PAINTING THE SKIN

Pigments on Bodies and Codices in Pre-Columbian Mesoamerica

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CONTENTS

2

Materiality and Meaning of Medicinal Body Colors in Teotihuacan

MARÍA LUISA VÁZQUEZ DE ÁGREDOS PASCUAL, SÉLIM NATAHI, VÉRONIQUE DARRAS, AND LINDA R. MANZANILLA NAIM

CONTEXT OF THE SAMPLES

THIS CHAPTER DESCRIBES, for the first time, the full range of body colors found in various contexts in the multiethnic neighborhood center of Teopancazco (table 2.1).[1] To date, only the results of the first phase of this study have been published.

Teopancazco is located in San Sebastián Xolalpan, which corresponds to sector S2E2 of Teotihuacan on Millon's (1973) map (map 2.1). This neighborhood center developed around a temple in the Miccaotli phase (A.D. 150–250). Construction activity in Teotihuacan reached its height during the Tlamimlolpa phase (A.D. 200–350) and the Xolalpan phase (A.D. 350–550). This was followed by a period of less active construction during the Metepec phase (A.D. 550–650; Beramendi et al. 2012). During the Tlamimilolpa and Xolalpan phases, Teotihuacan operated as a confederation of various neighborhood centers (Manzanilla 2015). Each neighborhood, including Teopancazco, had a coordination center that included a ritual sector, an administrative sector, a military sector, a highly specialized sector for craft production, a sector devoted to medical care and childbirth, and lined kitchens (Manzanilla 2012b:20). The results collected in this study suggest that the preparation and confection of body colors (i.e., pigments used for painting one's skin) constituted one of the specialized activities at Teopancazco, which must be confirmed with further studies on this topic. Another specialized activity was the practice of medicine. Both of these activities are closely related.

Most of the samples analyzed were found in a mortuary context from burials 105–108, which were located in the funerary pit on the axis of the Templo de los Tableros Decapitados (activity area 227; Manzanilla 2012a:519).[2] Of a total of fifty pigment samples, thirty issue from this context. This funerary pit concentrated the most important Tlamimilolpa burials. The more preeminent of the two individuals in burial 105 was a fifteen- to twenty-year-old male interred in a seated position whose legs were flexed over a dismembered ritual puppet-figurine. The grave goods accompanying this individual included pottery, stone slabs, slate, bone, mica, seals, various miniature vessels, and pigments (Manzanilla 2012a:519). In burial 108 was a ten- to fifteen-year-old female placed at the back of burial

105 and also in a seated position. Her role was probably to accompany the male in burial 105. Buried next to her were pigments, pottery, and a mica disk.

The body colors found in burial 105–108 included red, gray-black, black, and yellow. Interestingly, these pigments were set and displayed according to color and seemed to exhibit a pattern. All the black and gray pigments were deposited in different types of miniature pottery—mostly plates, bowls, and pots. The yellow pigments, however, were presented in the form of isolated pellets that appear not to have been contained in any kind of vessel. This suggests that they were originally wrapped in vegetable leaves or textiles that today are lost. The red and orange pigments were set on the floor inside miniature pottery vessels and adhering to seals. The red and yellow pigments therefore exhibited a wider placement and arrangement pattern within the pit than the other colors, whose display patterns were more restricted.

The second largest context of samples is also funerary but dates from the transitional period between the Tlamimilolpa phase and the Xolalpan phase (ca. A.D. 350). This context is a large mortuary pit where decapitated individuals were interred (activity area 142–144). The pit is situated above an ancient altar from Tlamimilolpa times (Manzanilla 2012a:508). Found here were five color samples. The pit held four layers of decapitated individuals, some of whom were from the Teotihuacan corridor leading to the Gulf Coast (Morales et al. 2012). Most of the decapitated heads were set in a crater and covered with another vessel. Our analysis confirms that some pigments were arranged as offerings to the decapitated heads of burials 51 and 67. The head in burial 51 belonged to a newborn baby. It was placed in the first row next to the heads of other newborns and young infants (burials 45, 49, 56, 57, and 61). The decapitated individual in burial 67 was a middle-aged adult, possibly female, covered in red pigment. She was deposited in the second layer of the pit next to burials 65, 66, 96, and 70. Body colors were just one of the relevant offerings in the grave; other offerings included stone slabs, jadeite, shells, bone, and slate (Manzanilla 2012a:508–509).

Four new body pigments were found in burials 115 and 116 (Early Xolalpan period, A.D. 350–420). Burial 115 is interesting because the only white colors found in the whole sample issue from here. This burial seems to be located in a rounded pit (activity area 214C) and holds pottery offerings, miniature vessels containing white pigments, obsidian, slate, and fiber residues (Manzanilla 2012a:518). Two body colors of warm gamut accompanied the eighteen- to twenty-two-year-old male individual placed in the oval pit, which today corresponds to activity area 239. Ceramics, stone slabs, and bone also formed part of this offering (Manzanilla 2012a:495).

Various red and yellow body colors complete the fifty samples in our study. Three of these red pigments issue from room C251A in activity area 154. Another three reds issue from rooms C162D (activity area 168), C262B (activity area 208), and C251A (activity area 92), which is located under the garment-maker's workshop. Two of the four yellow pigments were found in room C260 (activity area 206), and the other two were found in rooms C83 and C162E, which are located in activity areas 170 and 188, respectively.

