THE COLOR-MUSIC CONNECTION: PHILOSOPHICAL, AESTHETIC AND SCIENTIFIC PERSPECTIVES

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ABSTRACT

Since the days of Aristotle and Pythagoras, philosophers, artists, musicians and scientists have debated whether an analogy exists between color and sound harmonies. An examination of the aesthetic theories and creative works of significant modern artists and musicians reveals the ongoing nature of this debate. In addition to a variety of theoretical justifications for their beliefs, a number of creative artists have applied color-sound correlations in a practical way through the development of color-organs and other instruments for synthesizing the visual and auditory arts. Although scientific proof of a direct connection between color and sound remains subjective and elusive, the weight of philosophical and historical evidence supports the contention that a connection does exist on an intuitive and aesthetic level. Furthermore, the effort to produce an art form that unifies these two modes of creative expression continues unabated in the rapidly evolving field of computer-based interdisciplinary art.

CHAPTER 1

INTRODUCTION

Background

The experiences of color and music in the Western world have always been closely intertwined. From the days of the ancient Greeks through the Middle Ages and into the Renaissance, both color and music were widely considered to possess inherent moral powers to influence their viewers and listeners for better or for worse. Even during the Age of Enlightenment and into contemporary times, many mystics and followers of occult traditions have insisted that particular colors and types of music, especially synchronized combinations of the two arts, possess the ability to induce trances and hypnotic states. Recent studies of epilepsy[1] actually concur that some types of seizures can be triggered by the color and sound patterns of video games and animated cartoons. In the modern world of ubiquitous multimedia productions, an examination of the possible association between color and music has become increasingly significant.

Statement of the Problem

Is there really a connection between color and music? If so, what is the nature of the association between the two arts? Does a connection exist on philosophical, aesthetic or scientific levels? What have philosophers, creative artists, and scientists themselves

[1]See description of scientific studies in Chapter 6, subheading "Tempo and Motion Image Sensitivity" (p.p. 42-3).

had to say on the subject? Are experiences of a color-music connection part of a measurable, objective reality or part of the subjective, inner life of the observer?

Purpose of the Study

The purpose of this discussion will be to determine the nature of the relationship between color and sound by first examining the theories of major philosophers throughout history who have held opinions on this topic. Secondly, the influence of the color-music connection on contemporary art will be considered. Subsequently, an assessment will be made of the relationship between technological developments and the creation of instruments to produce simultaneous color-music compositions. Finally, scientific evidence will be analyzed briefly. Conclusions will then be drawn based on a collective weighing of philosophical, aesthetic and scientific perspectives on the color-music connection.

The uniqueness of this study is the attempt to combine these three major perspectives in order to reach a collaborative conclusion concerning the nature of the color-music connection. In addition, prior discussions have been focused almost exclusively on the entertainment and aesthetic value of color-music compositions. This study expands upon two other areas of potential use for color-music—applications of color-music in psychotherapy and in innovative approaches to interior design.

Theoretical Basis

The conceptual framework of this study is built upon the hypothesis that there is, indeed, a connection between color and music. Further, that this connection is aesthetic

and intuitive rather than objective and scientific. The value of these individual perceptions and interpretations of the color-music connection to the ongoing evolution of the arts is emphasized.

Limitations of the Study

This discussion is focused on the development of Western aesthetic theory and innovations in the arts. Non-western philosophies and artistic endeavors have not been considered. Since cultural associations with both color and music are strong and sometimes highly differentiated, the nature of the color-music connection may vary widely from culture to culture. Scientific investigations into the color-music connection also seem to be limited to studies of individuals in the Western paradigm.

Definition of Terms

color-music- a visual art comparable to symphonic musical compositions and usually consisting of mobile abstract color shapes; the forms are sometimes geometric, often amorphous and occasionally representational; usually involves the integration and interpretation of music; also referred to as kinetic art, visual music and lumia

absolute films- a form of abstract animation which attempts to synchronize visual forms with sound

CHAPTER 2

REVIEW OF THE LITERATURE

The literature pertaining to the topic of color-music is generally scattered among books and periodicals on such diverse topics as color theory, cultural history, psychology, fine art, religion, interior design, aesthetics, mathematics, music history, philosophy and medicine. This eclectic situation makes the study of the color-music connection both challenging and fascinating.

Entire books on the topic of color-music are extremely limited. Notable exceptions are A. Wallace Rimington's *Colour-Music: The Art of Mobile Colour* (1937), Donna Stein's introduction to an exhibition catalogue on the work of Thomas Wilfred entitled *Thomas Wilfred: Lumia, A Retrospective Exhibition* (1971), and Tom Douglas Jones' *The Art of Light and Color* (1972).

Primary sources directly applicable to this discussion include M.E. Chevreul's *The Principles of Harmony and Contrast of Colors and Their Applications to the Arts* (translation based on the first English edition of 1854), Wassily Kandinsky's *The Art of Spiritual Harmony* (1914), the psychological monograph *Colour-Music* (1938) by Theodore F. Karwoski and Henry S. Odbert Frank, the research article entitled "The Effect of Stimulation of the Senses of Vision, Hearing, Taste, and Smell Upon the Sensibility of the Organs of Vision" (1940) by Allen and Manuel Schwartz, the article "Auroratone Films for the Treatment of Psychotic Depressions in an Army General Hospital" (1945) by Herbert E. Rubin and Elias Katz, and the 1993 research paper

entitled *TEMPER: A System for Music Synthesis from Animated Tessellations* by Goffredo Haus and Paolo Morini.

Two authors have explored the color-music connection in separate chapters as a part of larger works on related topics. Maitland Graves' book *Color Fundamentals* (1952), a comprehensive text on color theory, includes a very useful chapter entitled "Color Music." John Gage's more recent *Color and Culture: Practice and Meaning from Antiquity to Abstraction* (1993) includes a detailed chapter called "The Sound of Colour" in which he traces the belief in a color-music connection from a historical perspective. Gage looks at the influence of the color-music connection on developments in various forms of the arts, primarily painting.

This investigation of the color-music connection differs from other studies in the field by drawing from the widest possible range of disciplines in order to provide highly inclusive coverage of the topic. By looking at the color-music connection from as many angles as possible, implications for future applications of color-music outside of the arts themselves become more readily apparent.

CHAPTER 3

THE THEORECTICAL CONNECTION BETWEEN COLOR AND SOUND

Ancient Philosophies

Throughout history, the potential correspondence between color and sound has received repeated attention from prominent philosophers, artists, musicians and scientists. Similarities between color and sound were clearly noted by the ancient Greeks. Some Greek theorists considered 'color' to be synonymous with 'timbre' as a quality of sound itself. In the fourth century BC, Plato's friend Archytas of Tarentum called a new kind of musical scale 'chromatic' (Gage 227). Since the days of the Greeks, the two arts—color and music—have shared a notably common nomenclature: tone, pitch, intensity, volume, form, etc.

The analogous aspect of color and music that seems to have been the most convincing to the Greeks was the almost mathematical similarity in their "regularly stepped scales" (Gage 227). In other words, both color and sound could be arranged in a series of stages with equal differences between each measured step. The ratios among gradations of colors in a color scale would be similar to musical ratios and proportions. In his book *De Sensu*, Aristotle discussed in a general way a possible analogy between color and sound harmonies (Graves 89). Although Plato himself eschewed "any attempt to discover the proportions of colours," Aristotle wrote briefly of the potential success of this endeavor in his treatise entitled *On Sense and Sensible Objects*:

> It is possible to believe...that [the] number [of colors] is due to the proportion of their components; for these may be grouped in the ratio of three to two, or three to four, or in other musical ratios (or they may be in no expressible ratio...) so that these colours are determined like musical intervals. For in this view the colours that depend on simple ratios, like the concords in music, are regarded as the most attractive, for example purple and red and a few others like them[...]. (qtd. in Gage 228)

Aristotle may have agreed with the early Greek theorists that purple could be identified with the musical fifth, red with the fourth and white with the octave, but he seems to hesitate to construct a complete color scale in direct consonance with the musical scale (Gage 228).

Pythagoras also contemplated a parallel between the musical scale and the spectral colors. In fact, the word "synesthesia" is derived from the Greek words 'syn,' which means 'together,' and 'aisthesis,' which means 'perception.' Synesthesia refers to individuals who experience involuntary cross-sensory associations. The most common form of synesthesia is "colored hearing," or seeing colors when a sound is heard. Interestingly, Pythagoras "considered synesthesia to be the greatest philosophical gift and spiritual achievement" (Lyons 8).

