

# Color Theory in Science and Art: Ostwald and the Bauhaus\*\*

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The outstanding but controversial position of Wilhelm Ostwald as a scientist and philosopher was highlighted exhaustively last year, in this journal among others, to mark the 150th anniversary of his birth.<sup>[1]</sup> Yet among the many diverse activities Ostwald engaged in during his life, his artistic work and its impact on his philosophical ideas has generally been overlooked. During his scientific life, and especially after his formal retirement in 1906, he dedicated much time and energy to artistic endeavors. His favorite leisure activities were painting, playing the viola, and writing poetry. But Ostwald's interest in the arts was not incidental to his scientific and philosophical theories; rather, the two were interwoven. This is particularly evident in his work on color, which exerted a marked influence on the industry and fine art of his own period. Little has been said about the interac-

tion of Ostwald's ideas with fine art, and here we hope to close this gap somewhat by describing an historically rare mutual concordance between science and the arts, in which Ostwald and the personalities of the Bauhaus school of art, architecture, and design appear as the main actors.

## The Bauhaus School

The Bauhaus School was founded in 1919 by the architect Walter Gropius under the utopian slogan "The building of the future". It sought to train a new type of artist, capable of reaching beyond the confines of academic specialization and of bridging the gulf between fine art and the traditional crafts. In essence, Gropius wanted to remove the long-standing distinction between the pure and the applied (something that surely resonates with scientists today). To achieve that, he recognized the necessity of establishing new teaching methods in his school. This was the goal he strove towards during the first period of the Bauhaus in Weimar; but after a somewhat anarchic beginning, the mission of practical training was reiterated when the school relocated, for political reasons, to Dessau in 1925. In the 1919 Bauhaus manifesto, Gropius wrote: "*Architects, painters, and sculptors must once again come to know and comprehend the composite character of a building, both as an entity and in terms of its various parts. Then their work will be filled with that true architectonic spirit which, as 'salon art', it has lost.*"<sup>[2]</sup>

It soon became clear that this reconciliation of art and crafts could not be backward-looking (in the way that it had

been in the British Arts and Crafts movement), but needed to embrace the reality of a technical civilization, with its incipient methods of mass manufacturing. In short, the aesthetic of the artist had to be installed in the factory and workplace. In 1923, the Bauhaus acknowledged this with a new motto: "Art and technology—a new unity". The design standards promoted at the school would thenceforth recognize the demands of industry in both its functional and aesthetic aspects. The Bauhaus workshops produced prototype artifacts for mass production, ranging from individual household lamps to complete dwellings.<sup>[2]</sup>

From 1921, every student of the Bauhaus was required to take a compulsory "preliminary course" (*Vorkurs*) before entering into a workshop of his choice, where he would be taught both practical and artistic skills in a unified manner. Ever since its foundation, the school was able to attract talented artists and craftsmen, acquiring an extraordinary collection of personalities that made the Bauhaus a thriving center of European art. Its illustrious gallery of teachers ("masters") and pupils favored late Expressionism and early Abstraction (Figure 1), and together they helped to define the course of artistic modernism. They included the painters Wassily Kandinsky, Paul Klee, Oskar Schlemmer, Johannes Itten, Lyonel Feininger, and Josef Albers, the architects Gropius himself and, in the late phase, Ludwig Mies van der Rohe and Marcel Breuer, and the photographers László Moholy-Nagy (also an accomplished painter) and Andreas Feininger. Students flocked to the school to study with these famous names, although Gropius

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**Figure 1.** The masters on the roof of the Bauhaus building in Dessau. From the left: Josef Albers, Hinnerk Scheper, Georg Muche, László Moholy-Nagy, Herbert Bayer, Joost Schmidt, Director Walter Gropius, Marcel Breuer, Wassily Kandinsky, Paul Klee, Lyonel Feininger, Gunta Stölzl, and Oskar Schlemmer.<sup>[2]</sup>

discovered that they tended to arrive with dreams of becoming fine artists rather than being content to turn out designs for factories.

