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**VISUAL DYNAMICS**

by **Douglas Deane Peden**

**Douglas Deane Peden**

**B.S.Ae., University of Michigan, 1956**

**Fine Arts**

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Visual Dynamics Douglas Deane Peden

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Being new, visually dynamic art is still simple in its physical make-

Peden, Douglas Deane (M.F.A., Fine Arts: Creative Arts). It seems to

Visual Dynamics abilities for development as a significant art experience.

Thesis directed by Assistant Professor George Woodman

This abstract of about 235 words is approved as to form and content.

Visual dynamics, a relatively new development in the visual arts, is the illusion of movement where there is none. Visually dynamic paintings, sometimes called "op art," visual research, and chart painting, may appear to wriggle, vibrate, or produce strong after-image movements. The paintings are typically composed of repetitive, simple, geometric forms with contrasting colors which are close in value.

Attitudes toward form, color and imagery typical of visual dynamics can be seen developing in earlier painters, the Impressionists, the De Stijl group, Russian Constructivists and Kandinsky. Victor Vasarely, in the 1940s, created illusory movement through forms, although only recently has color been used dynamically by Richard Anuszkiewicz and Larry Poons.

Illusory movement may be created either from a multiplicity of simple forms and extreme color contrast in figure-ground relationship, or from an unstable edge caused by close value relationships between figure and ground colors. The first may be called a form-vibrational system; the second, an edge-vibrational system. Dynamic quality is markedly

influenced by environmental lighting, position of the viewer, and physiological functions of the eye.

Being new, visually dynamic art is still simple in its physical make-up and elicits a relatively simple response from the viewer. It seems to contain many possibilities for development as a significant art experience.

This abstract of about 215 words is approved as to form and content.

Signed

George E. Woodman

Instructor in charge of thesis

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not part of the art object per se." Illusion, here, is more of an apparition. In examples of optical paintings, the eye is dazzled with after-images, unstable boundaries, eye-aching color contrasts, and fluctuating spatial positions. These things, for the most part, are not painted but are optical phenomena induced by the arrangement of shapes and colors.

This recent development in art has gone under the various headings of visual research, kinetic art, chart painting, op art, and other names. Many of these paintings may be painful or confusing to look at; nevertheless, a new attitude has been created. One of the main characteristics of this attitude is its interest in illusory movement: the mental

creation of movement where there is none physically. Illusory movement is an optical phenomenon which will be called, in this thesis, visual dynamics.

CHAPTER I

INTRODUCTION

Within the past few years there has been an intensified interest in optical illusion in art, particularly in painting. The kind of illusion usually associated with painting is illusion by deception; examples are the illusion of space by mechanical perspective and overlapping shapes, or the illusion of actual objects by descriptive painting. The definition of optical illusion in this thesis is "the perception of something that is not part of the art object per se." Illusion, here, is more of an apparition. In examples of optical paintings, the eye is dazzled with after-images, unstable boundaries, eye-aching color contrasts, and fluctuating spatial positions. These things, for the most part, are not painted but are optical phenomena induced by the arrangement of shapes and colors.

This recent development in art has gone under the various headings of visual research, kinetic art, chart painting, op art, and other names. Many of these paintings may be painful or confusing to look at; nevertheless, a new attitude has been created. One of the main characteristics of this attitude is its interest in illusory movement: the mental

creation of movement where there is none physically. Illusory movement is an optical phenomenon which will be called, in this thesis, visual dynamics.

A brief look at some of the painters engaged in visual dynamics may give a clearer idea of what is presently being done. Victor Vasarely, a European painter, was one of the first to direct his energies to visually dynamic systems, exhibiting optical works twenty years ago. Not only has he pursued visual sensation by painting on canvas, but has also made use of transparent and mobile superimposed surfaces. His imagery consists of simple geometric shapes. Sometimes he works with a checker-board or lattice type pattern, manipulating some of its integral parts for various spatial and optical tensions. Often his compositions are taken from the geometric simplifications of Cubism of the twenties and thirties, mainly the fractured composition in which bars, rectangles and triangles are set to one side or another. He uses predominantly black and white. When he uses color, it is fairly conventional; that is, it does not have the vibrational quality of that used by the present generation of optical artists. In some of his works, particularly the more densely patterned ones, optical movement and vibration are apparent.

Richard Anuszkiewicz, a younger American painter, uses formally balanced compositions constructed of simple, repetitive geometric shapes. Many of his paintings are similar in composition to Vasarely's

works; however, Anuszkiewicz uses the element of color to increase the visual dynamism of his works. He uses eye-wrenching color contrasts which tend to elicit a maximum physical response from the observer. In some of his paintings, the patterns recede and reverse, giving a third dimension to the two-dimensional composition.

