Glimpse

the art + science of seeing

volume 2 issue 3

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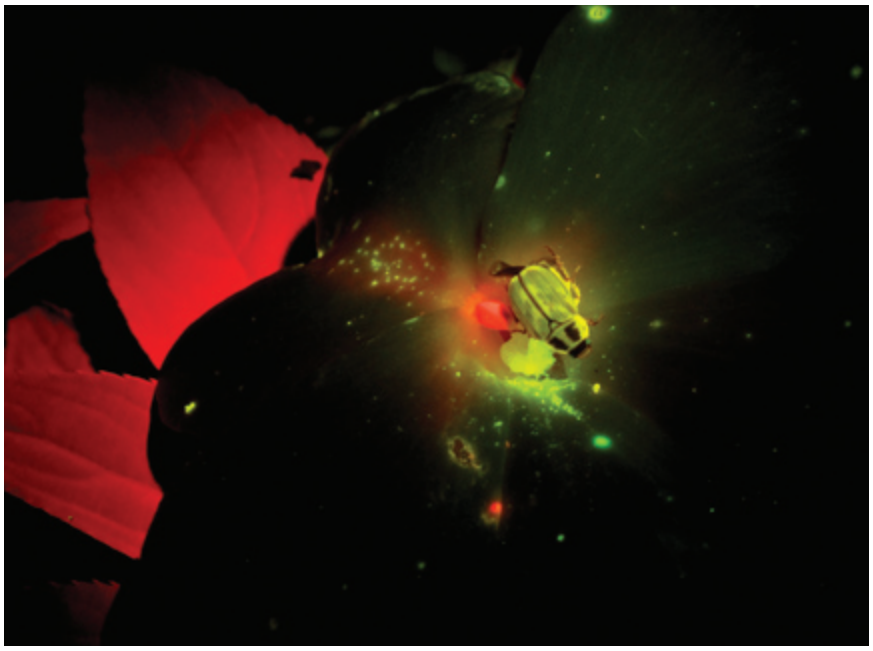
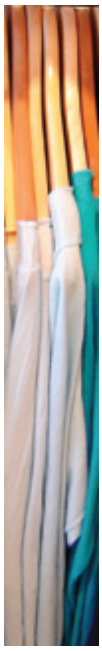
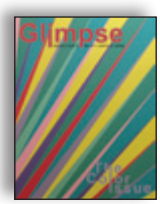
The Color issue





Cover Images Odili Donald Odita, Fusion, 2006, *acrylic on canvas, 96 x 120 inches. OD06.010.*

Image courtesy of Jack Shainman Gallery, New York.

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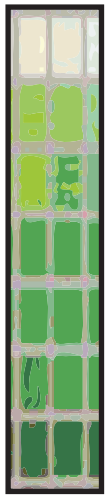
CONTRIBUTORS

FRED COLLOPY

Dr. Collopy is Professor and Chair of Information Systems and Professor of Cognitive Science at Case Western Reserve University. He received his PhD from the Wharton School of the University of Pennsylvania. He designed the first version of Imager for the Apple II computer in 1977. He has played Imager with the Cleveland jazz ensemble Kassaba, San Francisco experimental composer Henry Warwick, Miami DJ Dino Filipe and with his own Rhythmic Light Ensemble. He has been a visiting scientist in the computer music center at IBM's Watson Research Lab.



RICK HANLEY

Dr. Hanley has been Professor of Neuropsychology at the University of Essex, UK since 1998. In addition to his work with Dr. Debi Roberson on color, he has a wide range of research interests. He has published several papers that have examined the influence of writing systems on learning to read. They include studies of Chinese, English, Greek, Spanish and Welsh readers. Other current research projects include the way in which we retrieve information about familiar people, and the effect of brain injury on speech production.