Several masters of the Bauhaus were intensely interested in theories of color and its relation to form. Such “constructivist” work took place mainly in the courses directed by Itten, Kandinsky, and Klee, and to a lesser extent with Schlemmer, Moholy-Nagy, and Albers. There was a strong feeling that color composition could be pursued in an objective, “scientific” way. Itten, who was responsible for devising the preliminary course, believed that colors could be assigned definite and universal emotional values, an idea that he pursued with something akin to dogmatic mysticism (Figure 2, left). Klee made reference in his teachings to standard ideas about color taken from the theories of Goethe and the works of the

French painter Eugène Delacroix, which stressed the use of complementary pairs (red–green, blue–orange, yellow–violet). But he was always wary of too much theory: “Of course we may use it for a bit, but we hardly have any need for a theory of colors. All the infinite mixtures will never produce an emerald green, a Saturn red, a cobalt violet.”<sup>[3]</sup> In other words, Klee felt that the characteristic hues of these materials engendered profound emotional effects that could not be dissected, laid out, and analyzed on color tables and charts.

But it was Kandinsky who was responsible for most of the color teaching at the Bauhaus. He experienced the condition of synesthesia, a neurological confusion of the senses in which two different sensations can be triggered by the same stimulus. This commonly results in an association of color with sound, so that certain timbres or pitches

create a sense of color. So it is not surprising that Kandinsky believed that “color directly influences the soul”—that a carefully chosen arrangement of colors could pluck the heartstrings of the emotions as deliberately as a pianist strikes chords on the keyboard. The task was then to identify the psychological meanings of different colors, which Kandinsky tried to establish by “scientific” tests. He issued a questionnaire<sup>[4a]</sup> in which participants were asked to match the three primary colors (red, yellow, blue) to particular forms (circle, square, triangle)<sup>[5]</sup>—with somewhat inconclusive results.

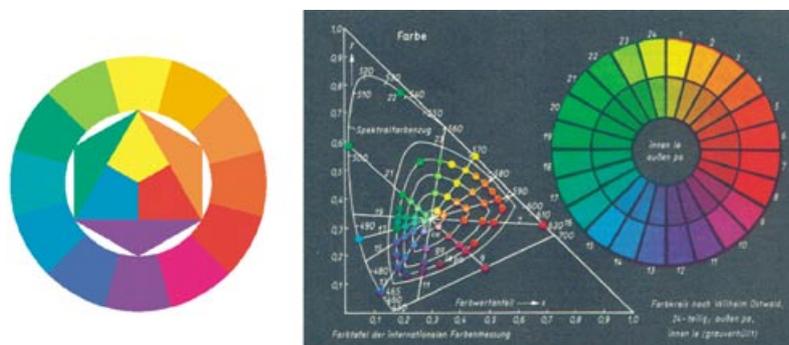
Thus the Bauhaus, standing at the intersection of art, design, and industry, turned out to be very receptive to all kinds of systematic approaches to art, including those that claimed to have a foundation in science.

### Ostwald's Color System in Theory and Practice

Wilhelm Ostwald (Figure 3) was an enthusiastic amateur painter during most of his lifetime, especially after he retired from his academic career. He considered painting and drawing to be a form of “physical and psychic recovery”, and his first explicit reference to these activities was in 1884, when he painted during a journey.

After 1904, he undertook such painting excursions nearly every year (Figure 4). His artistic efforts, which were generally naturalistic and traditional (even, for their time, conservative), were, however, not simply a form of relaxation but an expression of his closely intertwined scientific and philosophical preoccupations, guided by his enormous intellectual curiosity. Since his childhood, Ostwald had used his interest in and knowledge of chemistry to synthesize pigments for use in art.

Around 1914, Ostwald began to develop a systematic theory of color as well as a quantitative color science, culminating in the publication of several books and publications on the topic between 1917 and 1922—most notably, *The Colour Primer* (original German version, 1917).<sup>[9]</sup> Ostwald's most important contribution to color theory was the role he assigned to gray as a key



**Figure 2.** Two examples of color systems invented by Itten at the Bauhaus (left) and by Ostwald (right).<sup>[6,7]</sup>



**Figure 3.** Portrait of Wilhelm Ostwald by A. Klamroth (pastel, 1904).<sup>[8a]</sup>

coordinate of “color space” (Figure 2, right). His attempts to map this space were influenced by the work of the American artist and teacher Albert Munsell, whom Ostwald met in 1905. Munsell tried to quantify and standardize colors according to the parameters of hue (roughly speaking, the dominant wavelength), saturation (the intensity or “richness” of the color), and brightness (which can be crudely equated with the shade of gray the color gives in a black and white photo).<sup>[4b]</sup> The last of these parameters was particularly important to Ostwald. He believed that a scale of perceptually equal steps in the brightness of a color could be achieved by adding black and white in ratios that followed a logarithmic progression. This, he said, provided a scheme for achieving perfect tonal balance and harmonious color composition in a painting. The idea of “harmony” in painting was one much discussed by Renaissance artists, and no doubt goes back even further. It alludes to the skill of combining colors so that no part of the composition stands out glaringly in relation to others. This is not necessarily a naturalistic device; even in their



