Colour and Colorimetry
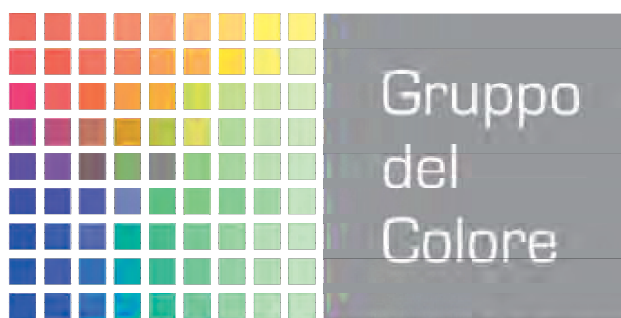# Multidisciplinary Contributions

Vol. IX B

Edited by
Maurizio Rossi

Associazione Italiana Colore

Colour and Colorimetry. Multidisciplinary Contributions Vol. IX B

Proceedings of the 9ᵗʰ Colour Conference.
GdC-Associazione Italiana Colore - www.gruppodelcolore.it
Università degli Studi di Firenze
Firenze, 19-20 September 2013

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Index

The Representation of colour

Prince of Naples Gallery

[1]Riccardo Florio, [2]Teresa Della Corte

[1]Dipartimento di Architettura, Università degli Studi di Napoli 'Federico II', riccardo.florio@unina.it
[2]Dipartimento di Architettura, Università degli Studi di Napoli 'Federico II', teresa.dellacorte@unina.it

1. The color as structuring material

"Shapes are stable, whereas colours are elusive" [1].

It is well known that, particularly in architecture, the visual acquisition of the colour scales is directly influenced by both the conservation conditions of the elements, which are subjected to the continuous action of chemical and atmospheric aggressions, and the optical effects caused by the reciprocal influence between colour and colour, the famous "*interaction of color*" by Josef Albers: "no colour exists by itself and the nature of every hue changes in reaction to the adjacent colours" [2].