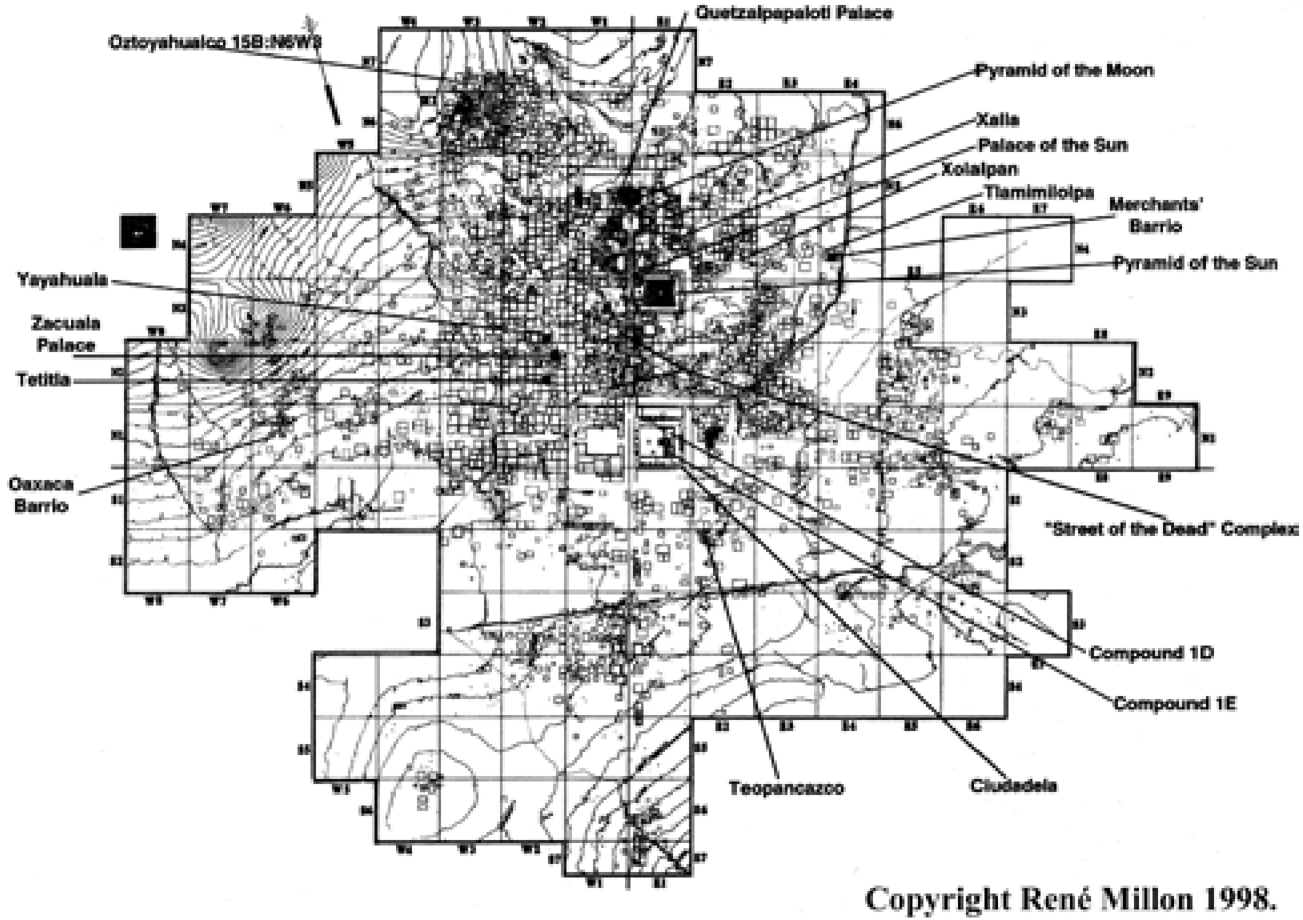
ANALYTICAL TECHNIQUES

The protocol for the physicochemical analysis used in this study combines techniques that have been optimized to identify both organic and inorganic components. First, the samples were analyzed by

TABLE 2.1 Description of the Samples and Their Contexts

Sample Reference No.	Color	Description	Room	Activity Area	Burial or Ritual Context
75679	Yellow	Pigment pellet	C181B-261	AA227	105–108
74498	Yellow	Pigment pellet	C181B-261	AA227	105–108
77568	Yellow	Pigment pellet	C181B-261	AA227	105–108
78165	Yellow	Pigment pellet	C181B-261	AA227	105–108
76689	Gray-Black	In a miniature plate	C181B-261	AA227	105–108
76681	Gray-Black	Inside a miniature bowl	C181B-261	AA227	105–108
75610	Gray-Black	Inside a miniature pot	C181B-261	AA227	105–108
76111	Gray-Black	Seal	C181B-261	AA227	105–108
79058	Gray-Black	Inside a miniature bowl	C181B-261	AA227	105–108
76688	Gray-Black	Inside a miniature bowl	C181B-261	AA227	105–108
75621	Black	Inside a miniature pot	C181B-261	AA227	105–108
76955	Red	In a miniature plate	C181B-261	AA227	105–108
75511	Red	Pigment pellet	C181B-261	AA227	105–108
78200	Red	Pigment pellet	C181B-261	AA227	105–108
75868	Red	Pigment pellet	C181B-261	AA227	105–108
75443	Red	Pigment pellet	C181B-261	AA227	105–108
23985	Red	Pigment pellet	C181B-261	AA227	105–108
76861	Red	Pigment pellet	C181B-261	AA227	105–108
71695	Red	Pigment pellet	C181B-261	AA227	105–108
73144	Red	Pigment pellet	C181B-261	AA227	105–108
76421	Red	Pigment pellet	C181B-261	AA227	105–108
76683	Red	Seal	C181B-261	AA227	105–108
76687	Red	Four-petaled seal	C181B-261	AA227	105–108

75616	Red	Seal	C181B-261	AA227	105–108
76107	Red	Seal	C181B-261	AA227	105–108
75608	Red	Seal	C181B-261	AA227	105–108
76105	Red	Seal	C181B-261	AA227	105–108
75613	Red	Four-petaled seal	C181B-261	AA227	105–108
76682 A	Red	Seal	C181B-261	AA227	105–108
76682 B	Red	Seal	C181B-261	AA227	105–108
75607	Red	Seal	C181B-261	AA227	105–108
79056	White	Inside a miniature vessel	C181B-261	AA214 C	115
79057	White	Inside a miniature vessel	C181B-261	AA214 C	115
79257	Orange	Inside a miniature vessel	C106D-362E	AA239	116
79256	Red	Inside a miniature vessel	C106D-362E	AA239	116
68899	Yellow	Pigment pellet	C162F	AA142–144	Pit of the decapitated
66523	Yellow	Pigment pellet	C162F	AA142–144	Pit of the decapitated
70204	Yellow	Pigment pellet	C162F	AA142–144	Pit of the decapitated
68884	Red	Inside a miniature vessel	C162F	AA142–144	67; pit of the decapitated
66386	Yellow	Pigment pellet	C162F	AA142–144	51; pit of the decapitated
67188	Red	Inside a miniature vessel	C251A	AA154	Possibly a disposal pit
79059	Red	Inside a miniature jug	C251A	AA154	Possibly a disposal pit
66666	Red	Inside a miniature vessel	C251A	AA154	Possibly a disposal pit
72090	Yellow	Pigment pellet	C260	AA206	Pit with materials
72537	Yellow	Pigment pellet	C260	AA206	Pit with materials
69064	Yellow	Pigment pellet	C83	AA170	Rectangular corridor
65218	Yellow	Pigment pellet	C162 E	AA188	Room with access to the main courtyard
68056	Red	Inside a miniature vessel	C162D	AA168	Corridor with well-preserved stucco floor
65193	Red	Inside a miniature vessel	C251 A	AA92	Square room under garment workshop no. 1
66155	Red	Inside a miniature vessel	C262 B	AA208	Room under C162 B



MAP 2.1 The city of Teotihuacan in Millon's map (1973). Proyecto Teotihuacán: Élite y Gobierno. Base map by René Millon (1973), redrawn by Linda R. Manzanilla and Rubén Gómez with site names.

light microscopy. This analysis was followed by mineral characterization with scanning electron microscopy/energy dispersive X-ray microanalysis and Fourier transform infrared spectroscopy. The first identification of the organic compounds in the samples was obtained using the latter technique, which was vastly improved by pyrolysis–gas chromatography/mass spectrometry. All the analyses were carried out in the Laboratorio de Análisis y Diagnóstico de Obra de Arte of the Universitat de València and in the Laboratory of the Institute of Restoration of the Cultural Heritage of the Universidad Politécnica de Valencia. Below, we briefly describe the instruments and equipment used.

Light Microscopy (LM) Leica, model DMR, with incident and transmitted light systems and a polarization system in both cases.

Scanning Electron Microscopy/Energy Dispersive X-ray Microanalysis (SEM/EDX) JEOL, model JSM 6300, with Link-Oxford-Isis microanalysis system operating at 10–20 kV between cathode and anode.

X-ray Powder Diffraction (XRPD) XRPD was carried out on randomly oriented samples after grinding the powder samples in an agate mortar. A Bruker D8 Advance system, operating in θ:θ mode was used; generator setting 40 kV, 40 mA, Cu anode (Cu-Kα = 1.5418 Å), Ni filter, 2θ range 5°–80°, step size 0.02°, scan speed 0.5° min^{-1}. Qualitative phase determination was carried out using the software QualX2.0 and the correlated COD database (Altomare et al. 2015).

Fourier Transform Infrared Spectroscopy (FTIR) Vertex 70, with total attenuated reflection system equipped with coated FR-DTGS detector to stabilize the temperature.

