

Colour and Colorimetry Multidisciplinary Contributions

Vol. XI B

Edited by
Maurizio Rossi and Daria Casciani



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The Colour of Maya Architecture

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1. Introduction

Due to the almost complete disappearance of colours from the architectural surfaces of the pre-Columbian cultures of Mesoamerica, the importance of the use of colours that added legibility, vibrance and mystical meaning to statues, low reliefs and architecture in general, is often overlooked. Unfortunately, this happens both among common people as well as among scholars. Today, colourless for the most part¹, low reliefs are very difficult to perceive by the untrained eye and when they are, scenes of Mayan life are mute in their well-ordered chaotic art made of traces, curls and dots. As it happens in each and every culture based on primordial tradition, colours are a part of a series of symbols that go beyond simple decoration. Further in the paper, we will see that the colour blue, for example, is not ‘only’ a colour but it suggests a deeper reality. Staring at such traces calls the watcher to the famous puzzle game of connecting the dots to discover the hidden figure. The peculiar light of the tropical regions of Mexico flat the image so much that it is quite impossible to mark the whitish surface of the intricate low reliefs. Colours, as much as a critical and disciplined mind are the key to being able to appreciate the still life’s scenes of the Maya. The paper will explain materials and technique of Maya color production as well as their use and meaning both in everyday’s life and ceremonial rituals.

2. On the perceiving of colours

One would be amazed on how mayan cities were a dazzling display of colours, these, also worn as textiles, ornaments and body paints were not a mere decoration but a meaning of identity.

Today as a physical effect, colour is perceived as a vibration in the electromagnetic resonance of light. The visible spectrum for human eyes lies between the range from red to blue, at wavelenghts between 360 and 760 nm. Processed by the brain, the sensation of light is a complex intersextion of wavelenght, reception and neural transmission. From the sensory point of view, colour may be perceived through three different attributes such as brightness, hue and saturation; while brightness can be expressed as a total energy value and characterizes the gradations from dark to light, hue is dependent on the wavelength of light and contributes to label a certain colour and saturation defines the purity and intensity of a certain hue.

Setting aside the physiological nature and the perceiving processes of light and colour, in maya coulture, colours formed an unique entity and maintained a strong relation to the material they were found in nature or were made of, thus *yax*, the blue-green, confers the sense of ‘new’ or ‘first’ in reference to the hue of fresh foliage.² In general, colour was applied according to the material of the object portrayed, however, colour was also used symbolically.³ In a certain way, colour gave life to matter so that the act of removing it from an architecture was a way to ‘kill’ it.



Fig. 1 – Kohunlich, Mexico, *Templo de los Mascarones*,

| Colours | Language | | Material | Symbolism/Meaning |
|---------|------------------|--------------|--|----------------------------------|
| | Classic Ch.orti' | Common Maya | | |
| Blacks | <i>ik'</i> | <i>*ejq'</i> | Carbon black, manganese oxides and hydroxides | west,difficult,supernatural,fear |
| Whites | <i>sak</i> | <i>*saq</i> | calcium carbonate, aragonitic, calcitic and dolomitic limestones | north,clear,artificial,skill |
| Reds | <i>chak</i> | <i>*kaq</i> | hematite minerals | east,hot,blood,great,rage |
| Yellows | <i>k'an</i> | <i>*q'an</i> | geothite minerals | south,vegetation,ripe |
| Blues | <i>yax</i> | <i>*ra'x</i> | azurite, palygorskite clay mixed with indigo | center,clear,moist,devine,first |
| Greens | <i>yax</i> | <i>*ra'x</i> | malachite | center,clear,moist,devine,first |

Tab. 1 – Maya colours, components and meanings



Fig. 2 – Copán, Honduras, Late Classic Period, *Rosalila*, Life-size reconstruction of the temple at the site museum of Copán