It would be necessary to add other considerations about the themes of the perception event, the transparency, the appearance, the expression, the simultaneous contrast of colours, their composition and the syntactic structure tied to the opposing duality between harmony and disharmony, in order to reveal the so-called visual cohesion forces. These forces are the true nature of the world and reality; it is not the nature of a fruitless sequence of objects which are placed side by side , but it is the nature of a continuous stratification of elements, because "every object pushes beyond the merely *visible* and ventures into the ampler kingdom of the really *seeable*, which is
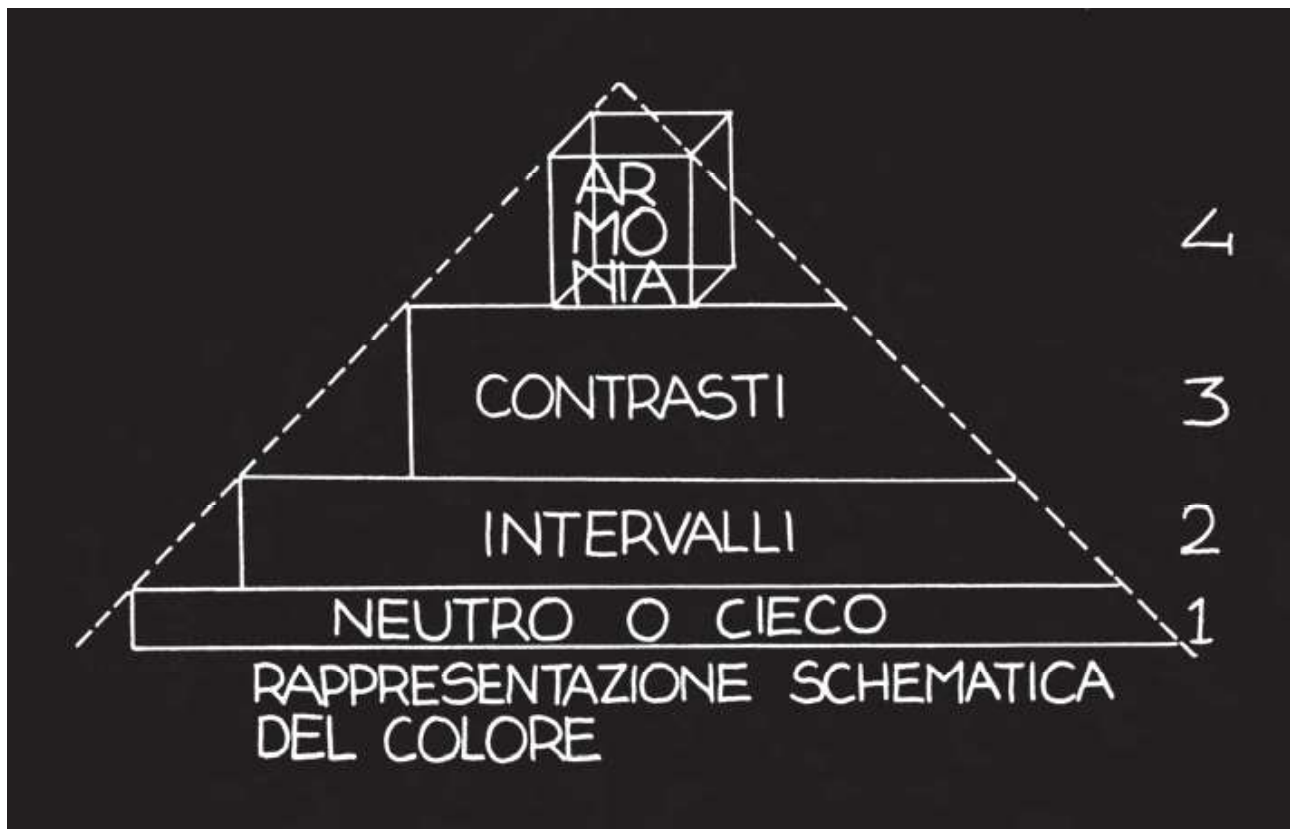
Illustration 1 - Theo Van Doesburg, *Schematic representation of the colors*, 1923.
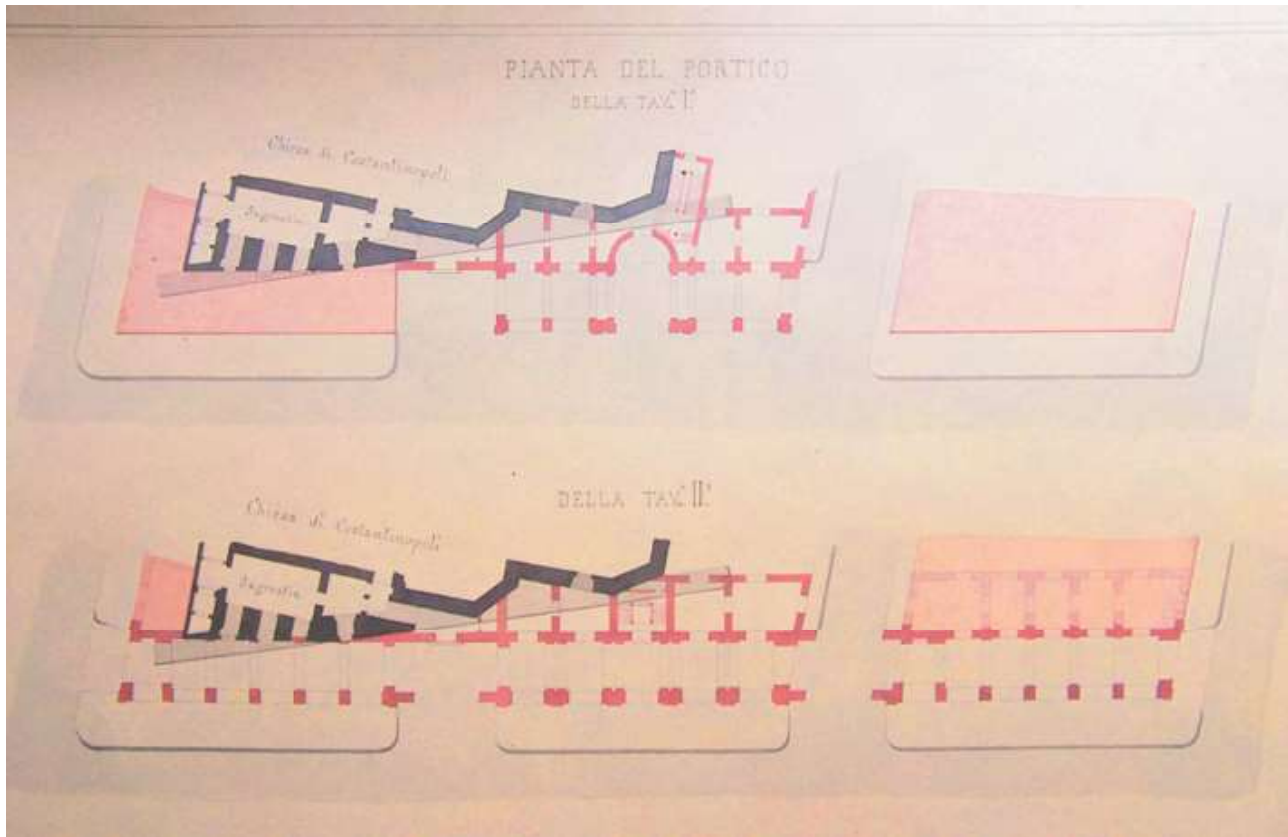
Illustration 2 - Giuseppe de Novellis, Nicola Breglia, *Plan of the Porch*, undated (ASMuN: Fondo cartografie e disegni, Quartiere S. Lorenzo, S.L.25).
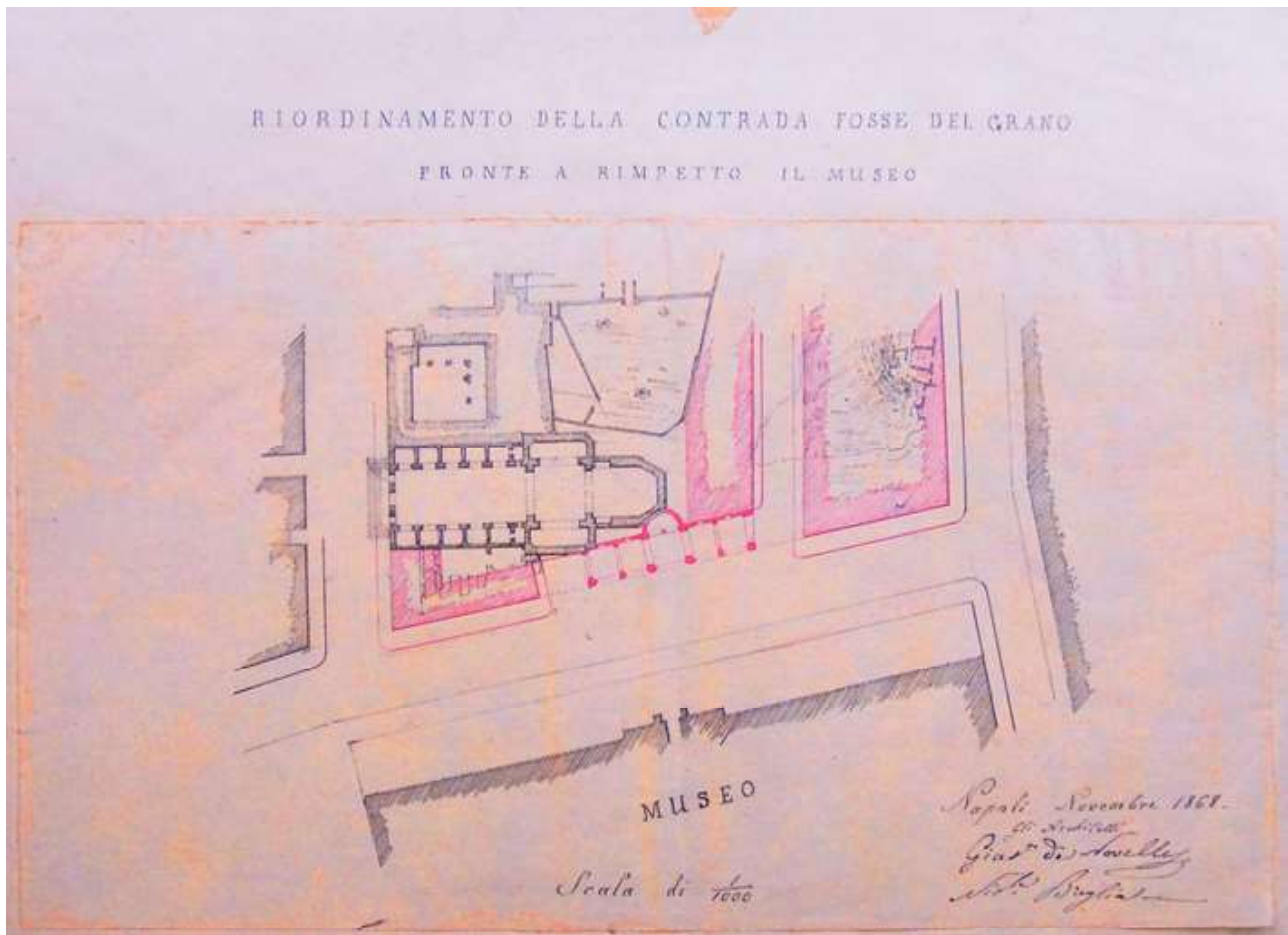
Illustration 3 - Giuseppe de Novellis, Nicola Breglia, *Rearrangement of the contrada Fosse del Grano Fronte in front of the Museum*, 1868 (ASMuN: Fondo cartografie e disegni, Quartiere S. Lorenzo, S.L.26).

