

On The Premise, Promise and Complexity of Color Versatility in Built Environments

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***Abstract:** The Milan 2010 Salone confirmed the emergence of a powerful new light technology for color 'flow', customization, and flexibility in environments. Such departure from the exiting paradigm of color permanence, requires examining how to engage color in built environments as non-committal and versatile. Historically 3-color eras with distinct color logic emerge, from Color–Nature to Color–Lab and most recently to Color–Cyber. Evolutionarily we grew accustomed to specific color sources, constraints, manifestations, manipulations, and ultimately expectations that govern design and experience of color in built environments. But with infinite color choices, customized and changed at no cost, color permanence becomes an unnecessary imposition and tyranny. We need new rules as we identify novel questions and emergent opportunities, assessing our readiness to embark on this new paradigm of color versatility in designed environments, and mediating between modern chromophobia and chromophilia.*

Keywords: Color, Technology, Evolution, Agile design, color, pattern, harmony

1 Introduction

The evolution of Man – Color relationship can be broadly segmented into three unique eras: Ancient times typified by color-mining from nature resources,

modern times with lab-produced synthetic pigments and new color practices (measuring, manufacturing, marketing and clearly design), and current postmodern times where cyber color irreversibly redefines color availability affordability and usability. Underlying these changes is a shift in associated opportunities and challenges, the role of color in man's life and the role of man in working with, thinking of and experiencing color. As all evolutionary phenomena are punctuated by revolutionary defining moments, we're now stepping into such metamorphosis time and curiously observe recent transitions from color-by-lab to color-by-cyber, from artificially synthesized pigments to dynamically produced web-colors, from color-as-permanent to color-as-flowing and morphing, from color-finite to color-infinite availability, from old to new color commerce patterns, from past and passé to future and emerging color-skills and user behavior. Deconstructing the evolutionary path of man-color relationship one can note defined color eras with a distinct set of opportunities and challenges.

2 Color-Nature: The Era of The 'Color Gatherer & Extractor'

The first mention of man- color relationship is associated with cave paintings 32,000 years ago in Europe and possibly as early as 100,000 ago in India or even earlier, 150,000- 200,000 years ago, in Africa. Pigment grinding equipment estimated to be over 350,000 years old has been found in a cave in today's Zambia (Burchett, 2005). The oldest color actively used by humans to intervene in their environment is ochre (iron oxide, red/yellow pigments of varying shades) and charcoal. It is the first known conscious attempt to represent experience (Finlay, 2002).

The earliest known color palette is clearly derived from availability; it is tied to local resources and the limited technologies available to extract them rather than aesthetic purposes necessarily. There is no evidence that pigments used, which we may find beautiful today, were intentionally selected or planned, however the desire to intervene in the human environment with the ultimate functional purpose of communication and the pursuit of happiness (by way of ingratiating the Gods) is already manifested.

The Ebers Papyrus (dating to 1,500 BC) is the first known literature on color, and confirms the vital role of color in Egyptian religious practices (Finlay, 2002). Starting around 2,500 BC a more conscious use of color began to develop. Colors were employed as means of expression, and the art of the early civilizations shows that the intrinsic beauty of color was important and the result of deliberate choice. In parallel with the nascent intellectual exploration of nature,

an intellectual examination of color started to take shape in the 4TH century BC in Greece (Burchett, 2005).

Besides the exploitation of natural colors intrinsic to materials (like copper bronze and gold, stone and wood) all color used before the Industrial Revolution was derived from pigments of natural origin. With the expansion of the Greek and Roman empires, contact with remote and previously unknown geographies became possible and the pool of natural resources for color extraction grew concomitantly. In addition to ochres and iron oxides, pigments that were extracted from unusual sources like botanical materials, animal waste, insects, mollusks and precious stones, could be traded over long distances. Biological pigments were difficult to obtain and their production process was kept secret.