3. Painted architecture

In pre-Columbian mesoamerica cultures, colour was an important aspect of both architecture and monumental sculpture; paint was carefully considered before construction and was an integral part of the creative process of buildings and sculptures. Colour was perceived and functioned less as a decoration than as a vehicle for symbolic meanings.⁴ Maya culture, but this may be said of almost every pre-Columbian cultures, was based on a very specific and highly regarded tradition full of rites, customs and habits that permeated every aspect of society. Every citizen, whether king, noble, priest or commoner, everyone had to contribute even through bloodletting self-sacrifices to the preservation of the world through cosmic cycles.⁵ A quite common idea among scholars is that colours were also associated to cosmic directions, that is red for the east.; black for the west; yellow for the south; white for the north and blue-green for the center. Yet, the presence of a center suggests that the same colours are not a simple expression of the four cardinal points but are, as any traditional culture, an expression of a cosmic movement or cycle of existence, thus red-east is related to the spring equinox; black-west is related to the autumn equinox; yellow-south is related to the summer solstice and white-north to the winter solstice while blue-green is the center, the unmovable Principle.⁶ In Preclassic architecture, the extensive use of red, black and white shifted to the polychromy paint of the Late Preclassic which was used on modeled stucco and decorations of the pyramid facades. In the Classic period, polychrome facades are replaced by the use of selected colours such as either white or red for the external surfaces and the interiors walls, those could also be painted with geometrical white and red patterns; polychromy was reserved for interior figural murals or architectural sculptures.



Fig.3 – Chichen Itza, Mexico, Late Classic Period, *Templo de los Jaguaros*, Top, the Temple as it appears today. Bottom, colour reconstruction based on found evidence



Fig.4 – Chichen Itza, Mexico, Late Classic Period, *Los Osarios*, Top, the Temple as it appears today. Bottom, colour reconstruction based on found evidence

4. Maya colours

Most of the paints and pigments of the Maya tradition were made using mineral pigments of inorganic origin, lakes and organic compounds and were used in two ways, naturalistically and symbolically.⁷ Lakes are basically pigments manufactured by precipitating dyes with an inert binder, or 'mordant' such as clay, chalk or gypsum. Paints were made by collecting pigments such as minerals or coloured earths and had to undergo a long series of washing to remove impurities and concentrate the colour. Almost all Maya paints used water as a vehicle with the addition from time to time of various clays, lime slurries and vegetal gums.⁸ Recent works⁹ have revealed the use of carbon black for black, hematite for red, goethite for yellow and both or either calcium carbonate and gypsum for white.

Blacks

Black pigment came from two different sources, one organic, the other mineral. Carbon black, an organic material, appears to have been the dominant black pigment and was obtained from burning tree resins or burnt bone and produces a deep black pigment. The inorganic counterpart was used primarily for pottery and was made from manganese oxides and hydroxides.¹⁰ Black does not appear to have been used in polychrome color schemes, although it remains prominent in the linear style and as working drawing.

Whites

White was provided by the lime of stucco, its quality was altered by the purity of the lime source and by the mixing of additional material into the plaster such as bark extracts. The main source for white paint came from calcium carbonate such as, depending on availability and location, aragonitic, calcitic and dolomitic limestones.

Reds and Browns

Reds come from hematite a closely related iron oxide mineral. Hematites and other iron based minerals are found in abundance throughout the region and, based on purity and quantity, produce colors from dark orange/browns through bright reds and pinks.

Yellows and Ochres

Yellows come from goethite, a closely related iron oxide mineral just like the hematite. They come in colours that vary from yellow to brown depending on its degree of hydration, crystallinity and purity. Both goethite and hematite also occur as ochers, earthly forms of the minerals mixed with clay.¹¹

Blues

Blues came from azurite and indigo. Azurite is a copper carbonate hydroxide found in secondary copper ore deposits. Over time, azurite was used less and less and had been replaced by Maya blue which is a lake made by dyeing white palygorskite clay

with indigo.¹² Maya blue is a very stable paint, unaffected by acids, alkalis, solvents, oxidants, reducing agents, biocorrosion or moderate heat.¹³

Greens

Greens come from malachite a copper carbonate hydroxide that as the azurite, is found in secondary copper ore deposits. Green in colour, its shades can be manipulated by altering the grind of the pigment.¹⁴

5. Conclusions

In its time, Maya architecture appeared as a marvellous explosion of colours that provided a greater sense of completeness. Colour was meant to emphasize characters and meanings of the reliefs, distinguishing the various and multiple aspects of maya tradition or the inner aspects of their faith and religious rituals. In architecture, colours were not meant only as simple paint to enliven forms, identifying objects, people and gods, but as a way to attribute to its vessel both natural and supernatural values, to establish an indissoluble link between the maya traditional civilization and the cosmogony and beliefs of the perpetuation of cosmic cycles. As this is true for architecture and wall painting, it is not always so for the coloring of statues on which colour may have been purely decorative.

