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Editors

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The research on environmental color design: Brief history, current developments, and possible future

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ABSTRACT

This paper reviews some of the outstanding contributions or points of interest in the research and application of color in architecture, from the ancient times to the present. Special focus is made on the contributions that have built bridges between color science and the uses of color in architecture, on the designers that have used instruments derived from color science, and on the researchers that have introduced links between color science and design. As a conclusion, and based on various of the examples exposed along the paper, it becomes evident that the evolution in the use of color in environmental design and the research in this field will increasingly rely on the interaction between scientists and designers.

1. INTRODUCTION

Before entering into the subject, I would like to make a clarification. Given the vast scope that encompass the title of this paper, I will necessarily narrow it by concentrating on a few aspects in each section, and by giving examples only taken from the field of architecture, as one of the oldest and widest branches of design. It is not my intent to make a thorough review of the history of research and use of color in environmental design, nor even in architecture, a purpose that would deserve an entire book. However, I hope that some of the gaps in this paper can be filled with the bibliographical references provided.

2. THE FIRST ARCHITECTS WHO HAVE CONVEYED KNOWLEDGE ABOUT COLOR

In written sources, one of the first references to color in architecture is found in the treatise by Vitruvius. In book 7, chapter 7, he deals with the natural colors. Vitruvius' interest focuses on the description of pigments and colorants, and the places where they can be found. He does not make difference between color and coloring matter, confusing both concepts: "As for colours, some are natural products found in fixed places and dug up there, while others are artificial compounds of different substances treated and mixed in proper proportions so as to be equally serviceable". In chapters 10-14 of book 7 he deals with the artificial colors (again, understood as coloring matters), describing the way of producing them. The two last chapters are dedicated to the purple dye obtained from a marine shellfish and to its possible substitutes. But an interesting aspect is when in chapter 3 of book 7, about vaultings and stucco work, he describes the appearances obtained with polishing instruments: "Just as a silver mirror that is formed of a thin plate reflects indistinctly and with a feeble light, while one that is substantially made can take on a very high polish, and reflects a brilliant and distinct image when one looks therein, so it is with stucco […] it is not only brilliant after being subjected to repeated polishing, but also reflects from its surface a clear image of the beholder".[1]

Leon Battista Alberti, in his *Ten books of architecture* (1452), follows Vitruvius conception of color, merely as coloring matters or paints "with which the wall may be adorned" (book 6, chapter 9): "Of painted surfaces some are done while the work is fresh, and others when it is dry. All natural colours which proceed from the earth, from mines or the like, are proper for paintings in fresco; but all artificial colors, and especially those which are altered by means of fire, require a very dry surface." In chapter 10 of book 7, Alberti makes an observation that relates color with aesthetic values

or preferences. When dealing with the decoration of temples, he says: "I am very ready to believe, that purity and simplicity of colour, as of life, must be most pleasing to the Divine Being". However, when dealing strictly with the aesthetic values of architecture, he takes a rather narrow point of view, only including geometrical aspects —figures and forms, number, position or collocation, congruity of parts, proportion, geometrical composition— and not including color or other aspects of appearance (book 9, chapters 5-7).[2] The treatment of color in Alberti's book *On painting* (1435) is quite different. Here, the approach is much more abstract and philosophical, relating color to light and making a classification of colors. He even refers to the affective or emotional value of colors.[3] The strange thing is how he did not follow this wider conception in his book on architecture, finished 17 years later.

I will not include here Leonardo da Vinci's conception of color, because his treatise deals specifically with color in painting. Instead, Giovanni Lomazzo's treatise, which includes a section on the symbolism of the principal colors, is also about sculpture and architecture. The *Trattato dell'arte della pittura, scultura ed architettura* was published in Rome in 1584.

3. THE 19th CENTURY AND THE RESEARCH ON THE HISTORY OF COLOR IN ARCHITECTURE

Let's now make a big historical jump and arrive to the first half of the 19th century, when a relevant discovery was made by Jacques-Ignace Hittorff: the Greek architecture was not white —as it was supposed during centuries based on the color of the ruins— but polychromatic. The Greeks used to paint the temples and also the domestic architecture with vivid colors. Hittorff published these findings in two texts: *Architecture polychrome chez les Grecs* (1830), and *Restitution du temple d'Empdocle a Selinunte* (1851). This discovery came to change a long-held view about the Greek sense of beauty and harmony. However, it took some time to change this view, and the neoclassicist architects of the 19th century continued to make neoclassic buildings (based on the orders of the Greek architecture) in gray, white, or with a monochromatic appearance. As a practicing architect, Hittorff was also an exception, because he made polychromatic buildings, as it can be seen in his Winter Circus, in Paris, and in some other buildings.

