Wave Space Painting with Science

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EVOLUTION AND DISCOVERY

My initial background in science included engineering preparatory courses in high school and undergraduate studies in aeronautical engineering followed by graduate studies in nuclear engineering at the University of Michigan, Ann Arbor. During the summers, I worked at several companies in California, primarily as a mathematician. It was not until my university years that I was introduced to the arts and humanities. This opened up a whole new world of experience; when time permitted, I studied art, philosophy, psychology and medicine on my own. Eventually, however, I found it necessary to find employment once again. I secured work in Detroit as a nuclear-reactor design engineer on Fermi I, the first “fast breeder” reactor. However, I continued my studies in the arts and humanities and, after 5 years, I quit work to become a painter. I moved with my family to Colorado, where I obtained a Master of Fine Art (MFA) degree in painting and art history from the University of Colorado.

I started painting, as most painters do, by drawing from nature and studying the masters. In the process, my painting style, my artist’s “signature,” evolved from “realistic” imagery to a completely abstract format. My personal/original painting style began with painting simple free-flowing curvilinear forms, as exemplified in Fig. 1, which marks the beginning of my Organic Period (1963–1964) [1]. These paintings were composed of radiating lines in a figure-ground relationship of contiguous color opposites, such as red/green in the original version of Fig. 1, or orange/blue or yellow/violet, with equal tonalities, which is a technique resulting in an optical vibrancy like that developed by the prevalent 1960s style Op (optical) Art; that is, if two contiguous colors have close or equal tonal values (tonal value is the measure of the lightness or darkness of a color on a grey scale from white to black), the edge they form will appear to vibrate. This is an optical phenomenon whose physiology I will not go into here; but such a design can cause visual discomfort to the viewer, which, early in my learning process, I occasionally achieved when I wanted to see how “loud” I could paint. To maximize the edge instability or vibration, the colors must be not only of equal tonal value but also color opposites at maximum color strength or purity. In theory, a black-and-white photograph or television image of two such contiguous, equal-value colors would be seen as a single grey—the edge would disappear. On the other hand, maximum edge stability maximizes tonal contrast, which is black against white. Even here, however, we can achieve optical vibration if we draw a field of tightly spaced black-and-white parallel lines. If the lines are curvilinear, the vibratory illusion is even greater, as can be experienced in the work of the British painter Bridget Riley [2]. Another interesting optical phenomenon that, through the visual dynamics of color, causes shapes and/or regions to optically vibrate involves the environment in which the painting is displayed. For example, two colors that have equal value in a natural daylight environment would appear unequal in value in a warmly or coolly lit room. Also, if the light source is dimmed, the colors toward the red/warm end of the spectrum will appear to darken, while those toward the blue/cool end will appear to brighten. This would be more noticeable in a hard-edged, color-saturated painting such as Fig. 1: Here the red lines would appear to darken and the green regions to brighten as the light dimmed. Another visual phenomenon of such a painting is how it optically changes through the varying light of the day: It has a subtle vitality of its own, induced by changes in light angles, brightness and reflections over time. This phenomenon is a feature of all color paintings, but is most obvious in those specifically painted with the optical close-tone dynamic in mind. However, even in a constant light environment, such as in a museum, the relative contrasts can vary. This variation occurs with a change in viewing distance. Warm-col-

Fig. 1. Sand Flea, oil on canvas, 24 × 30 in, 1963. (© Douglas Peden)
ors will appear to darken relative to the cooler colors as the distance between the viewer and picture is reduced and vice versa, and the edge intensity will change accordingly. Indeed, these are all subtle variations that occur in any multicolor environment, but they require a somewhat practiced eye to see them.