Medieval and Renaissance Theories

Throughout the Middle Ages and the Renaissance, the music of the ancients remained as a living ideal. Rudolph of St. Trond, a theorist of the late eleventh century, claimed that the modes of plainsong could be identified with the ancient Greek modes

and that both could be allied with particular colors. In his notational system, the Dorian mode was to be written in red, the Phrygian mode in green, the Lydian mode in yellow and the Mixolydian in purple (Gage 228). The Milanese theorist Franchino Gaffurio reintroduced this idea in the fifteenth century. Gaffurio further associated the colors and modes with the Greek humors (Gage 228).

Vincent of Beauvais, the medieval author of a work called *Great Mirror*, attempted to expound upon Aristotle's proportional color-music ratios. However, Beauvais believed that only seven colors could embody proportions that would appear pleasant to the eye. This resulted in a different color-chord consonance. Beauvais related pink to the musical fifth and light green to the musical fourth (Gage 228).

During the Renaissance, the Venetian theorist Gioseffo Zarlino claimed that modern musical counterpoint had added the major and minor thirds and the major sixth to the ancient fundamental ratios of the fourth, fifth and octave. Musical consonance was thus brought directly "into a potential relationship with the new scale of primary and secondary colours" (Gage 229). Leonardo da Vinci, who insisted on rational and geometric arguments for the color-music connection, was sufficiently convinced of the consonances to draw diagrams of "colour organs" (Lyons 8).

Arcimboldo, a Milanese painter of the sixteenth century, was one of the earliest artists in a long line of luminaries to endeavor to merge the arts of painting and music. Arcimboldo "devised a method of color harmony established upon a color scale similar in its system to the musical scale" (Graves 89).

Ideas in the Age of Enlightenment

In 1662, Athanasius Kircher renewed interest in possible connections between color and music with pertinent comments in his *Musurgia Universalis*. The philosopher John Locke likewise touched upon the subject in his 1690 publication entitled, "An Essay Concerning Human Understanding" (Lyons 8). The pivotal scientist Isaac Newton put forth a set of color/sound correspondences in his famous foundational book *Optiks*, originally published in 1730. In this work, Newton related the spectral colors to the diatonic scale in a simple, straight-forward approach: red was equivalent to the note C, orange was paired with the note D, yellow was matched with the note E, green was associated with the note F, etc. (Birren 163).

On the other hand, the German poet and philosopher J.W. von Goethe's famous three-part publication *Theory of Colors* (1810) attacked much of Newton's color theories (Gage 202). Goethe did not believe that color and sound could be compared in any way (Jones 14). However, Goethe did emphasize the psychology of vision and the allegorical and symbolic values of color. These conflicting ideas set the stage for modern artists and musicians to interpret the color-music connection according to their own temperaments, scientific leanings and aesthetic sensitivities.

The Modern Debate

Classical and modern composers fond of relating colors to their music include Liszt, Beethoven, Schubert and Rinsky-Korsakoff. According to Birren, Liszt described his dramatic intentions with decorative phrases: "More pink here;" "This is too black;" "I want it all azure" (163). Beethoven is reported to have referred to B minor as the black

key. Schubert is said to have "likened E minor 'unto a maiden robed in white and with a rose-red bow on her breast'" (Birren 163). And Birren states that Rimsky-Korsakoff associated the color of sunlight with the key of C major and a strawberry red with the note F sharp (163).

A. Wallace Rimington (1854-1918), a prominent instrument inventor, writer and artist in the nineteenth and early twentieth centuries, wrote extensively on the analogy between color and sound in his book *Colour-Music: The Art of Mobile Color*, published in 1911. Rimington, like a number of other theorists, constructed a scale of direct color-music analogies (see Appendix A). Most importantly, Rimington set forth and thoroughly discussed what he considered to be the major "points of resemblance between colour and music" (34).

In the first place, Rimington begins, both color and sound are produced by vibrations that act upon the eye and ear respectively. Secondly, both color and music are limited to particular ranges of visible or audible vibrations. Third, both create their effects through changeable levels of harmony and discord. Fourth, both tints and notes give pleasure or distress to the audience through a variety of combinations and sequences. Fifth, both color and music can also be combined with other art forms for a heightened experience. Sixth, rhythm can be used to add interest in both artistic and musical compositions. Finally, changes in dynamics can be created in color through increases in the strength of the hue. This is similar to the potential for increasing tone strength through volume changes in music (Rimington 34-37).

Many of Rimington's ideas were not new, of course, as these were probably some of the very issues pondered by the Greeks in ancient days as well as by alchemists,

mystics and philosophers throughout history. Although a remarkable number of the luminaries noted above were convinced of the presence of some sort of color-music connection, others disagreed. One of the more influential naysayers was M.E. Chevreul (1789-1889), a brilliant chemist who changed the entire course of modern art with his insightful theories concerning color perception and color harmony.

The effort to devise a scientific approach to color usage continued to be foremost in the minds of eminent physicists and chemists in the nineteenth century. Chevreul's landmark publication in 1839 was completely devoted to addressing this issue. Chevreul's book, called *The Principles of Harmony and Contrast of Colors and Their Applications to the Arts*, reported his extensive observations of the optical effects of colors. Chevreul further developed a series of guidelines for color usage that could be adapted to artistic endeavors of all types.

Simply stated, Chevreul's "laws" affirmed that a pure hue placed next to another pure hue would result in a more dramatic optical effect than side-by-side colors that have been muted through traditional shading and rendering (136). For example, when opposite colors are placed together, red and warm colors are seen a split second before green and cool colors. This "causes a vibration to take place" in the perception of the viewer (Maxion 88). The Impressionists seized upon this fact to aid them in their attempt to create naturalistic shimmer and movement in their works (Maxion 88).

Chevreul also observed that colors placed next to one another affect the actual color seen by the beholder. For instance, a red placed next to black will appear to be a different hue when compared with the same red placed next to a patch of yellow, white, blue, or any other hue. This type of observation was a deepening and expanding of

Goethe's understanding of the "physiological, optical, and neurological reactions to color" (Birren 53).

Although Chevreul readily admits that hearing is the sense that has "the greatest affinity with sight," he also stresses that "the marked difference between sounds and colours strikes me much more than their generic resemblance" (Chevreul 240). Chevreul believed that color is intrinsically connected in the mind of the observer with the material form on which it appears. Music, on the other hand, exists immaterially (Chevreul 240-1). Chevreul's observations were made, of course, prior to the advent of a truly abstract art that would later liberate color from recognizable form and from the mental constructs of dogmatic symbolism.

Chevreul also emphasized the temporal element of music and the importance of a succession of sounds versus the essentially static nature of color (240-1). Once again, his observations were made before the invention of electricity, colored lights, animated abstract films, and the highly mobile and rhythmic laser shows of the modern world. Perhaps such experiences would have softened Chevreul's careful logic.

Another naysayer was the monumental German composer Richard Wagner (1813-1883). In spite of the fact that much of Wagner's music was pictorially oriented ('fire' music, for example, which "was meant to interpret the crackling and flickering of flames"), he clearly rejected a direct color-music connection (Jones 102). Wagner once wrote: "I have met intelligent people with no sense at all of music, and for whom tone-forms had no expression, who tried to interpret them by analogy with color-impressions; but never have I met a musical person to whom sounds conveyed colors, excepting by a figure of speech" (Jones 102). Those figures of speech, of course, can

indicate a more general psychological association between color and sound that is significant in its own right.

Finally, Tom Douglas Jones (b. 1910), author of the book *The Art of Light and Color* (1972) in which the above quote by Wagner appears, is a modern artist and instrument inventor who was a pioneer in the development of kinetic color art. Like Wagner, Jones gives no credence to discrete color-music correspondences:

> This book agrees and assumes that there is no scientific relationship between the vibration frequencies of color and the vibration frequencies of sound. In fact, color wavelengths or frequencies are natural phenomena, to be objectively measured. The diatonic scale in music, however, is an arbitrary concept of Western culture, and even though certain frequencies bear relationship, one to the other, any possible alliance with color would be presumptuous. (100)

Jones does believe, however, that both emotional and psychological associations between color and music are valid, including the alliance of colors with various instruments and with "the sound qualities of things other than musical instruments" (Jones 101). Whether the affinity between color and music is scientific or purely individual and intuitive, the following survey of a selected number of noteworthy contemporary artists and musicians illustrates that the color-music connection has unquestionably influenced the direction and quality of the modern arts.