Owen Jones and Gottfried Semper were two architects of the 19th century who deserve also to be mentioned by their contributions to the study of polychrome architecture. Jones was the "colorist" of the Crystal Palace, built by Joseph Paxton in 1851,[4] and wrote *An attempt to define the principles which should regulate the employment of colour in the decorative arts* (1852), and *Color in architecture and decoration. An apology for the colouring of the Greek court in the Crystal palace, with … a fragment of the origin of polychromy by Gottfried Semper* (1854).

John Ruskin, the theoretician who exerted a vast influence on the architects and designers of the arts and craft period, and also on the pioneers of modern architecture, included interesting considerations about color in his famous book *The seven lamps of architecture* (1849). In the chapter "The lamp of truth", he advocates for the use of materials in their natural colors, without appealing to the recourse of paints (a tenet which will be followed in the 20th century by the organicist and brutalist trends of modern architecture). In the chapter "The Lamp of beauty" he conceives sculpture without color (meaning monochrome) but he cannot conceive architecture in the same way. He speaks of architecture as an organic being, and makes a call to use color by taking examples from Nature.[5]

Some of the most important historians of architecture have dedicated sections to the use of color in different periods. In 1875 Eugène-Emmanuel Viollet-le-Duc published a history of the human dwelling, in which he always includes sections to describe the use of color in houses, palaces, villas, and all kinds of domestic architecture in the Ancient China, Egypt, Assyria, Greece, during the Roman Empire, in the Middle Ages in Europe, and also in the Ancient Muslim world. In the Appendix of the book, he includes four colored plates depicting the interior of an Egyptian house, a house in Athens in the 5th century B.C., a Roman palace, and the room of a feudal castle.[6] In his famous *History of architecture*, of 1899, Auguste Choisy always dedicates a section with a specific heading about color in every chapter, reviewing the use of color in the architecture of the Ancient Egypt, Chaldea and Assyria, India, China and Japan, the pre-Hellenistic and the Greek architecture.[7] In spite that all these historians do not give precise details about their sources, and we cannot be sure

about the accuracy of their assertions, their words and drawings are probably the only sources we can have now to know something about the colored environments of thousands of years ago.

More recently, Rex Distin Martienssen, in his Ph.D. thesis of 1941 on *The idea of space in Greek architecture*, has made a detailed research about the polychromy of the Greek temples.[8] His sources were his own direct observations of the ruins, and the writings of L. Magne (1895), A. Choisy (1899), M. L. D'Ooge (1908), G. Dickins (1912), P. Gardner (1921), F. Poulsen (1920), and D. S. Robertson (1929, 1932). Curiously, he does not mention the pioneering studies by Hittorff.

As an addition to this section on historical research on color, we can refer to the paper by Karin Fridell Anter about Pompeiian colors, presented in this AIC congress 2005.[9]

4. ARCHITECTS OF THE 20th CENTURY

Now, let's go to the practicing architects who worked at the beginning of the 20th century and are considered as the masters of modern architecture, and let's see their conception of color. The most outstanding case that we can find in this context is Le Corbusier. His first writings on color appear in the articles about purism and cubism written for the journal *L'Esprit Nouveau*, in collaboration with the painter Amédée Ozenfant. An article of 1918 reads:

> The idea of form precedes that of color. The form is preeminent, color is but one of its accessories. Color depends entirely of the material shape: the concept of sphere, for instance, precedes the concept of color; it is conceived as a colorless sphere, a colorless plane, color is not conceived independently of some support. Color is coordinated with form, but the reciprocal is not true. We believe, thus, that a theme should be selected for its forms and not for its colors.[10]