the face of reality that is oriented towards us" [3]. With regards to the questions that are more directly referable to the use of colour in architecture, the colour has to be certainly considered as an intrinsic element of the final expression and form, through the factual propriety that makes the spatial effect perceptible. "The building will gain its right meaning through its transformation in an out-and-out architecture, that is a monumental synthesis of space, shape and colour" [4].

Through the study of the structural relations expressed by the colour syntax, the colour score becomes the spatial device that produces the exaltation of the contrasts between the architectural components that are organised in the compositive system; moreover, it gives visibility to the plasticity of the space according to a combinatory sequence. Through intervals and contrasts, this sequence aims for an harmonic condition of balance, where every colour conserves its own energy force [5]. In the space-time dimension of its plasticity, where the constructive and functional factor transforms itself in a multiple aesthetic factor, architecture acquires the colour in its significant role as *expressive element* and *structuring material* like other materials as iron, stone, glass. "[…] colour is not only useful for orienting […] but also, and even more, for satisfying the need to display the reciprocal spatial relationships in terms of proportions, relations, directions. The accord of these relationships is the aesthetic aim of architecture […]" which "[…], finally dissatisfied to show its hidden structure, will develop as an indivisible, inspired totality" [6]. So, there is the densification of a concept: the concept that architecture without colour (that is, the architecture without the colour scale that goes from the *neutral greys intervals*, which are optically inarticulate, to the *evident contrasts* that give combinatory fullness) proves to be inexpressive and, in the sense of necessary complementarity between light and colour, it can only be considered a *blind architecture* [7].

Another significant aspect is the aspect that excludes every difference between the *colour application* and the essence of *colour in itself* of the matter: just like all the materials, the colour scores dispense energy and, in the interference of their contrasts, produce a tensional regime which, in turn, determines the architectural and aesthetic function [8]. Starting just from this last assumption, the contribution that
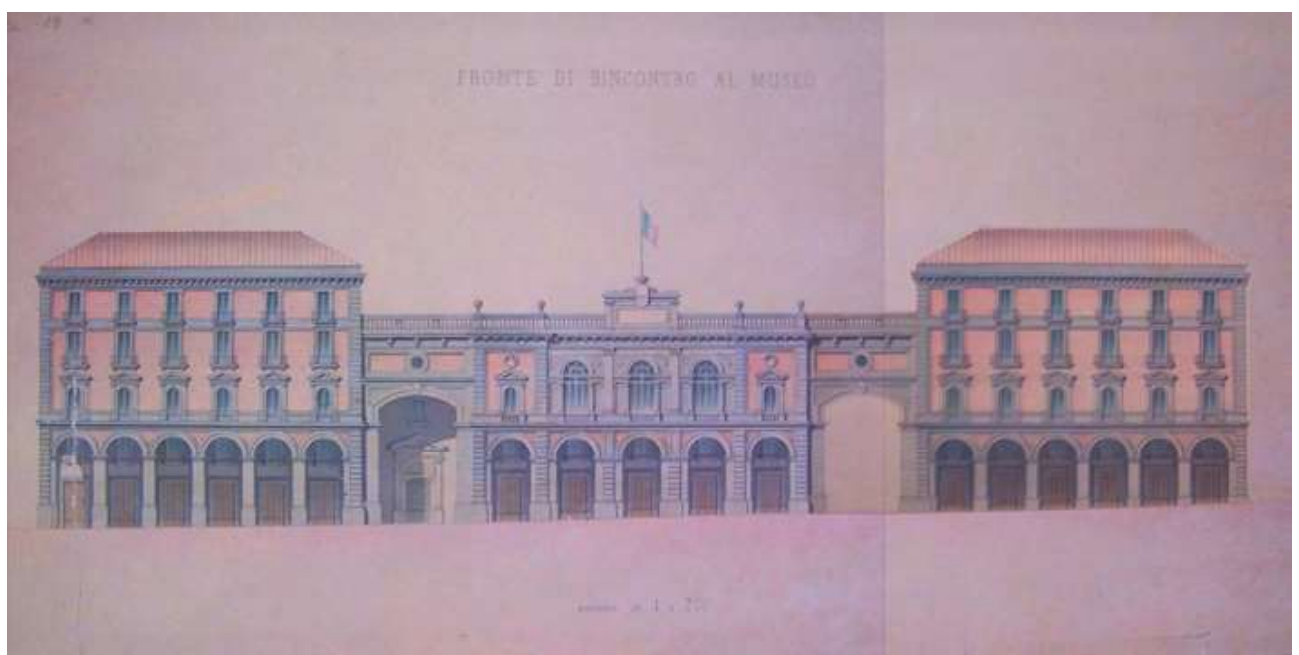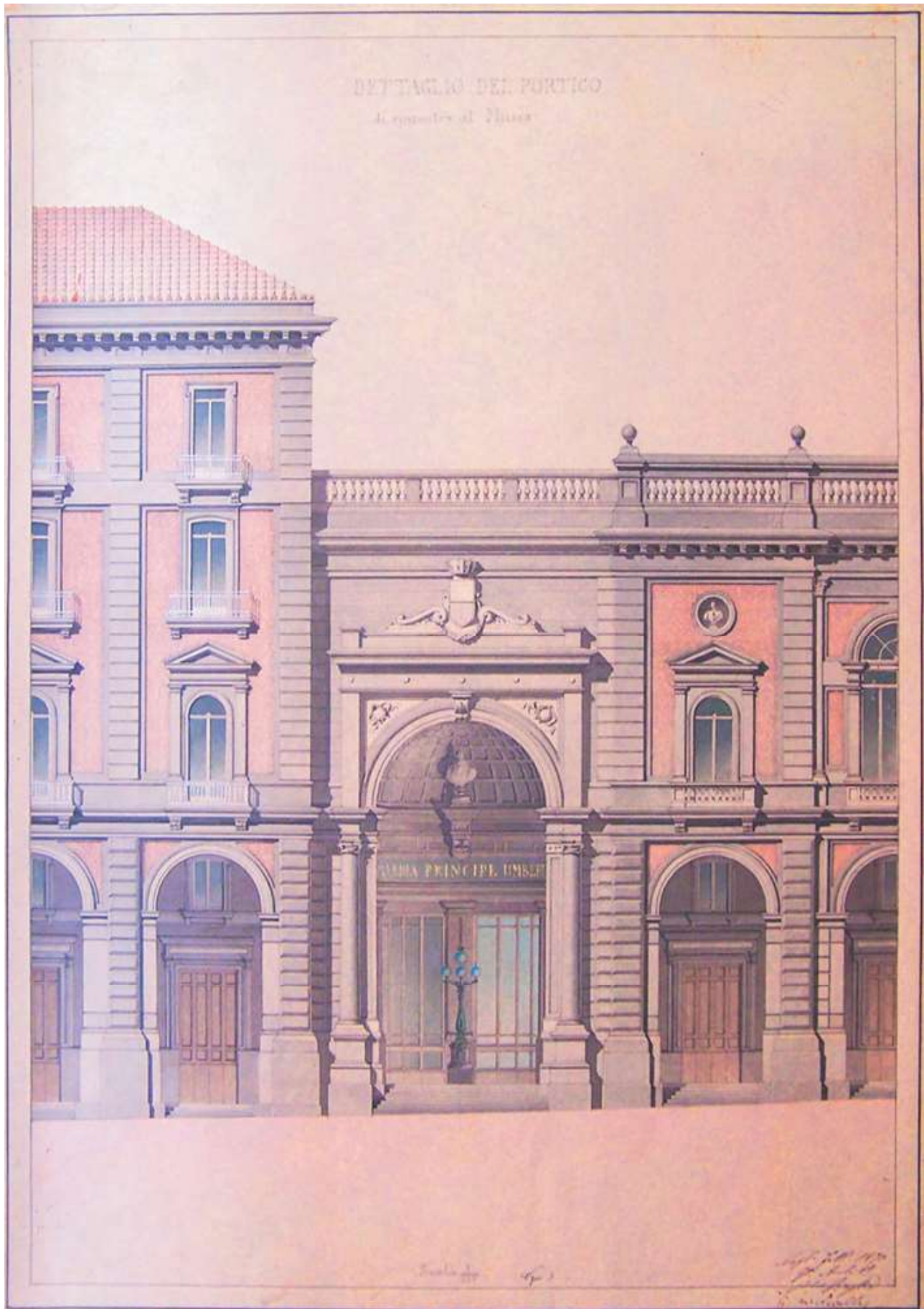
Illustration 4 - Giuseppe de Novellis, Nicola Breglia, *Facade opposite to the Museum* 1868 (ASMuN: Fondo cartografie e disegni, Quartiere S. Lorenzo, S.L.19).
Illustration 5 - Giuseppe de Novellis, Nicola Breglia, *Detail of the Porch in front of the Museum* 1868 (ASMuN: Fondo cartografie e disegni, Quartiere S. Lorenzo, unclassified).