CHAPTER 4

THE INFLUENCE OF THE COLOR-MUSIC CONNECTION ON CONTEMPORARY ART AND MUSIC

Wassily Kandinsky

Aside from the ponderings of theorists and philosophers, a significant number of artists and musicians in the late nineteenth century, some of them actually endowed with synesthesia themselves, assumed a fundamental connection between color and sound. Wassily Kandinsky (1866-1944), one of the most well known artists, esthetic philosophers and synesthetes of his day, believed unequivocally in the link between color and sound. In his work of 1914, *The Art of Spiritual Harmony*, Kandinsky postulates that cross-associations among the senses exist in all highly sensitive people. Kandinsky states that sense impressions are communicated "immediately to the soul, and thence to the other organs of sense" (50). He boldly asserts that "the sound of colours is so definite that it would be hard to find anyone who would try to express bright yellow in the bass notes" (51). For Kandinsky, yellow is the shrill sound of a trumpet, green is a violin, light blue is a flute, a darker blue is a cello, "a still darker blue a thunderous bass," and "the darkest blue of all—an organ" (74-77). White, Kandinsky believes, is the color of silence, and corresponds directly to the pauses that occur in musical rhythms (77).

Kandinsky does points out some distinctions between the two major creative art forms—art and music—that are remarkably similar to the protestations of Chevreul! On the one hand, Kandinsky states, music is not bound by reliance on visual geometric structure. On the other hand, music requires time for the communication to be

completed. In contrast with this, painting requires the arrangement of images in definite patterns but can also "present to the spectator the whole content of its message at one moment" (Kandinsky 42).

In spite of these differences, Kandinsky proposes important implications for the future of the arts based the general parallels between color and music. He sees the drawing together of these two primary arts as a positive development from which "will rise the art that is truly monumental" (Kandinsky 43). Early indications of this include parallels between the music of Debussy and the art of the Impressionists. Both rely on natural phenomena for subject matter. This equivalence results in a corresponding inner spiritual harmony. The sensitive music of Debussy, Kandinsky maintains, has in turn influenced the compositions of the Russian composers Mussorgsky and Scriabin (34).

Alexander Scriabin

Alexander Scriabin (1872-1915) experienced a level of synesthesia that was apparently even more intense than that of Kandinsky. Scriabin's synesthetic experiences directly affected his creative works. One of Scriabin's most famous musical pieces, a composition called Prometheus, was scored for orchestra, piano, organ, chorus and a special instrument called the Clavier á Lumiéres. This instrument was "designed to produce a scale of colored lights in direct relation with the modulations and variations of tone colors" (Schloezer 308). In order to have the harmonies of this instrument appreciated by the audience, the composition had to be performed in the dark so that the colored lights could be projected on a screen (Birren 163).

Scriabin believed that his personal color-music associations "must be shared by all endowed with colored hearing" (Jones 103). Scriabin associated particular colors with various musical keys, and also assigned a complete set of correlations between colors and exact musical notes. An intriguing aspect of this system of color-tone associations is that those who invented other systems of color-tone equivalences most certainly did not agree with Scriabin's designations (see Appendix B for details). Scriabin's strong spiritual leanings and his ardent devotion to Theosophy may also have prejudiced some of his less mystical contemporaries against his claims to a more refined understanding of the arts. In any case, Scriabin broke new ground with his bold public performance of what was perhaps the "first musical score ever written to include a part for the color organ" (Jones 104).

Piet Mondrian

In more recent years, a number of visual artists who have focused their mature work solely on exploring color and form relationships have also contemplated the equivalencies between colors and sounds. Foremost among these artists is Piet Mondrian (1872-1944), a native of Holland. Mondrian began his mature work with a variation of Cubism that was based on images in nature—the sea, sand dunes, the sky, canals, trees, etc. However, Mondrian's missionary zeal for a higher level of harmony in art eventually took him far beyond the bounds of Cubism. Mondrian believed that art could elevate man, and his desire to contribute to the spiritualizing of civilization grew in part from his Theosophical leanings (Rowland 161). Mondrian was also part of an idealistic group of artists in the Netherlands known as De Stijl or "the style." De Stijl's creed was a

combination of total abstraction, a minimum of creative terms, and restriction to the primary colors of red, yellow and blue and the non-colors of black, gray and white (Jaffe 11).

Mondrian sought the centrality and essence of an art stripped of peripherals. Like the architects of the International Style, a highly influential group of his contemporaries, Mondrian believed that beauty did not have to be heavy and monumental like the ponderous public buildings and over-worked paintings of the past, but practical, light and ephemeral. Mondrian's continued striving for spiritual clarification in his work eventually led him to a grammar of shape based strictly on horizontals and verticals. With these simplified elements and his masterful use of color contrasts, Mondrian achieves a remarkable degree of energy and vibrancy in his art.

Mondrian's late works are perhaps best exemplified by a large oil on canvas piece that he called Broadway Boogie Woogie (1942-3). Mondrian's composition is a grid of rectangles and squares balanced with almost mathematical precision. Not only is the reference to a musical corollary implicit in the title of this masterpiece, but Mondrian's interpretation of the New York street grid is also as joyful and lively as his beloved jazz music. In this remarkable piece, Mondrian uses only white, red, blue and yellow. His rhythmic arrangement of the geometric color forms are accelerated and syncopated in an unmistakably musical way. The singular use of primary colors also echoes the primitive, almost primordial aliveness of early jazz. This is not the tempered concerto of the drawing rooms of the past, but a work that flashes with the voltage and sounds of contemporary life. Mondrian's gymnastic geometry reverberates clearly with resonating tones of hope for the increasing sensitivities of modern man.

Kenneth Noland

In contrast with Mondrian's altruistic aims, the works of Kenneth Noland (b. 1924) and those of other American color field painters are considered by some art critics to be the most "socially indifferent canvases in the history of American art" (Hughes 156). Although each of the major color field painters, including Helen Frankenthaler (b. 1928), Morris Louis (1912-1962), Jules Olitski (b. 1922) and Kenneth Noland developed distinct modes of expression, they shared a common emphasis on color as a central aspect of painting. This extraordinary artistic movement both continued and challenged prior aesthetic traditions.

Key contemporary movements that contributed to the development of American color field painting include Impressionism, Cubism, Fauvism, Surrealism and Abstract Expressionism. Color field painting evolved as a new type of art that reevaluated traditional pictorial elements including naturalistic perspective, the function of line and shape, the role of formatting and, most importantly, the use of color. The infinite potential for variations in light and color pursued by the Impressionists was carried forward by Noland as well as the other color field painters. Noland investigated this phenomenon in a deep and intuitive way that resulted in a clear attempt to translate color harmonies into musical sounds.

Noland also inherited from the Impressionists the practice of painting in series. Noland chose basic geometric forms as "racks for color" (Hughes 156). The universality of the circle was particularly suitable for the abstract color language of Noland's art. In his circle paintings, which numbered close to two hundred, Noland successfully uses a

simple arrangement of concentric circles, sometimes referred to as targets, to display his incredibly keen sense of color. Like Mondrian's earlier Broadway Boogie Woogie, Noland's circle paintings pulsate with energy and movement.

For Noland, color placement is akin to musical composition. Noland believes that each color possesses a pitch "that resonates beyond itself and affects other, adjacent colors, which in turn affect the overall palette of the composition" (Agee 38). Colors, Noland insists, can also be placed at higher and lower pitches and "can be composed like chords across the spectrum" (Agee 38). Colors can also be used in conjunction with each other like major and minor chords, and repeated in varying ways to create visual counterpoint. Noland's musical analogies include harmony, dissonance, tone, and volume dynamics (Battcock 229).

Noland's marvelous painting entitled Song (1958) is the most obvious example of his attempt to translate musical sounds into color harmonies. In this work, a central pink circle is surrounded by a ring of red, then a concentric band of black, then red again, then deep blue and finally a band of gray with a hazy, irregular edge. The effect is like a single brass note vibrating outwardly until the sound begins to disintegrate and fade. Noland's horn is blaring triumphantly: life, color and pleasure are to be acclaimed loudly and without apology. In Noland's Song, color has found a tight chorus of voices and the internal harmonies are exquisitely strong.