Some other articles published in 1921, 1923 and 1924 proceed more or less in the same vein, that is, denying any importance that color might have in the construction of space in painting.[11] The curious thing is that a few years later, in his writings on *Architectural polychromy* of 1931, Le Corbusier seems to have changed completely his mind, to the extent of quoting and agreeing with Fernand Léger, who said: "Man needs colors to live, it is an element as necessary as water and fire". In addition, Le Corbusier describes examples of his own use of color in order to drastically change the spatial perception of architecture, as in the neighborhood designed and built in Pessac.[12,13]

In his monograph written for the exhibition of the *Pavillon des Temps Nouveaux* of 1937, Le Corbursier includes a chapter entitled "Polychromy = Joy", in which he associates the creative ages of architecture to the vitality of chromatic color and the stagnant academicism to sad gray.[14] (By the way, it should be noted that there is a contradiction here with some other advocates of modern architecture who associate color with the decoration and ornament of the traditional architecture, as opposed to the white purity that modern architecture should exhibit). It seems that both in his theories and works, Le Corbusier evolved towards a more conscious and thorough consideration of the power that color has to modify the spatial environment. This is especially evident in the buildings projected and built after World War II, in what is called his "brutalist" period.

The importance that Walter Gropius, another of the masters of modern architecture, gave to color studies is clearly shown in the programs for the Bauhaus school and in some of the professors that were selected to teach there: Wassily Kandinsky, Paul Klee, Josef Albers, and Johannes Itten, among others.[15] In his book *Scope of total architecture* (1956), when dealing with the education that architects and designers should receive, Gropius includes sections about "The language of vision", "Some biological facts about our way of seeing", "Optical illusions", and "Psychological influence of shapes and colors".[16]

The Dutch neoplasticist movement, organized since 1917 around the publication *De Stijl*, and having its sources in the abstract paintings of Piet Mondrian, helped to create a better consciousness about color theory and practice,[17] introducing color as determinant of space, in opposition to its traditional decorative function. However, this movement produced no important realizations in the field of architecture and design, except for a few works by Theo van Doesburg (the cabaret Aubette), Jacobus Johannes Pieter Oud (the restaurant De Unie), and Gerrit Rietveld (the Schröder house, his

famous chair, and a few more designs). Of these examples, only Rietveld managed to make a true spatial organization of color and planes, while the others remained practically producing two-dimensional transpositions of the neoplasticist elements of painting to architecture. The influences were exerted more through the theoretical manifestos and the imagery of projects, drawings and maquettes than through concrete buildings.

By far, the most outstanding and bold colorist among the architects of the modern movement was Bruno Taut. Even when he is not considered at the same level of importance as Le Corbusier, Gropius, Mies, or Wright, because his influence on the next generations was not so strong, he was the one who most advocated for the use of color. The audacity of Taut's color schemes induced Le Corbusier to say in 1927: "My God, Taut is color-blind!" Commenting about the impact that his Falkenberg housing estate of 1915 in Berlin-Grünau caused, the own Taut declared that his color scheme "provoked the Berliners who, coming from the gray tenement quarters, repeatedly declared that the architect deserved to be locked up". Among his many writings, the big majority of which are not easily available, and only in German, and which deserve a wider dissemination, Taut published in 1919 a "Call for colorful architecture", which was co-signed by Walter Gropius, Peter Behrens, Hans Scharoun, Max Taut, and others.[18]

It is obvious that much of the discussion of the modern architects with regard to the conception and use of color was not established between the advocates of non-color and the advocates of color, but with regard to the different ways of dealing with color. Even those who were very austere or purist in this sense (like Gropius or Mies, for instance) did not ignore the importance of color. The white color of the most purist modern architecture was intended to make the building contrast with the environment, or to make the details or furniture in the interiors stand out, or to let the chromatic weight of the landscape penetrate with more strength into the interiors through the large surfaces of glass or the horizontal windows. The followers of the organicist architecture (whose paradigm is Frank Lloyd Wright), supporters of not covering with paints the surfaces but leaving the materials to express their inherent color, were not less conscious of the value of color.

For those who wish to go deeper into the multiple aspects and variations of color in the first half of the 20th century, and especially in the decade of 1920, there is an excellent monograph by Maurice Besset.[19]

The postmodern reaction of the seventies and eighties brought about a host of architects concerned with the references to history and to the environment, and color in architecture took also a new meaning under these orientations. As examples, we can mention the works by Charles Moore, Robert Venturi, Robert Stern, Michael Graves (in the USA), Paolo Portoghesi, Aldo Rossi (in Italy), Mario Botta (in Switzerland), Hans Hollein (in Austria), Aldo van Eyck (in The Netherlands).