HOPI ELISABETH HOEKSTRA

Dr. Hoekstra is currently the John L. Loeb Associate Professor of Biology in the Department of Organismic and Evolutionary Biology and the Curator of Mammals at the Museum of Comparative Zoology at Harvard University. She is broadly interested in the genetic basis of adaptation and speciation in vertebrates. Her research has primarily used natural populations of rodents to understand the ultimate and proximate causes of evolutionary change.

KIMBERLY A. JAMESON

Dr. Jameson is a cognitive scientist conducting research at the Institute for Mathematical Behavioral Sciences, at the University of California, Irvine. Color figures prominently in her empirical and theoretical work, which includes research on the mathematical modeling of color category evolution in societies of communicating robots; individual variation and universals in human color cognition and perception; the genetic underpinnings of color perception, and comparative investigations of the ways the worlds' cultures name and conceptualize color in the environment.

ROLF G. KUEHNI

Rolf Kuehni is a former chemical industry executive and currently an adjunct professor in color science at North Carolina State University. He is the author of several books on color, in particular, together with A. Schwarz, *Color Ordered, A survey of color order systems from antiquity to the present* (Oxford University Press, 2008), and of many peer-reviewed articles. Originally from Switzerland, he graduated as a textile chemist from Fachhochschule Niederrhein in Krefeld, Germany.

ODILI DONALD ODITA

Odita was born in Enugu, Nigeria and lives and works in Philadelphia and New York. Odita is currently an Associate Professor of Painting at Tyler School of Art, Temple University in Philadelphia. Odita has participated in numerous one-person and group exhibitions including the Studio Museum in Harlem; Yerba Buena Center for the Arts, San Francisco and the 52nd *Venice Biennale International Art Exhibition*. Odita received a Louis Comfort Tiffany Foundation Grant in 2007, and a Joan Mitchell Foundation Grant in 2001.

From the Editor

For those of us blessed with a full complement of color perception, it's easy to take color for granted. It is everywhere. Electromagnetic waves of visible spectra bounce around us constantly. To quote Odili Donald Odita, the artist whose striking painting adorns this issue's front and back covers, "Color matters." Humans are emotionally moved by color. Color signals to us from nature, and we, in turn, use it to signal to one another. It cloaks us, it accentuates aspects of ourselves, it unites us, it calms us, it excites us, it mesmerizes us. It is as if all organisms and their environments have been tuned to and for each other in a great call and response of color.

Glimpse vol. 2.3 celebrates what we know about color perception so far, and examines what still eludes us: From our historical efforts at wrangling color into well-understood systems that can be harnessed for our own creativity, to the impressive bio-fluorescence just outside our range of natural perception–but now visible with one engineer's inventions. We see how the brain's interpretation of color adapts to our environments, and how our environments may very well adapt to our perception. On a personal level, we learn how skin color influences self- and social-perception (and we can't help but re-contextualize human "colorism" as petty when considered in a broader biological spectrum). We examine centuries-old recipes for the optimal Prussian blue paint and red inks, and learn one NASA engineer's scientific method of achieving optimal visual effects in his watercolor paintings.

Further still, how is our perception of color reinforced or interrupted by language–by our naming of colors? And, since, startlingly, a small percentage of individuals have a gene for tetrachromatic perception (versus the majority of humans who transmit trichromatic perception), will their offspring evolve to see colors that we do not see today? And, what might the long-sought-after symphony of color-correlated-to-sound look and sound like? Can sound amplify our experience of color and vice versa? We conclude with thoughtful reviews of two films in which color is conceptually integral.

This issue is, as with each, a collaboration of many researchers, scientists, scholars, artists, and thinkers assembled by the *Glimpse* staff (notably, Acquisitions Editor, Carolyn Arcabascio). We thank each of our contributors for sharing their deeply-considered understanding of color. Collectively, they have transformed my own understanding of the ever-present, spectacular phenomenon. If you agree, we encourage you to share the *Glimpse* Color issue with others, and to "invest in (in)sight" by subscribing to *Glimpse*, buying a gift subscription for a friend or advertising with us.