Illustration 6 - Giuseppe de Novellis, Nicola Breglia, *Detail of the interior of the Gallery*, 1868, particular n.1 (ASMuN: Fondo cartografie e disegni, Quartiere S. Lorenzo, S.L.23).
Illustration 7 - Giuseppe de Novellis, Nicola Breglia, *Detail of the interior of the Gallery*, 1868, particular n.2 (ASMuN: *ivi*).

DETTAGLIO DELLO INTERNO DELLA GALLERIA
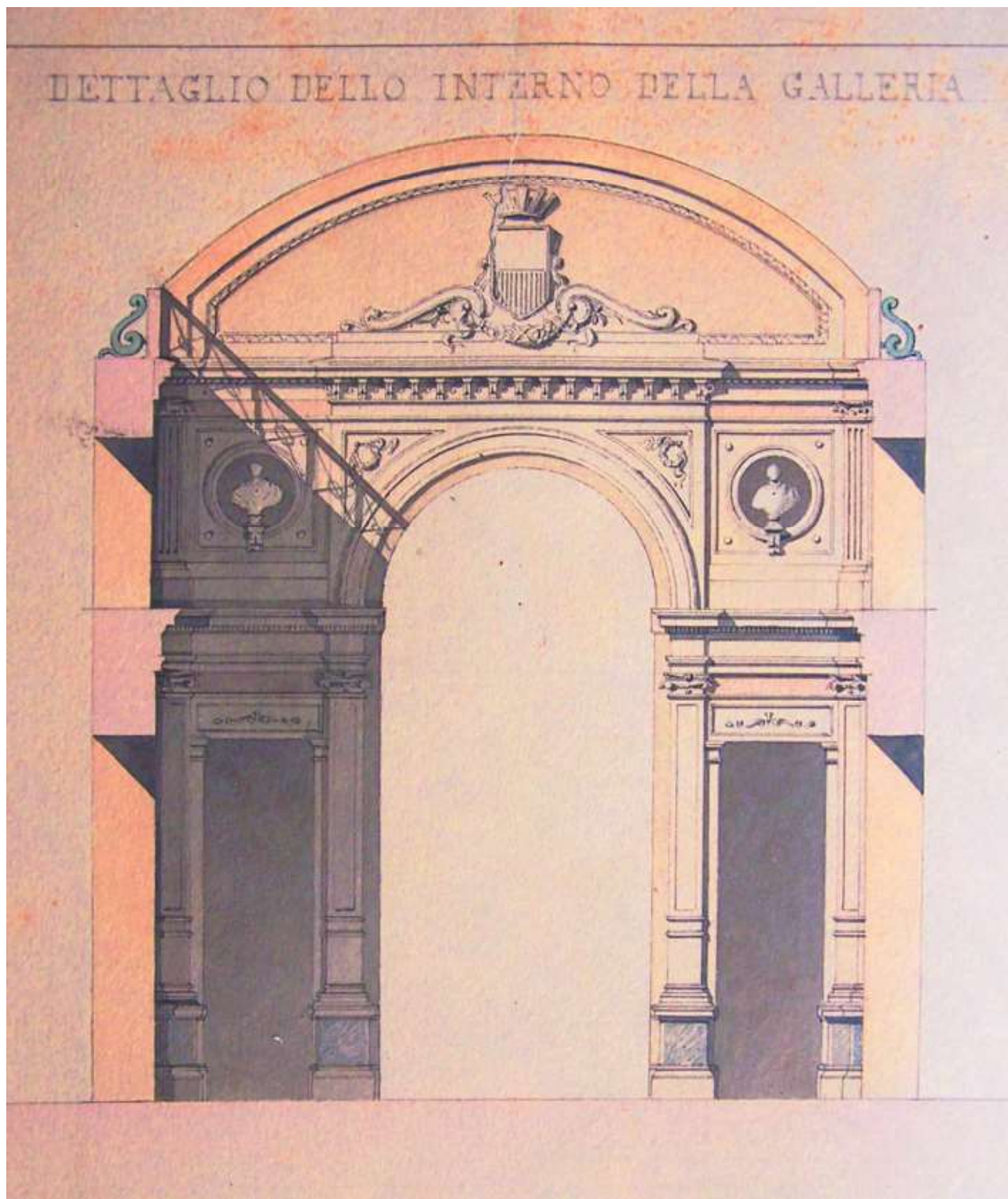
building, in relation to an experience conducted about the comparative readings of the original project drawings and the re-elaborations recently made through infographic processes, according to a system of data gained *in situ*.