For the decade of 1990, we can find in Harold Linton's book on color in architecture a good account of the works by architects and colorists of the more recent generations, who mainly act as color consultants: Jean-Philippe Lenclos (France), Shashi Caan and Donald Kaufman (USA), Begoña Muñoz (Spain), Eva Fay (Australia), Lourdes Legorreta (Mexico), Malvina Arrarte (Peru), Shingo Yoshida (Japan), Giovanni Brino (Italy), Michael Lancaster (UK), Leo Oberascher (Austria), among them.[20] These works encompass not only color projects for new buildings but also color restoration of historical urban centers, landscape color plans, and models developed for color research and education in architecture. The specificity of the knowledge about color in environmental design has given rise in the last decades to a new profession: the color consultant, who can work in collaboration with other architects or designers, or be hired for special projects by companies and private or governmental institutions. In her articles about this topic, Sonia Prieto mentions various renowned color consultants who have worked in the last decades in France: Georges Patrix, Jacques Fillacier, Fabio Rieti, Bernard Lassus, Jean-Philippe Lenclos, and France Cler. Some of them are also authors of publications with theoretical insights.[21,22]

In order to finish this section on color in architecture in the 20th century, apart from the previous chronological sequence, and making a geographical move to Latin America, I want to mention three cases of recognized masters of architecture that are paradigmatic for the conception and application of color: Carlos Raúl Villanueva (Venezuela), Luis Barragán (Mexico), and Clorindo Testa (Argentina). The most famous work by Villanueva is undoubtedly the University Campus in Caracas, an architectonic organization that in the year 2000 was declared cultural heritage of mankind

by the UNESCO, in which polychromy plays a key role.* The Mexican Luis Barragán, a colorist who has created spaces of great expressiveness, was the second architect, after Philip Johnson, in being awarded the Pritzker Prize (the equivalent to a Nobel prize in architecture) in 1980. Clorindo Testa, who was born in Italy but studied and developed his whole career as an artist and architect in Argentina, began at the early stages of his professional work to make a kind of architecture influenced by Le Corbusier's brutalist period, but soon evolved towards a very personal and original treatment of the spatial configurations and color. In 2005, at the age of 82, he continues being considered as a living master who constantly renovates himself and constitutes a source of inspiration for the young generations.

5. RESEARCH ON ENVIRONMENTAL COLOR DESIGN IN RELATION TO THE A.I.C.

Having made and overview on the first theorists of architecture who have dealt with color, on some of the historians of architecture who have included color in his studies, and on some of the research and application of color in the architecture of the 20th century, I want to make a short review of what has been researched on color in architecture and design during the most recent years, after the foundation of the International Color Association (AIC) and the participation of many specialists working in these areas in the AIC meetings. As it is impossible in this paper to even mention all the authors that have contributed to the development of color theories or applications related to architecture and design, I will make a more or less arbitrary selection mostly based on my personal knowledge of the people involved. I will refer just to a few pioneers and to some of the people who have been related to the Environmental Color Design (ECD) Study Group of the AIC.

Sven Hesselgren was a color theorist and a practicing architect. Early in his career, he tried to put into practice the color harmonies developed by Ostwald by applying them in a project for a hospital. According to his own words, the results were "terrifying".[23] Later on, he developed a color order system that was one of the antecedents that gave origin to the Natural Color System.[24,25] These two facts alone show to what extent was he interested both in doing color research and in testing research findings in the architectural practice. Among his contacts with the AIC, Hesselgren participated in the AIC Forsius Symposium on Color Order System in 1983, delivering one of the invited lectures.[26]

The contributions by Antal Nemcsics, Anders Hård, Lars Sivik, Werner Spillmann, and other past and present members of the ECD Study Group to the constitution and development of this group have been highlighted in a previous paper.[27] On the scientific side, the main achievements by Nemcsics and Hård have been without doubt the development of two color order systems that are very useful in architecture and design. Nemcsics' Coloroid system has the unique feature that its scales are homogeneous from the aesthetic point of view, and the interest that it includes in the same model both the boundaries for all perceptible colors and the boundaries for the set of surface colors.[28,29] Hård, who in 1997 received the AIC Judd Award, was the main responsible for the development of the Natural Color System on the grounds of Hering's theory of color opponency.[30,31] Today, the NCS is perhaps the most used color order system in architecture and design. Werner Spillmann has worked both as a color consultant in architectural projects and as a theorist. He delivered the opening lecture of AIC 1989, precisely on the topic of color in architecture and design.[32] Among other aspects of his research interests, his knowledge about ancient and modern color order systems is paramount.[33,34]