Watch for *Glimpse*'s next issue, Cosmos, which will transport this issue's concerns with electromagnetic waves beyond Earth's atmosphere, as this International Year of Astronomy draws to a close.

Megan Hurst, *Editor*
editor@glimpsejournal.com

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Glimpse
PO Box 382178
Cambridge, MA 02238

ISSN 1945-3906
www.glimpsejournal.com

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PLAYING (WITH) COLOR

by Fred Collopy, Case Western Reserve University

> *The necessity for the use of color in its various phases has only been felt by artists since 1800. The intensity of modern life has made a greater intensity necessary in art. Only by being more intense than life can art hold its own as a vital factor in either taste or inspiration.*
>
> **– Stanton Macdonald-Wright, *A Treatise on Color*, 1924**

I didn't know my grandfather; he died before I was born. But I did know a particular image of him. As a child, I used to visit a mural that was part of Weinold Reiss' magnificent Cincinnati Union Terminal suite. There, my grandfather, who had posed for Reiss, stood at the controls of a big green mixing machine with the most beautiful yellow liquid flowing into the barrels below.

Figure 1. *Detail from Weinold Reiss' Cincinnati Union Terminal Mural. This panel was one of 14 mosaics, which were moved to the Northern Kentucky/Greater Cincinnati International Airport in the 1970s before Union Terminal's concourse was destroyed. Image courtesy of Cincinnati Museum Center at Union Terminal, Cincinnati, Ohio.*

As a paint-mixer for the Ault & Weiborg Corporation, he spent the long hours of each workday staring into large vats where he controlled levers and dials that transformed a few basic pigments into the variety of colors that the expanding demands of early 20th century taste required. Those who knew my grandfather said that he was a mellow man. Of course, inhaling paint fumes day after day could explain this reported temperament—though I like to think spending so much time with color also played a role.

Years after having visited the mural, as I got to know some of the work of modern artists, I was struck by a 1964 musing of Frank Stella, quoted in David Batchelor's *Chromophobia*:

> *I knew a wise-guy who used to make fun of my painting, but he didn't like the Abstract Expressionists either. He said they would be good painters if they could only keep the paint as good as it is in the can. And that's what I tried to do.*[1]

And that's what my grandfather witnessed each working day—the paint "as good as it was in the can." Color, pure and simple.

Color is an essential aspect of how we see the world. Whatever else visual artists set out to do, they cannot get around the need to attend to color. Even the absence of it constitutes a choice, since this, too, is a way of dealing with it. It is therefore no surprise that mankind's fascination with visual instruments began with color. Over two centuries ago, dreamers started to imagine instruments that would use combinations and sequences of color to calm us, delight us, confound and intrigue us, much as musicians do with combinations and sequences of sounds.

Color Scales

Sir Isaac Newton puzzled over the nature of light and its relationship to sound. The physicist understood, as have many inventors and artists since, that both are wave phenomena that operate over a range of frequencies. With this knowledge, many pioneers became interested in creating an art of light—like the art of music—by creating instruments to make "color music."[2, 3]

