

*La nature de toute technè est de s'appliquer à la genèse d'une œuvre, d'en rechercher la technologie et la théorie parmi les choses réalisables, et d'en trouver le principe dans la personne qui la fait naître et non dans l'œuvre elle-même.*

Aristote. *Éthique à Nicomaque* (Livre VI, chapitre IV, 4)

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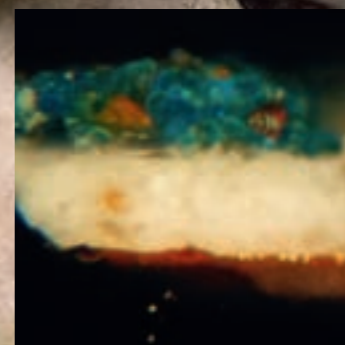
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Terres cuites de la Renaissance Matière et couleur

Numéro 36  
2012

# TECHNE LECHNE

*La science au service de l'histoire de l'art  
et des civilisations*



Terres cuites de la Renaissance  
*Matière et couleur*

Centre de recherche et de restauration des musées de France

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Le Centre de recherche et de restauration des musées de France met en œuvre la politique du Service des musées de France en matière de recherche, de conservation préventive et de restauration des collections placées sous son autorité. Il rassemble et diffuse notamment une documentation sur les matériaux, les techniques et les méthodes de conservation et de restauration, et contribue au contrôle technique de l'État dans ce domaine, en application de la loi sur les musées de France, avec le soutien de la Mission recherche et technologie du ministère de la Culture (MRT).

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# TECHNE

TECHNE a pour objet de rendre compte de l'application des sciences exactes à l'étude du patrimoine culturel: examens et analyses sont conduits en vue de sa conservation et de sa restauration, mais aussi dans une plus large perspective d'enrichissement de l'histoire. Sur ces travaux, chercheurs, conservateurs, restaurateurs, historiens, philosophes, artistes posent des regards différents: allier sciences exactes et sciences humaines, dans une démarche véritablement interdisciplinaire, est indispensable à la constitution d'un savoir humaniste.

TECHNE s'adresse en priorité à la communauté des scientifiques, conservateurs, restaurateurs, archéologues, archéomètres, en France et à l'étranger, mais aussi à tous ceux qui se passionnent pour l'art et/ou la science et pour leur rapprochement, ainsi qu'à un public élargi: la fréquentation croissante des musées et des expositions engage ce public à savoir «ce qui se cache derrière» les œuvres et les objets. Diffuser les travaux de laboratoire et de restauration par la publication ou l'exposition peut contribuer à satisfaire cette légitime curiosité de la genèse des objets, de leur circulation, de l'origine des matériaux qui les composent, de leur vieillissement dans leurs différents contextes.

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*En couverture*

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*Au centre*

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## Terres cuites de la Renaissance : matière et couleur

Journées d'études  
tenues à l'Auditorium du musée du Louvre et  
à l'Auditorium du C2RMF les 26 et 27 octobre 2011,  
sous la direction d'Anne Bouquillon et de Marc Bormand

<b>Éditorial</b>	<b>3</b>
Editorial <i>Marie Lavandier</i>	
<b>Préface</b>	<b>5</b>
Foreword <i>Henri Loyrette</i>	
<b>Introduction</b>	<b>6</b>
Introduction <i>Marc Bormand, Anne Bouquillon</i>	

I · « SCULPTER ET PEINDRE » :  
LES MÉTAMORPHOSES DE LA TERRE

<b>Scultura dipinta o pittura a rilievo? Riflessioni sulla policromia nel Quattrocento fiorentino</b>	<b>9</b>
Sculpture peinte ou peinture en relief? Réflexions sur la polychromie au <i>Quattrocento</i> florentin Painted sculpture or relief painting? Thoughts on polychromy in the Florentine <i>Quattrocento</i> <i>Giancarlo Gentilini</i>	
<b>“Colorite de boni colori et ornate secundo il naturale”. La terracotta policroma: simulare, imitare la natura</b>	<b>18</b>
« Colorées en bonnes couleurs et ornées d'après nature ». La terre cuite polychromée : simuler et imiter la nature “Painted in the right colours and adorned from life.” Polychrome terracotta: simulating and imitating nature <i>Maria Grazia Vaccari</i>	