The proposed problem concerns the complexity of the process that is activated if we take a sample of colour measurements, according to different measurement systems (from Eugène Chevreul's operative systems, to Albert Munsell's systematic catalogues, until Harald Küppers's rhombohedron [9]), and if we establish actions of comparison and reproducibility through digital techniques. "In our century the prevalent interest about the colour system has distinguished and applied itself around colorimetry […] or simultaneously to the experimentation of the colour

visual perception […] This is actually the summary of the colour modern history: applied colorimetric and psichological techniques (survey and production)" [10].

The reference architecture is the Prince of Naples Gallery, a building strongly representative of a significant urban transformation of the so-called Fosse del Grano a Napoli area, from the National Museum to Dante square. This transformation, begun since the last decade of the Bourbon reign, materialized in the second half of the Eighteenth Century, starting from the Unity of Italy. Different hypotheses of intervention were formulated; among them, the hypothesis proposed by the architects Saponaro, Catalani, Capaldo and Alvino certainly deserves a mention, as well as the definitive solution which saw the engineer Giuseppe de Novellis and the architect Nicola Breglia in action. These ones, following the demolition of the Monastery of S. Giovanniello, elaborated a parcelling plan that included the opening of Pessina street, in place of Fosse del Grano uphill street, of Bellini street, Broggia street and Conte di Ruvo street, the creation of the Academy of Fine Arts, the Bellini theatre and the new Prince of Naples Gallery, for which in 1868 they presented an hypothesis for the arrangement of the "Front opposite the Museum" [11].

This project was accompanied by other two solutions that led to the final version, which included an iron and glass roof, the first-ever created in Naples, for completing the final stretch of Bellini street in the direction of the Museum.

The drawings that accompanied these different proposals, including the final one, are preserved in the historical municipal Archive of Naples. They are characterized by being made with precise chromatic scores both in the wider compositions and in those, numerous, close-up ones; so, they are a precious documentary equipment for developing the comparative study with the representation of the current situation, which derives from the last restoration work, concluded in 2007. (R.F.)

Illustration 8 - Giuseppe de Novellis, Nicola Breglia, *Interior of the Gallery*, 1868 particular n.1 (ASMuN: Fondo cartografie e disegni, Quartiere S. Lorenzo, S.L.21).
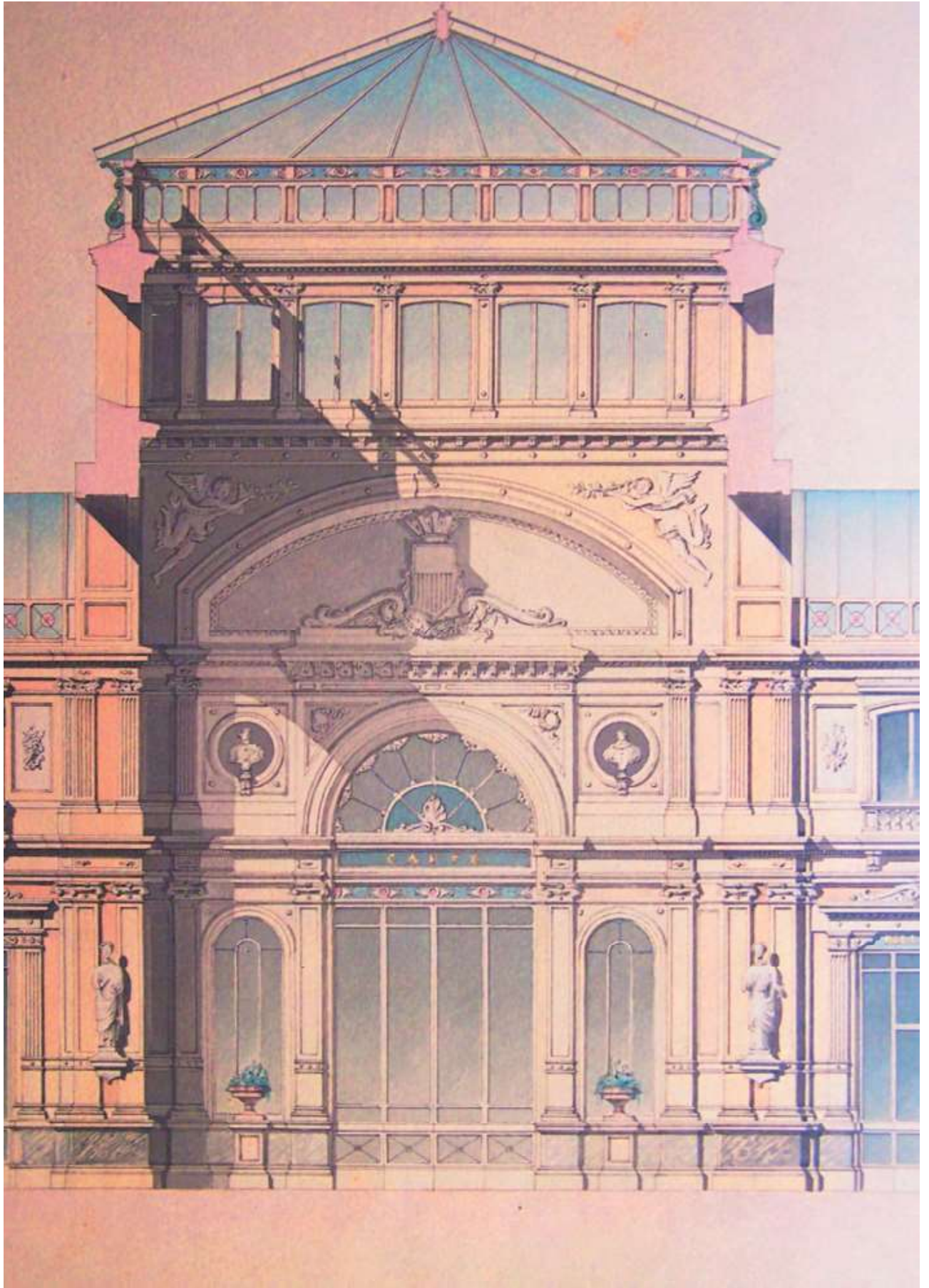
Illustration 9 - Giuseppe de Novellis, Nicola Breglia, *Interior of the Gallery*, 1868 particular n.2 (ASMuN: ivi).