References

- [1] S. Houston; C. Brittenham; C. Mesick; A. Tokovinine; C. Warinner, *Veiled Brightness*, University of Texas Press, Austin, 2009
- [2] L. Schele, Color on Classic Architecture and Monumental Sculpture of the Southern Maya Lowlands. In E.Hill Boone, ed., *Painted Architecture and Polychrome Monumental Sculpture in Mesoamerica: A Symposium at Dumbarton Oaks, 10th to 11th October 1981*, Dumbarton Oaks Research Library and Collection, Washington, D.C, 1985
- [3] E. Hill Boone, The Color of Mesoamerican Architecture and Sculpture. In E.Hill Boone, ed., *Painted Architecture and Polychrome Monumental Sculpture in Mesoamerica: A Symposium at Dumbarton Oaks, 10th to 11th October 1981*, Dumbarton Oaks Research Library and Collection, Washington, D.C, 1985
- [4] R. Joyce; R. Edging; K. Lorenz; S. Gillespie, *Olmec Bloodletting: An Iconographic Study*. In *VM Fields. Sixth Palenque Round Table 1986*, University of Oklahoma Press, Norman, Oklahoma, 1991
- [5] R. Guenon, *Symbols of Sacred Science*, Sophia Perennis, www.sophiaperennis.com, 2004
- [6] E. T. Baird, Naturalistic and Symbolic Color at Tula, Hidalgo. In E.Hill Boone, ed., *Painted Architecture and Polychrome Monumental Sculpture in Mesoamerica: A Symposium at Dumbarton Oaks, 10th to 11th October 1981*, Dumbarton Oaks Research Library and Collection, Washington, D.C, 1985
- [7] D. Magaloni Kerpel, Técnicas de la pintura mural en Mesoamérica, *Arqueología Mexicana*, 3(16), editorial raíces S.A. de C.V., Del Miguel Hidalgo, Mexico, 1995
- [8] B. de la Fuente, *Pre-Columbian Paintings: Murals of Mesoamerica*, Jaca Books, Milan, 1999
- [9] A. O. Shepard, *Ceramics for the Archeologist*, Carnegie Institution of Washington and Ann Arbor: Braun-Brumfield, Washington, D.C., 1985
- [10] A. Tozzer, *Landa's Relacion de las Cosas de Yucatan: A Translation*, Papers of the Peabody Museum of Archeology and Ethnology 18, Peabody Museum, Harvard University, Cambridge, Mass, 1941
- [11] M. Jose-Yacamán; L. Rendon; J. Arenas; M. C. Serra Puche, Maya Blue Paint: An Ancient Nanostructured Material. *Science* (n.s.) 273(5272), 1996
- [12] R. J. Gettens; E. West Fitzhugh, Malachite and Green Verditer. *Studies in Conservation* 19(1), 1974

¹ [1] Most pre-Columbian painted works have been damaged over time by humidity, fungus, vegetation, and general weathering. Pg.61

² [1] Pg.16

³ [2] For example, feathers, water and jade were given a 'natural' blue, flesh was a 'natural' red; sacred or supernatural objects were given a 'symbolic' blue. Pg.46

⁴ [3] Pg.173

⁵ [4] Ritualised sacrifice was usually performed in public by religious or political leaders piercing a soft body part, most commonly the tongue, ear or foreskin. The blood was then collected and either smeared on an idol, burned on flames or mixed in the bread dough, baked and eaten. Pg.2

⁶ [5] Pp. 57-67, 96-100

⁷ [6] The low reliefs from the Great Vestibule of Tula reveal "a well organized colour scheme in which red is used for background and some ornaments; blue indicates feathers and jade and turquoise ornaments; yellow denotes other feathers, weapons and jewels; white also indicates feathers as well as eyes, teeth, and cotton clothing; skin is pinkish-ochre; and black is used to outline motifs and to make them stand out." Pg.115

⁸ [7] Pp.23-23.

⁹ [8]

¹⁰ [9] Pp. 40-41

¹¹ [9] Pg.37

¹² [10] There is a wood or plant from which indigo is made, which the natives of these provinces formerly employed for a blue dye or paint, hence the Spaniards availed themselves of it and started large plantations, that they have come to make large quantities in the provinces. Pp. 117-118

¹³ [11] Pg. 223

¹⁴ [12] Fine grinds result in a very light green while coarser grinds result in darker hues. Pg. 8