**Figure 4.** One of the artistic products of Wilhelm Ostwald’s annual excursions: the painting *Clouds and Waves* from 1913.<sup>[8a]</sup>

abstract works, painters like Klee and Kandinsky show an awareness of the need for harmony to lend unity to their pictures. Ostwald was, at face value, offering a foolproof set of rules for achieving such harmony (and he was quite prepared to criticize famous works of art which violated them).

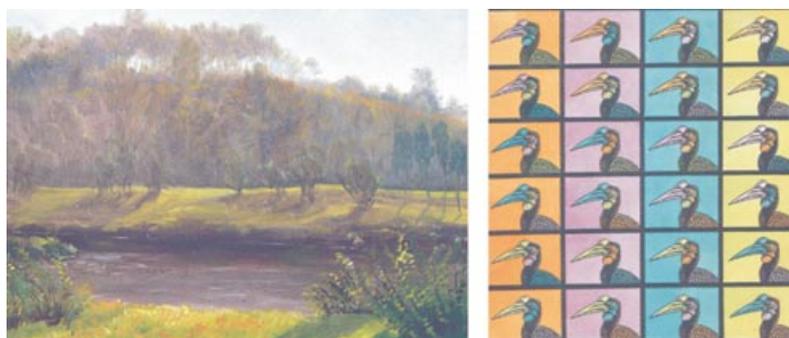
Ostwald used his fame as a chemist and Nobel laureate to impress his color theory on the German paint industry. In 1912 he joined the Deutsche Werkbund, an organization dedicated to introducing standardization into industrial design, and in 1914 he arranged an exhibition of commercial paints and dyes at a Werkbund exhibition in Cologne. Eventually Ostwald established his own pigment factory near Leipzig, which operated from 1920 to 1923.

While at first Ostwald directed his artistic endeavors towards the “accurate” reproduction of nature, after 1915 his paintings reveal his experiments on

how his color theories should be put into practice (Figure 5). In other words, he was trying to create art from a scientific standpoint, which ultimately led him towards the notion of the “ideal” painting constructed according to principles of his color theory. He spoke about this idea in a lecture at a congress of the Werkbund in Stuttgart in 1919; but such a rigid program for art was rejected by most contemporary artists.<sup>[10]</sup> In the same period Ostwald did little to endear himself to those of an artistic sensibility by announcing that Titian had once used a blue “two tones too high”.<sup>[11]</sup>

### Ostwald and the Bauhaus

Thus Ostwald was prepared to convert the artistic world to his ideas on color. Having encountered him on several previous occasions (for example, in the Werkbund), Walter Gropius seems



**Figure 5.** Two examples of Ostwald’s artistic work before (left) and after (right) being influenced by his own color theory.<sup>[8a,9]</sup>

to have approached him in late 1926 with a view to arranging a visit to the Bauhaus. In a letter to Oswald on November 20, 1926, Gropius says "...enclosed you will find a small brochure describing how the teaching of form and color is organized within our institute... On November 4th we are going to inaugurate our new institute building. I send you an invitation and I would be very pleased to meet you again."<sup>[12]</sup> Oswald's reaction is recorded by his daughter Grete in her diary of December 1926: "He is so fascinated by a brochure written by Gropius that he even decided to visit it [the Bauhaus] on the occasion of the inauguration of its new buildings. Beauty = Law, this is what Gropius has also understood, and he [WO] is interested in how this can fit with Kandinsky and in particular with Klee. Indeed, it transpired that Gropius is the constructive head, but is indifferent to color. Unfortunately, it was only possible to exchange some brief words with him. On the other hand, he had a heated discussion and lunch together with a painter with a Polish name... , who is constructing paintings out of squares and rectangles."<sup>[13]</sup>

Beginning with the meeting on December 4, 1926, there was an intense exchange of letters and books between Oswald on one side and Gropius, Moholy-Nagy, and the designer and typographer Herbert Bayer on the other. Grete's diary mentions on February 28, 1927, that "he [WO] is looking forward to the promised Bauhaus week."<sup>[13]</sup> This week was first scheduled for the beginning of April 1927, but was later postponed so that it finally took place on June 10–15, 1927, in Dessau.