2. Comparative interpretations and unifying textures. The digital and analog chromatic veilings

The necessity to define an operative methodology in order to significantly represent Prince of Naples Gallery also from the chromatic point of view, questioning its reality, has considered to support the interpretative reading of the data that are perceptible in situ with the study of the original project drawings, which are conserved in the ASMuN [12] . Throwing light on the problem about the originality of colour as an efficient support for the assignment of the tones to the computer modelled surfaces, the comparative analysis between the pigments taken as sample and the colour scores found in archive has indirectly reinforced questions and doubts about the representability of colour through digital models.

The evocative potential of De Novellis and Breglia's representations, comparising them with the potential of the digital elaboration of today, does not lie as much in the obvious fascination of time, which is emanated by the supports and paper surfaces, but rather in the ability to make perceptible the continuity and density of the infinite chromatic variations that allude to the natural vision.
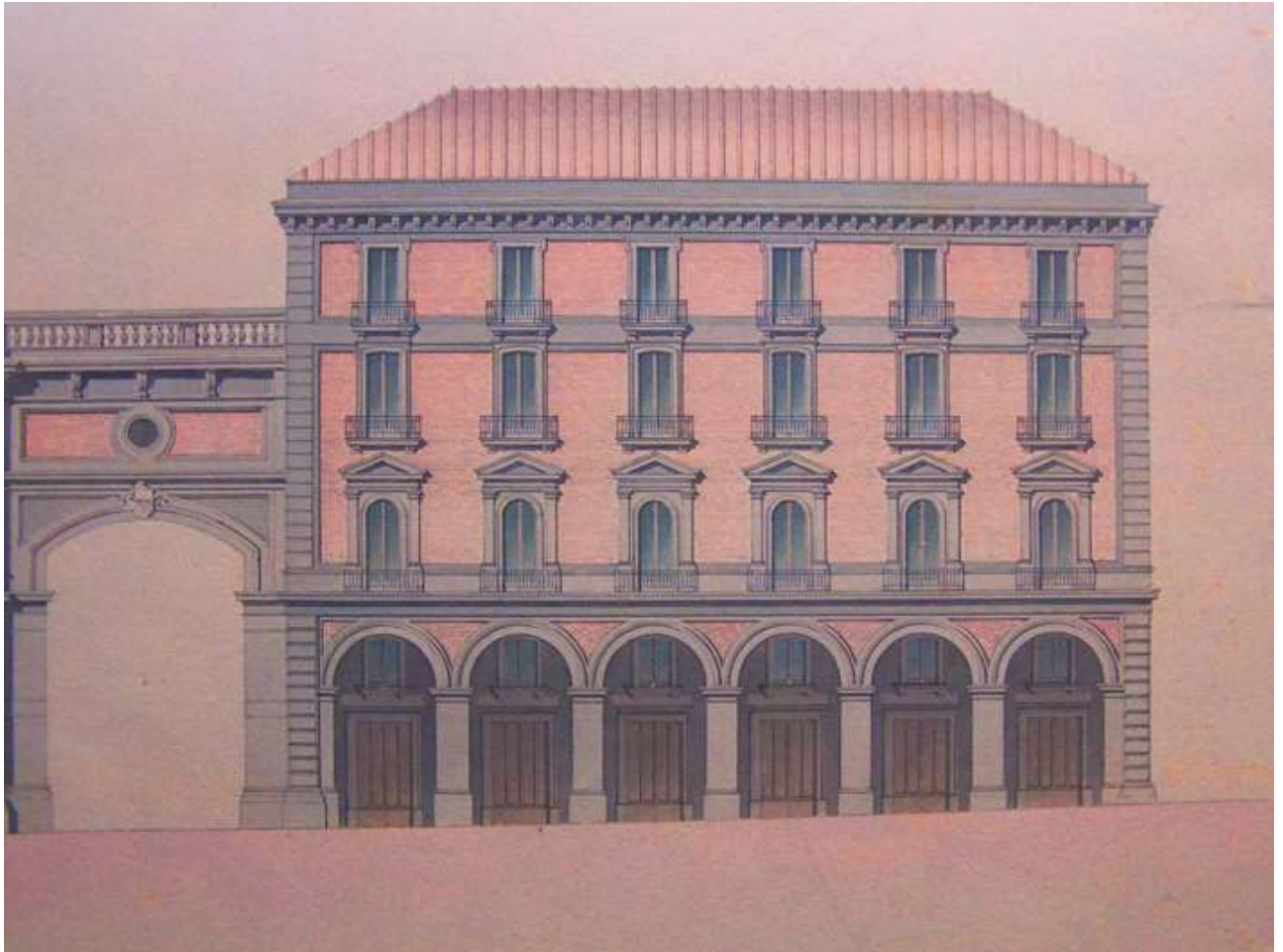
Illustration 10 - Giuseppe de Novellis, Nicola Breglia, *Facade opposite to the Museum* 1868, particular of the porch (ASMuN: Fondo cartografie e disegni, Quartiere S. Lorenzo, S.L.19).

Comparing the compact uniformity of the pixel uniform layers and what is perceptible in the chromatic gradients rendered by the refined graphic-pictorial techniques of the old drawings, the comparative study reveals the indubitable obviousness of the approximation that is inherent in the computer systems; but moreover, this comparative study identifies a concurrence between the digital approach and the approach of the traditional analog representation.

The colour digital models have to contain informations that are structured according to the language of the finite numbers, which is typical of the computers. Consequently, these models are able to represent only a finite number of colours. Indeed, after the arrangement of a grid of spatial sampling, the computers assign one ore more finite numerical values (the bits) to every pixel; these values indicate the colour. This process entails an approximate representation of the colours, which is achievable through the combination of a limited number of some specific colours, which are called 'primary colours': Red, Green, Blue and Cyan, Magent, Yellow. The main models of colour for the digital images are just the RGB, which uses the additive synthesis in order to compose a specific colour, and the CMYK, which corresponds to a subtractive colour synthesis.

