

Combinatorics and order as a foundation of creativity, information organization and art in the work of Wilhelm Ostwald

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Abstract - The physical chemist and 1909 Nobel laureate Wilhelm Ostwald (1853-1932) developed broad and multifaceted interests in philosophy (of nature), history (of science) as well as color theory and the international organization of scholarly work. Applying combinatorics, which grew out of his philosophy of nature and which was viewed by Ostwald as a basis for creativity, Ostwald developed a theory of forms and colors. His work influenced marginally the activities of such movements in art like the German Werkbund, the Dutch De Stijl, and the Bauhaus. This poster supports a today more and more visible connection between "in-formation", education as well as art and design.

Keywords - Wilhelm Ostwald, creativity, combinatorics, order

I. INTRODUCTION

Wilhelm Ostwald, 1853 (Riga, Latvia) - 1932 (Leipzig, Germany) was one of the founders and organizers of the discipline 'physical chemistry' at the end of the 19th century [1][2]. He worked from 1887 until 1906 as professor in Leipzig, received the 1909 Nobel Prize in chemistry for his work on catalysis, equilibria and rates of chemical reactions. Especially after his retirement he developed broad and multifaceted interests in philosophy (of nature), history (of science) as well as color theory and the international organization of scholarly work.

II. COMBINATORICS AND OSTWALD'S PHILOSOPHY OF NATURE

The search for harmony and order in combination with Ostwald's energetic imperative ("Do not waste energy, but convert it into a more useful form") was a foundation of his activities in the organization of scholarly communication, in the system of scholarly disciplines itself, in colors and forms. He proposed a "science of order" as a basis of his "pyramid of science" [3]. The need for standardization especially expressed in his ideas about paper formats as well as the need for a synthetic auxiliary language to facilitate international communication of science was also an outcome of his philosophical concept of order.

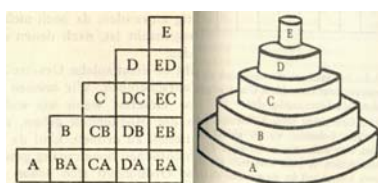


Figure 1. Combinatorics and the pyramid of sciences.

After describing how concepts or terms could be combined, Ostwald noted in a book about the philosophy of nature: "The laws of combinatorics even allow it to decompose an area of research formally and exhaustively in its branches and fields of research - by initially locating empirically the elements of the domain and then by exhaustively combining them [...] The application of combinatorics in scholarship is far from being widespread, as it should be. [4]"

Taken from his chemical experience, Ostwald's method of scholarly research can be described as: Defining the problem (1), exploring the problem by going back to the basic concepts of it (2), and combining these basic concepts in a combinatorial way to explain the diversity of the complex world (3). The diverse objects created through combination had to be held together by a holistic framework (4) like Ostwald's monistic world view and scientific energetism (see Table 1).

Table 1. Ostwald's method of scholarly research

1	Chemistry	Informat. Organizat.	Color theory	Theory of forms	Sciences
2	Chemical Elements	Fragmentation to unique thoughts	Pure colors, white and black	Basic forms	Defining basic sciences
3	Combined within periodical system	Combined within classification	Combined within a double-cone	Combined in diverse ways	Combined within a pyramid (Figure 1)
4	Physical Chemistry as General Chemistry	Central agency, World Brain	Harmony of colors	Harmony of forms	Energetic imperative, Monism

III. APPLYING COMBINATORICS

A. The Organization of Scholarly Work

In 1911 Ostwald founded with others "Die Brücke [The Bridge]", an "International Institute for the Organization of Intellectual Work" which tried to build a comprehensive, illustrated encyclopedia on sheets of standardized formats and to improve and organize scholarly information and communication. As a "World Brain", as Ostwald called the Bridge, it should connect people and institutions working for scholarly purposes. He developed ideas to disassemble the contents of printed journals and disseminate single papers separately (monographic principle). To arrange the separate pieces these

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were held together through a universal classification (UDC). For Ostwald the standardization of paper sheets was a practical application of his energetic imperative. He sought to create conditions for the unity of science and a seamless unity of scientific thinking with practical life.

B. Creativity and Education

"Combinatorics doesn't replace productive imagination only, but is superior to it!" [5]. For Ostwald creativity contained also "combinatorics". Ideas and discoveries were often only "a novel combination of existing components". New facts in research also had to be combined with diverse existing ones to create new insights. His idea on creativity corresponds with modern views concerning an alternative exposure to copyright and intellectual property within the "Creative Commons" licenses: "Share, reuse, and remix - legal".¹

Ostwald's activities in education showed his sense for individual development combined with systematic treatment. He believed that "the art of discovery" should become "a part of the intellectual inventory of every one [6]." Ostwald was aware that teaching research skills combined with enabling effective use of libraries was important. He suggested that teaching centers should be created at technical universities to improve techniques for the presentation of engineering knowledge and that these should be integrated into engineering education [7].

