color areas allows for experimentation and change as the painting progresses. The palette is reduced to a minimum (four primaries and white) for ease of handling and speed, though refinements can be made through inclusion of intermediate hues.

The complexities of the physical, physiological and psychological aspects of color and vision as discussed in this paper, invites rigid and involved patterns of application. As broken color is used in the art form of scenic design, the tendency must be towards simplification. An understanding of the cause and effect of light and color is important to the mastering of the craft. It will not deter a creative expression, however, if an attitude of exploration is maintained.

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LITERATURE CITED

Birren, Faber. Color, Form and Space. New York: Reinhold Publishing, 1961.

_____. Creative Color. New York: Reinhold Publishing, 1961.

Chevreul, Michel Eugene. The Principles of Harmony and Contrast of Colours and Their Applications to the Arts. London: G. Bell, 1899.

Cogniat, Raymond. The Impressionists. New York: Macmillan, 1951.

Hake, Herbert V. Here's How! (A Guide to Economy in Stagecraft). Evanston, Illinois: Row, Peterson and Co., 1947.

Leymarie, Jean. Impressionism. Two volumes. Paris: Albert Skira, 1959

Pickford, Ralph W. Individual Differences in Colour Vision. London: Routledge and Kegan Paul, 1951.

Raynal, Maurice. History of Modern Painting from Baudelaire to Bonnard. Geneva: Albert Skira, 1949.

Rewald, John. The History of Impressionism. New York: Museum of Modern Art, 1946.

Simonson, Lee. The Art of Scenic Design. New York: Harper & Bros., 1950.

THE USE OF BROKEN COLOR IN SCENIC DESIGN

by

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Broken color is the phenomenon of mixing color by simultaneous contrast. When small areas of color are laid side by side the colors will influence the appearance of each, and when viewed from an appropriate distance will optically fuse together and produce a tone that is different from the original both in hue and apparent intensity.

The intent of this paper is to investigate to what extent the ideas and principles of broken color, as embodied in the Impressionist and the Neo-Impressionist movements in painting, and as studied, both physically, physiologically and psychologically since then, might be applied to stage painting and design.

The use of broken color by the founders of Impressionism began as an intuitive means of suggesting the movement and vibration of sunlight. The atmosphere created was permeated with light as color rather than value. The reliance was on the optical perception of bright colors juxtapositioned, rather than on the mixing of pigment.

The Neo-Impressionistic movement of Seurat and others, gave a scientific basis to this concept, and ended in the formulas of Pointillism. One of Seurat's principles was the palette based on Chevreul's four fundamental colors, red, yellow, green and blue, and their intermediate tones. None of these were mixed among themselves, although white was added to produce tints.

The mixing of colors by simultaneous contrast is according to the light circle, or mixing by addition. However, the medium is pigment, and while the effects achieved in mixing the light

primaries of red and blue for magenta, and blue and green for turquoise is fairly satisfactory, the mixing of red and green for yellow is quite limited. Therefore, yellow becomes a necessary fundamental color in the simplification of a palette for broken color. This coincides with the arrangement of the vision circle, and is a means of illustrating the least number of hues needed for producing a complete range of hues.

The modeling of form can be suggested through the shift of a color around the color circle. As the color moves towards orange, the effect would be one of advancing or moving into the light. As the color moves towards blue, the tone recedes and moves into shadow. Thus color can give the illusion of form as well as an atmosphere of independent illumination.

As applied to the stage, broken color is influenced greatly by the arbitrary lighting situations of filtered light with its varied changes in the appearance of the colors. A resistance to this change is experienced by the eye according to the phenomenon of color constancy.

The complexities involved, even with simplification of a palette and methods of application, limits to a degree its use. However, broken color on stage has unlimited possibilities for those who are willing to combine the understanding of the phenomenon with an exploratory approach.

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