Giovanni Brino, already mentioned before, was a pioneer in developing color plans and methodologies of color restoration in historical centers, as well as in setting up a school of urban restoration in Turin. I would like just to quote from his invited lecture at the AIC 1993 congress in Budapest: "The 'colour plan of Turin', carried out by the writer between 1978 and 1983, represented the first attempt in Italy at a rational response to the problem of restoring façades on a city-wide scale, on the basis of objective historic documentation."[35]

Shigenobu Kobayashi, working at the Nippon Color & Design Research Institute, has developed a color image scale, a fundamental instrument that links image words to color

* This work by Villanueva can be seen at www.centenariovillanueva.web.ve/Portal.html.

combinations. This is clearly a device connecting a systematic psychological research on color meanings with applications in design.[36,37]

Lars Sivik received the AIC Judd Award together with Anders Hård and Gunnar Tonnquist in 1997. Coming from the field of psychology, his whole career in color research has been always linked to environmental color design. His fields of interest range from color order systems (he was deeply involved in the development of the NCS), to color meaning associations and color combinations.[38-41]

Theano Fanny Tosca has worked mainly on semiotic aspects of color in architecture and urban spaces, and has developed color rehabilitation projects in Greece.[42-44]

Leo Oberascher made his PhD thesis on color and cognitive psychology, and has been working as color consultant in architecture and design for decades. His real scale models that explore the realms of color, texture, cesia and other aspects of appearance can be both an educational tool and a source for testing spatial configurations applicable to architecture.[45,46] In the AIC, he has been a conspicuous figure in nearly all congresses since 1987, and has chaired the ECD Study Group.

Paul Green-Armytage possesses a vast expertise in teaching color to students of design, and has presented his ideas in most of the AIC congresses since 1981, as well as in other meetings and publications. The most salient aspects of his work, from my point of view, are the calls for the development of a color language that can be shared in all fields of color research and education, as well as the efforts to promote bridges between the findings in color science and the applications in design.[47-50] Precisely, the lecture on "Colour science for colour design" presented here in Granada is very enlightening in this regard.[51]

Lucia Ronchi, former president of the AIC during the 1994-1997 term, has always shown a great interest in the studies on color and the environment, and contributed with related papers in various AIC meetings, with a glossary of terms, and conveying the research on color vision that could be useful in the field of design.[52-54]

The most recent laureate with the AIC Judd Award, John Hutchings, is a physicist with interdisciplinary interests, who has worked mainly on color in food, appearance, color in folklore, and environmental color design. A remarkable contribution to the links between color science and design was made in a couple of articles entitled "The continuity of colour, design, art, and science", published in *Color Research and Application*.[55] He has also traced links between color appearance in food and design.[56,57] It is an honor for the ECD Study Group to have him among its members. A former and somehow narrower version of his Judd Award lecture in this AIC 2005 was about design ethics in the use of color in food marketing, and was originally intended for one of the ECD symposia.

The use of spectrophotometric techniques for color measurement and of standardized samples from color order systems for classification and specification purposes, appears today as a necessity in studies of colors, color plans, or projects of rehabilitation or restoration of historical buildings and urban districts, giving the possibility of constituting accurate color-data banks. Some of these methodologies can be seen applied, for instance, in the works by Angela García Codoñer in Valencia, Spain,[58] María Mercedes Avila in Córdoba, Argentina,[59,60] Grete Smedal in Norway,[61] and Frank S. Welsh in the USA,[62] just to make reference to members of the ECD Study Group and to papers presented in AIC 2005 in Granada.

A number of researchers on environmental color design have been employing experimental methodologies (derived mainly from the research in psychology, psychometrics and psychophysics) in their studies. I just want to mention an outstanding case in the ECD group: Monica Billger.[63,64]

Today, the ECD Study Group is a truly interdisciplinary network, with members coming from various different fields, such as architecture and urban studies, textile design, graphic design, fine arts, history, physics, optics, vision, psychology, ecology, and engineering.