C. The Harmony of Colors and Forms

In 1914 Ostwald was asked by the German Werkbund which aimed at standardising industrial design to prepare a "rational" atlas of colors (see Figure 2). His ideas for color composition from a scientific viewpoint were combated by most contemporary artists. In connection with his color theory Ostwald was also engaged in the "harmony of forms" [8]. Using the rules he developed Ostwald created ornaments and new forms "according the laws of combinatorics" which were "all beautiful, without any exception" [9]!

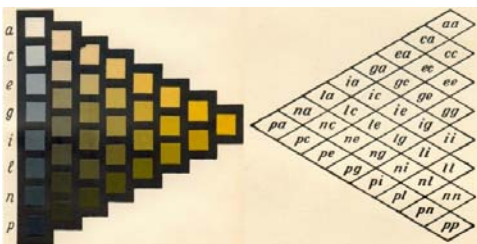


Figure 2. Combinatorics in colors.

IV. CONNECTIONS TO WERKBUND, DE STIJL, AND BAUHAUS

His imperative "order = legality = harmony" and his color theory had influence on the Werkbund, the Bauhaus and the Dutch artistic movement De Stijl. In 1912 Ostwald joined the Werkbund. He published a paper on "standards" in the yearbook of the Werkbund in which he called art a "social product" which made it necessary to standardise it [10]. In the first volume of the journal De Stijl a review on Ostwald's "Color Primer [Farbenfibel]" was published. Two years later

this journal of the Dutch art movement published Ostwald's paper on the "Harmony of colors" [11]. In the Twenties Ostwald got contact to members of the Bauhaus, e.g. to Walter Gropius. He gave talks at the Bauhaus in Dessau in 1927. The same year he was invited to join the Bauhaus board of trustees. Nevertheless most of the Bauhaus members remained offish to his ideas [12][13].

V. HIDDEN CONNECTIONS UNTIL TODAY

Today more and more connections between "in-formation", education as well as advertising,² art and design are visible in domains like information literacy, information design and knowledge media design. One 'hidden' connection to information science is shown here: Horst Rittel, later professor of design in Berkeley [14], was a successor of Max Bense at the Ulm School for Design founded by Max Bill. Ostwald was mentioned by Bill in the afterword of the German edition of Kandinsky's "Point and line to plane" [15]. Max Bense wrote books about philosophy of nature and aesthetic information, Rittel together with Werner Kunz a book on the foundation of information science in Germany [16]. All this supports the German philosopher Ernst Bloch's quote: "It will be perceived [...] with the aim of *in-formatio* about the world and of the world itself [17]."

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¹ <http://creativecommons.org>, visited March 20, 2008

² See [7] and also the weblog "Creative Combinatorics", accompanying this paper: <http://notes.hapke.de>, visited March 20, 2008

Combinatorics and order



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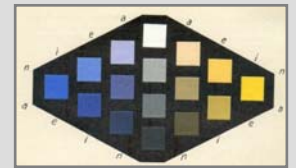
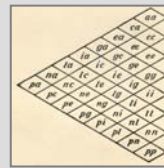
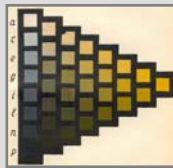
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as a foundation of **creativity, information organisation and art** in the work of Wilhelm Ostwald

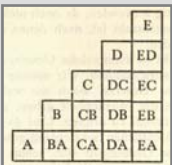
"Combinatorics doesn't replace productive imagination only, but is superior to it!"

Wilhelm Ostwald (1853-1932), physical chemist in Leipzig, Germany, Nobel Prize 1909



Applying combinatorics

Philosophy of nature



Organization of scholarly work



Theory of forms and colors



Energetic imperative, combinatorics of concepts, "Theory of order" as basis of "pyramid of sciences"

World Brain, monographic principle for publications, use of universal classification (UDC), standardization of paper formats

Order = Legality = Harmony
Creating forms "according the laws of combinatorics" being "all beautiful, without any exception", standardization of colors

Werkbund, De Stijl, Bauhaus

Energy, Entropy, and Information

Information and Knowledge Media Design

Hidden connections

Horst Rittel, later professor of design in Berkeley, was a successor of Max Bense at the German Ulm School for Design founded by Max Bill.

- Ostwald mentioned by Bill in the afterword of the German edition of Kandinsky's "Point and line to plane"
- Books by Bense about philosophy of nature and aesthetic information
- Book about foundation of information science in Germany (1972) by Rittel and Werner Kunz

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In-formation and Education