Thomas Wilfred

Thomas Wilfred (1889-1968) was one of America's first artists to compose exclusively in light and color. Wilfred began his experiments in 1905 and worked with

this art form for the next sixty years. Like the American color field painters, Wilfred was concerned primarily with "the visual and theoretical importance of light and color" (Stein 9). His desire for movement and abstracted rather than subject-based art can be linked to the work of Post-Impressionist painters including Vincent Van Gogh and Georges Seurat (Stein 9). The basis of an art in motion, or kinetic art, is the utilization of time in a distinctly musical way. Wilfred's most significant contribution to the ongoing attempt to associate color waves with sound vibrations was the addition of the essential element of time (Stein 10). The historical distinction between the spatial arts—architecture, painting and sculpture—and the temporal arts—music, poetry and drama—had finally been completely obliterated.

Wilfred gave the name "lumia" to this new art. Wilfred's art developed into "complicated arrangements of form and color" which occurred in cyclical patterns (Stein 30). Two primary elements historically considered to be characteristic of music are integral to Wilfred's lumia. These are tempo and rhythm. According to Wilfred, these two elements apply to lumia in the following ways: tempo is the velocity of the motion of the visual phenomena and rhythm refers to the recurrence of particular forms or the cycle of the art (Stein 30). In addition to the use of the principle of simultaneous contrast of color explored so thoroughly by M.E. Chevreul and passed down to Wilfred by the Impressionists, Wilfred also employed his own principle of successive contrast (Stein 30). Successive contrast refers to the unique optical effect created by one color following another in sequence.

Although technological developments in motion pictures were advancing rapidly during the span of Wilfred's working career, he refused to have his works filmed.

Wilfred insisted that "absolute continuity of motion" was a main feature of lumia and that the limited number of frames per second in film would result in a disturbing level of flicker (Stein 30). He also believed that "the intensity range of a lumia composition" was "too vast for any known reproduction process" (Stein 30). Finally, Wilfred believed that reproductions would be inherently too mechanical. "Lumia..., like music," he stated in his 1956 treatise *Musing On the Spheres*, "needs an interpreting artist who also gives something new every time he plays.... Lumia is, like music, a living art;...the interpreter cannot be eliminated" (qtd. in Stein 202).

Wilfred also devised a system of notation for his art that is akin to musical notation. He arranged a series of letters and numbers on a vertical staff with columns reserved for each of the various elements in the composition including form, color, motion, and so forth (Stein 34). The composition could then be "played" by anyone competent in the use of the clavilux—a light instrument that he invented through fourteen years of experimentation (Stein 10).

Although Wilfred's method of composing lumia differed significantly from methods of musical composition (see appendix A), he believed that the two arts were based on parallel foundations:

> Music is build upon a basic foundation of silence....Lumia, likewise, rests on a basic foundation—darkness. Darkness must be established initial to any manifestation in the art of light, and only that light which the artist releases from his instrument must be permitted to fall on the screen. The end of a composition should be a moment of absolute darkness. (Wilfred 62)

Silence in a music hall during a performance is, of course, a necessary prerequisite for a comprehensible auditory experience. Similarly, ambient light would destroy the impact of a lumia performance.

Another shared foundation between the color art of lumia and the sound art of music is the need for continuity. If a symphony is stopped suddenly on any particular chord, the sound being produced at that exact instant may not possess a harmonious balance of instruments and notes. The sound only has meaning as part of the larger sequence of phrases and musical ideas. Similarly, an individual still of a fleeting image in a lumia composition "has meaning only as a link between what has been seen and what is to follow" (Wilfred 162). Wilfred believed that learning to think in an uninterrupted visual sequence rather than "in terms of a succession of static images" would be "one of the greatest difficulties the painter has to overcome when he turns to work in lumia" (162). Wilfred himself became so skilled that he was able to create visual symphonies of color that were described in contemporary reviews as "slowly evolving, shifting, glowing, abstract patterns" (*Time* 78).

Wilfred also experimented with creating lumia pieces that would harmonize directly with actual music. In 1926, he composed a visual work as a setting for Rimsky-Korsakov's Scheherazade. Wilfred performed this piece in conjunction with the Philadelphia Orchestra conducted by Leopold Stokowski in a series of concerts. Wilfred created motifs in lumia that corresponded to the themes of the music. Wilfred "did not follow the music measure for measure, but created an atmosphere around each movement" through the blending of form and color (Stein 36). However, Wilfred was

unsatisfied with this attempt and did not compose lumia as a visual accompaniment to music again for fifteen years. At that time, he composed a lumia piece as a visual environment for the Swan of Tuonela by Jean Sibelius (Stein 36).

In spite of these efforts, Wilfred's inherent bias was towards visual composition. He generally employed music "to enhance the meaning of a visual composition" rather than the other way around (Stein 36). Sometimes he simply used music as a prologue and epilogue for his lumia concerts. Wilfred established an Art Institute of Light in New York and toured the United States and Europe giving concerts (Moritz 2). A list of his compositions includes titles like Chorus (1936), Rhythm in Steel (1936), Crescendo (1939), Nocturne (1940), and Intermezzo (1941). Although Wilfred's terminology for his art was clearly musical, he did not combine the two modes in an unequivocally unified way. For Wilfred, the color-music connection was not a this-color-for-that-note proposition, but a more generalized fusion of two complementary modes of creative expression. Most of his contemporary "color music" artists and almost all of those who followed for the next three decades interpreted the connection between color and music in a similarly generalized manner.

Mary Hallock Greenewalt

Wilfred's greatest rival for international audiences in the 1920s was the concert pianist Mary Hallock Greenewalt. Greenewalt had studied piano with the legendary Theodore Leschetizky and had done recordings of Chopin for Columbia Records (Moritz 2). Greenewalt began her work in visual music due to her "desire to control the ambience in a concert hall for sensitive music like Chopin's" (Moritz 3). Greenewalt

utilized colors in a manner similar to theatrical lighting, and gave her first color-music concert in Philadelphia in 1911. Like Wagner, Greenewalt did not believe in a direct correlation between color and tone, but composed pieces "with strong programmatic associations" (Gage 245). For example, she wrote a color accompaniment for Beethoven's "Moonlight Sonata," and included a 'moonlight' key in her console along with several other "pre-established varieties of natural lighting" (Gage 245).

Greenewalt toured extensively until the late 1930s and also devised her own system of color notation akin to musical notation. She used this form of notation to record the intensity and outlay of various colors during her performances (Moritz 3). Greenewalt considered the use of colored light to be a perfectly natural complement to music: " 'since the nature of light is that of an accompaniment to all happenings' " (Jones 21).

Morgan Russell and Stanton Macdonald Wright

Morgan Russell (1886-1953) and fellow artist Stanton Macdonald Wright (1890-1972) collaborated for over twenty years in their quest to extend their abstract paintings into the realm of visual music. They produced a number of designs for color-light instruments and pursued various combinations of kinetic color art and music. Russell "felt that the music should produce a dialogue with the lights...so that one would not overwhelm the other" (Collopy 1). This desire to fuse color and music on an equal footing with each other heralded the return to attempts at a more exact synchronization of color and music. This synchronization became increasingly possible with the emergence of animated film as a powerful, new interdisciplinary art form. Additionally, the

development of computers and software programs in the last quarter of the twentieth century that are capable of translating music directly into graphics and color has further renewed interest in precise color-tonal correspondences. In these ways, the development of increasingly sophisticated color-music instruments has been integral to the continued quest for a thorough synthesis of the visual and auditory arts. This can be demonstrated more directly through a brief overview of the chronological development of color-music instruments.

CHAPTER 5

THE DEVELOPMENT OF COLOR-MUSIC INSTRUMENTS

Early Instruments

History indicates that combinations of color, sound and motion have always fascinated people. Virtually every culture has some form of traditional dance that combines colorful costumes, rhythmic music and whirling, energetic dance steps. In the Middle Ages, magicians and entertainers mesmerized their audiences with a variety of devices that used firelight to project shadows against walls. Movement was simulated by "wheels spinning in front of a light, revolving discs,...and innumerable crude...devices that created a variety of visual effects" (Bobker 3). Athanasius Kircher, mentioned above as the author of Musurgius Universalis, designed an early projecting instrument in 1648. He proposed the utilization of candlelight and colored glass lenses, but his instrument was never built. The first color-sound instrument that was actually built was the creation of a French Jesuit priest, Louis-Bertrand Castel (1688-1757).