Pyrolysis–Gas Chromatography/Mass Spectrometry (Pyr-GC/MS) Agilent 6890N.

COLOR AND MEDICINAL PROPERTIES OF THE BODY COLORS

To date, fifty-one body colors or pigments have been identified at Teopancazco burial sites (table 2.2; see table 2.4): one black, seven gray-black, two white, twenty-eight red or reddish, one orange-yellow, and twelve yellow. Only three of these colors present a simple formulation made up of only one element, the chromatic pigment matter itself, which was normally of mineral origin. These three colors are a black manganese pigment (75621), a red hematite pigment (67188), and a ferrous yellow pigment known as jarosite (77568).

The other forty-seven body colors identified at Teopancazco are mixtures made up of two to five components. It is in these composite cases that we can properly speak of intended formulations or technical recipes. The three most recurrent components among these forty-seven compounds include the pigment itself, an organic additive, and mica. These constituent components were found in several combinations: combinations of two constituents (pigment$_1$-pigment$_2$, pigment-mica, pigment–organic additive) or combinations of all three constituents (pigment–organic additive–mica, pigment$_1$-pigment$_2$-mica, pigment$_1$–pigment$_2$–organic additive, pigment–organic additive$_1$–organic additive$_2$). A fourth component, clay, was also regularly encountered, though less often. We

TABLE 2.2 Body Colors Discovered and Analyzed

Samples	Reference Number
Black	75621
Gray-black	76688, 76689, 76681, 75610, 76111, 79058, 75621
White	79056, 79057
Red/reddish	76955, 75511, 78200, 75868, 75443, 23985, 76861, 71695, 73144, 76421, 76683, 76687, 75616, 76107, 75608, 76105, 75613, 76682 A, 76682 B, 75607, 79256, 68884, 67188, 79059, 66666, 68056, 65193, 66155
Orange-yellow	79257
Yellow	75679, 74498, 77568, 78165, 68899, 66523, 70204, 66386, 72090, 72537, 69064, 65218

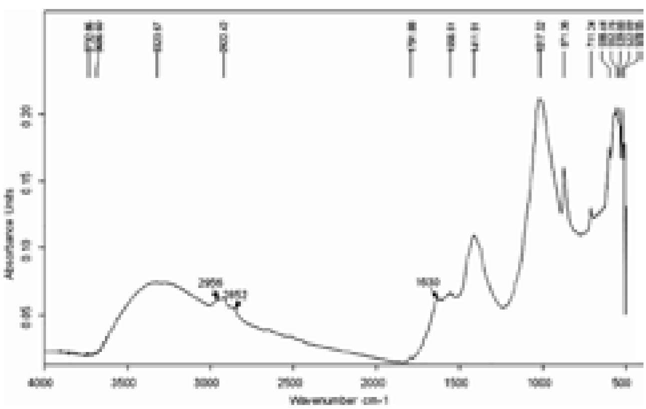


FIGURE 2.1 A white body color elaborated with calcite and illite, sample 79057, seen by FTIR. Image by Laboratorio de Análisis y Diagnóstico de Obra de Arte, Universitat de València.

believe that the purpose of many of these formulations at Teopancazco was to create body pigments that served not only to paint the body but also to confer hygienic-medicinal properties on the skin. Our preliminary hypothesis is supported by the fact that some of the combinations contributed little to modifying the color, which implies that they had some other purpose beyond the purely aesthetic.

To the category of pigments-drugs we can ascribe, for example, the white color made up of calcite and illite, a laminar-type white clay (ref. 79057; figure 2.1; see plate 2.1a). Illite modified the gloss of the painted surface in a way similar to the effect produced by adding mica. This equivalence is due to the structural similarity between illite and mica, especially muscovite-type mica (Besoain 1985:414). However, illite contains a higher proportion of water (Besoain 1985:415), which confers two further properties on this clay that account for its use in ancient and modern cosmetics since early Mesopotamia (Rytwo 2008:16).[3] These two properties are luminosity and moisture (Whitney 1990), both of which are highly suitable in face masks, for which the white material in sample 79057 was probably used.

On the other hand, illite contributed more than just luminosity to this white body color: it also conferred hygienic-medicinal properties thanks to its capacity to absorb impurities from the skin. It is interesting to note that illite, and clays in general, remove and eliminate dead cells, toxins, and impurities, thus normalizing skin texture (via peeling and purifying effects). This is why illite was used in antiquity to prepare face masks. Illite was also employed in pelotherapy, that is, natural clay in the form of mud baths applied to the skin for purifying and medicinal effects.[4] These types of clays and cosmetic products with medicinal properties were probably used in the *temazcal*, or Mesoamerican steam bath, whose name derives from the Aztec word *temazcalli*.[5] In this context we should not forget that one of the main hygienic-medicinal purposes of the temazcalli was precisely the treatment of skin disorders and diseases (Franch et al. 1980:122).

It is worth noting that illite is also a constituent of the other white body color—diatomaceous earth (ref. 79056)—that was identified and characterized in the burials at Teopancazco (figure 2.2a–h). This earth is made from the fossilized remains of aquatic organisms called diatoms. Diatoms (*Bacillariophyta*) are hard-shelled, unicellular algae that the people of Teotihuacan obtained from fossil deposits in the sedimentary layers of ancient dried-out lakes in the Basin of Mexico (Martínez et al. 2012:188). The siliceous and clayey substrate of the diatomaceous earths may be associated with other minerals, which would explain the vast chromatic variety of these earths, which range from pure white to yellow-white, rosy-white, gray-white, and black (Martínez et al. 2012:188). Sample 79056, for instance, is a pure white diatomaceous earth that was known to the Aztecs as *tizatl*, or "white earth" (Dupey 2015b; Miller, this volume).[6]

The use of diatomaceous earths in medicine and cosmetics dates back to ancient Mesopotamia. They were used because of their antiseptic, antibacterial, and antifungal properties that, like algae, act upon the skin as a barrier to germs, bacteria, and fungi (Kumar et al. 2013). These and other properties, such as the antioxidants and anticoagulants contained by some species, were known and applied for medical purposes by ancient civilizations in the Near East and north Africa (Kumar et al. 2013:212), as well as possibly in the Andean area. In the latter region, alginate has been identified by infrared spectroscopy as a constituent of the yellow natrojarosite pigments ($NaFe_3[SO_4]_2[OH]_6$) found at the pre-Hispanic necropolis of Playa Miller 7 (on the remote northern coast of Chile; ca. 500 B.C. to A.D. 900–1450), which seems to confirm the use of algae as an organic material in the Andean area for agglutinating pigments for several purposes, including treatment of the skin (Sepúlveda et al. 2011).

The medicinal properties of diatomaceous earths are further attested in the prescriptions from the *Libellus de medicinalibus indorum herbis* or *Códice de la Cruz Badiano*. This manuscript prescribes the use of a white earth with medicinal properties that is different from the white earth known as *iztactlalli*, which is thought to be an earthy salt (Cruz 1991:227). To ease a sore throat, for example, the manuscript prescribes an herbal beverage mixed with honey, pumice, and a white earth, which could be a diatomaceous earth: "(1) The sore throat is soothed by placing a finger in the mouth and gently massaging the sore area with the sap from the tlanexti and teoiztaquilitl herbs, which grow in stony places and are ground with pumice stone and white earth and mixed with honey" (Cruz 1991:31).

Thus, the diatomaceous earth in sample 79056 should be interpreted as a product that has two possible uses: as a body color (i.e., body paint or skin unguent) and as a facial mask. In both cases the diatomaceous earth blended aesthetic properties (luminosity) and medicinal-hygienic properties (antiseptic, antibacterial, antifungal) that must have held some significance in the contexts in which they were deposited and possibly used, that is, tombs and burials.