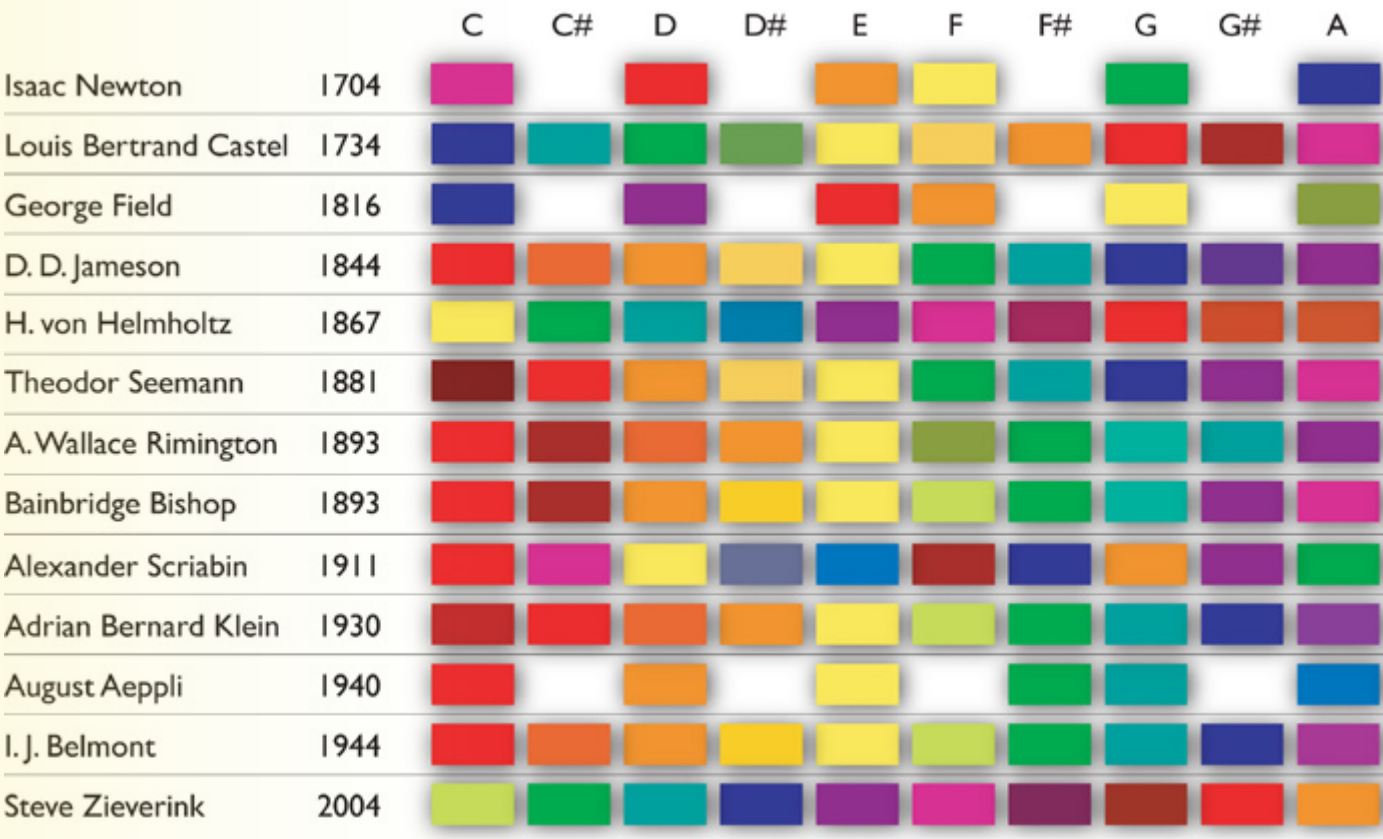
Newton associated each of the seven colors that he saw in prismatic light with the seven notes of the harmonic scale. Visual artist Karl Gerstner pointed out the randomness of this mapping, claiming that "Newton saw seven colors in the spectrum because *he wanted* to see seven colors, in order to correlate them with the notes and not vice versa...In actual fact observers can distinguish as many shades of color in the spectrum as they want: red, green, and blue being the most prominent, with fluid but short transitions."[4] Gerstner attributes this unscientific color mapping to Newton's involvement in alchemy.

Sir Isaac Newton puzzled over the nature of light and its relationship to sound.

Still, Newton inspired a movement that has lasted for three centuries. In 1725, responding in part to Newton's ideas about the nature of light, Louis Bertrand Castel, a Jesuit priest and physicist, wrote an essay announcing his invention of an ocular harpsichord. He proposed making colors transient the way that musical notes are. Using the keys of an ordinary harpsichord would reveal colors alone or in combinations, producing a succession that would elevate painting to the level of music. Castel proclaimed that his invention would lend colors "a certain vivacity and lightness which on an immobile and inanimate canvas they never have."[5]

The idea of relating the notes of the musical scale to various colors occurred many times over the succeeding two centuries (Figure 2). Beyond their obvious arbitrariness, additional problems also exist with these scales.[6] Perhaps the most significant is that they don't account for how differently we make sense of visual and audio information. A pattern that sounds harmonious doesn't necessarily look harmonious.