Another American, Larry Poons, paints in patterns of coin-sized dots or ellipses on a relatively large background of color. The dots and background are painted in complementary or close complementary colors such as red against blue, red against green, orange against green, etc. Barbara Rose, a New York art critic, says of Poons: "He creates complex surface patterns which jump, dance, disappear and reappear, defying any attempt the eye may make to hold them down. After-images are frequent, creating a secondary pattern that both re-inforces and competes with the original pattern."<sup>1</sup> In some of Poons' works she has observed, after prolonged examination, "a more soft and rippling movement and vibration, rather than a harsh, stinging crackle."<sup>2</sup>

Rather than discuss more artists, let us consider what the above painters and others like them have in common. One of the most important aspects of visual dynamics is color. It is not color alone, but the

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<sup>1</sup>Barbara Rose, "The Primacy of Color," Art International, III, No. 4 (1964), 22.

<sup>2</sup>ibid., p. 22.

manner in which it is used that is a major factor in the optical movement in these works. The colors and color combinations used are not entirely governed by intuitive choice, as they would be in the case of an Abstract Expressionist, but partly by a scientific knowledge of the interaction of certain colors to produce a specific effect. For example, an Abstract Expressionist would use color to express itself as an emotionally felt idea, whereas an optical artist would use color more as a tool to give a specific vibrational quality or after-image effect to specific areas of the painting.<sup>3</sup>

Another common factor in the visually dynamic paintings of today is the repetition of simple, basically geometric shapes. Some artists use the repetition of line in various angular and curvilinear sequences. The components which make up the paintings are characterized also by their technically hard edge. The word "technically" is stressed because, upon observation, the edges of some of the shapes or lines appear quite fuzzy or unstable.

There seem to be two basic types of composition. The first is a group, or groupings, of shapes symmetrically contained within the framework of the canvas; Anuszkiewicz and Vasarely use this type. The second is conceived as a limitless field or pattern of visual events where the boundaries of the canvas contain a finite experience of these

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<sup>3</sup>More will be said about vibrational quality and after-images in Chapter III.

events; Poons exemplifies this type.

Spatially, the works seem to be less related, though they all have in common a relatively shallow space. Some have fixed figure-ground relationships; others have a reversible figure-ground. Some strive for strict two-dimensionality, while still others give strong feelings of perspective space.

Another trait common to these painters is a non-painterly technique; the visible brush stroke is subordinated. They are not interested in expressing the materials used or the method of application because these things are too related to the objective, tangible world outside the painting and tend to detract from the perception of the interactions of space, form, and color.

The present state of optical art is aggressive, not in a literal sense, but in a physical sense. It forces the spectator to actively participate by stimulating his physiological and psychological reflexes. In a sense, the response is more visceral than intellectual.

This thesis will be devoted to some of the historical and technical aspects of visual dynamics, with a discussion of criticisms and comments pertaining to visual dynamic art.

<sup>1</sup> Michel-Eugène Chevreul (1786-1889). Chevreul's influence came through his researches on color contrasts (*De la loi du contraste simultané des couleurs*, 1839) carried out at the Gobelins tapestry works where he was director.

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## HISTORICAL AND CONTEMPORARY INFLUENCES

Influences in any new development come from many sources, history, science, society, and others. To clearly name all the sources directly manifest in visual dynamics is obviously an impossible task. However, it seems that there are well-defined interests and movements in certain directions which may well connect the past with the present and possibly give a hint to the future of a specific movement. Therefore, let us consider some of the possible sources of influence upon visually dynamic art, specifically in relation to color, imagery, space, and composition.

Many of the artists involved in visual dynamics are very interested in what science has established about color. This interest in the scientific aspects of color can be traced to the late nineteenth century with the theories of the French chemist, Chevreul.<sup>1</sup> His theories had a direct influence on such painters as the Impressionists and Cezanne and

<sup>1</sup> Michel-Eugène Chevreul (1786-1889). Chevreul's influence came through his researches on color contrasts (De la loi du contraste simultané des couleurs, 1839) carried out at the Gobelin tapestry works where he was director.

Seurat. Basically, the idea derived from Chevreul's theories was the optical mixing of two or more colors to give a third. The result was a glittering luminosity which had not been seen before. Similarity between the Impressionists and today's optical painters is found not only in the filtering of scientific knowledge for artistic use, but in the optical result of the eye seeing something that physically is not there. In Impressionism, it is a color which results from the optical mixing of other colors; in visual dynamics, it is movement which is the optical result of a static picture.

With the Russian Constructivists and the De Stijl group, color is used to express itself as color, as opposed to the phenomenal-descriptive use by the Impressionists or the physical-descriptive, symbolic, and decorative uses in the past. Here color is used, partly because of its visual weight, to balance abstract geometric compositions. Kandinsky found optical forces active in color. He found that color optically created spatial planes: Color orients itself in space according to its hue and environment. He found that certain colors also gave feelings of expansion or contraction. The American painter, Hans Hofmann, further utilized this power of color in his Abstract Expressionist works in the 1940s. He called this spatial resolution of colors "push-pull," that is, the felt push and pull of colors interacting in space. In these examples, there is the realization that color has the power to evoke, directly and abstractly, an objective response from the spectator.

A more recent and direct influence on today's painters are the publications, paintings, theories and experiments of Josef Albers.<sup>2</sup> His work, dealing with the interaction of colors and modifications caused by their juxtaposition, has undoubtedly given great impetus to the present state of optical art. Anuszkiewicz, for example, became experienced in the theoretical and empirical use of color as a pupil of Albers at Yale.