The gray-black body colors were also combined to form cosmetics that were linked with both aesthetics and medicine. Samples 76681, 75610 (figure 2.3a–b), 76111 (figure 2.3c–d), and 79058 are of this sort. These body colors are made from two components: galena (lead sulfide) and charcoal of vegetable origin. The gray-black tonality was produced by mixing the two materials, and the dark

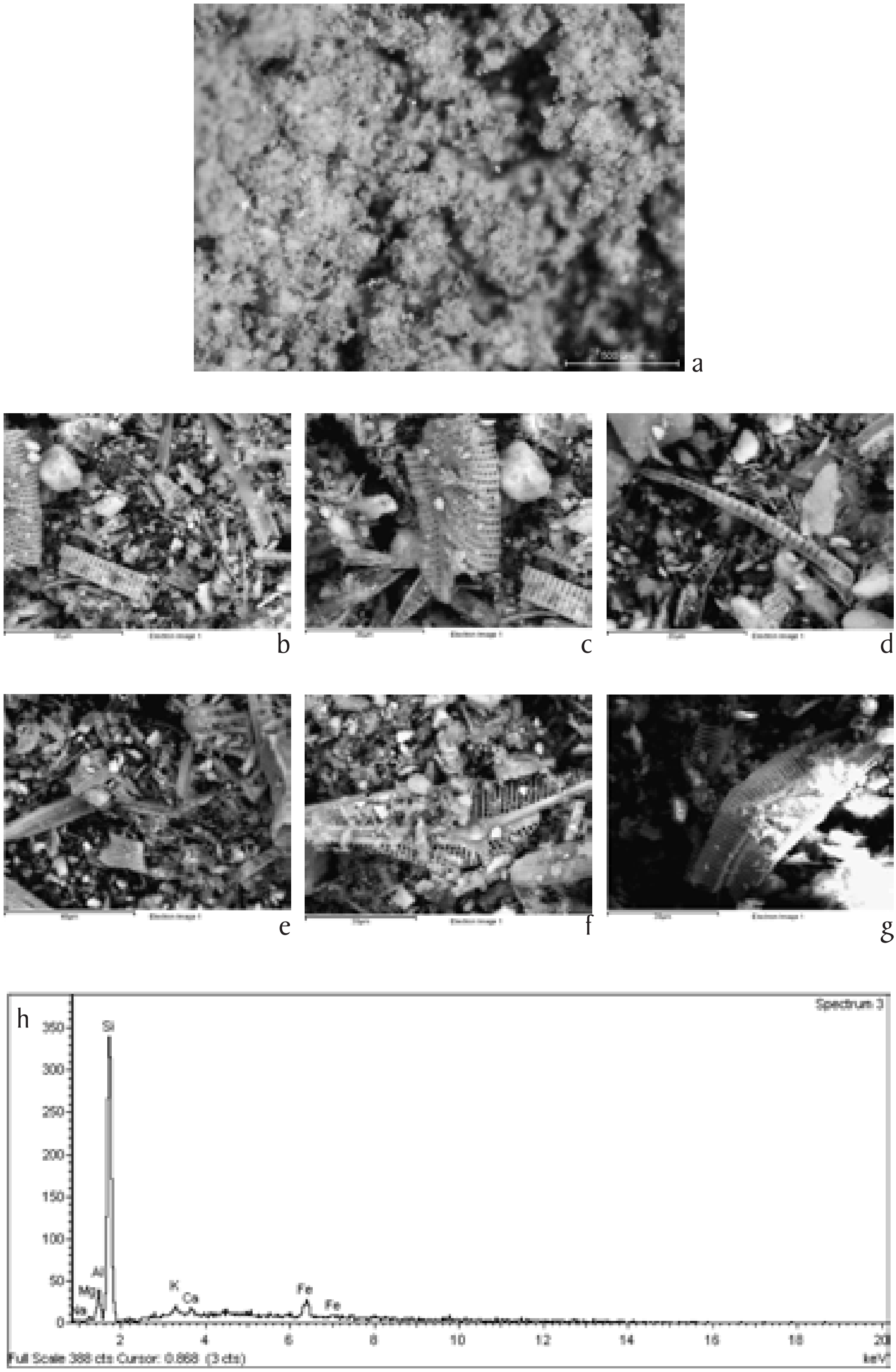


FIGURE 2.2 A white body color prepared with diatomaceous earth, sample 79056, seen by (a) LM, (b–g) SEM, and (h) EDX. Images by Laboratorio de Análisis y Diagnóstico de Obra de Arte, Universitat de València.

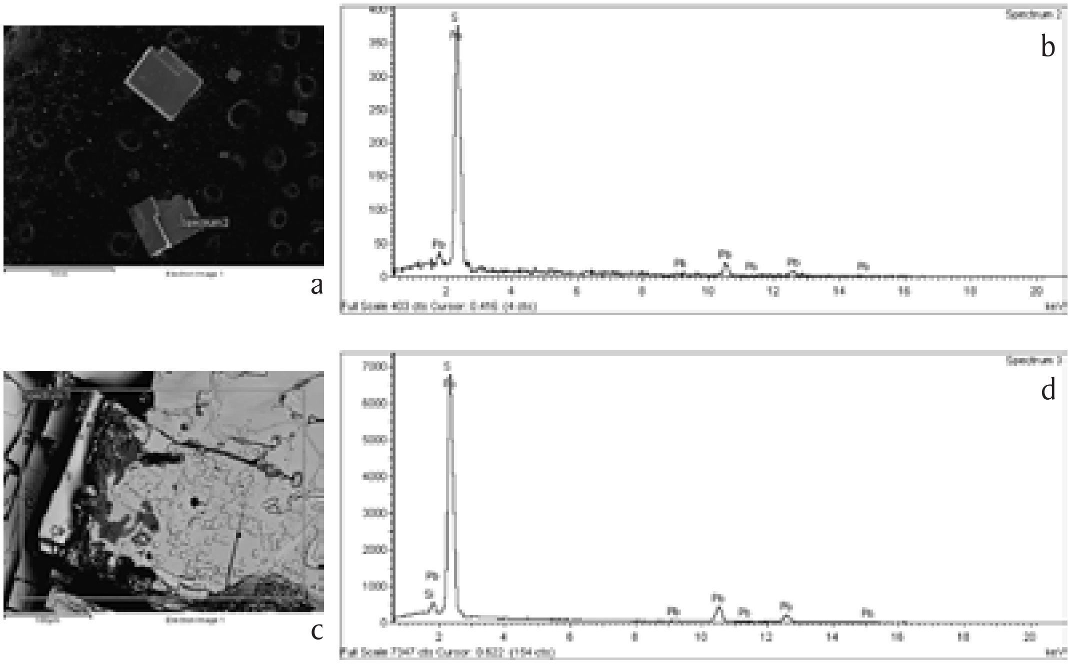


FIGURE 2.3 Body colors made with galena and charcoal of vegetable origin seen by SEM/EDX: (a–b) sample 75610, and (c–d) sample 76111. Images by Laboratorio de Análisis y Diagnóstico de Obra de Arte, Universitat de València.

gray color of galena was blackened by adding charcoal. However, this was not the only nor perhaps the most important function of charcoal in the formulation. Its most important purpose was to ameliorate the harmful effects of galena on the skin caused by its main ingredient: lead (Doménech et al. 2012; Fussler 2011; Vázquez de Ágredos et al. 2012).

