Ecology and colour – the emerging design perspective

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Until some time ago it was possible to identify a sort of popular correspondence between ecology and colour. In fact, sustainability of a product could be expressed with the green colour. Many products were characterised by a blend of colours: the memory of the various materials was combined in the new product; for this reason they used to appear varied and personalised, being clearly recycled. In other cases the material, either semifinished or crafted, could exhibit unambiguous signs or symbols related to nature. Among the examples is the laminate whose weave incorporates natural elements in transparency, although this does not grant real sustainability. Our question is whether and how colour can still be considered an ecological metaphor, or whether colour is being used in different ways due to changes occurring in the wider issues of sustainability, connected with environmental policy, productive processes, sensorial culture. Ecology is an increasingly complex concept. It can be expressed through various features; since it is free from stereotypes and commonplaces, it can be represented by various colours. Colour is an essential cognitive driver (function), poetic syntax (decoration), historical and cultural subject (communication); we intend to verify whether, in the design perspective, it still proves consistent with its conceptual framework: bio-diversity, decomposability, handicraftness, quality of life, sobriety, smoothness, frailty, mimesis, lightness, edibility, sustainable technology, expressive freedom, playfulness; within a continuous dialogue with matter, object, space, memory. In such a framework we will address the concept of sustainable sensoriality. Colours can represent a powerful ecological metaphor in some design scenarios.

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Ecology and colour: egemony of green

The adoption of green colour to describe nature and the environment is a relatively recent experience [1]: it dates back to the Nineteenth Century Romanticism [2], more oriented towards ‘whispering love in wide lawns’ than it used to be in the Middle Ages; in that period nature was coloured like the four aristotelian elements: the mat black of earth, the dark blue of air, the brilliant red of fire, the greyish cobalt blue of water.

Since then colour, as deep personal feature, has been only left to the object (colour as pure perception) and progressively reduced to pure measure. Johan Wolfgang von Goethe, in open controversy against Newton, writes: 'With a delicate game of weights and counterweights nature swings in this or that direction, and therefore a here and there, an up and down, a before and after arise; this influences all the phenomena occurring in space and time ... In such a way nature speaks to unknown senses; it speaks to itself and to us through a thousand phenomena' [3].

Goethe considers that colours being only a pure physical phenomenon is inadmissible, and accuses newtonians of having buried a centuries-old work. On the contrary, he believes that colours are alive and without any doubts they come from natural phenomena, but they find their composition and their completion in the eye, in the mechanism of vision, even in the spirituality of the observer's soul. Therefore colours cannot be explained only through science, but they need to be also connected to poetry, aesthetics, psychology, physiology, and symbolism.

Colours are physical phenomena, but also 'allegories' culturally coupled with symbols and meanings. Precisely in the definition of the green colour Goethe speaks of the symbol of what is natural, of mixture perfectly equilibrated between two extremes, of something simple which eye and soul rest upon, of a central colour in the visible spectrum arising from the opposition of yellow (close to white) and blue (close to black).

We owe the word 'ecology' to the biologist Ernst Haeckel in his book Generelle Morphologie der Organismen (1866). He defined it as 'the body of knowledge concerning the economy of nature; the analysis of the complex relations of an animal with its environment is both organic and inorganic, including especially its positive and negative relations with animals and plants with which it comes into contact directly or indirectly.'.

From the environmentalists' perspective 'ecology', meaning a 'guide' for the relations of mankind with its environment, surged in popular and scientific interest during the 1960-1970s, with the rising of environmental movements. In that moment the correspondence of green and ecology became deeper with the streamlined relation between nature preservation and ecological practices. Especially in the language of politics and journalism, the term green is used in reference to groups and movements advocating protection of the environment and the natural balance in order to safeguard the conditions of human life, fauna and flora [4].