**L'éclat du sombre ? Terres cuites façon bronze de la Renaissance italienne** **26**

The sheen of the dark? Italian Renaissance  
imitation bronze terracottas  
*Philippe Sénéchal*

**Bozzetti und Pseudo-Bozzetti aus Terrakotta in der Berliner Skulpturensammlung** **34**

*Bozzetti* et pseudo-*bozzetti* en terre cuite dans  
la collection des Sculptures des Musées de Berlin  
*Terracotta bozzetti* and pseudo-*bozzetti* in the  
Sculpture Collection, Museums of Berlin  
*Volker Krahn*

II · DONATELLO

**Autour de quelques exemples de reliefs de Donatello sur le thème de la Vierge et l'Enfant** **43**

Focus on examples of Donatello's reliefs on  
the theme of the Madonna and Child  
*Marc Bormand*

**The Kress Madonna: Revelations of an Extraordinary Sculpture** **47**

*La Madone Kress*. Les révélations  
d'une sculpture extraordinaire  
*Simona Cristanetti*

**La Vierge adorant l'Enfant de Donatello, dite Madone Piot. Étude et restauration** **54**

Donatello's *Madonna and Child*, known as the  
*Piot Madonna*. Study and restoration  
*Jennifer Vatelot*



## III · MATÉRIAUX ET ÉTUDES DE CAS

**Terres célèbres, terres révélées et terres énigmatiques : terres et ateliers dans l'Italie de la Renaissance** 63

Famous clays, clays brought to light and enigmatic clays: clays and workshops in Renaissance Italy

*Anne Bouquillon, Marc Bormand, Christel Doublet*

**La polychromie des sculptures italiennes de la Renaissance. À l'origine des couleurs, état d'avancement des analyses menées au C2RMF** 72

The polychromy of Italian Renaissance sculptures. Investigating colour: progress report on analyses carried out at C2RMF

*Anne-Solenn Le Hô*

**L'empreinte de la mort. Étudier et restaurer un masque funéraire** 78

The imprint of death. Studying and restoring a funerary mask

*Agnès Cascio, Nathalie Pingaud*

**Le analisi scientifiche rivelano un'opera d'arte sconosciuta: il *Compianto* di Michele da Firenze. Risultati e confronti con altri gruppi in terracotta restaurati all'OPD** 85

Les analyses scientifiques révèlent une œuvre d'art inconnue : la *Lamentation* de Michele da Firenze. Résultats et comparaison avec d'autres groupes en terre cuite restaurés à l'OPD

Scientific analyses reveal an unknown artwork: the *Compianto* by Michele da Firenze. Outcomes and comparison with other terracotta groups restored at the OPD

*Monica Galeotti*

**Lavori in corso al Museo d'Arte Antica di Milano. Le terrecotte rinascimentali: studi, scoperte e restauri** 92

Travaux en cours au Museo d'Arte Antica de Milan. Les terres cuites de la Renaissance : études, découvertes et restaurations

Work in progress at the Museo d'Arte Antica, Milan. Renaissance terracottas: studies, findings and restoration

*Laura Basso, Alessandro Barbieri, Paola Bosio, Marilena Anzani, Alfiero Rabbolini*

## IV · LA DIFFUSION DE L'ART D'ITALIE EN EUROPE

**The conservation of Giovanni da Maiano's terracotta roundels at Hampton Court Palace (2005-2012): A summary report** 103

La restauration des médaillons en terre cuite de Giovanni da Maiano conservés à Hampton Court (2005-2012). Compte rendu sommaire

*Kathryn Hallett, Kent Rawlinson, Zoe Roberts*

**Des Italiens en France : sculptures en terre cuite du Val de Loire** 110

Italians in France: terracotta sculptures from the Val de Loire

*Geneviève Bresc-Bautier*

**Polychromie des terres cuites françaises du Maine** 118

Polychromy of French terracottas from the Maine region

*Yannick Vandenberghe, Sandrine Pagès-Camagna, Nathalie Balcar*

**Bibliographie générale** 126

Simona Cristanetti

## The *Kress Madonna*: Revelations of an Extraordinary Sculpture

La *Madone Kress*. Les révélations d'une sculpture extraordinaire

**Abstract.** *The National Gallery of Art's early Renaissance Kress Madonna was the subject of a multi-year study carried out at the National Gallery encompassing the treatment and in-depth technical study of the terracotta sculpture. The project combined scientific, art historical and conservation aspects to address questions of manufacture, history and function. The investigation provided significant insight into the artist's working process, and revealed several important features hitherto unknown about this work's manufacture.*