The Ocular Harpsichord

Castel was a mathematician and writer with an interest in aesthetics. In 1730, he built a stringed musical instrument that combined sound with prisms intended to cast colored light (Collopy 1). Castel began by placing a square frame above a standard harpsichord. This frame supported sixty small windows of different colored glass panes. Small curtains were attached by pullies in front of each pane. When a key was struck, the associated curtain would lift to reveal the corresponding color.

According to William Moritz, a professor of film and animation history and author of the *Animation World Magazine* article entitled "The Dream of Color Music and the Machines That Made It Possible," the ocular harpsichord was a phenomena in its day: "Enlightenment society was dazzled and fascinated by this invention, and flocked to his Paris studio for demonstrations. The German composer Telemann traveled to France to see it, composed some pieces to be played on the Ocular Harpsichord, and wrote a German-language book about it" (1). Castel later went on to create a second, improved model with greater projecting power for the benefit of larger audience.

This new model, built in 1754, used about five hundred candles with reflecting mirrors to provide greater light to shine through the colored glass (Moritz 1). Castel's approach was clearly a color-for-note correspondence, but how he arrived at his choice of colors is unclear. Although the instrument was clumsy and there was "considerable chance of noise and malfunction between the pullies, curtains and candles," Castel believed that the Ocular Harpsichord would one day be mass-produced (Moritz 1). He envisioned his instrument in the parlor of every home in Paris, but Castel's dream was not to be fulfilled. The unavoidably awkward mechanics proved to be the Ocular Harpsichord's fatal flaw.

A number of other ambitious designers experimented with colored liquid filters and stained glass apertures attached to harpsichords and pianos. Others created moveable colored glass slides for the magic lanterns popular in the nineteenth century. However, all of these attempts at color-music instruments met with limited success. Real progress had to await the pivotal invention of electricity.

Modern Instruments

The number of color organs and visual music instruments invented in the first half of the twentieth century is legion: the Clavilux, the Sarabet, the Light Console, the Clavier á Lumiéres, the Colortron, Chromaton, Celeston, and the Sculptachrome are among the more well known. Each of these was unique in various ways. Some created geometric, angular forms while others produced softer, flowing images. Some linked certain colors directly with particular tones while others aimed at generating colorful atmospheres that loosely interpreted associated music. Some were 'visual music' in the sense that they created moving color shapes in a way analogous to music, but were not actually accompanied by sound. A few produced representational images, but most resulted in abstract color contours.

Dozens of devoted artists and musicians dedicated virtually endless hours and years to perfecting their instruments and compositions. Indeed, a number of creative artists and inventors made the development of this new color-music the focus of their life's work. This level of commitment underscores their fundamental conviction that a color-music connection not only exists, but that the conscious unification of color and sound is a viable and important dramatic artform. An examination of a few of the key instruments created after the discovery of electricity illustrates the integral relationship between technology and advancement in the arts.

The Clavilux

Thomas Wilfred named his first successful color-organ, the clavilux, after the Latin terms meaning 'light played by key' (Stein 10). This complex instrument was the

result of fourteen years of experimentation and included a keyboard, numerous powerful light projectors, condensing lenses, filters and an assortment of discs. The minimum of four projection units was controlled through registers and dials arranged in tiers (Stein 11). Wilfred's instrument also featured a set of rollers on which the papers containing his vertical system of notation were mounted. The paper moved upward "like the record in a player-piano, disclosing only the passage to be played" (Stein 66). Wilfred called this unique mechanical system, which also included a metronome, the Chronograph. Additional mechanisms related directly to artistic variations in the colored lights in 'lumia' were actually developed for the Sarabet, an instrument created by Wilfred's rival counterpart, Mary Hallock Greenewalt.

The Sarabet

The color-organ constructed and patented by Mary Hallock Greenewalt was " 'capable of giving forth a light scale conforming with a musical scale' " (Jones 21). Greenewalt's instrument won a gold medal at the Sesqui-Centennial International Exposition at Philadelphia in 1926 (Gage 245). Greenewalt invented two electrical mechanisms—the rheostat and the liquid-mercury switch—that allowed her to modulate light smoothly on the Sarabet. A number of other composers (including Thomas Wilfred) began to invent variations of these two switches. Greenewalt tried to sue for patent infringement, but a judge denied her case, ruling that "these electric mechanisms were too complex to have been invented by a woman" (Moritz 3)!

The Colortron

Tom Douglas Jones, the inventor of the Colortron, was a graphic designer, a professor, and a fairly competent engineer. The Colortron began as a teaching device that Jones used to demonstrate the additive color circle of light mixtures to his students at the University of Kansas during the thirties (Jones 39). The Colortron, however, became much more than this:

> It not only solved the immediate teaching problem but proved to be an invaluable tool for experimentation and for demonstration of colored shadows, afterimage, simultaneous contrast, irradiation, color constancy, and many other phenomena of light and color that ...must be isolated in a controlled situation.... It also provides a quick and convenient way of exploring such matters as color harmony, color preferences, color memory, that affective power of color, and color appropriateness in relation to form and function. (Jones 39)

Jones describes the construction of the Colortron in detail in his book *The Art of Light and Color: Featuring Mobile Color Expression, Lumia, Kinetic Light—with Instructions for the Creation of Dramatic Color and Light Instruments* which was published in 1972. Rather than a keyboard, Jones used a series of switches and dimmers that were calibrated so that he could record the settings. In this way, he could recreate particular compositions at will.

Jones also experimented with illuminating silhouettes of sculptured forms and with shining colored lights through mobile metal stencil plates. Although Jones did study

the piano, he was primarily a visual artist. Jones used music as "a stimulus to fantasy and invention" and as a "framework on which to build" his compositions (Jones 70). The music that Jones chose was always quiet, calm, and slow in tempo. Jones' practical mentality shied away from mystical meanderings. He would only go so far as to say officially that "parallel expressions" existed between color compositions and musical moods (Jones 70). Jones' pursuit of this "intellectual and aesthetic adventure" resulted in the creation of a number of colored light instruments. Among them was the Celeston, a machine capable of even more fluid and music-like effects.

The Celeston

With the creation of the Celeston, Jones demonstrated an increased enthusiasm for uniting the arts of color and music. Although he continued to reject the notion of a concrete link between particular colors and notes of the musical scale, he worked carefully with correspondences of tempo and dynamics—matching softness with dimness and loudness with a greater intensity of light—and with pairing appropriate moving color forms to his chosen musical scores (Jones 87). As Jones himself wrote in *The Art of Light and Color*: "the Gestalt thus produced was more than the sum of its parts—bringing a new excitement and pleasure to all who saw and heard it; even to those with little feeling for color or music alone" (87).

The Celeston was fairly simple in conception. A single light bulb shone through two rotating discs on which colored pieces of glass, small prisms, colored beads and colored acetate were mounted. As the discs revolved in front of one another, fluid transitions of form and color were created like those that might be produced by a refined

type of kaleidoscope. Sets of discs could be used interchangeably to create a virtually infinite number of patterns. Even the relatively pragmatic Jones had to admit that the Celeston produced "amazing and beautiful results" (Jones 93). The liquid effects produced by the projector-like Celeston were also characteristic of the compositions of other color-music artists who chose to work in the new medium of film. The role of early filmmakers in the development of this art form and their varying approaches to the color-music connection deserve some further consideration.

The Advent of Film

According to A.B. Klein, author of the 1937 encyclopedic work entitled *Coloured Light: An Art Medium*, several different techniques were available to filmmakers during the early years of film production. The simplest was the cartoon technique. This technique was similar to standard cartoon drawing. Individual colored drawings were prepared on celluloid sheets, and motion was simulated by filming each image in rapid succession. The process was intensely laborious—a film might easily require ten to fifteen thousand drawings. A variation of the cartoon technique was the use of colored paper, scissors and paste instead of drawings (xxvii).

Another technique involved solid models made of materials such as clay. Step by step photography could later be recorded on film and projected in a relatively seamless fashion. A series of photographs of the images produced by color-music organs could also serve as the basis for a color-music film. A final method involved hand painting directly on clear film with colored dyes or adding colors to a series of black-and-white images (Klein xxvii-xxviii).