Albers and some American painters such as Clyfford Still (b. 1904), Barnett Newman (b. 1905), and Mark Rothko (b. 1903) have been influential in the use of color as the primary source of interest to engage the eye. In their work, they tend to minimize the visual importance of the image in order to give color primary importance in the total expression. Their paintings, however, are gentler and more subtle in their color as compared to those of the optical painters who seem to strive to maximize the power of color and visual dynamism. The former seem to be a more contemplative art compared to the latter group which, in a sense, does not ask the viewer to respond, but forces him, physiologically, to do so.

Color as a visually dynamic force, at this stage of development, is no longer used to describe or symbolize objects or emotions. Nor is it any longer used as a tangible descriptive element in itself, but has become, in optical art, a means of physiological and psychological activation or sensation--a dynamic visual experience.

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<sup>2</sup>Josef Albers (b. 1888), German, former member of the Bauhaus in Germany, is presently teaching at Yale University.

The large, simple images of Rothko, Newman, and others were found inadequate by the optical artists who wanted an intense visual experience. They found that by repeating like or similar shapes in a dense pattern, the dynamism of the picture could be increased. The forms used by today's optical artists are simple and basically geometric in shape. In their simplicity and multiplicity they tend to negate their individual importance for the effect of the whole, which in itself is sometimes quite simple. Many optical pictures have essentially eliminated imagery. They create what might be called non-image fields where variations in the optical or vibrational intensities imply rather than define form.

The use of a repeated abstract form is found in early art as a decorative motif. It was not used to create formal tensions as in the work of the De Stijl group, or as a source of optical movement. In the later paintings of Mondrian can be seen the beginning of a visually dynamic art. Mondrian wanted to express action by the implied tensions of form, line, and color. He said: "Whether obscured or clarified, rhythm expresses dynamic movement through the continual opposition of the elements of composition."<sup>3</sup> However, in some of his last works, there is something added. In the paintings, Broadway Boogie-Woogie and Victory Boogie-Woogie (ca. 1942-1944), the lines which divide his

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<sup>3</sup>Quoted in Allen Leepa, The Challenge of Modern Art, New York, 1961, P. 110.

rectangular sections are sub-divided into smaller rectangular areas. This gives a repetitive, rhythmically contrived motif. By the use of the repetitive motif, he does not just express movement; he creates movement optically. Similarities can be found between these latter works and Poons' rhythmic use of the motif.

About the same time that Mondrian was painting his last works, Vasarely first exhibited what he called "plastique cinetique."<sup>4</sup> In it there is the use of geometric form, not with the compositional balance and tension of the Constructivists and De Stijl group, but as a source of optical illusion and movement. Vasarely makes wide use of repeated form. He sets up a rhythmic sequence or progression of like or similar shapes, progressively changing, in some cases, the size or varying the orientation of the shape for added visual tension and illusion. Vasarely uses repeated forms, but without the optically dynamic use of color. In Vasarely's work, and perhaps in the late Mondrian's, we begin to see the use of the motif as a purely abstract expression; that is, a motif having no mass, or weight, as in the previous geometric art. The motif is also relatively insignificant in size, yet, when shown in multiplicity, a visually dynamic whole.

Space has already been mentioned in the discussion of some of the historical aspects of color. We have seen that there is a more varied

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<sup>4</sup>kinetic plastic

use of space among the individual optical artists. Rather than study each kind of space mentioned before (see page 5), let us see what kind of space seems most compatible in a visually dynamic system. To be consistent with the meaning of visual dynamics, such space should optically fluctuate.

The space used by Kandinsky and Hofmann caused spatial tensions by the tendency of color to recede or come forward, expand and contract. Though the optical illusion of space is present in their works, it is still a static space, except for perhaps the initial optical movement of the colors shifting into an illusionary spatial orientation within the composition. In Mondrian's paintings, there is a spatial orientation that may be perceived in either of two ways. His paintings may be seen either as lines on multicolored planes, or as rectangular shapes on a flat ground. In other words, the figure-ground relationship of the painting can be visually reversed. Here is a type of space that can be changed at the will of the observer. It can mentally be made to fluctuate. In Albers' paintings there is a spatial fluctuation which is a little more complicated and perhaps a little less an intellectual manipulation. Here, more than two planes appear to fluctuate in space but with a seeming will of their own. In this instance, there is a visually dynamic space, a space which may remain in a state of flux as long as it is being observed.

Visually dynamic art offers nothing new in compositional idea.

The knowledge that such a response is possible is nothing new. It has been the concern in a great deal of artistic expression, particularly in that of the twentieth century. Wassily Kandinsky, a Constructivist sculptor, said:

### III

It [Constructivism] has revealed a universal law that the elements of a visual response, possess their own forces of expression, independent of any association with the external aspects of the world; that their life and their action are

#### RESPONSE AND TECHNIQUE

People respond to form and color in various individual ways. In that these elements are not chosen by convention for any utilitarianly abstract signs, but they are immediately and organically the primarily psychological, or subjective, sense, different reactions can become extreme. A cross may evoke deep religious feelings in a Christian whereas a Buddhist may be unmoved. An ink blot may express death to one person, or life to another. Kandinsky held a disgust for the color yellow; Mondrian disliked green. Color may bring about a reflex action upon the vascular system through the emotions. In some people, red light produces an elevated pulse and blood pressure, while green tends to do the opposite. In others, the reverse has been found true. In other words, various mental and physical states may be induced in individuals through their subjective associations with various forms and colors. However, the concern here is not with subjective reaction to form and color, though such reaction is necessarily a part of all visual perception. The concern is with a response based on the inherent evolutionary and primordial make-up of the human organism--an objective response as opposed to the more personal response relating to experiences and associations acquired in an individual's life span.