The same combination of brightness or intensity (amount of white added to the pure colour) of every primary colour produces a finite number of chromatic outcomes, because this combination is included in a gradient that is generally divided in 256 regular intervals [13] .

Illustration 11 - Giuseppe de Novellis, Nicola Breglia, *Detail of the Porch in front of the Museum* 1868, particular 1 (ASMuN: Fondo cartografie e disegni, Quartiere S. Lorenzo, unclassified).

Illustration 12 - Giuseppe de Novellis, Nicola Breglia, *Interior of the Gallery*, 1868 (ASMuN: Fondo cartografie e disegni, Quartiere S. Lorenzo, S.L.21).

Also in the case of very well-defined images, which are characterized by high values both of image resolution (pixel for inch) and colour depth (bit for pixel), and, so, by a large colour spectrum in hand, every pixel which constitutes the structure of the image always contains an only colour, which is equally allocated on its own surface.

Illustration 13 - Longitudinal section of the Prince of Naples Gallery, from *Rappresentare la discontinuità. Una integrazione mancata: la Galleria Principe di Napoli, Degree Thesis by* Daniela Capasso and Valentina Ciriello, Supervisor Riccardo Florio, Assistant Supervisor Teresa Della Corte.

The particular pleasantness of the natural image which attracts us for the richness of the colour shades, where "the infinitesimal passing of the bright intensity sends a sense of total sensorial satisfaction to the mind through the sight; a sense of satisfaction that spreads a deep emotion which can not be described with the use of words, … an emotion that touches the spirit" [14], transcribed in the spatial-numerical discretizations, proves to be confined and compressed [15] in the possibility of sliding of the zoom function: from the maximum enlargement, where is evident the chromatic uniqueness of every pixel, to the progressive reduction of the enlargement, where we can see a gradual fusion of the adjoining pixel in similar areas and the creation of shades, shadows, rings which simulate the colour complexity through the gradual passage from light to dark; this passage is one of the most convincing demonstrations of the idea of continuity.

Prior to the survey operations, this intrinsic approximation of the digital representation of the colours is overlapped by a considerable level of indefineteness, which is tied to the individuation in situ of the tonalities that we have to represent and, particularly, to the peculiar perceptual elusiveness of the chromatic data. Similarly to the perception of other characteristics, due to the individual interpretative aspects and the consequent not objectivity of the colours, and clarified that the colours are actions of the light, we could still ask if they are registrations or our creations.

According to the purposes of the present comparative investigation, a particular interest is attributed to Edwin Land's studies about the chromatic perceptions [16], and to the more recent studies conducted by Semir Zeki [17]. Land's theory is essentially the following. The surfaces of the objects do not have labels of colour of
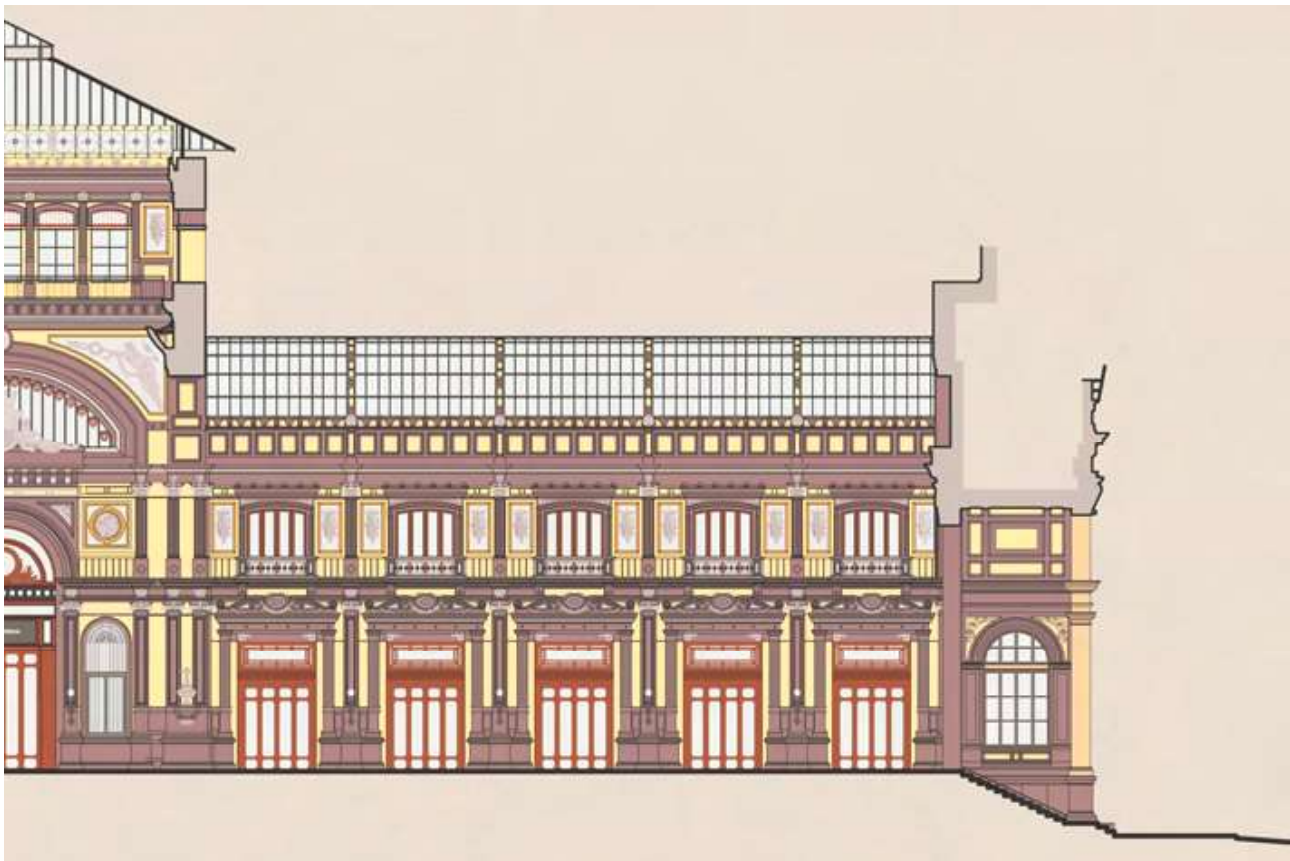
which our neurons do nothing but take cognizance in a passive way. On the contrary, our brains actively operate with innate rules, thanks to which the data that arrive from that surfaces are judged with the construction of colours. The construction fullfills itself because, according to their nature, our brains are able to continuously compare the wavelength of the light that is reflected on the surface of an object, with the wavelengths that are reflected by surfaces of things placed next to the considered object.