In addition to relating various hues to particular musical notes, painters have explored the emotional content of colors and their potential for musical expression. Most famous among such characterizations can be found in Wassily Kandinsky's classic essay, *On the Spiritual in Art*. Kandinsky describes each of the most common colors and compares them to musical sounds. He writes that "absolute green is the most peaceful color there is: it does not move in any direction, has no overtones of joy or sorrow or passion, demands nothing, calls out to no one...I would think the best way of char-



acterizing absolute green would be the quiet, expansive middle register of the violin."[7]

The painter Stanton Macdonald-Wright also characterized the emotional meanings of a dozen colors: "Yellow is superficial, has no depth of character, is frivolous, light, young-girlish and gay...Violet, we might sum up as being a cry, *de profundis*. It is the color of deepest depression, which comprises unhappiness, sorrow, silence, and the nearest approach to death in color."[8]

Many of Kandinsky and Macdonald-Wright's characterizations are in close agreement: Green is calm, quiet and peaceful; blue is ethereal, tranquil and heavenly; and red is deep, powerful and energetic. And Kandinsky's description of violet evokes Macdonald-Wright's: "Violet is thus a cooled-down red, in both a physical and a psychological sense. It therefore has something sad, an air of something sickly, something extinguished about it (like a slag heap!)."[7]

Kandinsky: "Absolute green would be the quiet, expansive middle register of the violin."

But Kandinsky's characterization of yellow is a different matter. He believed that "yellow, when directly observed (in some kind of geometrical form), is disquieting to the spectator, pricking him, stimulating him, revealing the nature of the power expressed in this color, which has an effect upon our sensibilities at once impudent and importunate." Furthermore, he believed that yellow was "a color that inclines considerably toward the brighter tones, [that could] be raised to a pitch of intensity unbearable to the eye and to the spirit. Upon such intensification, it affects us like the shrill sound of a trumpet being played louder and louder, or the sound of a high-pitched fanfare."[7]

This depiction of yellow is hardly the "frivolous, light, young-girlish" thing we find in Macdonald-Wright's characterization, and such differences of opinion underscore the challenge of establishing parallels between color and sound.

Figure 2. *Three Centuries of Color Scales. Courtesy of the author. Sources: Newton: Isaac Newton,* Opticks, *1704, Book 1, Part II, Proposition VI, Problem 2; Castel: Kenneth Peacock "Instruments to Perform Color-Music,"* Leonardo *(1988), 400; Field: Adrian Bernard Klein,* Colour-Music, *1927, 69; Jameson: D. D. Jameson,* Colour-Music, *1844, 12; Helmholz: Herman von Helmholz,* Treatise on Physiological Optics, *Vol. 2, 1962, 117; Bishop: Bainbridge Bishop,* A Souvenir of the Color Organ, *1893, 11; Seeman: Klein,* Colour-Music, *86; Rimington: Peacock, 402; Scriabin: Tom Douglas Jones,* The Art of Light & Color, *1972, 104; Klein: Klein, 209; Aeppli: Gerstner,* The Forms of Color, *169; Belmont: I.J. Belmont,* The Modern Dilemma in Art, *1944, 226; Zieverink: Steve Zieverink,* Twelve + Twelve, *2004, UnMuseum, Contemporary Arts Center, Cincinnati.*

Color Harmonies

Much of the effect of music has to do with the simultaneous occurrence of multiple notes. The intervals between the notes create consonances and dissonances. The color theorist Wilhelm Ostwald (1921; cited in Gerstner[4]) proposed a system based on musical intervals. To each musical interval (e.g. the minor second) he assigned a shade composed of two color tones (e.g. a reddish yellow and a greenish yellow). By careful arrangement of his scale, he was able to capture many elements of musical consonance and dissonance.