Cleveland, 1969, p. 153.

\*Gestalt is basically an innate biological ability of the mind to tendency to organize stimuli, visual in our case, in the most understandable way.

Koffka, Principles of Gestalt Psychology, New York, 1935.

The knowledge that such a response is possible is nothing new. It has been the concern in a great deal of artistic expression, particularly in that of the twentieth century. Naum Gabo, a Constructivist sculptor, said:

It [Constructivism] has revealed a universal law that the elements of a visual art such as lines, colors, shapes, possess their own forces of expression, independent of any association with the external aspects of the world; that their life and their action are self-conditioned psychological phenomena rooted in human nature; that those elements are not chosen by convention for any utilitarian or other reason as words and figures are, they are not merely abstract signs, but they are immediately and organically bound up with human emotions.<sup>1</sup>

Though Gabo was speaking of Constructivism, the statement could just as well have been applied to abstract art in general.

Much work has been done in the field of Gestalt Psychology dealing with optical phenomena created by the mind from perceptual stimuli. These are reactions that are supposedly independent of cultural-personal background.<sup>2</sup> Whether the response evoked is, or leads to, an esthetic response is something else. Let us just say that this ability of the human mind is to be viewed as another tool, just as color, line, and other elements, to serve our expressive needs.

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<sup>1</sup>Quoted in Herbert Read, The Forms of Things Unknown, Cleveland, 1963, p. 163.

<sup>2</sup>Gestalt is basically an innate biological ability of the mind to organize mental experience in terms of unified configurations, the tendency to organize stimuli, visual in our case, in the most understandable way. For more information concerning Gestalt theories, see K. Koffka, Principles of Gestalt Psychology, New York, 1935.

Perception is a function both of the physiological make-up of the eye itself and of the person's mental ability and capacity to assimilate visual experience. Therefore, the experience is psychophysical. Let us consider some of the elementary physical functions of the eye that are directly associated with some of the optical illusion of visual dynamics. The part of the eye that we will be most concerned with in this paper is the retina, the inner, back area of the eyeball. The retina is composed of two kinds of receptors specialized for light perception, called rods and cones. The cones function both in color vision and in achromatic vision. The rods function in achromatic vision, and vision in dim light when cone vision is known to be almost absent. All objects seen by means of rods appear in shades of gray. The periphery of the retina contains only rods. The area of most acute vision (fovea centralis) contains only cones. Elsewhere on the retina, rods and cones are mixed, except in the blind spot where the optic nerve attaches to the eyeball; here neither rods nor cones are found.

Now let us consider some of the basic psychophysical reactions directly related to visual dynamics.<sup>3</sup> Probably one of the most important phenomena contributing to visual dynamics is the after-image. An after-image is a primary retinal stimulation which remains through a succeeding stimulus. Various kinds of after-images may be

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<sup>3</sup>For a more comprehensive study of color, see Josef Albers, Interaction of Color, New Haven and London, 1963.

experienced depending on the nature and intensity of the primary stimulus and that of the secondary stimulus. One kind is where the after-image remains the positive of the primary stimulus. For example, the after-image of an intense red light may remain red through a succeeding stimulus. Another kind is where the after-image becomes the negative or complementary of the primary stimulus. For example, if we stare at an area of red, the primary stimulus, and then gaze at a neutral surface, the secondary stimulus, we may experience the sensation of green. If, in either case, the secondary stimulus is other than white or neutral, the primary stimulus may be modified accordingly. If the secondary stimulus of the second example above is blue rather than neutral, the resultant sensation may be blue-green, an optical combination of after-image and secondary stimulus. Also, the greater the brightness of the primary stimulus relative to the secondary stimulus, the greater the time duration, or lasting power, of the after-image. Since vision is not an instantaneous retinal process, after-images are with us constantly. However, they are only perceivable under certain conditions of light, contrast, and intensity.<sup>4</sup>

One way for an after-image to occur is when the eye moves from the primary stimulus; another is when the eye is plunged into darkness. The first case is of interest in visual dynamics because when the

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<sup>4</sup>For further information, see G. S. Brindley, "Afterimages," Scientific American, CCIX, No. 4 (1963), 84-94.

after-image moves with the eye relative to the position of its stimulus, it gives an illusionary, or optical movement of the image. After-image movement can range from the rather simple mode of motion and duration of our single stimulus and after-image relationship to more complex modes involving the multiplicity of stimuli. This latter case can be readily seen in a series of small shapes on a ground with an extreme contrast in color: for example, the parallel black and white lines or bars, or the checkerboard pattern as used in some of Vasarely's work. The result is a system that seems to vibrate. Curving parallel lines tend to accentuate the vibrational field with a vibrational intensity that varies according to the curvilinear pattern. The dots and ellipses of Poons are good examples of the after-image as applied to today's optical use of color other than black and white. In such optical systems, new after-images will occur as others die, giving a continuous and changing sequence of optical events.