The cost and difficulties of color/pigment extraction processes led to rare and limited use of specific colors like blues and purples affecting the importance and relative power of those who had know-of and know-how of these resources and the status and reputation of the color itself and/or its wearer. Suddenly a new dimension was added to color; it was no longer a functional means for communication, or symbolic spiritual connection with existential notions only as in earlier times, but it now enjoyed a social perception whereby its rarity and thus preciousness, was associated with higher powers, worldly and otherworldly. The color purple with its association to royalty best exemplify this color era:

The purple dye is one of the oldest pigments known. Traditionally Purple was always regarded a royal color. What earned Purple its status was its rarity due to the difficulty by which it was generated. Murexes, types of drilling snails, have a mucus-secreting organ from which Tyrian purple is extracted in small amounts. The color name comes from the habitat of the mollusks, traditionally harvested near Tyre in the eastern Mediterranean. Extracting purple dye from shellfish required special skill and knowledge that only a small group of Phoenician (now Lebanese) 'experts' mastered. Exactly how this rare color was produced is not clear. Yet archeological evidence from this time offers that production was on a large scale, and began with leaving the mollusks in huge vats to decompose in the sun.

The most valued shade of Tyrian purple was the product of a double-phased process. Two different snail types were found near Tyre, both producing slightly different colors. Cloth were dipped once in the indigo dye of one type of marine snail, and once in the purple-red dye of another type to achieve the Tyrian purple color. To better understand the rarity and difficulty associated with producing the color, it took about 12,000 mollusks to produce enough Tyrian purple to dye a single dress the size of a Roman toga. With such tremendous efforts to generate Tyrian purple the wearer of this color was the wealthy and privileged. Indeed, the purple toga was introduced to the Romans by the first kings of Rome around 753 BC. Some hundreds years later, in 1467, Pope Paul II introduced "Cardinal's Purple" a scarlet color extracted from the Kermes insect

from which the English word crimson derives. It became the first luxury dye of the Middle Ages bringing cardinals to a status similar to that of the kings of Rome. But all of this was about to change forever with the discovery that it's possible to produce purple dye from lichen (as we'll elaborate on later).

With the great explorers, from Marco Polo in Asia to the Spanish and Portuguese conquests in the West Indies, new trade routes that were opened and consequently new pigments were introduced to both sides of the Atlantic. In the 16th century the color Carmine attained status in Europe (Butler Greenfield 2006). It was derived from dried and crushed South- and Central American cochineal insects and had never been seen in Europe before. Carmine and silver became the most valuable exports from Mexico for the Spanish conquerors. The pigment gave Catholic cardinals their red robes. While Carmine red was becoming popular and more easily available, blue remained exclusive, retaining its association with wealth and power. And indeed, despite changes in trade and thus color availability, the basic equation of {color/pigment rarity + extraction /accessibility effort = wearer social status & color reputation} remained unchanged.

3 Color-Lab: The Era of the ‘Color Inventor & Producer’

While the intensity and multitude of color remained associated with social status through the first creation of synthetic pigments, the changes that were about to come were unimaginable and paradigm-shifting. After centuries of little to no scientific and technological progress in the area of color the Industrial and Scientific Revolution saw the beginning of a whole new gamut of color usability and application opportunities with profound effects on worldwide economies, on art, fashion, product manufacturing and social classes. Before the Industrial Revolution the use of color outside of the realm of art was conceivable only for the upper social classes, or even kings and clergy. The choice of individual hues was not as relevant as the ostentation of pigmented materials. The choice was between color and no color. The invention of synthetic pigments first, and synthetic dyes later, revolutionized and democratized the use of color.

The initial efforts were concentrated on blue, as it was the most expensive and rare pigment to obtain, derived from lapislazuli powder. Prussian blue was the first synthetic pigment, discovered by accident in 1704, probably by the paint maker Diesbach in Berlin (Garfield, 2001). The discovery of mauveine, the first aniline dye, in 1856 by William Perkinⁱ, was a forerunner for the development of hundreds of synthetic colors, and the foundation for the development of the organic chemistry industry. This brought industrial prosperity and wealth to Germany and other countries of Northern Europe, but also meant

the decline and impoverishment of the Spanish New World Empireⁱⁱ. Organic chemistry also signaled the demise of the cochineal industry in Peru and Mexico. The revolutionary importance of these developments is profound. Color became affordable for industrial production, from textiles to other consumer products. It was now possible to choose between colors, without being limited by regional natural resources availability. This in turn created a whole new derivative industry, with color systems (e.g. Munsell and others) and manufacturing, marketing, design and measuring methodologies.