In a letter to his wife Helene written on June 10, 1927, Oswald says that he arrived in Dessau in the morning and was invited to stay with Gropius in one of the recently erected school buildings in the famous Bauhaus style. After taking lunch with Gropius and his wife, the two men were clearly intent on entering into intense discussion: "...going a long distance together..."<sup>[14]</sup> as Oswald put it. This is confirmed by an entry in the diary of Gropius's wife Ise concerning the same day: "Oswald has arrived... he behaves very brightly and naturally here, and his intensity does not slow down for a moment."<sup>[15]</sup>

In the afternoon Oswald gave his introductory talk and reported to his wife that 120 people attended, including "the professors, except for Klee ... it might be disconcerting for him to meet me."<sup>[14]</sup> Ise Gropius recorded on June 12, 1927, that Oswald was giving daily talks which were well received by the Bauhaus pupils, and she praises Oswald's brio and vitality.<sup>[15]</sup>

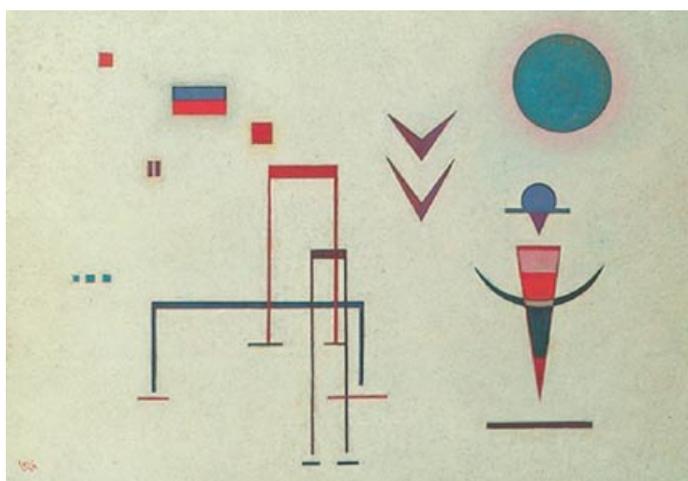
What kind of lectures did he give there? In her diary entry for the June 13, 1927, Ise mentions that "Oswald gave his last lecture about his tenet of harmony. As big as the impact of his tenet of order has been, the opposition to his tenet of harmony is of comparable size. I too believe that it is wrong to apply his tenet of color to painters..."<sup>[15]</sup> Later she refers to a "color organ" that Oswald gave to the Bauhaus, which attracted interest from Bayer and Hinnerk Schepfer, the designer who had devised the color scheme for the new building in Dessau.<sup>[15,16]</sup> The connection between music and color has ancient origins, and it shaped Isaac Newton's division of the visible spectrum into seven rainbow colors. The connection was particularly evident to the synesthetic Kandinsky (Figure 6), as well as to the Russian composer Alexander Scriabin, who had the same condition and composed in color for a "keyboard of light". Oswald explored these notions in a 1925 manuscript "Musical Art and the Art of Light".<sup>[16]</sup>

The tenets of color, order, and harmony to which Ise Gropius refers

might be related to Oswald's lecture manuscripts "The Euphonies of the World of Colors" (presumably 1927), "The General Order of Forms into Regular Networks—A Contribution to the Harmony of Forms" (presumably 1927), and "The Harmothek" (1926). All of these documents are still available in Oswald's written estate.<sup>[16]</sup>

### Oswald's Impact on the Artistic World

The reaction at the Bauhaus to Oswald's talks was mixed. He made a strong impression as a personality, but there was considerable skepticism towards his theories. It wasn't the first time the artists had encountered them, of course—Oswald's ideas had been a topic of debate at least since the publication of *The Colour Primer*, and Gropius referred to them in the catalogue of the Bauhaus exhibition of 1923. Kandinsky had been initially ambivalent about Oswald's color theory, but had become more sympathetic to it by 1925; nonetheless, his color course after 1927 was not entirely uncritical of Oswald's framework. Klee, meanwhile, remained unwilling to be fettered by any scientific theory of color. He had come across Oswald's ideas as early as 1904, when he had read the chemist's *Malerbriefe (Letters to a Painter)*. He once commented on these theories in the most acerbic and dismissive terms: "That which most artists have in common, an