Another effect which may be related to the after-image phenomenon concerns the division of colors, that is, the edge, or boundary between the colors. A visually dynamic edge is one that optically vibrates. Albers defines two types: the first is a well-delineated, hard and vibrating edge; the second vibrates also, but is not so distinct. It appears to vanish though it is a technically well-defined edge.<sup>5</sup> The

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<sup>5</sup>Albers, *op. cit.*, p. 65.

The first type is achieved by using colors which contrast in hue but are similar in value, or light intensity.<sup>6</sup> Red against blue with similar light intensity will give a very vibrant edge. Red against green, orange against blue, violet against orange are other examples. The greater the saturation of the two colors, the more the edge will tend to "jump."<sup>7</sup> If the saturation of one or both colors is reduced, the edge will seem to vibrate at a higher frequency but a "softer" intensity. In the case of a vanishing boundary, the effect is obtained by using neighboring colors of equal value. Colors such as violet and red, red and orange, blue and green, with equal light intensity will give an unstable, hard to discern edge. Color saturation is of less importance in this case than the previous case.

An infinite range of edge conditions can be obtained by manipulating the variables of hue and light intensity, from the hardest and most stable edge between black and white, to no edge at all. However, for the maximum optical vibration of the edge, the light intensity between the two colors must be equal.

At this point, we can define two special optical phenomena relating to dynamism. The first is a dynamism through the use of form: form dynamism, or a form vibrational system. The other is a dynamism

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<sup>6</sup>Value, or light intensity, is the relative lightness or darkness of a color.

<sup>7</sup>Color saturation is the strength or purity of a color.

by the use of the vibrating edge: edge dynamism, or an edge vibrational system. If we look at a painting of alternating black and white parallel bars, strong bar-form after-images will appear. This is a form vibrational system. Repetitive form becomes very important in this type of system. It appears to amplify and sustain the after-images and dynamism of the system. Much of Vasarely's work is based on form dynamism. A simple example of edge dynamism can be seen in a painting divided into two complementary color areas of equal value. The boundary dividing the two colors will optically vibrate. If we take the example painting of alternating bars with two colors of equal value instead of black and white, an over-all vibrational quality will ensue. Form dynamism in this example, if apparent at all, is reduced to secondary importance. Repetitive form tends to be less important to an edge vibrational system except in its capacity to add multiplicity to the vibrating edge. It is interesting to note that when the black and white bars in the above example are reduced to thin, parallel lines, the type of optical vibration is like that of an edge vibrational system. The after-images are no longer noticeable as distinct forms; instead the result is an over-all vibrational quality. This is probably because the bars are approaching a pure edge configuration in their reduction.

The environment in which an optical painting is placed has a strong influence on its visual effect. For example, two colors which have equal values in an environment of diffused indoor daylight may

appear unequal in value in a warm fluorescent or cool fluorescent light. In other words, a color which looks darker than its neighbor in one light condition may look relatively lighter, or of equal value, in another. If we assume a specific type of lighting, we also find a variable in the amount of light used; that is, relative values of colors are affected by the intensity of light. This fact was first investigated by Purkinje in 1825, and is known as Purkinje's phenomenon.<sup>8</sup> He observed that with failing light the relative brightness of different colored objects varied. The colors toward the red end of the spectrum, the so-called warm colors, became relatively darker and those toward the violet end, the cool colors, appeared brighter. When the light became very dim, the reds appeared almost black, and blues bright. This phenomenon can be readily seen in painting. If we use an example of thick, parallel red and green lines of equal light intensity, we find by dimming the lights that the red lines become darker relative to the green. If we brighten the lights, starting from our initial light intensity, the green lines will appear relatively darker. However, as normal lighting is already fairly intense, the relative values of the two colors in a very intense light will not be as extreme as in a very dim one. It should also be noted that when the light is very dim, and the red lines appear

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<sup>8</sup>Johannes Evangelista Purkinje (1787-1869), was a Bohemian physiologist and biologist who made discoveries of primary importance in widely diversified fields, notably in ophthalmology and embryology.

almost black and the green lines relatively bright, very strong linear after-images appear. Here we have the transition from an edge vibrational system to a form vibrational system. When the painting is restored to normal lighting, we find that the strong linear after-images disappear.

Even in a constant light environment, the relative light intensities of colors may vary. This variation can be found as a function of the viewing distance. Let us study the preceding red and green composition under a constant lighting condition. Assume that at a given viewing distance the color values are equal. If the distance is decreased; that is, the painting approached, red will appear increasingly darker relative to green. If the distance is increased, green will appear increasingly darker relative to red. In other words, warm colors appear to darken relative to cool colors if the distance between observer and painting is decreased; cool colors appear to darken relative to warm colors if the distance is increased. Also the vibrational intensity of the edge will decrease as the distance is increased or decreased, tending to a form vibrational system.