'Green' as symbol is even more evident if we think that until a very recent past, for the clear, simple and direct expression of an ecological material this colour could not be ignored. As the fourth dimension of sustainability the green colour imposed a sort of reciprocal and popular correspondence between ecology and colour.

For a long time in order for many products to immediately prove 'green' they have been mainly conceived in a green nuance or with a pattern and surface oriented at the imitation of the so-called 'natural' materials (Figure 1).

Figure 1: Ligneah, mix of technology and handcrafted qualities, bag in wood with tactile and appearance properties of leather and textile.

Today sustainability is not anymore only a feature that can be attributed to the materials forming a product; things are much more complex, and a 'green' product is not anymore green; more precisely, such a complex concept cannot be related only to colour. In fact, ecology and sustainability have become multidimensional, dense and polysemic, involving heterogeneous factors such as the productive process, consumption of energy and natural resources, and also the cultural level [4]: this concept is being communicated in various ways, among which marketing strategy, corporate communication, brand philosophy, etc.

In such a way, for example, the natural linen spectacles realised in 2012 by the Italian Custom-6 cannot openly expose its 100% natural composition, and it is advertised with an image locating the product on a green lawn (Figures 2 and 3).

Figure 2: Custom-6 realised natural philosophy where ecological and natural concepts are chosen with the material, handcraft philosophy and Italian production.

Figure 3: Oat shoes, shoes made with biodegradable materials.

Otherwise, in the promotion strategies of the biggest international holdings such values are communicated by widely known personalities able to grant trustworthiness. A recent example of such a strategy is the extremely light and ecological soccer shoe realised by Nike for the Brazilian champion Neymar; it only weighs 160 grams, it is made with the recycled fibres of the Brazilian 'mamona' plant which is widely farmed in Brazil and also used to produce bio-diesel fuel; the message is conveyed towards the whole society by this soccer star.

But colour, mainly if it is green, is still able to show ethical, natural, healthy and well-being orientations in areas such as the biological agro-industrial sector whose 'image' is still related to the green colour, associated to authenticity and nature. In such a way the chlorophyll green is preferred to the wheat yellow, although the message is strengthened with symbols showing quality certifications

(ISO, CE, etc.) or with category labels (DOP, DCO, DOPG, etc.). Green is always the colour of renewable energies, zero-mile food, holidays, innovation and smart technologies. Therefore, it is true that we can represent ecology with infinite colour scales, but very often we still lack the thought categories allowing us to multiply it.

Complex and multi-dimensional ecology

The tight connection between ecology and materials, together with the development of many experimental channels for research upon production, pushed the definition of 'ecological material' to a more complex and multi-dimensional meaning. In fact, we have some materials – and therefore objects – endorsing bio-degradability, other materials obtained from recycled or sustainable materials composed by renewable sources, other ones leading to energy sparing in production or transportation, or emphasising local resources. The label 'ecology' is then a focal point which can be pursued through various ways according to corporate experiences or strategic visions, such as marketing plans. These productive logics are often far from the user and they are not directly perceived, witnessing a separation between what is sustainable and what is liked.

- Recycled products
- Recyclable products
- Bio-degradable products
- Certified natural products
- Renewable source derived products
- Energy saving products
- Products investing on product sustainability
- Products encouraging ecological behaviour and style

Within this taxonomy of products we verified that the majority of the products listed does always use the green colour in communication or in labels, while the nude prevails (the true expression of product ecology), since unpainted. On the contrary, for some materials research is linked to the possibility of making them similar to other, less ecological materials in order for them to exploit aesthetical options and prove at least comparable with other materials. This implies that the meaning is being shifted from material to product communication in a relevant way.

Colour was formerly used to communicate customer the value of his/her choice since it contributed to identify a channel for 'green' research; it remains an important element of communication, and is enhanced with shades and meanings connected to the whole product lifecycle. In such a way the process refers to colours linked to yellow/orange (the sun), to blue/green (water), to blue (hydrogen), to the colours of natural ingredients, to pure white (clouds, or re-birth) until the final concept is identified. This is where many remarks come from: smart&green, colour&green, experience&green, cultural&green.