6. CONCLUSION: THE IDEAL FUTURE

I have no doubts that the evolution in the use of color in environmental design in the future, and thus the research in this field, will have to rely more and more on a fruitful interaction between scientists and designers. The surveys made by Jan Janssens and Byron Mikellides on color in architectural education show that there is a severe lack of knowledge about color research among architectural students.[65,66] This situation needs to be reverted. In this sense, the most important task for

the researchers on environmental color design will be to act as a nexus between both groups, developing applications of color science in color design, proposing theoretical hypothesis that could be scientifically tested, and contributing to the mutual communication by agreeing on terminological matters based on common grounds. In my view, the most interesting scenario that we can desire and expect for the future is a true integration of all fields of color research, and the sharing of a common language. This has been one of the main goals of the International Color Association since its creation in 1967. In this sense, I would like to finish by quoting Paul Green-Armytage in his lecture for the closing session of AIC 2001:

> In the future that I hope for there will be more interaction between the arts and sciences in the field of colour. Artists and scientists each have their own way of contributing to knowledge. I hope we can encourage more artists to join the designers and architects in the AIC. […] I was struck by an instance during the congress where an artist and a scientist had come to similar conclusions, but through their own distinct ways. […] If there is to be more co-operation between the disciplines, between people in the sciences and the humanities, and if that is to be productive, a first move might be to tackle the thorny problem of terminology. It will be a good way to start if we can learn to speak each other's colour languages.[67]

REFERENCES

1. Vitruvius, De architectura libri decem (i. 43 B.C.-14 A.C.). English translation by M. H. Morgan, The ten books on architecture (Harvard University Press, Cambridge, MA, 1914).
2. L. B. Alberti, De re aedificatoria (1452). English translation by G. Leoni (1755), reprinted as The ten books of architecture (Dover, New York, 1986).
3. L. B. Alberti, De pictura (1435). English translation by J. Spencer, On painting (Yale University Press, New Haven, CT, 1956).
4. See the paper by Katrin Fagerström, "Architecture forgetting colour. Crystal Palace and impressionism", paper to the ECD Symposium, in this AIC 2005.
5. J. Ruskin, The seven lamps of architecture (London, 1849).
6. E.-E. Viollet-le-Duc, Histoire de l'habitation humaine (Paris, 1875).
7. A. Choisy, Histoire de l'architecture (Baranger, Paris, 1899).
8. R. D. Martienssen, The idea of space in Greek architecture (Johannesburg: Witwatersrand Univ., doctoral thesis, 1941). Posthumous publication (Witwatersrand Univ. Press, Johannesburg, 1956).
9. K. Fridell Anter, "Colours in Pompeiian cityscape: in search of a lost treasure", invited lecture to the ECD Symposium, in this AIC 2005.
10. A. Ozenfant and Le Corbusier, Aprés le Cubisme (Edition des Commentaires, Paris, 1918). Spanish translation, "Después del Cubismo", in Acerca del Purismo. Escritos 1918-1926, ed. A. Pizza (El Croquis Editorial, Madrid, 1994), 8-47.
11. A. Ozenfant and Le Corbusier, "Le Purisme", L'Esprit Nouveau 4 (1921); "Nature et Creation", L'Esprit Nouveau 19 (1923); "Idées personnelles", L'Esprit Nouveau 27 (1924). All articles, in Spanish translation, in Acerca del Purismo. Escritos 1918-1926 (El Croquis, Madrid, 1994).
12. Le Corbusier, Polychromie architecturale (manuscript, Foundation Le Corbusier, Paris, 1931). Posthumous ed. by A. Rüegg, Polychromie architecturale. Les claviers de couleurs de Le Corbusier de 1931 et de 1959 (Birkhäuser, Basel, 1998).
13. See also V. Schindler, "Prefabricated rolls of oil paint: Le Corbusier's 1931 colour keyboards", forthcoming in AIC 2004, Color and Paints, Proceedings.
14. Le Corbusier, Des canons, des munitions? Merci! Des logis… S.V.P. (Éditions de L'Architecture d'Ajourd'Hui, Paris, 1938).
15. The consideration of color in the Bauhaus and the group Stijl, and their connections with Ostwald's theory are admirably developed in J. Gage, Color and culture (Little, Brown & Co., Boston, 1993), chapter 14.
16. W. Gropius, Scope of total architecture (Harper & Row, New York, 1955).
17. See ref. 15.