By looking at a painting with colors of equal value and squinting, there will appear a relative darkening of the warmer colors and lightening of the cooler.

One other variable to be mentioned in detail is that concerning peripheral vision. It has been shown that for the dark-adapted eye,

colors that appear to be of equal light intensity by direct vision appear with different intensities on indirect vision. For example, red against green with equal value will be seen as a dark red against a bright green in indirect viewing.<sup>9</sup> Contrast between direct and indirect vision seems to be even more pronounced in dimmer lighting. The dynamic importance of this phenomenon is the continual change of peripheral and foveal perception as the eye moves. This factor would be more noticeable and more important in large compositions where the picture itself takes up most or all of the visual field.

Differences in the physiological make-up of individual eyes, the angle from which the work is viewed, and reflections from surrounding objects are some of the other factors that may more or less detract from the intended effect of the work. Though these conditions tend to affect any painting, they will more readily affect works which are dynamically dependent on close value relationships. Two paintings, one based on red and green of equal values, and the other based on a dark red and bright green, submitted to like observations, will behave differently. The value relationships of the first example may be equal or reversed either way, depending on viewing conditions. In the second example, the red will remain darker relative to the green in all viewing situations. Though there will be a relative change in the value relationships of the

<sup>9</sup>Herbert Parsons, An Introduction to the Study of Color Vision, Cambridge, 1963, p. 84.

colors in the second example, it will not be as apparent as in the more finely balanced example, if it is observed at all.

Chapter II stated that space also could be visually dynamic.

This dynamism ranges from consciously controlled figure-ground reversal to planes which seem to move in space of their own accord. This latter case is probably related to an optical phenomenon called continuous reversal. Continuous reversal is an illusion of spatial orientation that will deviate from, and return to, its initial position regardless of how one tries to hold the orientation mentally. This will occur continuously as long as the stimulus is viewed. One example is a drawing of a tilted transparent cube described only by its twelve line edges. We first see it with a certain orientation in space, for example, tilted toward us. After we have stared for a length of time, the cube will suddenly reverse its orientation in space, tilting away from us. In other words, the edge lines initially appearing closest to us will, at the next moment, appear the most distant. It is true that in this instance the reversal can be done at the will of the observer. However, it will be found that a single orientation cannot be mentally maintained, the spatial position will inevitably change. Unfortunately, not enough technical, visual or theoretical knowledge of this phenomenon is available at this time to present any more than the fact that such a phenomenon does exist.<sup>10</sup> However, it is possible that this form of

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<sup>10</sup>For additional information consult W. C. H. Prentice,

dynamic space will become more and more important in the future development of optical art.

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"Aftereffects in Perception," Scientific American, CCVIII, No. 1 (1962), 44-50.

#### CRITICISM AND COMMENTS

The present state of optical art is one of simplicity. This is true not only in compositional and color idea, but also in the response evoked in the observer. For the most part, the paintings are composed of simple patterns with a limited number of colors and a very limited variation in color value. Many works may appear too obvious and uninteresting after brief observation. Their dynamic quality, though an intellectually interesting phenomenon, may become visually monotonous in its simplicity.

Visually dynamic art is still relatively young and would naturally tend toward simplicity. An understanding of the simple seems a necessary beginning and foundation for the complex. The evolution of Cubism is an example. In its initial stages, the forms and spatial relationships were quite simple, perhaps too-obvious. As the Cubist esthetic and technique developed, forms, space, and idea became more complex; this is particularly true in the latter stages of Analytical Cubism.

However, one should not get the impression from the discussion that paintings should become complex in form to be significant art. With

the development of Synthetic Cubism, form and space became less complex as visual things, but more complex in idea; that is, idea of space and form is related to the experienced world. Visual dynamics is greatly dependent on the multiplicity of optical events. Therefore, it appears

#### IV

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the development of Synthetic Cubism, form and space became less complex as visual things, but more complex in idea; that is, idea of space and form as related to the experienced world. Visual dynamics is greatly dependent on the multiplicity of optical events. Therefore, it appears that an increasingly complex art will result. The responsibility of the artist is the deepening of idea and esthetic experience. Perhaps this will become clearer in the following discussions.

A weakness of much of the optical art of today is the dependence of the close value relationships of the colors on the lighting environment. The works dependent on close values are painted for maximum effect under a specific lighting condition, and when they are exhibited in another lighting condition, their vibrational quality is decreased, in some instances, perhaps, becoming dynamically dead. This functional dependence of dynamism on light environment was shown in Chapter III. The day may come when the artist will specify that his paintings be exhibited in certain lighting conditions for a required visual effect.

The previous chapter pointed out some of the variables involved for the "correct" visual effect of an optical work. With the knowledge and experience of these factors, it is possible to use them for greater visual variety with less dependence on environmental conditions. A visually dynamic painting need not be strictly dependent on a specific lighting condition. By the manipulation of value relationships, a painting can be made with zones of different vibrational intensities.

depending on the lighting conditions and observation situations. In other words, some areas would be dynamically intense while others were relatively static, and the position of these areas would depend on the type and intensity of the lighting and the position of the viewer. True, the picture may no longer be entirely dynamic, but the static areas could become quite important as places for the eye to rest from the optical activity of the other areas, or as sources of variety or contrast to emphasize the inter-woven dynamism. Theoretically, a continuously varying light condition should result in an added movement of the changing fields of dynamic intensity. The use of colored lights has possibilities in this respect also.