The disadvantages and advantages of the film media were hotly debate. As mentioned above, some artists, including the imminent Thomas Wilfred, felt that the color-music films were a mechanical, impersonal artform. The performer and the instrument itself were notably absent. The performance would also be limited to "halls specially equipped...to project cinematographic films" (Klein xxix). Obviously the omnipresent modern movie theater was not a reality in the late 1930s! Another objection was that the scale of the illuminated area would be "decidedly small" (Klein xxix). The large movie screens of today were likewise apparently unforeseen.

According to Klein, however, the advantages of film, were also "manifold and evident":

1. Expensive and unique instrumental equipment is eliminated.
2. Perfect sound synchronization is assured.
3. Magnificent musical material is available via reproduction.... Or original music can of course be recorded on film.
4. Compositions can be created and preserved and referred to without necessitating the rare presence of a colour-music performer....
5. The reactions of a vast public can be rapidly collected and analyzed leading to the more rapid evolution of an established art.
6. The composer is offered limitless scope as to the class of composition he desires to create. No instrument and no collection of instruments and performers could compete with the reproductive powers of the film.... There is probably nothing that the human

> visual imagination can conceive which the colour film could not be caused to record (Klein xxix).

As history has demonstrated, the pioneers of early color-music film chose to avail themselves of a media that was to become more ubiquitous than any of them could ever have imagined.

Ginna and Bruno Corra

Two Italian brothers, Ginna and Bruno Corra, experimented with hand-painted film as early as 1911 or 1912. One of their early works was an abstract color film that was accompanied by Mendelssohn's "Spring Song" (Gage 245). Other works were to be accompanied by music that the brothers had written themselves. A short demonstration piece began with seven small cubes in the spectrum colors horizontally aligned at the bottom of a black screen. The colored cubes were grouped together in various ways, "crashing against each other, shattering and reforming, diminishing and enlarging, forming columns and lines, interpenetrating, deforming, etc." (qtd. in Gage 245).

Although the work of the Corra brothers was innovative, the contemporary forms formed an unusual juxtaposition with the style of the Baroque and Romantic music that they used. Rather than form a smooth connection between the color images and the sound, these early experiments were "at best a rather hybrid form of entertainment" (Gage 245). In fact, whether any of their films were ever shown in public is unclear. The first color-music film known to have been screened for a general audience was created by a German filmmaker, Water Ruttmann, about a decade after the Corra brothers had begun their experiments.

Walter Ruttmann

Walter Ruttmann (1887-1941) screened his "Lichtspiel Opus I" in his native country in 1921. Ruttmann's contemporaries report that he used painted designs on small glass plates. Ruttmann then distorted these designs with mirrors to create an early form of animation (Collopy 1). Ruttmann's moving patterns particularly impressed the art critic Bernhard Diebold and his friend Oskar Fischinger (Collopy 1). Fischinger became one of the most prolific and important pioneers of animated color-music films.

Oskar Fischinger

Oskar Fischinger (1900-1967) worked for thirty years in the animated film arena. Often referred to as 'absolute film,' Fischinger's compositions utilized a wide variety of techniques including clay-figure modeling, sliced-wax images and charcoal drawing (Collopy 2). Fischinger was particularly interested in "the dynamics of motion" and his work with music "often related a visual rhythm to an auditory one" (Collopy 2). The influence of Fischinger's work can also be seen directly in the 1940 Walt Disney film Fantasia. Fischinger's work was regularly screened during the time that Fantasia was being produced. One of the Fantasia animators, Harry Everet Smith, actually named one of his own creations after Fischinger (Collopy 2).

Harry Everet Smith

Harry Everet Smith (1923-1991) worked from the 1930s to the 1980s. During his early period, he did a batik style of painting directly on film. Then he moved on to a series of non-objective studies, then to "semi-realistic animated collages," and finally to

"chronologically superimposed photographs of actualities" (Collopy 2). Some of his later works were presented on multiple screens. As part of the Fantasia team, Smith helped to produce a work that significantly raised the profile of animated color-music film and brought the idea of a color/image correspondence with sound into the everyday realm.

Disney's Fantasia is a composite of various approaches to color-music film. Some sequences, such as J.S. Bach's "Toccata and Fugue in D Minor," are completely abstract. Other portions of the feature-length film, such as that which accompanies Mussorgsky's "Night on Bald Mountain" and Beethoven's "Pastoral Symphony," emphasize images suggested by the music rather than relying only on color and amorphous or geometric shapes. In these ways, Fantasia "raised fully to the conscious level the kind of concepts which the chosen pieces of music usually evoked in the listener" (Tame 81). The important role of animated art and color-music motion graphics in the film industry was to become increasingly significant with the explosive growth of film and multimedia productions in the decades that followed. Another set of brothers, John and James Whitney, further lifted the modern profile of color-music.

John and James Whitney

John and James Whitney (ca 1917-1995) began working with sound and film animation in 1940. John Whitney was a filmmaker, a composer and a technical innovator. His partner and brother, James, was a painter. They believed in a "unified bi-sensory relationship between film and music" (Lyons 10). One of their more famous sequences is the Stargate passage in 2001: A Space Odyssey. For their portion of this recognized cinematic masterpiece, the Whitney brothers used slit-scan photographic

techniques (Lyons 10). John continued to develop additional technological advances for their work by utilizing analogue computers that he purchased from military surplus centers.

With this primitive technology at his disposal, John created animations "of sufficient quality to secure him long time on-going support from IBM" (Lyons 10). In fact, John Whitney is considered by many film and computer historians to be the father of computer animation. John wrote extensively about his collaborative work with his brother James in his book *Digital Harmony: On the Complementarity of Music and Visual Art*, published in 1980. John believed that computer-generated animation would eventually allow music to be matched exactly with both patterns of movement and color (Lyons 10). The Whitney brothers played a critical role in helping color-music composers to make the transition from extremely labor-intensive animation techniques to the use of increasingly sophisticated computer programs.

Visual Music Software

The variety of computer programs and systems available for motion graphics and 2-D and 3-D color-music animations has expanded phenomenally in the last two decades. Examples of these programs and systems are known by such dynamic names as Houdini, Musikaliscope, TEMPER (discussed below), Open Inventor, Crystalume, Bliss Paint, Visual Music Tone Painter (discussed below), SeeMusic, Lightworks Graphic Synthesizer, Music Animation Machine, and Sonovision. The resulting audio-visual works may be highly geometric, fluid, or a combination of both. Some of these programs allow the operator a great deal of freedom in creating their own color-music

interpretations. Others use mathematical formulas to translate sound directly into color graphics.

TEMPER

The mathematical approach to computer-generated graphics is discussed in a series of articles edited by Michele Emmer and published in 1993 in the book *The Visual Mind.* This book includes a fascinating piece entitled "TEMPER: A System for Music Synthesis from Animated Tessellations" written by Goffredo Haus and Paolo Morini. The authors are researchers and program designers who are investigating direct associations between graphics and music.

Haus and Morini specifically report on a graphic process known as tessellations, or tilings—"drawings made up of one or more shapes that fill the plane without gaps between them" (Emmer 172). Haus and Morini developed their computer program to match the periodicity of both rhythm and pitch in music with the strictly geometric tessellations. Although they did not attempt to translate directly between sound and color, a similar principle exists in other programs. A unique feature of the TEMPER program seems to be the program's ability to translate "drawings created only for graphic purposes" into "interesting musical pieces" (Emmer 176). Thus, the TEMPER system goes both ways on the visual-auditory pathway—it can create graphics to accompany music and music to accompany graphic input!

Visual Music Tone Painter

Stephen Nachmanovitch, an author, composer and software developer who has extensively investigated the connection between color and sound, is the inventor of the

Visual Music Tone Painter program. Nachmanovitch's invention, which converts synthesizer signals into a visual display, was recently featured at the Lemelson Center of the National Museum of American History in the Smithsonian Institution. During a conference called *Play and Invention*, held September 22-23, 2000, Nachmanovitch's Visual Music Tone Painter was available for direct patron interaction as an exhibit entitled "Visible Music."

A fascinating aspect of the Visual Music Tone Painter is that color and light are also merged with touch sensitivity. Soft touches result in graphic displays which are different from those created by more forceful touches. Nachmanovitch, author of the 1991 book *Free Play: Improvisation in Life and Art,* believes that improvisation is at the heart of all forms of creativity. By merging sound, light and touch in the Visual Music Tone Painter, Nachmanovitch has emphasized the role of improvisation in his unique approach to this contemporary art form.