Emerging issues and perception

Many strategies are being developed and adopted to face and possibly solve the productive issues of sustainability; at the same time we are recording a quick change of sensitiveness in consumer choice

and lifestyle, due to a deeper awareness of a wide economic crisis and of a global approach to planet's resources. New lifestyles created a market expanding all over the world, Americans called it LOHAS, acronym for 'Lifestyle of Health and Sustainability' [5].

Therefore, on one hand we have a deeper awareness of issues related to ecology, and on the other hand we record a diffused inclination towards cheap but not necessarily ecological products. Within such a contradiction, also generating hard battles about the origin of products and their crafting processes, we face 'an explosion of attention to research of deep qualities, connected to more rooted needs and cultural structures', planning intangible properties of objects.

LOHAS consumers, defined 'cultural creative' by the sociologist Paul Ray, 'do not care about the quantity of goods they can accumulate during their life, but they do care about living a meaningful life' [6]. Probably we are in a stage that Ezio Manzini had already envisaged as follows [7]: 'Man must yield benefits from his intelligence, from his ability to forecast: to respect natural equilibria is not at all a natural behaviour. It is a deeply cultural and therefore artificial fact'. Such new qualities and environmental constraints define new ecological scenarios.

Creativity in rescuing the existing setting is being privileged, such as softness in relationships. Ecology is not anymore prerogative of a close milieu of people, it rather becomes a modus vivendi finding its equilibrium in everyday routine in a smooth and natural way. The new themes that we can consider the landmark of future society are:

- Softness: the 'female' approach is being emphasised since it privileges lightness and softness in the relationship with the world, through the rediscovery of sensitive approaches where there is no fear of shades, subtle and frothy colours, of games and experimentations. Therefore clear and feeble colours are preferred, also in unexpected areas.
  Keywords: softness, responsibility, lightness, game, society

- Personalisation: it becomes possible to compose and re-qualify own space adopting logics of personal consistency, derived from the individual present experience. In such a way different aesthetic views come closer to each other in search of an imperfect but expressive, functional, experimental world. A new approach to decoration is then generated, looking for languages and syntaxes of storytelling through new dynamic equilibria. In such a vision some on-demand products matter, with a wide colour range able to set a dialogue with other products due to a new chromatic code.
  Keywords: experience, storytelling, uniqueness, decoration, identity

- Cognitive qualities: many scientific discoveries, related to the mechanisms of human body, focus upon its physiology and its biologic rythms measuring nature through humanity and discovering the dynamic equilibria able to support and move him, and to guide him in choice and orientation. Such a view strengthens the project-crafting approaches linked to colours and generated by sensitiveness and by the relationship with history and culture of products. Therefore we have ecological-process products but also artificial-ecology products based upon depth, identity, memory and sensitiveness. We can refer to the eloquent image (identity) of materials and products able to adopt a language using grammar and syntax to stimulate our whole endowment of emotional, perceptive and intellectual reactions.
  Keywords: experience, storytelling, uniqueness, decoration, identity

- Invention: this is related to creativity associated with technology in order to solve urgent problems in simple and economical way. Technology supports a more sustainable vision of the world, making the climatic and energetic emergency an opportunity for development. The 'green' technologic discoveries likely become main ways which can direct policy tools and actions in disadvantaged areas dominated by environmental problems and scarce economic resources. It would be a new energetic world looking at the ecologic future as possible, generous of proposals and rich of enthusiasm. Colours are therefore saturate and energetic, shapes are organic like in the Renault Twin'Z Concept, electric model ready to substitute Twingo in 2014.

  Keywords: green technology, intelligence, economical orientation, simplicity

Examples of design scenarios

Which design scenarios are in the process of unfolding, related to the relationship between colour and ecology?