Another possibility that needs some consideration is the combined use of form and edge vibrational systems. For the most part, today's optical artists seem to be limited to one or the other system. Combinations of the two systems could result in a rhythmic play between the solid, non-vibrational edge and the hard vibrant edge or the vanishing edge. The result could be the visual combination of distinct, slow moving after-images on subtle, vibrating edge conditions, or various other combinations. A simple example of combining would be a painting in which part was done in black and white to give a form dynamism and the other part done in close-valued colors to give an edge dynamism. The eye shifting between the two areas would tend to visually mix or superimpose them.

A strictly theoretical visual dynamic possibility involves the phenomenon of continuous reversal.<sup>1</sup> This possibility is the combination of two or more simple, continuously reversing patterns to give a single complex pattern. Assume the first pattern to be reversible in the sequence ababab. . . , and the second pattern to be reversible in the sequence 121212. . . . The two reversing patterns occurring simultaneously may give any number of resulting patterns depending on the time interval between a and b, and between 1 and 2. Some of these might be 1a2b1a2b1a2b. . . , or 1a21b21a21b2. . . , or a121b212-a121b212. . . . The possibilities are infinite. It should be stressed that this is not produced by a mechanical device, but is dependent solely on psychophysical reaction. However, much more research and development of optical phenomena is needed before simultaneous continuous reversal can be realized.

The research of the physicist, Edwin H. Land, opens up the possibilities of non-chromatic color. Land wrote: "The eye does not need nearly so much information as actually flows to it from the everyday world. It can build colored worlds of its own out of informative materials that have always been supposed to be inherently drab and colorless."<sup>2</sup> The perception of color may well become more and more

<sup>1</sup>See page 23.

<sup>2</sup>Edwin H. Land, "Experiments in Color Vision," Scientific American, CC, No. 5 (1959), 84.

dependent upon the psychophysical make-up of the individual. These are just a few present and future possibilities in a visual dynamic art. Practice and theory cannot help but discover more.

A common criticism of optical art is its scientific approach, with quality of research, decided analytical character; perhaps this is a valid criticism. Though intuitive, personal decisions are undoubtedly made in the paintings, there may still be too much of an obvious research quality about them. Such obviousness could easily detract from any deeper esthetic significance. Once again, newness seems to dictate the trend. In other words, the research quality seems a natural result of a young art. New uses of color, form, and space must be explored and learned, and research is a necessary part of learning. Picasso's "research" in his early explorations in Cubism can easily be seen in such works as Les Femmes d'Alger (O. J. R. M.) (1907). Artists must understand the medium before transcending its limitations to create an esthetically meaningful art.

Optical art is sometimes regarded as an impersonal art, an art that does not communicate. A work of visually dynamic art probably seems impersonal because of the viewer's difficulty in relating to it. One can relate, or identify, with an object because it contains elements with which one is familiar through past experience. Such elements might include representation of familiar form, space, etc. A scientist may feel a strong personal identification with a geometric abstract

painting because geometry is, or has been, an integral part of his life. Some people may identify with the artistic technique such as the tactile use of paint. Such things give a work the "human touch" like the sculptor's thumb print left on his sculpture. People may identify with the materials used such as wood, bronze, oil paint--these are things with which they are personally familiar. Even if the art object is highly abstract in terms of materials, technique and familiar form, it may be related to because of its optical stability which is inherently expected. We live in a world of tangible form, and we expect a certain stability. There is a physical congruity between inert pigment and non-dynamic art. However, in visually dynamic art, there is form, color, and space which is disassociated from the stability of common experience. Paintings that one would expect to be stable, predictable facts have become visually active and ambiguous. Certainly a great deal of Twentieth Century art tends toward the ambiguous, or unusual. It seems, however, that visual dynamics has pushed the unusual a bit further: it has eliminated another "familiar fact"--that of optical stability.

The power of optical art to directly evoke a visceral response is another experience which is, for the most part, unfamiliar to the art viewer. Such reactions as dizziness, hypnotic feeling, optical pain, and even nausea have been noted. Some of these responses are pleasing, while others are annoying and possibly even frightening, but the majority of these sensations are unrelated to the expected art

experience. In other words, the more that a new experience is unrelated to our previous experience, the less personal it seems. Therefore, the experience of visual dynamics may seem very impersonal.

We have just discussed the personal relationship between the art object and the viewer. Herbert Read has written: "What we really expect in a work of art is a certain personal element."<sup>3</sup> Which brings up the aspect of optical art regarding the personal relationship between the artist and his work. Each master artist has a personal style of presentation which connects him as an individual to the art object. Experience and artistic maturity appear to determine the mode in which an artist will express himself. Some of the early masters who initialed optical art, such as Albers and Vasarely, have developed uniquely personal styles. However, much of the present optical art has a distinct inter-familiarity. A great number of artists have recently become interested in optics, and there is undoubtedly a rapid exchange of ideas in this new and developing art. Groups of artists are even working working in teams to produce optical works.<sup>4</sup>

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<sup>3</sup> Herbert Read, The Meaning of Art, Baltimore, 1963, p. 27.