Others, though, have taken advantage of the fact that colors are rarely perceived in isolation. They exist instead in a world of other colors and our perception of each color is affected by its context. In the early 19th century, Michel Eugène Chevreul, a French chemist and color theorist, studied this phenomenon. While working in a yarn-dyeing factory, he noticed that some colored yarn appeared different when seen in the context of other colors. He referred to this occurrence as "simultaneous contrast."[9]

This notion of color context became prominent in the minds of color instrument designers. By the end of the 19th century, experimenters like Bainbridge Bishop turned their attention to how color music could evoke harmony and discord. Bishop believed that "by carefully examining the scale it will be seen that a direct contrast of color comes in as a discord—for example, a true green and red, or an orange and blue; but if we change the green for a bluish or yellowish green, the effect is much more harmonious."[10]

Many theorists of the time—Ogden Rood and Percyval Tudor-Hart among them—investigated the perceptual effects of various color combinations that would result in different visual harmonies and dissonances. These advancements in color theory inspired Stanton Macdonald-Wright and Morgan Russell, two of Tudor-Hart's students, to found a new style of painting called Synchromism, a movement dedicated to the physical and emotional effects of color. Rood's theory of harmonious color triads, or colors separated on the color wheel by 120 degrees, formed the bases of many of the Synchromists' paintings. And Tudor-Hart's conviction that sound and light are perceived in analogous ways became their inspiration.

Russell and Macdonald-Wright both pushed their interest in color and light to the point where it lifted off of the canvas. For Russell, this took the form of a *Kinetic Light Machine*, which he first wrote about in 1912. He actually designed several machines, which were described in detail in his notebooks. A central feature of all of his machines was the use of rheostats, devices that allowed a "coming and dying out" effect with light. Russell wrote to Macdonald-Wright about his experiments: "I felt that abstraction led to lights and had fiddled with them in winter 1915-16 and late spring 1914 a bit." And in a later letter he concluded: "As a matter of fact when I left off the synchromies in paint I got to meddling with lights also, but never got funds or encouragement...It was inevitable that synchromies should lead to this [manipulation of light]."[11]

Macdonald-Wright's response to the same basic impulse took a slightly different form. In 1919, he painted over five thousand pastels, each three by four feet. These were made into what he claimed was "the first full-length, stop-motion film ever made in color."[12] Russell and Macdonald-Wright saw their efforts as the creation of a new art—an art that differed from painting and dealt directly with time, movement and light itself.

Stanton's brother, Willard Huntington-Wright, drew on the experiences of the pair to speculate about the future of art. In a magnificent little book, *The Future of Painting*, he opens by arguing that "modernist painting" has little to do with painting as it has come to be understood. Instead, it is an accident that its practitioners have been driven to use pigments on canvas. Despite their struggles and the challenges of experimentation with new materials, what these artists are creat-

ing with color instruments is an art that is more of a performance, like a symphony, than a decorative art. The last chapter of Huntington-Wright's essay opens this way:

> *The color-instrument of the future will not merely throw pretty squares, circles, coils, and volutes of colored light on a screen, but will be able to record the artist's moods, desires and emotions along any visually formal aesthetic line. Only when such an instrument has been perfected can the modern artist's creative conceptions be properly expressed. With the completion of this new medium the art of color will have entirely dissociated itself from the art of painting, not only in impulse and conception, but in the world's attitude toward it.*[13]

Russell and Macdonald-Wrights' color scale represents an important development in the art of "playing light." Their scale revealed that soft and harmonious color combinations arise from pairing a color with one of its near-complements, or one of the colors on either side of its color complement. Likewise, they discovered that using complementary pairs would produce the color equivalent of dissonance in music. Macdonald-Wright instructed that "if a harsh clash is desired use red-orange and blue-green. For a clash less harsh use orange and blue. All sets of complementaries follow in the order of their harshness: yellow-orange and blue-violet; yellow-green and red-violet; green and red; and softest of all opposites, yellow and violet."[8] The intensity of the clash or dissonance is reduced as the colors are neutralized, by reducing their saturation or tonality (value).[8] Taken together, these and other insights from the Synchromists provide a remarkably rich and musical approach to the construction of color harmonies and dissonances. Huntington-Wright sensed the importance of these insights for the developing art of light, and compared the use of color dissonance to the role that *fortissimo* passages play when we attend a symphony concert.