18. On details about Taut and his colored architecture, see S. Kisby, "Bruno Taut: architecture and colour", in www.kisbee.co.uk/sarc/ext-sa/taut.htm (2003). Accesed: february 2005.
19. M. Besset, La couleur et l'architecture dans les annees 1920 (DA-Informations 144, Ecole Polytechnique Fédérale de Lausanne, Lausanne, 1993).
20. H. Linton, Color in architecture. Design methods for buildings, interiors, and urban spaces (McGraw-Hill, New York, 1999).
21. S. Prieto, "Emile Aillaud et Fabio Rieti: une entente exemplaire entre architecte et coloriste", in AIC Colour 93, Proceedings, vol. C (Hungarian Colour Committee, Budapest, 1993), 15-17.
22. S. Prieto, "The color consultant: a new professional serving architecture today in France", Color Research and Application 20 (1), 4-17 (1995).
23. Reported in S. Hesselgren, "Why colour order systems?", Color Research and Application 9 (4), 220-228 (1984), p. 222.
24. S. Hesselgren, Colour atlas (T. Palmer, Stockholm, 1953).
25. S. Hesselgren, Subjective color standardization. Excursus on a color atlas (Almqvist & Wiksell, Stockholm, 1954).
26. S. Hesselgren, ref. 23. This paper was originally presented in the AIC Midterm Meeting 1983; see the Proceedings, Invited lectures (Colour Report F28, Scandinavian Colour Institute, Stockholm, 1983), 17-28.
27. J. Caivano, "A history of the International Color Association Study Group on Environmental Color Design, from 1982 to 2002", in AIC Color 2002, Proceedings (Faculty of Mechanical Engineering, Univ. of Maribor, 2003), 187-195. Also in www.fadu.uba.ar/sicyt/color/ecdhist.htm.
28. A. Nemcsics, "Color space of the Coloroid color system", Color Research and Application 12 (3), 135-146 (1987).
29. A. Nemcsics, "Coloroid: colour system of colour environmental design", in ArgenColor 2002, Actas (Grupo Argentino del Color, Buenos Aires, 2004), 467-478.
30. A. Hård and L. Sivik, "NCS-Natural Color System: a Swedish standard for color notation", Color, Research and Application 6 (3), 129-38 (1981).
31. A. Hård, L. Sivik and G. Tonnquist, "NCS, Natural Color System -from concept to research and applications", Color Research and Application 21 (3), 180-220 (1996).
32. W. Spillmann, "Colour in architecture and interior design", in AIC Color 89, Proceedings, vol. I (Grupo Argentino del Color, Buenos Aires, 1989), 31-42.
33. W. Spillmann, "Colour order systems and environmental design", in AIC Midterm Meeting 1983, Invited lectures (Colour Report F28, Scandinavian Colour Institute, Stockholm, 1983), 152-163. Also published as "Color order systems and architectural color design", Color Research and Application 10 (1), 5-11 (1985).
34. W. Spillmann, "A short history of color order systems", in H. Linton, Color consulting: a survey of international color design (Van Nostrand Reinhold, New York, 1991), 170-183.
35. G. Brino, "The colours of historical city centres in Europe –restoration experience, 1972-1992", in AIC Colour 93, Proceedings, vol. A (Hungarian Colour Committee, Budapest, 1993), 11-25.
36. S. Kobayashi and K. Sato, "The theory of the color image scale and its application", in AIC 1977, Proceedings (Adam Hilger, Bristol, 1977), 382-383.
37. S. Kobayashi, Color image scale (Kodansha, Tokyo, 1991).
38. L. Sivik, "Colour connotations and perceptive variables", in AIC 1969, Proceedings, vol. II (Muster-Schmidt, Göttingen, 1970), 1064-1072.
39. L. Sivik, Measuring the meaning of colors: Problems of semantic bipolarity (University of Göteborg, Psychological Reports vol. 4, Nº 12, 1974).
40. L. Sivik and A. Hård, "Some reflections on studying colour combinations", Color Research and Application 19 (4), 286-295 (1994).
41. A. Hård and L. Sivik, "A theory of colors in combination –a descriptive model related to the NCS color-order system", Color Research and Application 26 (1), 4-28 (2001).
42. T. F. Tosca, Arkhitektoniko khroma. Theoria kai skhediasmos [Architectural color: theory and design], in Greek (Ekdoseiz Adelphon Kuriakide, Thessaloniki, 1989).
43. T. F. Tosca, "Coexisting or mingling: the visual aspect of the problem in the urban context", Color Research and Application 15 (3), 129-150 (1990).