Linear/Landscape Period (1964–1970)

Perhaps because of my inherent love of the outdoors and landscape, and the feeling that the expressive potential of the radiating imagery of my previous period was limited, my painting evolved during my Linear/Landscape Period [3] into an open-ended, horizontally layered landscape format of line and color sections wherein the edges defined by two contiguous colored sections were configured to represent basic landscape symbols, such as water, mountains, clouds, vegetation and architecture. These were rhythmically and freely placed, like notes written in a music score, as seen in my triptych painting Homage III (Color Plate A No. 1). It is composed in a mostly cool color key (to borrow a term from music) of blue, which is somewhat counterbalanced by a warmer-color-keyed left panel. The middle section, with its radiating image, is reminiscent of my previous Organic Period. Also note my use of the sine wave in its various configurations, symbolizing the mountains and waterscapes—certainly a carry-over from my science background.

GRID/Euclidean Space Period (1971–1988)

After exploring the preceding format for a while, I found that I could convey a greater sense of “life” and energy in the flat spaces by adding a foundational Cartesian grid structure (as in graph paper). Using the grid format gave me the opportunity, as I painted the individual cells, to articulate the flat color spaces with diagonal rhythmic variations of variegated colors and tones as exemplified by Fig. 2. (In this particular painting, I experimented by adding a bit of impasto texture for a more tactile quality.)

CrossField GridField Space Period (1989–1991)

While working with grid geometry, I discovered what I found to be a new direction in both art and mathematics: I saw that I could go beyond the limitations of the straight-line Cartesian grid and coordinate system to a totally curvilinear geometry, presenting the possibility of endless grid and coordinate transformations. This mathematical concept I labeled GridField Geometry (GFG) [4–6]. It is a geometry that develops recursively through any number of wave fields, where a wave field is defined as a series of parallel waves one unit apart, whose parameters are freely chosen. I first conceived GridField Geometry using a grid configuration I labeled CrossField Geometry, which was so named because of the interdependence of two wave fields oriented perpendicular to each other, analogous to the x-y orientation of a Cartesian grid. This study became my CrossField Geometry Space Period (1989–1991) [7]. An example of a CrossField painting is Sym...
psyche #1: Transcendent Figure, shown in Color Plate A No. 2. Also, my landscape format was replaced with a musical interpretation—a visualization of sound in time; indeed, it is music not the “mathematics of sound”? These paintings were also oriented on two primary principles: content and meaning. First, the content was influenced by the sonata form in classical music, where the composition is divided into an Introduction or Exposition, that is, a statement of thematic material (as in Beethoven’s Fifth Symphony, First Movement: “dot-dot-dot-daaash”), followed by the Development section, which usually consists of the theme’s fragmentations, inversions, variations, etc., and its subsequent recombination, expressed in the Recapitulation and Conclusion sections. My thematic material, theme or leitmotif is either a single abstract shape or a series of mathematically related shapes. For example, the beginning theme in my Symphony #1 (see Color Plate A No. 2) is presented as the black figure on the far left. From left to right, it fragments and recombines in various ways to conclude in a “birdlike” final figure at the upper-right corner of the piece. The original theme (the black figure on the far left) is actually two birdlike figures combined. With my second principle of content and meaning, I attempt to incorporate a “literary meaning,” that is, an abstract narrative or metaphor analogous to examples of Program Music, such as the depiction of a landscape environment in Beethoven’s Sixth Symphony, “The Pastoral,” or the hero in Richard Strauss’s Ein Heldenleben (A Hero’s Life).

Other factors that become important to me in the expressive content of painting are the color and placement of lines and shapes. We have looked at the use of color edge stability, which is primarily a physiological response in the viewer; but color can also evoke a psychological response—an emotional response such as joy or sadness, feelings of triumph or tragedy. For example, the key of orange in a painting might be made the dominant color scheme to express warmth; or, perhaps, a dominant red might express violence; or blue, cold; green, calm. Indeed, I have not yet seen a hospital room painted red nor a woman dressed in red with the intention to calm the male psyche. Also, intensely bright or subdued colors could be used to bolster moods in the way that loud or soft sounds may evoke war or peace, respectively. In terms of placement, the close spacing of lines, high frequency of lines or a multitude of shapes in a painting might suggest speed or busyness. In any case, I try to give the thematic material a life of its own by “interacting” with its environment of color, space, line and rhythm. I think of these works as visual music, like tone poems, which make use of mathematical and aesthetic relationships to inspire a sense of sound, time, mood and life. However, any interpretation is certainly valid—my purpose here is merely to point out some details, personal and otherwise, that might be of interest regarding my creation of a painting. In the end, the “meaning,” intellectually and/or emotionally, is, of course, left to the individual viewer.