Similar combinations with identical purposes are found in cosmetics such as kohl, a pigment used as an eyeliner since remote times in Mesopotamia, Egypt, and India and still used today in the Near and Middle East (Hardy et al. 2008). There is ongoing medical debate regarding the toxicity *versus* the therapeutic properties of kohl, inasmuch as it protects the eye from ultraviolet sunrays (Ullah et al. 2010). Researchers agree, however, on the important role played by charcoal in the recipe, which was described in the first quarter of the twentieth century when kohl was submitted for physicochemical analysis (Lucas 1930:42).[7] As early as ancient Egypt, medical scrolls such as the Ebers Papyri presented ophthalmologic prescriptions that called for galena combined with charcoal and other components (mostly fat, honey, and other minerals) rather than galena on its own (Bardinet 1995). The extended use of galena shows that despite its toxicity, it was deemed to possess important healing properties. But precisely because of its toxicity, two key variables must have weighed heavily in the formulations that combined galena with components such as charcoal or bone char: frequency of use (Caluwé 2009) and proportionality. Although we lack reports on and evidence for the frequency of use of body colors containing galena in Teopancazco (Natahi 2013:78–79), samples 76681, 75610, 76111, and 79058 provide evidence of proportionality, that is, the proportion of galena required in the mixture to avoid or lessen its toxic effects.

The gray-black sample 76688 also combines galena and charcoal but adds biotite-type mica to the formulation. This type of mica adds a very special luster to the pigment by imbuing it with a metallic "shine" (Zorzin 2002:71). This same luster is shared by the aforementioned samples and by gray sample 76689. This latter sample is especially interesting because the galena is combined with a small proportion of white earth (halloysite/kaolinite), which, for lack of charcoal, must have been the component chosen to diminish the toxicity of lead. The internal exchange of ions between these clayey silicates and heavy metals, such as mercury or lead, allows the former to partially absorb the toxicity of the latter (Rytwo 2008:16). Adding halloysite or kaolinite to the gray color in sample 76689 served this purpose and countered some of the effects of galena on the skin.

The body pigments containing red cinnabar that were confected at Teopancazco, which contain high percentages of mercury, were similarly mixed (figure 2.4a–c; see plate 2.1b). We have not encountered a single case of isolated cinnabar among our samples. In other words, all six pigments containing cinnabar (76955, 75511, 78200, 68884, 71695, and 76682 A) correspond to complex formulations that combined two to five components. The most common components were white laminar-type clays and red pigments.

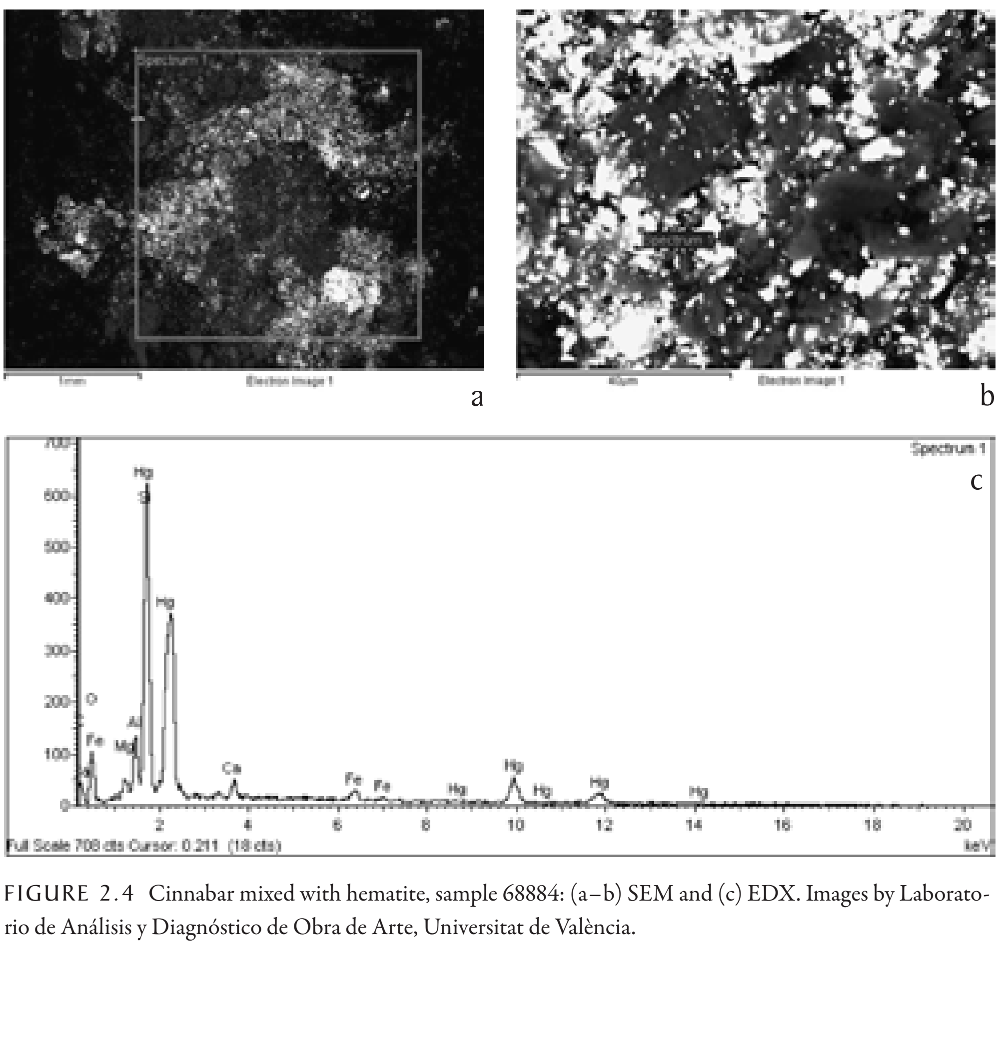


FIGURE 2.4 Cinnabar mixed with hematite, sample 68884: (a–b) SEM and (c) EDX. Images by Laboratorio de Análisis y Diagnóstico de Obra de Arte, Universitat de València.

Finally, it is interesting that all the white clays we have identified in the body color recipes at Teopancazco (e.g., hallyosite/kaolinite and illite) present a laminar structure rather than a tubular one; that is, their structures promote surfaces of intense luminosity (see plate 2.1c–d). The choice of laminar-type clays is not coincidental but should be interpreted as a purposeful choice conditioned by a cultural trait that is prominent in the history of aesthetics everywhere: taste. In other words, the inhabitants of Teopancazco had a taste or preference for body colors that, as well as being compatible with health, were luminous and bright. Luminosity and luster are therefore two important aesthetic qualities of body paints at Teopancazco. These qualities were sought in Teotihuacan not only on human skin but also (as we shall see in the next section) on other artistic and culturally significant surfaces.

In terms of composition, the remaining body colors found and identified at Teopancazco belong to the same group: iron pigments. Hematite (67188, 79059, 66666, 65193, 66155, 79256) and a wide range of earths (73144, 76421, 76683, 76687, 75616, 76107, 75608, 76105, 75613, 76682 B, 75607) were the most prominent red iron pigments in our sample base. Jarosite was the first choice for the yellow iron pigments used on the skin (75679, 74498, 77568, 78165, 66523, 70204, 72090, 72537, 69064, 65218). Only in two instances was limonite rather than jarosite the ferric mineral chosen for preparing yellow colors (68899, 66386). There was only one orange pigment, and it was composed of ilmenite, hematite, and quartz (79257). These findings confirm the preeminence of iron minerals for confecting warm-gamut body colors at Teopancazco ranging from red to orange to yellow.