In 1725...Louis Bertrand Castel, a Jesuit priest and physicist, proposed making colors transient the way that musical notes are.

Because they are such important musical concepts, current work continues to focus on harmony and dissonance. Katherine Lubar, for example, has explored color harmonies using Johannes Itten's color wheel to create color intervals analogous to the intervals of tonal music. She went on to examine the color intervals for their similarity to the effects of corresponding musical intervals (consonance or dissonance). Among Lubar's observations was that "tonal value plays an important role in the interpretation of the intervals between color" and that "the closer an interval gets to the tritone [complementary color], the more interestingly/harmoniously it works as a color combination."[14]

Color Tones

The discussions of scales and harmonies relate largely to how hues can affect emotion in a musical way. Controlling saturation and value can add expressive capabilities to a visual instrument in that the artist can achieve a variety of grays and tinted tones. An attention to saturation is illustrated in the work of one of the earliest color instrument designers, previously discussed.

Bainbridge Bishop's color organ placed a large white screen atop an ordinary organ. In addition to producing music, the controls pulled blinds down to expose stained glass windows of various colors through which light passed. In 1893, Bishop wrote about experiments in which he found that the use of tinted gray tones helped to produce a more musical quality to the light:

> *I soon found that a simple color did not give the sensation of a musical tone, but a color softened by gradations into neutral shades or tinted grays did so; also, that combinations of colors softened by gradations into neutral shades or tinted grays, with the edges of the main colors blending together, or nearly together, rendered the sensation of musical chords very well indeed.*[10]

Additionally, changes in the value of a color alter how dark it appears, achieving an effect which can also have a fairly direct relationship to musical tone. Having done an extensive analysis of Van Gogh's paintings and letters, Kurt Badt pointed to this relationship by noting that "dark and light colors do actually have effects which are comparable to low and high musical tones. Dark colors are sonorous, powerful, mighty like deep tones. But light colors, like those of the Impressionists, act, when they alone make up a whole work, with the magic of high voices: floating, light, youthful, carefree, and probably cool, too."[15]

F#

Concluding Remarks

Color theory has not enjoyed the success that music theory has. Consider, for example, the widely disseminated theory of the additive and subtractive varieties of color mixing. Additive/subtractive theory asserts that the rules by which colored lights combine are the inverse of those by which pigments combine. When the wavelengths on one color are added to another, they produce a color defined by the total. Similarly when one pigment is combined with another, it produces a color based upon the difference of their wavelengths. After describing some obvious problems with the theory, Patricia Sloane concludes that, as with much of color theory, the idea has little more going for it than its apparent elegance. "Additive/subtractive theory had acquired a reputation for being scientific and technically unimpeachable, before it came to the attention of the editors of the *Life* science series. The question, as often in color theory, is how so ill-conceived an idea survived for so long."[16]

Still, the Synchromists, Bainbridge Bishop and the others have managed to move us beyond the naïve mappings that dominated discussions of color music for so long. In wrestling as they have, at the level of perceptual issues, they have provided clues about how we should proceed in our consideration and advancement of this movement.

In my own experience, one *does* tend to land in places that are harmonious or dissonant when following their guidelines. Gradations *do* seem more musical and interesting, and darkness and lightness *can* effectively reinforce sonorous or light passages respectively. So, I continue to find inspiration in the work of these experimentalists and those who have followed them. Their efforts to articulate how various color elements work, and to reflect on and write about their choices, provide guidelines that serve us well in the absence of a comprehensive theory of color.

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