The basic equation of {color/pigment rarity + extraction /accessibility effort = wearer social status & color reputation} was forever altered. Natural resources gave way to laboratory capabilities. Pigment / color rarity was mitigated with artificial synthetic pigment production. Color accessibility became a matter of manufacturing and marketing. Design and fashion were now the new defining forces of social status. The man – color relationship have been altered from skills required to mine color to color consumption and leverage. Color leaders were no longer royal blood but designers and scientists. Color affordability democratized color consumption and the color consumer changed from the ‘the one’ to ‘everyone’ as (also) demonstrated through the evolution of purple:

Moving away from dyes for coloring cloth that are extracted of natural products, expensive and labor-intensive to produce, hard to wash and easy to fade, the accidental discovery of mauveine gave birth to the synthetic dyes industry. It revolutionized fashion, and sparked enormous interest in commercial applications of chemistry (for example German scientific discoveries allowed branching out into pharmaceuticals and explosives). Design and later sales and marketing became as important. The color itself became widely used and lost its royal and exclusive / distinguished status. Lebanese lead gave way to German one and artistic craft was now replaced by scientific knowledge of chemistry and production.

Color became a multifaceted phenomenon susceptible to political events and their influence on the common psyche and collective subconscious, emerging street fashion, influences from shifting power areas in the world, and global icons and local cultural heroes, to name only a few factors. Color was now a vehicle for individual emotional and social identity expression. It also became a very visible signal of world influences and their migration from the fast-moving avantgarde of fashion to the slowly emerging interiors and goods (such as cars and tooled furniture and equipment) that require higher investment to change color. A new color equation emerged whereby {color/pigment inventing/designing + producing + marketing = individual & social expression and color symbolism}.

4 Color-Cyber: The Era of The ‘Color Virtuoso’

The era of synthetic pigments, the “lab generated color”, continued to evolve and flourish. Color practices, methodologies, heroes, theories and applications were established and institutionalized and within 2 centuries a solid color paradigm has emerged to govern man-color relationship. And just when it seemed that no new rules could be added to this well evolved color paradigm, it was suddenly punctuated with the recent introduction of digital color and the new standardization models, “cyber color”. With color turning digital and tech-enabled, it also becomes transient, temporary, reversible, infinite, and dynamic. Color availability is no longer dependant on natural resources from which to extract pigments, on skills and trade capabilities or imperialism and worldwide commerce routes for color transport, on lab equipment and skills with which to synthesize pigments, etc. Instead, a switch, an algorithm, a right-click command, enable color selection and immediate alteration of that choice if so desired.

Infinite color availability comes with a new set of challenges from the technology limitations of monitor resolution and printing output to user skills, consumer psychology and commercial applications. Technologically, the quality and accuracy of color matching and renditions is only as good as the weakest link in the setup. The ease of communicating color specifications very often makes for a lower end experience, color that is flat and homogenized. Color digital flatness is exacerbated by the equally homogenized 3D rendering techniques, which lack the distinguishing imperfections of analog color pigments. Color that is ubiquitous and available is not as desirable any more.

But technological challenges make for only one set of issues. Of equal if not greater importance is the user / customer. Digital colors and lighting technology, specifically LEDs, make every color possible and available at the slide of a switch. It is not necessary to “commit” to a color when we can have them all. Any room can be transformed by the inhabitant of the moment, any apartment recolored depending on the current mood. The consequences are a shift in the meaning of color, the non-committal approach to any one specific hue. The LED hues are the colors of having it all. But would consumers be excited and confident about making color choices? Would they explore, dream, create, change, morph, alternate, exchange, transform, free-play with color? Would they feel a sense of competence, mastery, pride and ownership of their color expressions? What is the learning that a typical consumer should undergo to develop the virtuoso-like color capability or performance?

And how will companies approach color in their products, brands and environments when color is transient, dynamic, user-centric, versatile and infinite? Many modern corporations do not want to be identified with one single color any more, because they want to cover all bases and all emotions. Social Networking and the next phase of web development (Web3.0 Semantic Web and 4.0 Artificial

Intelligence) will signal The End of Trends as communication is too fast, diversified and infinitely networked to allow large trends to gel and exist. Information symmetry is becoming a reality, and with that the inefficiencies of our society that allow for asymmetric gains and manipulation will be eradicated. Everything is connected through hyperlinks that can take choice in multiple directions at any time, and color choices are one very visible manifestation of how these interconnections surface.