<sup>4</sup> Various groups have been organized in Europe: Groupe de Recherche d'Art Visuel in Paris; a group called Zero in Germany; two groups in Italy, Gruppo N and Gruppo T; and a group in Spain, Equipo 57. See "Op Art: Pictures that Attack the Eye," Time, LXXXIV, No. 17 (1964), 81.

The youth of the art and the "optical education" of its followers breed a certain similarity. Sometimes it is necessary to imitate in order to learn. In other words, it seems too early in the present developing condition of optical art to have really personal creations. It becomes a question of growth and maturity in the artist as well as the art form to make a unique expression. The validity of the art and the art work is found in history. In any new movement, artists exchange ideas and imitate each other at first. Picasso and Braque in the early stages of Cubism painted pictures that are so much alike it is difficult to determine who painted which. However, their mature styles can be easily distinguished. Both Picasso and Braque remained Cubists, but each with a unique, personal expression. It seems very probably true that with the development and maturity of visual dynamics and the artists involved, that personal modes of expression will develop.

Therefore, the reality of optical art is not in the art object, but in the viewer. Early art was concerned with the symbolic illusion of reality: the illusion of space through perspective, illusion of objects through naturalistic painting, illusion of emotions through epic, etc. These are symbols of external literal and non-literal fact. In the twentieth century an interest in the art object as a thing in itself takes place. The art object becomes its own reality; its meaning lies in

For an example of this and other optical phenomena, see Anna Berliner, *Hospital Psychology*, Chicago, 1949.

itself as a physical fact. Optical art is not entirely illusory. In fact, most of what is seen is the physical fact of what was painted. It may be said that "non-optical" art has a degree of optical illusion. However, the motivation in optical art seems to be in the direction where the object which is painted becomes less and less the visual fact.

### CONCLUSION

The primary subject of this paper has been an art based on the illusion of movement. Optical art in the broadest sense is an art based on any and all conditions of optical illusion, dynamic and static. An example of a "non-dynamic" illusion is found in a regular pattern of black squares on a white ground, or conversely, a regular white lattice configuration on a black ground. The illusion of a gray intensity appears at the intersections of the white lines.<sup>1</sup>

Optical illusions are aspects of visual experience and not of objects. Therefore, the reality of optical art is not in the art object, but in the viewer. Early art was concerned with the symbolic illusion of reality: the illusion of space through perspective, illusion of objects through naturalistic painting, illusion of emotions through color, etc. These are symbols of external literal and non-literal fact. In the twentieth century an interest in the art object as a thing in itself takes place. The art object becomes its own reality; its meaning lies in

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Optical art is not entirely illusory. In fact, most of what is seen is the physical fact of what was painted. It may be added that "non-optical" art has a degree of optical illusion. However, the motivation in optical art seems to be in the direction where the object which is painted becomes less and less the visual fact.

The result of such an art could be a very profound and close communion between art object, or artist, and viewer. For example, a hypothetical case might be the following: The artist creates a pattern, or composition, of optical stimuli which may be a very personal statement or feeling. The viewer reacts to the stimuli according to his inherent psychophysical constitution. The initial reaction would be through the physiological reflexes and Gestalt organization; that is, illusory movement and image fields would be mentally created according to the basic biological machinery of the human organism. After the initial "reflex" response and conscious comprehension of what is occurring, the subjective mind would come into play and further organize, modify, or add to the visual events and sensations according to its personal emotional characteristics. This would probably not be a distinct two part process, but more as a growing influence of the "personal self" over the "basic self" until a state of responsive equilibrium is reached between the two forces. At this point, a steady variation of visual events would continue while the object is viewed.

The viewer has actually participated in the creation of the art object. The final state of the illusion, hence the expressive content, depends on both the artist's composition and the responsive individual. Expressive content, being dependent on object and viewer is, of course, true in any art form, but it seems that in the kind of art cited above, the viewer has greater latitude to interpret and respond to the artistic statement. That is, he is not bound by the specifics of shape, color, and spatial relationships as painted in previous art, nor is he forced to see these elements, which were to a considerable degree seen in the same context by all viewers. The viewer is now led to a more individual experience in terms of space, color, and form.

However, today's optical art appears to be primarily at the level of physical sensation. Hopefully, with the experience and understanding of the technical and artistic principles involved in the inducement of optical sensation, the artist is building a good foundation from which to explore newer regions of artistic experience.

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Douglas Deane Peden

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as a supplement to the creative thesis

two acrylic paintings, one acrylic drawing  
No. and Medium

45" x 70"  
Size

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Title

24" x 37 1/4"  
Size

"97"  
Title

18" x 24"  
Size

"Suspension"  
Title

Which is in the permanent possession of the University of  
Colorado and recorded with the Department of Fine Arts.

Approved by

Roland Peiss

Co-Chairman of Committee

Thomas Woodman

Co-Chairman of Committee

Robert Day

Chairman, Fine Arts Dept.

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