On one hand technology becomes more and more complex and sophisticated, mainly at the nano-tech level; on the other hand such relevant innovations lead to the re-discovery of natural modes rich of symbiotic relationships with the environment, as a continuously evolving dimension, and expression of a changing vital complexity even oriented towards self-reproduction.

Colour as alive element: In such a framework also colour becomes a changing and alive element (e.g. in its relationship with time), or non-invasive element, able to support changes in search of a perfect symbiosis with the environment. In this way the relationship with science and biology becomes a natural expression of the object. For example, in 2000 Oron Catts and Ionat Zurr founded SymbioticA, a lab devoted to study and research of life sciences. This laboratory generated the most interesting 'bio-inspired' experiences [8] carried out by designers such as Lehanneur, Revital Cohen and Susanna Soares; in 2008 it was hosted in the MoMA exhibition 'Design and the Elastic Mind', curated by Paola Antonelli: it presented some products incorporating alive beings, and generating interactive and sensitive profiles of colour. Very interesting among these were the projects using bacteria and cells which, once cultivated, generate typographic characters and posters in continuous evolution since based upon the life cycle of multiplication and death of bacteria, such as Symbisios by Jelte van Abbema (Figure 4).

Figure 4: Jelte van Abbema, Symbiosis, 2009. Sperimental project of typography generated by bacteria proliferation.

Colour as planning element: Colour is also a planning element, since it can be programmed through interaction with some natural elements, changing them according to the occurring needs. In this way the most recent nano-tech research works unfolded a series of new opportunities for the planning processes, through the laboratory creation of natural materials and phenomena such as the interesting discovery of a group of scientists co-ordinated by Professor Yen Hsun Su in Cheng Kung University of Taipei. This Taiwan group observed that installing golden nano-particles, similar to sea urchins, in Carolina Bacopa plants, the leaves produce a bright reddish aura: this means that they generate light through golden particles, and facilitate the natural bio-luminescence of clorophyll. This could be imagined as the bio-LED of future, and it could be adopted to illuminate streets at night, trasforming trees in coloured street lamps (Figure 5).

Figure 5: Bio-Led, optained by nano-particles of gold, implanted in some plantes, to optain a bio-luminescence.

Golden or variously made nano-particles, able to get all the colours of the rainbow according to their nano-dimensions, have also been adopted as natural pigment for textiles, leather, hair, etc. With nano-pigments we can dye with no synthetic colours, i.e. with no chemical and surface-active agents, and therefore contributing to the growth of Nano&Green Economy.

Other studies have been based upon nano-technologies, observing the natural iridescence of colours in the wings of butterflies and other insects and using these micro- and nano-structures in ordinary products. In butterflies' wings colour does not depend upon pigments but upon specific micro-structures which reflect and refract light touching their surface, as is well known. The brightest colours are obtained when light interacts with surfaces with a periodic structure at micro- or nano-scopic scale. The complex structure of the Indonesian butterfly Papilio Blumei has been studied and artificialy reproduced by Mathias Kolle, Ulrich Steiner and Jeremy Baumberg [9], Cambridge University researchers. In such structures, covered by many layers of flakes, alternated with concavities 5-10 micrometres wide and filled with air, light coming from different angles is reflected once or more times according to the direction and the wavelength, and polarised, creating very intensive colour effects.

Figure 6: The reproduction of natural butterfly Papilio Blumei wings' structures can prove useful to settle industrial systems aimed at protecting safety of banknotes, credit cards and other documents preventing their counterfeiting.

Using a combination of nano-technologies – from laying down mono-atomic layers to self-assembly – it has been possible to replicate structurally identical copies of the elements forming the wings of the Papilio Blumei (Figure 6).

The reproduction of natural photonic structures unfolds interesting landscapes which can prove useful to settle industrial systems aimed at protecting safety of banknotes, credit cards and other documents preventing their counterfeiting.