Warm-color pigments are not contraindicated for skin application. Quite the opposite in fact: they can form a film of saturated color that protects against external agents such as wind or sun. We also know that when combined with other organic products of vegetable or animal origin, these earth pigments produce medicines that were widely used in pre-Hispanic Mexico. The main source of reference for this information is the *Libellus de medicinalibus indorum herbis* or *Códice de la Cruz Badiano*. This manuscript describes, for example, the remedy prescribed for bad breath: "(2) A decoction is made with roots and leaves of the herb they call tlatlancuaye, red earth, white earth, and the herbs temamatlatzin and tlanextia xiuhtontli; all these ingredients ground together and boiled in water with honey are a cure for bad breath" (Cruz 1991:35). Further on, the manuscript prescribes a remedy for intense menstrual bleeding: "(3) To dry and stop the flow of blood, prepare a dressing with salt, deer ash and frogs, egg white, the hairs of a hare, *ahuiyac xihuitl* and willow roots, acorns, burnt paper, together with deer horn, *eztetl* stone, fine gold and well-ground iron. All these ingredients are left to decant in rainwater and the decanted liquid is dripped onto the bleeding area" (Cruz 1991:83).

Similar prescriptions and recipes are found among many cultures in antiquity. Comparative analyses of formulations used in ancient Mexico suggest that the beneficial effects of red iron pigments were widely known and extensively applied in Eastern and Western medicine both before and after the conquest of the Americas. To cite one example, around the same time that the inhabitants of Teopancazco were using hematite to paint their bodies red without any hazard to their skin, the inhabitants of imperial Rome were using this same pigment in cosmetics and medicine, where it was known as *terra de Lemnos*. As described by Pliny and Galen in their respective treatises, every year the priestesses at the Temple of Diana prepared this red earth at the goddess's sanctuary on the island of Lemnos (Photos-Jones and Hall 2011).[8] Both authors refer to the significant use of this red pigment in three contexts: painting, rituals, and medicine. The pigment was used medicinally to treat, for example, epilepsy, which had been known as the "sacred disease" since the term was coined in the *Corpus hippocraticum* because of the association established in ancient Greece between this disease, the moon, and the goddess Diana (Lanata 1967). The use of *terra de Lemnos* in Western medicine extended from the Greek world well into the nineteenth century. It is still possible to trace the use of this pigment in the European pharmacies of today that have managed to preserve ancient drugs, aromas, and cosmetics. In the last decade, many of these pharmaceutical preparations have been subjected to detailed analysis.[9] Similarly, the Mesoamerican use of iron minerals to produce body colors that blended aesthetic and medicinal properties overflowed from the Preclassic into the Postclassic era: an early indication of this use is the mixture of hematite and acacia gum identified in a Preclassic Maya burial at Tak'alik Ab'aj (Vázquez de Ágredos et al., chapter 4, this volume).

This type of association between color, pharmacopoeia, magico-religious beliefs, and culture was crucial in Mesoamerica, and two key factors for understanding such associations in the body colors of Teopancazco include their luminosity and luster.

LUMINOSITY AND LUSTER: ONLY A MATTER OF AESTHETICS?

Luminosity is one of the optical effects that were sought in the confection of body colors at Teopancazco. The other is luster, which produces effulgence or "shine." Archaeometric results show that in the formulation of red colors, for instance, a biotite-type mica was present in those cases in which cinnabar was not part of the recipe. There are only three exceptions to this rule: sample 79256, made up of hematite and halloysite/kaolinite clay; sample 79056, identified as a mixture of iron oxide and calcite; and sample 67188, whose only component is this red iron pigment. In the reds containing cinnabar (71695, 76955, 75511, 78200, 688884, 76682 A), the pigment responsible for producing color was hematite or a red earth, rather than mica.

There is little doubt that the desire for pigments with a luminous and lustrous finish was one of the main reasons for including mica in the formulation. Iron colors like hematite and red earths, on the other hand, are rather opaque. Adding mica to these red body colors results in an optic effect that appears to be a constant feature in the body colors from Teopancazco. The yellow iron pigments also attest to this interpretation. These are made up of jarosite, limonite, or a combination of the two (figure 2.5; see plate 2.1e). Jarosite appears as the sole component of the body color only in sample 77568. However, in all the other cases we see the use of mica to attain a bright and lustrous finish (66523, 72090, 72537, 69064, 70204, 65218, 75679, 74498, 78165, 68899, 66386).

It is clear that biotite-type mica was preferred to calcite or laminar clays and that the aim of including mica in the recipe was to add brilliance to dull-colored pigments. In fact, out of the fifty body colors we analyzed, thirty-one included laminar-type mica or imperceptible mica particles, which conferred a special brilliance to the pigment's surface. This lustrous surface resembled sunrays reflected from spectral hematite or a mirror, which leads us to ponder what effect "makeup" that incorporated similar characteristics might have had on the onlooker. It is worth remembering that the type of mica chosen for the formulation of all these body colors was biotite. This is relevant because Teotihuacan imported from Oaxaca, its main supplier, two other varieties of mica for use in art and daily life: phlogopite and muscovite, which was much scarcer (Rosales and Manzanilla 2011). Biotite-type mica enabled artisans to re-create yellow and red body colors "dotted" with a translucent orangey-amber or reddish glitter, which is the chromatic effect given off by biotite (Rosales 2004:118). In other words, biotite brought out the natural luminosity and warmth of the warm-gamut body pigments.

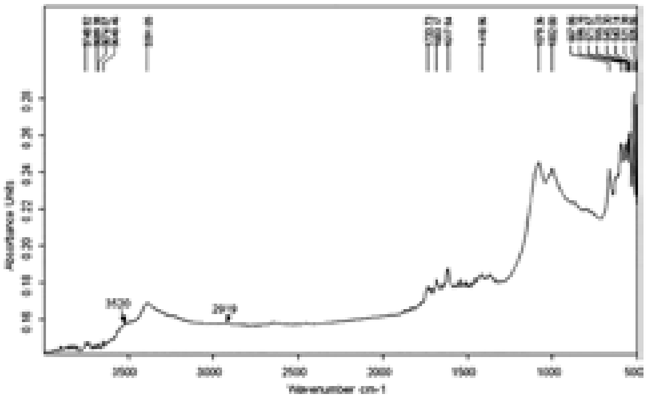


FIGURE 2.5 Jarosite body color, sample 74498, seen by FTIR. Image by Laboratorio de Análisis y Diagnóstico de Obra de Arte, Universitat de València.

Cinnabar and galena are not included in the list of pigments that used mica, except for the gray-black sample 76688 in which galena and charcoal were admixed with small amounts of mica. Simply put, cinnabar and galena do not need mica to enhance their properties. Both pigments have their own luster characterized by a high intensity that adds to the natural warmth of the former and to the intrinsic coldness of the latter. These properties are conferred on each pigment by mercury and lead, respectively. The result of all these combinations is that Teopancazco offers a range of warm, lustrous body colors, not only for the red and yellow pigments but also for the whites. As can be ascertained from their names in several Mayan languages and in Nahuatl, white pigments stood for light and clarity in the world views of many Mesoamerican cultures (Álvarez 1997:481; Dupey 2003:76; Rossi, this volume). We have already mentioned that the illite present in sample 79057 also served to intensify the luminous effect of this calcium white.