The unique aspect of color is the direct connection to the subconscious. Much like it happens with music, color can evoke instant emotion, positive or negative, strong likes and dislikes. With information becoming more available, intent will be more open and expression ultimately more sincere (note for example the various humanitarian initiatives/projects based on the use of color currently undergoing that benefit from information symmetry and aim to leverage color to impact positive experience of the environment context in which they operateⁱⁱⁱ). Color is likely to take a center stage in constructing a dynamic and versatile user-centric self-expression, shaping a dramatically new and progressing man-color relationship paradigm.

Conclusion

We live the time of progressive specialization. A new man-color relationship paradigm is emerging whereby man takes active and non-committal position, expressing color choices within an infinite and yet available controllable and manipulated color space, and modifying them instantaneously. Just as the industrial revolution changed color work and theory forever and enabled applying color in built environments in novel aesthetic and commercial ways, so does the current cyber revolution punctuating the Color-Lab paradigm dismantling its order and opening for new opportunities, challenges and approaches to color, many of which are not known to us as of yet. In pre- industrial revolution times, there was less differentiation among the individual categories that contributed to the environment. It was simply what surrounded us that became a manifestation of the culture of the time: a frieze on a temple, the frescos in a Renaissance palazzo, the cardinals' robes. Color was making its impact through different manifestations because of technological limitations of how pigments could be employed and applied.

Color-cyber frees us forever from the tangible aspect of color and thus from extraction and production limitation as well as color permanence once created and/or applies/employed.

The frieze, the fresco, the robe, the workplace, the cabinet, the tile, can all be designed with color impermanence and versatility in mind. The role of color-designer might now be one the consumer holds. Brands are likely to loose their yesterday's imposing power on consumer color decisions. Color expression is

likely to lead to color expansion and explosion much before a new color-paradigm emerges to govern color exploration and exploitation. And yet with all this ambiguity that is about to come one thing becomes evidently clear – in a cyber world of 255³ colors embedded in smart walls, tiles, e-papers/skins and materials, we have stepped into a new color era!

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ⁱ *In the mid 19th century, William Perkin produced a synthetic purple known as mauveine, bringing purple within reach of ordinary men. The active chemical constituent of Tyrian purple dye, 6,6'-dibromoindigo, was isolated in the early 20th century. Perkin's discovery of mauveine gave birth to the synthetic dyes industry and revolutionized fashion. This resulted in a dramatic increase in production capacity, making, purple cloth (among other colored cloth) inexpensive to produce and very fashionable. Queen Victoria, Empress Eugenie and the Pope all wear purple and contributed to its fashion success. The 1890s were sometimes referred to as the Mauve Decade because of the widespread use of that color in fashion. Apparently Perkin also discovered two new dyes, Britannia Violet and Perkin's Green, a discovery that set off a race to find more dyes with similar compositions. Later, in 1869, Perkin found a method to commercially produce alizarin, a brilliant red dye. The Perkin Medal was established in 1906 to commemorate the 50th anniversary of the discovery of mauveine and it is widely acknowledged as the highest honor in American industrial chemistry. Perkin's discovery and later, his life's work, had led to the existence of thousands of artificial colors.*

ⁱⁱ *The manufacture of synthetic dyes spread rapidly from England into Europe and specifically France and Germany, German chemists soon developed whole new "families" of colors and also learned to synthesize such popular natural dyes as indigo and madder. By 1914 Germany produced about 75% of the world's supply of dyes and dyestuffs. During the 1920s and 1930s the industry grew and diversified. Purple 'production' was no longer about gathering and extracting but instead it involved scientific applications for precision and consistency in production. The Lebanese on the other hand were no longer a central production hub for purple. Their production skills were antiquated and not relevant. Similarly, the status of the purple color shifted as well. No longer a hard to produce, expensive and rare, the color of royalty and the privileged, purple as an artificially-*

produced color was now available to the average man and no longer a symbol of distinguished royalty and/or wealth.

ⁱⁱⁱ Examples include “Color for Cause”

(<http://www.volvorentsconstructionequipment.com/stores/colorforacause>) the repainting of the Favelas in Brazil (<http://www.favelapainting.com/>), the upgrade of degraded housing stock in Tirana Albania

(http://www.esiweb.org/index.php?lang=en&id=311&film_ID=3&slide_ID=6),

Publicolor in NYC schools (<http://www.publicolor.org/>) to name a few examples. All these interventions leverage consumer-centric emotion targeting color associations and preferences to generate desirable experience in the selected environment.