Colour as vehicle of sustainable concepts: Recently a new concept of sustainability is rising; it considers local and territorial culture a major element of contemporary design aimed at a new form of planning that we could define 'sustainable' because it can exploit the existing (material, but also technological and scientific) resources combining them with the productive traditions whose strategic value is their 'glocal' nature, a synthesis of local and global excellence [10]: it is a sort of geo-historic trip covering from regional traditions to languages and styles, from materials to craftmen's skills, from traditional and advanced production techniques to patents, up to the visual arts; it emphasises the complex colour of tradition, re-discovering local dyes and materials.

It starts from the 'roots' generating a new form of hybridation in which colour is an indispensable component (Figure 7).

Figure 7: Richard Ginori, Italian company between tradition and innovation.

The appraisal of local traditions and culture is the source of a wide proportion of the Italian production, which is based upon 'know-how' connected with handicraft production, material site-specific resources, local techniques and cultures.

An eloquent example is Richard Ginori which sublimated the art of ceramics recovering traditions and adopting richness and variety of individual experiences, of bio-diversity, of techniques and colours widening the horizon of design projects from aesthetics to a complexity able to overcome the simple observation of technological innovation *per se*, but in its capability of enhancing 'its relationship with a world of gestures, forms, traditions, style which is not imposed but is consciously chosen. The emotional impact is therefore not limited to touch but it allows users to extract the (deepest and most complex) value of our personal history and of our relationship with reality' [11].

Another important example of such a panning approach able to read the past through the present is Lanificio Leo, a company leader in reinterpreting the bind of weave and warp in an advanced technological way. Textile is treated like a pixel grid or like a white sheet on which it is possible to draw using the language of weaving also due to the use of late-Nineteenth-Century machines together

with Fifties' ones, generating contemporary colour and design textiles. In such a way the 'punto pecora' was revamped with abstract elaboration of signs which become element of a Jacquard-kind technology being brought to the limit; it re-elaborates the traditional fishbone theme. 'Punto pecora' is adopted in various scales (S, M, L) as minimum unit to create textiles belonging to a single family (Figure 8).

Figure 8: Lanificio Leo, from the joint use of late-Nineteenth-Century machines with Fifties' ones, generating contemporary colour and design textiles.

Colour as constraint of product uniqueness: In this category we find the products generated by the use of one or more recycled materials. This category uses colour and 'material decoration' in explicit way, but also in different or occasional ways in order to compose small diversified and unique series. Te re-use of waste materials is prerogative of many companies aiming at optimising both production costs and corporate image, but only in a few cases it manages to generate interesting aesthetic experiences.

It may happen, for example, when the materials forming products need to be explicitly declared, showing the stratification of materials and colours. In such a way the chair Rememberme, realised by Tobias Juretzek for Casamania, is sustainable since it is produced with recycled denim, but is, above all, bearer of memories and certainly a unique piece, although industrial (Figure 9). in the same way the spectacles Hip-Eco-Hop realised by Vuerich B and by Diamond Supply (Figure 10) are made with fragments of skateboards, in maple wood layers of different colours, just in memory of the 'recent past'

Figure 9 (left): Tobias Juretzek, chair Rememberme, Casamania.

Figure 10 (right): Hip-Eco-Hop glasses, realised by Vuerich B and by Diamond Supply are made with fragments of skateboards, in maple wood layers of different colours, just in memory of the 'recent past'.

Also the interesting work of Simona Incatasciato and Massimo Pluchino is based upon recycling, although with a different approach. They do not recycle materials, but the whole chair. The two Sicilian designers from Modica realised for Plinca Home a series of chairs crafted through the reinterpretation of the traditional tavern chairs, transformed through colour and decoration in eclectic and unique objects. They are the fruit of craftwork being unique and readable at the same time, and combine colour and creativity with functionality generating objects whose differences appear even in the smallest details (Figure 11).

Figure 11: Plinca Home realise a series of chairs crafted through the re-interpretation of the traditional tavern chairs, transformed through colour and decoration in eclectic and unique objects.