As we can see from the lustrous surfaces of pottery and mural paintings (e.g., Magaloni 1995), the formulations of body colors at Teopancazco attest to a specific and extended taste or preference prevalent in Teotihuacan since early times. However, they also attest to something else, which was the need to obtain colors with medicinal properties based not only on their constituent components, as described in the previous section, but also on their ability to transmit heat or cold to an ailing body in order to counter a temperature that was causing illness.[10] If, as we believe, body colors in Mesoamerica were conceived as a second skin that served to embellish the body (aesthetic value) and confer new identity and power (e.g., warrior body markings and paintings), another property attributed to body colors was their capacity to heal. Here, color composition and color temperature were key. Composition was important because it minimized the risk of harm from certain chromatic materials in contact with the skin (e.g., lead or mercury) or because it enhanced the healthy properties of other pigments, such as those of the diatomaceous earths or red earths we mentioned earlier. Temperature was important because it was thought that the temperature of a color—determined by its own chromatic materiality and range from cold (e.g., galena/lead/gray-black) to warm (e.g., cinnabar/mercury, hematite/mica, jarosite/hematite/mica)—could reestablish a body balance that had been lost because of an excess or defect of heat in the body.[11]

Given that more than half of our samples issue from a funerary context and that in Nahua belief the color white (i.e., light) was related to creation and, by extension, to life (Dupey 2003:120–130), it should come as no surprise that the bias in these contexts should be toward colors that enhance luminosity, luster, and warmth. Yellow and red also evoke the idea of light and warmth in Nahuatl thought, and certain reds are directly associated with the *tonalli*. As the codices suggest (Dupey, chapter 12, this volume), the purpose of luminous body colors would have been to materialize the presence of the *tonalli* in the human body and to revitalize it.

We believe that the importation of jarosite, galena, mica, and, intermittently, cinnabar for confecting body colors at Teopancazco was not for aesthetic purposes alone. In our opinion, the main reasons for importing these minerals were medicinal and ritual. This makes the collection of body colors from Teopancazco the first in Mesoamerica to evidence the medicinal use of color on the skin based on three variables: composition, temperature, and aroma, the latter being imbued with strong ritual connotations.

BODY COLORS WITH PINE AND CHIA AROMAS

Twenty-four of the body colors from Teopancazco contain an aromatic, organic additive (tables 2.3 and 2.4). All the pigments with additives are either red or yellow; the additive was not present in any of the blacks or whites. In thirteen of these twenty-four cases, the organic additive was identified as pine resin, chia oil, or a mixture of the two. The additive and fragrant component of the other eleven samples has not been identified, but it may have been the same substance in all cases and equally applied to the same type of pigment: red earths.

Technically, a resin is insoluble in water. This means that the aid of an alkaline solution or oil is required to agglutinate color that can spread on the skin. Oil was, in fact, the option chosen by the specialists at Teopancazco for samples 69064, 71695, 75443, 23985, and 68056. Chia oil could be produced by crushing the seeds or by roasting them at high temperatures. The oil obtained by these processes conferred a medium texture on the body colors that was different from the plaster obtained by mixing only pine resin with the red and yellow pigments of samples 68899, 66389, 76955, 75868, and 76861. It was also different from the oily fluidity of samples 75679, 75511, and 78200, in which only chia oil was identified. We have therefore identified a combination that produced three different textures with different viscosities. Of the three, the formulation that contained oil was the most amenable as a skin cosmetic and so was favored by many ancient cultures (e.g., Bourliascos 2004; Giannelli 2000; Giordano and Casale 2007; Squillace 2010). Each formulation also added its own scent to the body colors. Some reds, for example, only added a pine (e.g., 76955) or chia (e.g., 75511) fragrance or the combined scent of both pine and chia (e.g., 75443). Of course, each fragrance also carried its own attendant reminiscences and evocations.[12]

TABLE 2.3 Body Colors of Teopancazco that Contain an Aromatic, Organic Additive

Additive Components in the Samples Studied	**Archaeological Reference Number**
Pine resin (*Pinus montezumae*)	68899, 66389, 76955, 75868, 76861
Chia oil (*Salvia hispanica*)	75679, 75511, 78200
Pine resin + chia oil	69064, 71695, 75443, 23985, 68056
Additive and fragrant component not identified	73144, 76421, 76683, 76687, 75616, 76107, 75608, 76105, 75613, 76682 B, 75607

TABLE 2.4 Formulations of Body Colors at Teopancazco

Sample Reference No.	Identified Body Pigments	Color/Hue
77568	Jarosite ($KFe_2[SO_4]_2[OH])_6$	Bright yellow
66523, 72090, 72537	Jarosite ($KFe_2[SO_4]_2[OH])_6$ + Cinnabar (HgS) + Hematite (Fe_2O_3) + Mica (biotite)	Red-yellow
69064	Jarosite ($KFe_2[SO_4]_2[OH])_6$ + Cinnabar (HgS) + Red earth + Mica (biotite) + Pine-resin fragrance (*Pinus montezumae*) + Chia oil (*Salvia hispanica* L.)	Red-yellow
70204	Jarosite ($KFe_2[SO_4]_2[OH])_6$ + Red earth + Mica (biotite)	Red-yellow
65218	Jarosite ($KFe_2[SO_4]_2[OH])_6$ + Red earth + Hematite (Fe_2O_3) + Mica (biotite)	Red-yellow
75679	Jarosite ($KFe_2[SO_4]_2[OH])_6$ + Mica (biotite) + Chia oil (*Salvia Hispanica* L.)	Bright yellow
74498, 78165	Jarosite ($KFe_2[SO_4]_2[OH])_6$ + Limonite ($Fe_2O_3{\cdot}nH_2O$) + Hematite (Fe_2O_3) + Mica (biotite)	Bright yellow
68899, 66386	Limonite ($Fe_2O_3{\cdot}nH_2O$) + Mica (biotite) + Pine-resin fragrance (*Pinus montezumae*)	Pale yellow
79056	Diatoms (Bacillariophyta)	White
79057	Calcite ($CaCO_3$) + Illite-type clay $(K, Na, Ca)_2O_{3.33}(Mg, Mn)_{0.43}(Al, Fe, Ti)_2O_{2.16}(Si, Al)O_2{\cdot}4H_2O$	White
79257	Hematite (Fe_2O_3) + Ilmenite ($FeTiO_3$) + Quartz (SiO_2)	Orange
76689	Galena (PbS) + Halloysite/Kaolinite ($Al_2Si_2O_5[OH]_4$)	Gray-black of dulled intensity
76681, 75610, 76111, 79058	Galena (PbS) + Charcoal (C)	Bright gray-black
76688	Galena (PbS) + Charcoal (C) + Mica (biotite)	Bright gray-black
75621	Manganese oxide (MnO)	Very dark black
71695	Cinnabar (HgS) + Calcite ($CaCO_3$) + Pine-resin fragrance (*Pinus montezumae*) + Chia oil (*Salvia hispanica* L.)	Light red
76955	Cinnabar (HgS) + Red earth + Pine-resin fragrance (*Pinus montezumae*)	Dark red
75511	Cinnabar (HgS) + Limonite ($Fe_2O_3.nH_2O$) + Chia oil (*Salvia hispanica* L.)	Orange-red
78200	Cinnabar (HgS) + Red earth + Chia oil (*Salvia hispanica* L.)	Dark red
68884	Cinnabar (HgS) + Hematite (Fe_2O_3)	Deep-hued dark red
76682 A	Cinnabar (HgS) + Hematite (Fe_2O_3) + Halloysite/Kaolinite ($Al_2Si_2O_5$ $[OH]_4$)	Medium-hued red
75868	Red earth + Pine-resin fragrance (*Pinus montezumae*) + Mica (biotite)	Medium-hued red
75443, 23985, 68056	Red earth + Hematite (Fe_2O_3) + Mica (biotite) + Pine-resin fragrance (*Pinus montezumae*) + Chia oil (*Salvia hispanica* L.)	Deep-hued dark red