In a telephone interview on October 17, 2000, Nachmanovitch described his attempt to find an objective methodology for correlating color and sound. In the Visual Music Tone Painter, he has linked the standard color wheel with the octave of musical pitches. In order to avoid the potentially mechanical product that might come from trying to create visual images to accompany a pre-existing musical score, Nachmanovitch's software allows for co-formation of the auditory and visual media. Although the added element of touch sensitivity yields a wide variation of possible visual music compositions, the use of this synthesizer-based software eliminates the infinite number of individual idiosyncrasies which are invariably present with art based solely on personal cross-sensory experiences.

CHAPTER 6

A LOOK AT THE COLOR-MUSIC CONNECTION FROM A MODERN SCIENTIFIC PERSPECTIVE

Research Into Cross-Sensory Connections

The ongoing debate over the nature of the color-music connection has existed simultaneously in the realms of philosophy, aesthetics and science throughout the modern era. A Russian scientist, V. Urbantschitsch, conducted scientific experiments attempting to find a definitive relationship between the senses of vision and hearing as early as 1888. These investigations looked at how the stimulation of one sense organ "influences in some degree the sensitivity of the organs of another sense" (Allen, Schwartz 105). In other words, a person listening to a particular tone will see colors in slightly different ways depending on the pitch of the tone being sounded. Other researchers continued to attempt to expand information pertaining to this fundamental discovery.

In 1927, the Russian investigator Lazarev concluded that the sensitivity of the rods increased during acoustical stimulation (Allen, Schwartz 105). Another Russian researcher, P.A. Yakovlev, found in 1935 that "stimulation of the ear by sound conspicuously enlarged the area of the field of cone vision" (Allen, Schwartz 105). Further investigations by Yakovlev in 1938 revealed specific effects of noise and sound on color sensitivity: "under the influence of both tones and noises the color field for extreme red was unaltered, that for orange-red was diminished, and those for green and blue enlarged to the greatest extent" (Allen, Schwartz 105). None of these researchers, however, found a definitive relationship between particular tones and exact colors.

Other researchers were exploring additional aspects of the color-music relationship. In the 1930s, Theodore F. Karwoski and Henry S. Odbert, two American researchers at Dartmouth College, looked at the links between colors and general musical pitch, colors and musical dynamics, and colors and musical tempo. They found that light colors correlated to high notes and dark colors with deep notes, that intense color related to loud music while "filmy, grayish" colors were matched with soft music, and that most people associated the color blue with slow music and red with fast music (Birren 164).

Tempo and Motion Image Sensitivity

The powerful effects associated with the movement of images corresponding to the latter dimension—tempo—were noted by some of the earliest color-music artists. Thomas Wilfred "used rapid motion sparingly because it produced dizzying effects" (Stein 30). Wilfred recommended to other potential lumia artists that they be sure to provide a visual anchor for their viewers:

> When you are moving all your form elements in one direction, you should not momentarily exceed a certain critical velocity of motion without providing a relatively stable area in the field or you may cause your spectator serious physical discomfort. This applies particularly to horizontal motion. (Stein 30)

This advice, however, was flung to the wind in the 60s and 70s with the forms of visual-music created for discos and rock concerts. Flashing lights, mirrored reflections, bold colors, fluid designs and abstract patterns were combined with roaring, rhythmic music to produce intentional sensory overload. For some individuals, this disorienting experience

was a positive way to break down social inhibitions. On the other hand, "pulsating, stroboscopic lights are hypnotic and can produce headaches, nausea, and minor forms of nervous breakdowns" (Jones 31). Modern research has confirmed the potentially harmful effects of quickly moving, repetitive, high-intensity multicolored or white patterns on individuals who are prone to epileptic seizures (Medical Sciences Bulletin 1). A important question then arises: if certain types of color-music patterns can have deleterious effects on viewers, are there also ways to construct color-music experiences so that they promote neurological and psychological health?

Color-Music and Psychotherapy

Different forms of color-music compositions have been used in conjunction with psychotherapy in two major ways: as a type of moving Rorschach test for diagnostic purposes, and as a cathartic aid for the therapeutic phase of psychotherapy. The potential for using color-music in the field of psychology was recognized early in its development. In the summer of 1939, Thomas Wilfred designed a special color-music instrument according to the specifications and recommendations of Dr. Norman Cameron, a psychologist at the Payne-Whitney Clinic in New York City. Wilfred called his invention the "Fantascope." The Fantascope was used as a mobile Rorschach test to study schizophrenia:

> This machine had a self-contained cabinet, a 20 x 30 inch translucent ground glass screen at one end and a control panel at the other. Located in a wall opening, only the machine's screen was visible to the subject and interviewer. In an adjacent room the forty minute sequence of form, color,

> and motion was synchronized with a sound recorder. Thus, the patient's verbalization could later be identified and analyzed in conjunction with the visual development observed on the Fantascope screen. (Stein 44)

Although the Fantascope was a type of visual symphony that was viewed in silence, other applications of color-music in psychotherapy also involved an intrinsic relationship between the visual forms and musical accompaniment. The most prominent example of this approach is the Auroratone films of Cecil Stokes.

According to Birren, the abstract sound motion pictures developed in the early forties by Cecil Stokes were a "flow of mobile color effects, featuring orchestral and organ music and the singing of Bing Crosby" (157). These thirty-minute films were used in the treatment of depressed psychotic patients in an army general hospital following WWII. In a study conducted by Herbert E. Rubin and Elias Katz, the films were used in addition to the usual psychotherapeutic treatments.

Rubin and Katz observed small groups of patients during the viewing of these films. They reported that the patients showed an increase in attention span, a decrease in agitated movement, and an increase in relaxation. Apparently the films were unusually moving, and "most patients became more accessible immediately following exposure to these films" (Rubin and Katz 334). This accessibility was the key to the effectiveness of the films:

> In this state of accessibility it was possible for the psychiatrist to establish rapport with individual members of the group.... The group discussion was conducted along more or less traditional lines. The psychiatrist drew heavily on the audio-visual experience with Auroratone films to which the

> group had just been exposed. Common characteristics of the depressed psychotic patients were ventilated, in order to gain a measure of insight, to provide reassurance, and to speed rehabilitation. (Rubin and Katz 334)

Although these films are also mentioned in a 1941 book on synesthesia written by Deborah Currey, in the April 1955 issue of Music of the West Magazine, and in the more recent 1998 biography of Bing Crosby written by Malcolm Macfarlane, the films seem to have faded from view shortly after the limited experiments of Rubin and Katz were conducted. However, more extensive studies examining the color-music connection have focused on explorations of the continually fascinating phenomena of synesthesia.

Studies of Synesthesia

Synesthesia has been studied repeatedly over the course of the last hundred years. The term has been used to describe a confusing array of sensory and symbolic associative "disorders." In order to clarify the exact phenomena under study, Dr. Richard Cytowic has proposed criteria for a definitive diagnosis of the condition. True synesthesia is involuntary, stable over the individual's lifetime, memorable, contains an emotional component, and is marked by discreet perceptions (Lyons 2). Although synesthetes may be no more divine than the rest of us, a December 1999 article in Discover magazine reports, "cognitive scientists contend that these unusual people are precious windows into the ultimate mystery of human consciousness" (Lemley 82). Mystical synesthetes like Scriabin and Kandinsky probably would have agreed!

Current scientific explanations of synesthesia are built on the hypothesis that "early in infancy, probably up to about 4 months of age, all human babies experience

sensory input in an undifferentiated way" (Lyons 3). Adult synesthesia may be a lack of the modularization between the senses that normally develops. An intriguing aspect of synesthesia is the fact that the phenomenon is highly individual. Although there appears to be a genetic link in the occurrence of synesthesia, even synesthetes in the same family associate different colors with different sounds. For example, one synesthete studied saw the color white in connection with hearing the vowel sound 'A,' whereas one of his daughters saw the color blue linked to 'A,' and another daughter saw the color black in association with the same sound (Birren 194). In any case, the mystery of conflicting experiences of synesthesia may soon be penetrated by a variety of modern techniques including brain imaging, electrophysiological recording, and DNA analysis.