Conclusions

Colour becomes an essential element in the global and wide meaning of the 'green' project; it is not simply devoted to the renewal of old forms in new products, but mainly as pre-project element able to set a dialogue with senses and mind through the meanings of materials, culture, form and interaction. It is not by chance that the most recent planning developments on sustainability focus upon the central role of the human being and his psycho-physical equilibrium, where emotion and senses as a whole are able to give strength and respect in the relationship between man and environment, proposing the true meaning of 'sustainability'.

Colour becomes an element of direct and meaningful dialogue with the user, confirming the concept of ecology in a constant equilibrium among various productive, creative and value factors.

Experimentations on colour witness the need to find new equilibria in the relationship with objects, facing the big needs of ecology with all the technological, cultural, perceptive tools available in the present time, following a revolutionary wave that we hope respectful of cultural diversity and richness.

'*We can define the expression 'Sustainable Sensoriality' like a combination of sensorial dimension and phenomenological richness, filtered by cognitive awareness and not only by the physiology of senses, with the environmental and cultural sustainability, i.e. of respect and development of the biodiversity and eco-compatibly: a meeting able to connect, within a systemic and holistic vision, the criteria of ethical and differential production with those of intensive and aware consumption, in a respectful construction of local and global values*' [12].

An eloquent synthesis is offered in the map elaborated by the authors of future emerging scenario between ecology and colour (Figure 12).

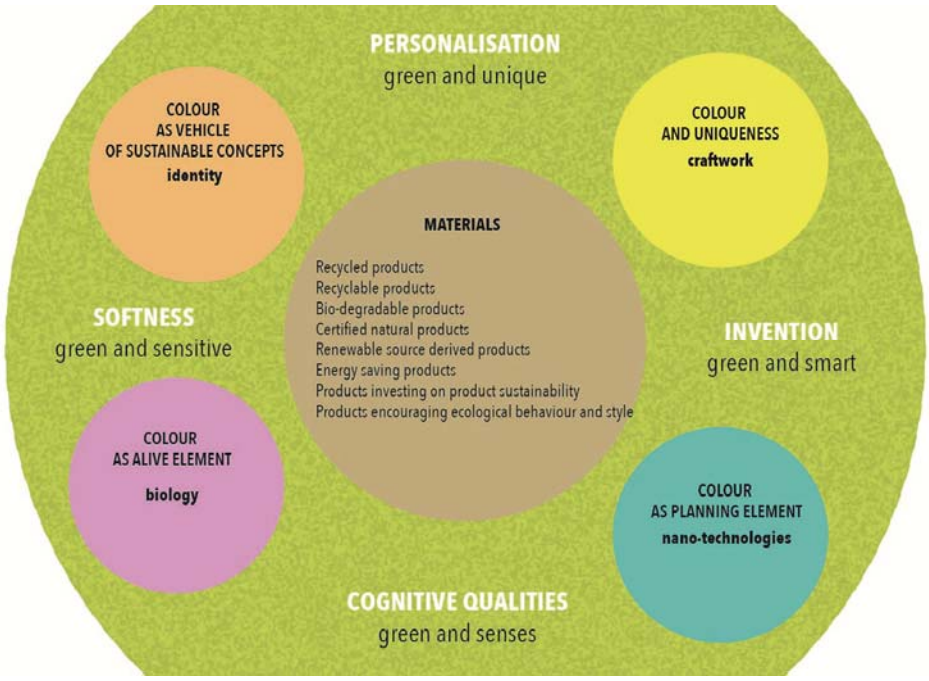

Figure 12: A symbolic map of future emerging scenario between ecology and colour.

Credits

The paper has been jointly conceived and widely discussed by the authors. For the sake of precision Francesca Cattaneo has drafted the paragraphs 2, 3 and 5; Sabrina Lucibello has drafted the paragraphs 1 and 4.

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