(*continued*)

TABLE 2.4 (*continued*)

Sample Reference No.	Identified Body Pigments	Color/Hue
76861	Red earth + Hematite (Fe_2O_3) + Pine-resin fragrance (*Pinus montezumae*) + Mica	Deep-hued dark red
79256	Hematite (Fe_2O_3) + Halloysite/Kaolinite ($Al_2Si_2O_5[OH]_4$)	Very light red
79059	Hematite (Fe_2O_3) + Calcite ($CaC0_3$)	Very light red
67188	Hematite (Fe_2O_3)	Dark red
66666, 65193	Hematite (Fe_2O_3) + Charcoal (C) + Mica (biotite)	Very dark red
66155	Hematite (Fe_2O_3) + Animal carbon? ($Ca_5[PO_4]_3OH$) + Mica (biotite)	Very dark red
73144, 76421, 76683, 76687, 75616, 76107, 75608, 76105, 75613, 76682 B, 75607	Red earths + Organic (unidentified) + Mica (biotite)	Dark red

Finally, we should not forget the strong rituality that permeated each of these aromas. Pine resin, for example, played the same role as copal did in the religious beliefs and daily lives of ancient Mesoamerican cultures (Vázquez de Ágredos et al., chapter 4, this volume). The heavy concentrations of *Salvia hispanica* L. found in the main square of Teopancazco are interpreted as evidence of the important role played by chia oil in the ritual ceremony that probably took place in the plaza, the epicenter of the neighborhood (Manzanilla 2012b:42). This ceremony is depicted in the main mural painting at Teopancazco, which shows two lavishly dressed priests bearing sumptuous attributes and showering chia seeds in front of an altar (figure 2.6). Chia oil was used not only to agglutinate and aromatize body colors, but also as part of the ritual that took place in the central plaza of this multiethnic neighborhood. The presence of chia in both contexts attests to its profound meaning and also appears to confer a cultural identity on the body colors that perhaps reflects the diverse backgrounds of the artisans who confected them. We should bear in mind that in every culture—past or present—the wider the ethnic background of its people, the stronger the cultural identity that binds them. And it is precisely ethnic diversity that distinguished Teopancazco from other neighborhood centers in Teotihuacan, such as La Ventilla (Teotihuacanos) or the Oaxacan barrio.

CONCLUSIONS

The physicochemical analysis of fifty body colors found in various tombs and other contexts in the multiethnic neighborhood center of Teopancazco has revealed their composition and, through their composition, their main function and purpose. To the aesthetic purpose, which is intrinsic to all body colors, we should add three others: medicinal, aromatic, and possibly a purpose related to identity. The close association between color, aroma, medicine, and culture is so emphatically expressed through the body colors at Teopancazco that it should encourage further research on similar samples from other neighborhood centers in Teotihuacan and, indeed, from other Mesoamerican cultures.

FIGURE 2.6 The principal mural painting at Teopancazco. Source: Proyecto Teotihuacán: Élite y Gobierno. © Instituto Nacional de Antropología e Historia, Mexico.

This would broaden our understanding, on the one hand, of a specific technology of color midway between the aesthetic and the medicinal that originated in Preclassic Mesoamerica and, on the other, of cultural and social rites and identities that can be traced through color to a *continuum* that often extends from the past to the present (Kindl, this volume). In this chapter, we have omitted any description of the toiletries that were found with some of the body colors, for example, pumice stone and seals, which were made of unbaked and baked clay. Some seals bear a design with four petals that stood for the fourfold political organization of Teotihuacan but also represented the flowers that gave off the scented and sacred essences that featured in the world view and daily life of Teopancazco, Teotihuacan, and Mesoamerica. But that is another matter.

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NOTES

1. For a recent genetic study that proves the ethnic diversity of the inhabitants of Teopancazco, see Álvarez-Sandoval et al. 2015.
2. The burial of adults or infants in mortuary pits with the body in a flexed or seated position is the most extended Teotihuacan burial type found at Teopancazco. Burial 105–108 conforms to this model, with

the particularity that two individuals are interred in the same pit rather than just one, which was the norm.

3. This text mentions two clays that were applied to the skin for their beneficial effects: illite and smectite.
4. Writing in the second century A.D., Greek physician Galen was the first to describe the effects of clays after studying how they were applied on animal skins. His experimental tests provided a scientific approach to his observations. See Cilliers and Retiefs 2006.
5. Although *temazcal* is accepted as a generic term for steam baths in Mesoamerica, other specific terms are used in different regions. One example is found in the Maya Lowlands, where steam baths are known as *chuj* in Mam, *chu* in Kanhobalan, *tuj* in Quiché, and *pus* in Tzetzal (Franch et al. 1980:109).
6. The Florentine Codex reports that the bodies of sacrificial warriors were covered in *tizatl* at certain Nahua religious festivals (Dupey 2015b). This is worth emphasizing given the ritual character of many of the burials in Teopancazco and the possible warrior identity of some of the individuals buried there. This could be evidence of a close relationship between *tizatl*, warriors, and sacrificial ritual in the historical sources that describe the Postclassic period.
7. Galena is the dominant chromatic substance in kohl, charcoal being the other principal component.
8. The goddess Diana was the Roman equivalent of the Greek goddess Artemis. Along with Selene (the moon), Artemis was considered a lunar deity, which made her one of the principal deities of magic in classical antiquity. The close association between magic and medicine up to contemporary times explains her preeminent role in ancient Western pharmacopoeia and why many pharmaceutical preparations bear her name; for example, silver nitrate ($AgNO_3$) is commonly known as moon salt or salt of Diana (Guineau 2005:493–494).
9. The Laboratorio Farmaceutico de Santa Maria della Scala in Rome, which dates back to the seventeenth and eighteenth centuries, has preserved many ancient substances—including *terra de Lemnos*—that are associated with preparations of American origin brought back to Europe after the conquest. This influx of new medicines and concoctions imposed changes on medical practice (and associated cosmetics) on both sides of the Atlantic. The physicochemical and cultural study of the collection of drugs, cosmetics, and aromas preserved at the Laboratorio della Scala, and their repercussions on the Old and New Worlds, is currently under research in the project headed by the author of this chapter, entitled Tracing Back to Antiquity the Composition and Significance of Ancient Drugs, Pigments, and Fragrances Found in a 17th-Century Roman Pharmacy: The Archaeometric Characterization and Historical-Cultural Study of an Overlooked Collection. This research project is an interdisciplinary collaboration between the Laboratorio de Análisis y Diagnóstico de Obra de Arte (LANDIARH, Universitat de València), the Laboratoire d'Archéologie Moléculaire et Structurale (LAMS, Université Pierre et Marie Curie, Paris), the Laboratory of the Department of Life Sciences (Università degli Studi di Modena e Reggio Emilia, Modena), the Laboratory of the Dipartimento di Scienze Ambientali, Informatica e Statistica (Università Ca'Foscari di Venezia), and the Laboratory of the Institute of Materials and Constructions (University of Applied Sciences and Arts of Southern Switzerland).
10. On the concept of thermal balance and imbalance as the key to understanding health or disease in pre-Hispanic Mexico, see López Austin 1989:1:285–318.
11. The essence that confers heat to the human body is the *tonalli*. On the association between certain colors and the *tonalli*, see Dupey 2010a.
12. On the psychotropic and medicinal effects of the aromas, see Corbin 2005; Heaviland-Jones et al. 2005; Van Toller and Dodd 1988.