So, what does all this research add to the ongoing debate over the color-music connection in the arts? Amazingly enough, only twelve percent of synesthetes experience colors associated with musical sounds and only nine percent directly link musical notes with colors. A wide variety of other cross-sensory episodes characterize synesthesia for many individuals, and even the relationships between colors and spoken sounds and colors and general sounds are stronger than the relationship between colors and music (see Appendix B). Furthermore, there is no evidence to support the common idea that synesthetes are more inclined towards the arts. Self-proclaimed synesthetes who are also artists or musicians may simply "revel in and talk about their experiences more than other synesthetes, who tend to be embarrassed by the condition" (Lemley 84). For better or for worse, the uniqueness of the experiences of synesthetes confounds attempts to use their perceptions to bolster theories of a color-music connection directly applicable to the evolution of color-music as an independent art form.

CHAPTER 7

CONCLUSION

Summary of Discussion

As this survey of the theories, creative works and scientific studies related to the color-music connection indicates, the attempt to determine whether an analogy exists between the arts of color and sound which was begun in antiquity continues today. The desire to unify the arts has been a driving force and the ultimate goal of many creative artists throughout the ages. However, there is a marked lack of agreement among philosophers, artists and musicians as to the exact nature of the color-music connection. These discrepancies prevent the formation of a single, integrated principle for an empirical understanding of the color-music phenomenon.

In addition, the scientific evidence reviewed did not support belief in a universal, physical correlation between color and music. However, a consideration of the substantial philosophical and historic data presented clearly supports the contention that there is a connection between color and music on intuitive and aesthetic levels. Most importantly, the realization that individuals experience reality in very different ways actually emphasizes the value of artistic expression in general. The differences in perceptions outpictured by various artists and musicians are crucial to the variety and ingenuity necessary to the ongoing evolution of the arts. As long as the color-music connection is a reality in the minds and hearts of creative artists, attempts to produce a harmonious blend of the two modalities will remain an invigorating force in the arts.

Current Applications of Color-Music

According to some critics, "color-music was an art form which was always about to be the most important twentieth-century art but never quite became it" (Gage 246). Admittedly, the success of color-music as an independent art form has indeed been limited. On the other hand, the fact that combinations of abstract color and music have become an important component in a variety of interdisciplinary art forms and modern multimedia compositions goes almost without saying. The use of laser light shows to accompany rock concerts; the colorful motion graphics that identify television stations, news shows, and other programming; the backgrounds and special effects in animated films, children's cartoons and video games; and the elaborate projected scenes used in ultramodern types of stage productions are some of the ways that color-music has entered the mainstream and become commonplace over the course of the last fifty years.

Color-Music and Interior Design

Another interesting arena into which color-music may one day penetrate more fully is that of interior design. The innovative Thomas Wilfred actually created a light mural as early as 1929 for the Hotel Shermann in Chicago:

> Wilfred was asked to decorate the ballroom space by designing architectural improvements and by providing a light environment. This was his largest work, a 21 x 210 foot projected mobile mural. Suspended from the dropped ceiling, three groups of twenty one individual projectors (one group for static and two for mobile projection) covered the three walls of the horseshoe shaped screen with changing scenic murals. A

> concealed keyboard room in the fourth wall controlled the projection equipment, which created moods and spatial effects. Combining representational images and abstract images, this versatile light mural could be an imposing Greek temple one minute and a picturesque Western landscape the next. (Stein 44)

Thirty years later, Wilfred did a lumia composition for an office interior for the Clairol Corporation (Stein 44). Such color-music compositions may be appropriate for a number of types of interiors: lobbies, airports, restaurants, schools and health care facilities may benefit from such design elements.

The use of projected color-music in health care facilities is particularly promising. Numerous studies in the last dozen years have documented the positive effects of scenes of nature in both acute and long-term clinical environments (Marberry, Zagon 90). The rhythmic, periodic movements of nature may also have a curative effect (Logsdon 208). Color-music that imitates the movements and patterns of water, leaves rustling in the breeze, etc. may act to speed recovery and reduce medical costs.

Specific colors appropriate to the patient's illness can also be chosen: "warm colors lead to an outward orientation and muscular effort, while cooler colors lead to reflection and passivity. Thus, cool colors, like blue and green, are better for anxious patients or those in chronic, long-term care.... Warm colors (red and orange tones) may be helpful for patients who are depressed...." (Olds 18). In addition to scenes depicting or imitating nature, abstract color forms have also been shown to be beneficial in some medical situations. For example, moving geometric abstractions created by John Healey have been used to soothe patients in the maternity ward in a London hospital (Time 81).

Combining these visual sequences with music may be even more advantageous in certain circumstances. Taped sounds of birds, the ocean or music "may be relaxing and comforting in treatment areas such as hydrotherapy and x-ray" (Olds 34). Perhaps the therapeutic effects of color-music in health care facilities can also be of value in other indoor environments such as homes and workplaces that are occupied for extended amounts of time.

Some futurists believe that man will spend increasing amounts of time indoors in the coming decades and that problems with sensory deprivation and perceptual isolation may result. Housing trends towards "massive...projects...plagued by blank walls" are an "equally disturbing" possibility (Jones 98). Some color-music enthusiasts see the projection of taped lumia sequences as an antidote to potential neurotic disturbances (Jones 99). And if space travel such as that depicted in the science fiction epic 2001: A Space Odyssey actually does come to pass in the coming century, variations of color-music and moving representational scenes may indeed be part of the revolutionary interior décor!

The Future of Color-Music

The increased availability of software programs and synthesizers capable of rendering a wide variety of color-music effects virtually assures that experimentation and creative efforts by interdisciplinary artists will continue in this field. Man's seemingly insatiable drive for harmonious, stimulating aesthetic experiences will almost certainly result in improved combinations of color-music with drama, dance, poetry and other art forms. Perhaps future developments in color-music will even precipitate the achievement

of its long-awaited status as an independent art form. Ongoing scientific studies by cognitive psychologists and environmental psychologists may also aid in the development of color-music as a therapeutic and aesthetic aspect of functional décor in indoor environments.

Although a direct correlation between colors and musical sounds may never be proven scientifically, objective facts often have no bearing on the individual's experience of subjective reality. As long as people believe—and feel—that color and music possess inner parallels, they will persist in producing forms of art and creating somewhat mystical philosophies based on this viewpoint. After all, who can ultimately argue with what appears to be intensely personal insight? And if a conviction in the existence of a concrete color-music connection results in advancement in the arts, or even in a horizontal proliferation of new ideas and creations, then the question of whether such a connection actually exists or not becomes entirely immaterial.

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APPENDIX A

CHART OF COLOR-TONE ANALOGIES

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CHART OF COLOR-TONE ANALOGIES

Musical Notes	C	C#	D	D#	E	F	F#	G	G#	A	A#	B
Newton	Red		Orange		Yellow	Green		Blue		Indigo		Violet
Castel	Blue	Blue-green	Green	Yellow-green	Yellow	Yellow-orange	Orange	Red	Crimson	Violet	Pale Violet	Indigo
Rimington	Deep red	Crimson	Orange-crimson	Orange	Yellow	Yellow-green	Green	Bluish green	Blue-green	Indigo	Deep blue	Violet
Klein	Dark red	Red	Red-orange	Orange	Yellow	Yellow-green	Green	Blue-green	Blue	Blue-violet	Violet	Dark Violet
Scriabin	Red	Violet	Yellow	Metallic	Pearly blue	Dark red	Bright blue	Rosy orange	Purple	Green	Metallic	Pale Yellow

APPENDIX B

TYPES OF SYNESTHESIA

APPENDIX B

TYPES OF SYNESTHESIA

Associations Experienced	Cases Out of 175	Percentage of Total
Numbers and letters evoking colors	121	69%
Units of time triggering colors	42	24%
Spoken sounds calling up colors	24	14%
General sound evoking colors	23	13%
Musical sounds calling up colors	21	12%
Musical motes setting off colors	16	9%
Pain evoking colors	6	3.4%
Odors triggering colors	5	3%
Personalities evoking colors	5	3%
Tastes evoking colors	5	3%
Sound evoking taste	3	2%
Sound evoking touch	3	2%
Vision evoking taste	3	2%
Touch evoking taste	2	1%
Sound evoking odor	1	.6%
Temperature evoking color	1	.6%
Taste evoking touch	1	.6%
Touch evoking smell	1	.6%
Vision evoking touch	1	.6%