After a period of working with the CrossField technique, I saw that, rather than cross the two wave fields, I could orient them parallel to each other rather than perpendicular as in CrossField Geometry [8] for (in my experience) a totally new grid and mathematically complex geometry. Thus began my InterField (this term was chosen because of the interweaving of the two fields) GridField Space Period (1992–2006) [9]. An example is shown in Fig. 3, wherein the theme “experiences” various transformations in a variety of GridField spaces, with a “brilliant crescendo” enveloping its pure white image at the top (which may be barely discernible in the illustration because of the close tonal relationship). Such a “triumphal” resolution appears in many of my later works.

CURRENT PERIOD IN PROGRESS

In my current work, I use the science and art of GridField imagery to interpret or express real music. An example of the methodology is as follows: Using the 7-measure melody shown in Fig. 4 as my theme, I painted the two-panel work shown in Fig. 5. In the bottom panel the melody is introduced in its original score. Directly above this introduction (still in the bottom panel) the score/theme is repeated in a larger size, but with the black notes changed by means of a color coding based on the seven-color sequence of the rainbow—red, orange, yellow, green, blue, indigo and violet (ROYGBIV)—which also complements the seven notes of the whole-tone scale, that is, the octave. I chose the color yellow to represent the musical pitch of C and matched the remaining rainbow sequence to the pitch sequence. In the same manner, where the musical staff is divided by line and
space to indicate seven levels of pitch, the rainbow sequence is similarly applied in the bright, striped middle-right section of the main canvas. Also, to complement the seven-pitch octave, I used the option of programming the stave spaces according to seven levels of tone, from white through shades of grey to black, which can be seen in the tonal layers leading to the white space at the top of the painting. I also used this technique in layering the GridField waves in the middle-left section of the painting and in the cell variations so dramatically displayed in the supporting rhythmic structure in the lower striped section of the main canvas. The melody is seen painted in different GridField transformations, sometimes maintaining the color coding of the musical notes originally assigned to the score. One example can be seen in the varying grey striped section leading to the extensive white space at the top. Two other examples can be seen in CrossField grids in the lower section of the main canvas—one on the left and one on the right. Sometimes the theme is scored in just one color, as can be seen twice—in the central varying grey striped section and once at the top of the painting. One might observe a preference for the number 7 in this painting—the melody is divided into seven measures and varied seven times. Note also that the whole melody is handled in much the same manner as a leitmotif.

The composition of the painting is based on the classical sonata form as discussed above, but in this case is meant to be read from the bottom of the painting to the top, where it concludes, transformed into a calligraphic configuration (based on an underlying InterField grid), “freely expressed,” in an uncluttered white space.

CONCLUSIONS

Until proven otherwise and for what it is worth, I believe I have achieved the following original contributions in art and science: in art, in the way I interpret landscape and music [10]. Arguably my originality can be seen in all my artistic periods. In science (mathematics), I submit that my achievement is in the conception of GridField Geometry. Although there are probably computer programs that can generate CrossField grids, to my knowledge there are no such programs or attempts to solve the much more complicated InterField Grid.

Whether GridField Geometry is of any use beyond art and design remains to be seen; but there is always the possibility acknowledged by the following statement.

There is no branch of mathematics, however abstract, which may not some day be applied to phenomena of the real world.

—Nikolai Lobachevsky (1793–1856)

References and Notes

Unedited references as provided by the author.


7. Peden [1], Hyperseeing (March–April 2008).

8. Peden [6].


10. Examples of how other artists have interpreted landscape and music can be found in the exhibitions “Approaching Landscape,” an exhibition of landscape paintings from Sioux City Art Center’s permanent collection, Sioux City, Iowa, 3 August 2009; and “Painting Music: Rhythm and Movement in Art,” at the Sheldon Memorial Art Gallery, Lincoln, Nebraska, 22 April 2009.

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