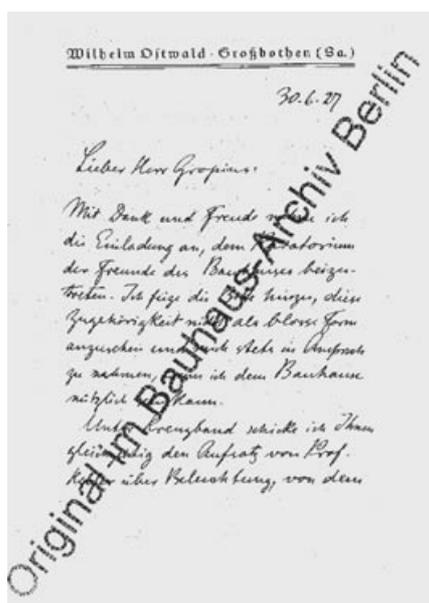
**Figure 6.** Wassily Kandinsky's painting *Jocular Sounds* from the artist's Bauhaus years (1929); virtually every element in the painting is adapted from music notation. (Copyright VG Bild-Kunst, Bonn, 2004).

aversion to color as a science, became understandable to me when a short time ago I read Ostwald's theory of colors. I gave myself a little time to see if I could succeed in getting something of value from it but instead was only able to get a few interesting thoughts... To hold that the possibility of creating harmony using a tone of equal value should become a general rule means renouncing the wealth of the soul. Thanks but no thanks."<sup>[3]</sup>

Schlemmer, who must have been present in Dessau in 1927, echoed these sentiments: "Ostwald's color building is a typical scientific result; artistically it is nonsense."<sup>[10]</sup> Ise Gropius likewise drew the conclusion that "he [WO] knows nothing whatsoever about the painters, although he is able to define 'the painter' in theory absolutely correctly. But if he stands next to him, he does not recognize him."<sup>[15]</sup> Yet it must be said that Ostwald's color theory was rather positively received by Piet Mondrian and his colleagues in the "De Stijl" group in the early 1920s. *The Colour Primer* was enthusiastically reviewed in the group's journal in 1918, and Ostwald is said to have become something of a "cult figure" for them. Mondrian's work with simple primary colors bears some evidence of Ostwald's influence.<sup>[4a,1b]</sup>

During the months after the visit, Gropius kept in close contact with Ostwald, who sent several of his pigments, binders, and books to Dessau. On June 28, 1927, Gropius asked Ostwald to join the advisory board of the Bauhaus, to which Ostwald replied two days later: "With thanks and joy I accept the honor of entering onto the board of trustees... I would like to add that I do not consider this membership a hollow formality, but I ask you to contact me whenever I can be useful to the Bauhaus..." (Figure 7).<sup>[17]</sup>

Such a collaboration could have been as fruitful as it would have been controversial—but apparently it did not develop to Ostwald's own satisfaction. In August 1928, one year after the lectures, Gropius had to reassure Ostwald in a letter that "it is not true, as you believe, that your lectures have not left any trace at the Bauhaus. I know that Schaper has dealt with them intensively and is using your systems in his courses."<sup>[18]</sup> Shortly after this assurance, Joost Schmidt contacted Ostwald to ask for



**Figure 7.** Facsimile of the first page of Ostwald's response to the invitation to join the Bauhaus board of trustees.<sup>[17]</sup>

explanatory material, which he planned to use in the course of his classes dealing with advertising techniques, and he even seems to have visited Ostwald in Großbothen to that purpose.<sup>[19]</sup> But there is no record of further visits by Ostwald after 1928, and he died in 1932, the year before the school, a center of "degenerate art", was closed by the Nazi regime. Its artistic stars were scattered across the world, several of them finding refuge in the USA. There, abstract expressionism was to establish color as the central constructive component of modern art, largely in isolation from any consensual theory about how color should be used or what it "meant". But at least the American artists' later engagement with the industrial materials championed by Ostwald was a matter of choice. After the closure of the Bauhaus, Oskar Schlemmer was forbidden to exhibit his work in Germany, and was reduced to making a living by testing materials for a paint company.

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