Zeki stated that this comparison "is a property of the brain, not a property of the external world" [18]; so, as Land restated, "colour is always a consequence; it is never a cause" [19]. In particular, in the perceptive evaluation that occurs between contiguous coloured surfaces, we can individuate the points of contact of the digital representation of colour with the analog one.

The dithering technique operates just using this comparative peculiarity and the tendency of our eyes and mind to combine the colours, contained next to another, in unitary syntheses. The dithering technique is applied to the digital images when the colour depth proves to be limited.

This expedient outdoes the effects of the simple fusion of the contiguous pixels, and is obtainable reducing the zoom. The fusion effect in any case remains only allusive of the complex structure of the natural image and it is very partially able to reach the aesthetic seduction of the chiaroscuro vibrations which make an analog traditional drawing living; on the contrary, this sort of 'noise' or voluntary 'disturbance', which unusually has a military origin, succeedes in coming close to the complete spectrum of the real and analog colours.

Superimposing a combination of black and white points on the image, according to an appropriate arrangement, the dithering distributes the chromatic error, making the cold transitions between the colour of the specific pixel and the colours of the surrounding pixels more gradual, through the elaboration of the average of them.

The dithering effect induces to the perception of the whole as a unique continuous entity; it does not discretize in pixels. So, it succeedes in simulating the natural density of the incessant and changeable interaction between lights and shadows and the related textures of the colours.

Furthermore, this sort of thin and light unifying texture that is used in the digital representation, surprisingly assimilates itself to the fascination of the so-called veilings, which are typical of the traditional pictorial techniques, or to the same frequent halftone screenings manually realized on the architectural drawings.

In the drawings of the original project of the Prince of Naples Gallery, in particular in the "internal longitudinal section", in the "Detail of the interior of the Gallery", in the façade of the "Facade opposite to the Museum", we can individuate watercolour veilings and halftone screenings made of strokes [20]; their layers are superimposed each other and cover the surfaces with colours that are more or less transparent. So, they reach a colouristic outcome that is impossible to obtain through the spreading on the paper of a 'unique' colour that gains the seductive ability of the natural graduated light.

 (T.D.C.)

Notes

[1] Rudolf Arnheim, *Prefazione*, in Augusto Garau, *Le armonie del colore*, Feltrinelli, Milano 1984, p. 7.

[2] *Idem*, p. 8.

[3] Paolo Bozzi, *Sugli oggetti e i loro fantasmi*, in «Sfera» *Materiale e Immaginario*, n. 31, Roma, November-December 1992, p. 11.In regard to this, you can also see Italo Calvino, *Visibilità*, in *Lezioni americane. Sei proposte per il prossimo millennio*, Garzanti, Milano 1991; in particular the comment to Balzac's *Le chef-d'œuvre inconnu*.

[4] Théo van Doesburg, *De Betekenis van de Kleur in Binnen-en Buitenarchitektuur*, in «Bouwkundig Weekblad», 1923, XLIV, n. 21, 26 May, pp. 232-234, tr. it. L'importanza del colore nell'architettura interna ed esterna, in Theo van Doesburg, *Scritti di arte e di architettura*, a cura di Sergio Polano, Officina Edizioni, Roma 1979, pp. 405-409.

[5] *Ibidem*. Cf. also *La teoria dell'armonia* in *Teoria delle mescolanze*, in Augusto Garau, *Le armonie del colore… op. cit.* p. 11; Arnheim observes that "harmony is essential, in the sense that all the colours of a composition have to reciprocally adjust themselves in order to form an unified whole if they must be able to be put in relation", *ibidem*.

[6] Théo van Doesburg, *De Betekenis van de Kleur in Binnen-en Buitenarchitektuur… op. cit.*, p. 409.

[7] Cf. Théo van Doesburg, *Farben in Raum und Zeit*, in «De Stijl», 1928, VIII, n.i 87-89 *Aubette*, pp. 26-36, Italian translation *Colori in spazio e tempo*, in *Theo van Doesburg, Scritti di arte… op. cit.*, pp. 484-488.

[8] For example, we can think to the conflicting elemental energies that are emitted by blue and yellow, or to the unbalanced mixtures and the chromatic connections and divergences argued by Garau, cf. Augusto Garau, *Le armonie del colore… op. cit.*

[9] Cf. Eugène Chevreul, *Des couleurs et de leurs applications aux arts industriels, à l'aide des cercles chromatiques*, Baillière, Paris 1864; Albert Munsell, *A Color Notation*, Boston 1913; Harald Küppers, *La couleur. Origine, méthodologie, application*, Office du Livre, Paris 1975.

[10] Manlio Brusatin, *Storia dei colori*, Einaudi, Torino 1983, pp. 112-113.

[11] Roberto Di Stefano, *Edilizia e urbanistica napoletana dell'Ottocento*, in Napoli Nobilissima, volume XI, Fascicules I-III, January-June 1972, p. 18.

[12] ASMuN, Historic Municipal Archive of Naples.

[13] In this case the representable colours, which can be synthetized in the expression $(1>X>256)*(1>Y>256)*(1>Z>256)$ where the components X, Y, Z represent the specific intensity of red, blue and green, are limited, although they are very numerous.

[14] Franco Purini, *La luce graduata*, in *Comporre l'architettura*, Editori Laterza, Bari 2000, p. 117.

[15] It is not a case if a low resolution image is technically defined as an image subjected to 'compression'.

[16] Edwin Land's studies, researches and experiments were made between the years 1964 and 1985. Cf.: Edwin Land, *Recent Advances in Retinex Theory*, in David Ottson e Semir Zeki (edited by), *Central and Peripheral Mechanism of Colour Vision*, Macmillan, London 1985.

[17] Cf.: Semir Zeki, *Splendors and Miseries of the Brain*, Wiley-Blackwell, Chinchester 2009 [Italian Translation *Splendori e miserie del cervello*, Codice edizioni, Torino 2010] and Semir Zeki, *A Vision of the Brain*, Blackwell Scientific, Oxford 1993.

[18] Semir Zeki, *Splendors and Miseries of the Brain…* op. cit. p. 23 [trad. it. Pp. 18-19.

[19] Edwin Land, *Recent Advances in Retinex Theory…* op.cit.

[20] In particular, you can see, in their original representation, the chromatic dialogues between the architectural scores of the interior of the Gallery and the treatment of the external surfaces, which are embellished with striped bricks.