44. T. F. Tosca, "Dreams of light for the city", Color Research and Application 19 (3), 155-170 (1994).
45. L. Oberascher, "Environmental colour design: simulating real world complexity", in AIC 96, Colour and Psychology (Colour Report F50, Scandinavian Colour Institute, Stockholm, 1997), 49-55.
46. L. Oberascher, "'Luminos 3' –a new tool to explore colour and light in 3D", in AIC 2001, Proceedings (SPIE, vol. 4421, Bellingham, WA, 2002), 131-133.
47. P. Green-Armytage, "Applications of colour order systems", in AIC Midterm Meeting 1983, Invited lectures (Colour Report F28, Scandinavian Colour Institute, Stockholm, 1983), 123-148.
48. P. Green-Armytage, "Primary confusion", in Aspects of colour (University of Art and Design, Helsinki, 1995), 191-200.
49. P. Green-Armytage, "Colorimetry, designers and xenophobia", in AIC 1999, Proceedings (Central Office of Measures, Warsaw, 1999), 245-264.
50. P. Green-Armytage, "The future of color in the visual arts, architecture, and design", in AIC 2001, Proceedings (SPIE, vol. 4421, Bellingham, WA, 2002), 1028-1031.
51. P. Green-Armytage, "Colour science for colour design", invited lecture to the ECD Symposium, in this AIC 2005.
52. L. Ronchi and S. Villani, L'interazione uomo-ambiente alle soglie del 2000 (Mariposa Editrice, Fornacette, Pisa, 1998).
53. L. Ronchi, comp., "Light and color in environmental design: some annotated terms", in www.fadu.uba.ar/sicyt/color/glossary.htm (2002).
54. L. Ronchi and J. Caivano, "Naming the appearance of patterned complex displays", in ArgenColor 2002, Actas (Grupo Argentino del Color, Buenos Aires, 2004), 499-506.
55. J. Hutchings, "The continuity of colour, design, art, and science (I and II)", Color Research and Application 20 (5), 296-312 (1995).
56. J. Hutchings, "Colour and appearance in food and design", in ArgenColor 2000, Actas (Grupo Argentino del Color, 2002), 333-338.
57. J. Hutchings, Expectations and the food industry. The impact of color and appearance (Kluwer Academic, New York, 2003).
58. A. García Codoñer et al., "Formal restoration processes of the historic centre. Urban colouring and shaping in the Carmen district of Valencia", paper to the ECD Symposium, in this AIC 2005.
59. M. M. Avila and M. Polo, Color urbano: indagaciones en ámbitos de la ciudad de Córdoba (Eudecor, Córdoba, Argentina, 1996).
60. M. M. Avila et al., "Colour and the design of urban image", forthcoming in AIC 2004, Color and Paints, Proceedings.
61. G. Smedal, Longyearbyen in colour –status and challenges (Kunsthogskolen i Bergen, Norway, 2001).
62. F. S. Welsh, "Historic paint colors of Spanish St. Augustine", paper in the session on architecture, in this AIC 2005.
63. M. Billger, Colour in enclosed space: observation of colour phenomena and development of methods for identification of colour appearance in rooms (Chalmers University of Technology, Göteborg, 1999).
64. M. Billger, "Colour combination effects in experimental rooms", Color Research and Application 24 (4), 230-242 (1999).
65. J. Janssens and B. Mikellides, "Color research in architectural education –a cross-cultural explorative study", Color Research and Application 23 (5), 328- 334 (1998).
66. B. Mikellides, "Colour theory & practice in architecture 2002: a longitudinal perspective", in ArgenColor 2002, Actas (Grupo Argentino del Color, Buenos Aires, 2004), 551-559.
67. Ref. 50, p. 1031.