**Keywords.** *National Gallery of Art, Kress Madonna, conservation, technical study, Renaissance, terracotta.*

**Résumé.** *La Madone Kress de la première Renaissance conservée à la National Gallery of Art de Washington a fait l'objet de plusieurs années d'études au sein du musée comprenant un examen scientifique approfondi de la sculpture en terre cuite. La démarche transversale, alliant les aspects techniques, scientifiques et historiques, a permis d'aborder les questions liées à la fabrication, l'histoire et la fonction de la Madone Kress. Les recherches ont fourni des informations importantes sur les méthodes de travail de l'artiste et révélé plusieurs particularités, ignorées jusqu'ici, concernant l'exécution de l'œuvre.*

**Mots-clés.** *National Gallery of Art, Madone Kress, restauration, examen scientifique, Renaissance, terre cuite.*

47

### Introduction

The National Gallery of Art's *Madonna and Child* (1943.4.93), known as the *Kress Madonna* (fig. 1), is regarded as one of the finest examples of terracotta sculpture from the Renaissance. This work is also one of the most enigmatic of the many sculptures of this genre created during the period. The hand modeling, the extensive gilding and punchwork, and the polychromy's fine details attest to the high caliber of the *Kress Madonna's* workmanship, while questions about its author, the presence of the rather unusual wooden backing, as well as the irregularity in the inscription<sup>1</sup> contribute to the intrigue surrounding this sculpture.

The *Kress Madonna* was the subject of a multi-year study carried out at the National Gallery in Washington, DC. The project encompassed the conservation treatment and an in-depth technical investigation comprising both scientific and art historical aspects to address questions of manufacture, history and function.

The primary goal of the technical study was to achieve a greater understanding of the sculpture by examining the materials, the methods and the techniques used by the artist

in the creation of this work. The identity of the artist has long been discussed and contested. Over the years, several prominent Renaissance artists have been suggested, including Lorenzo Ghiberti, Donatello, Michelozzo, Jacopo della Quercia and Luca della Robbia. It was hoped that identification of the materials used in the manufacture of the sculpture would contribute new information toward, and offer another approach to the question of attribution<sup>2</sup>.

### Analysis

A variety of imaging tools and analytical techniques was employed, including ultra violet illumination, infrared reflectography<sup>3</sup>, x-radiography, polarized light microscopy<sup>4</sup> (PLM), scanning electron microscopy<sup>5</sup> (SEM), gas chromatography / mass spectroscopy<sup>6</sup> (GC-MS), thermoluminescence dating, x-ray fluorescence (XRF), x-ray diffraction<sup>7</sup> (XRD) and Fourier transform infrared spectroscopy<sup>8</sup> (FT-IR). Each technique provided valuable information which has contributed to a more thorough knowledge of this work.

Simona Cristanetti, Project Conservator, University of Chicago (cristanetti@uchicago.edu).

II · Donatello



Fig. 1. (Front) *Madonna and Child*, NGA 1943.4.93, sometimes called the *Kress Madonna*. After treatment.  
© Courtesy of the National Gallery of Art, Washington, DC.

Thermoluminescence dating of a sample of the terracotta was performed in 2007 by Oxford Authentication Ltd., in Oxford (England). The analysis placed the last firing between 1400 and 1650<sup>9</sup>, thus confirming the proposed period of manufacture of the sculpture. XRD and SEM were

present over the earliest layers when viewed in cross-section. Pigment identification was carried out using PLM, XRF and SEM; the binders were identified using GC-MS. The blue on the interior of the Madonna's cloak and veil is composed of azurite with some particles of black, probably charcoal, in a gum tragacanth binder. The red on the underside of the Madonna's right sleeve is vermilion, while that on the figures' lips is a combination of vermilion and red lead. The flesh tones are composed of red lead, lead white and a few particles of carbon black, in an egg binder.



Fig. 1. (Reverse) *Madonna and Child*, NGA 1943.4.93, sometimes called the *Kress Madonna*. After treatment. © Courtesy of the National Gallery of Art, Washington, DC.

employed in the compositional analysis of the clay and ground. It was determined that the clay is composed mainly of quartz and aluminum oxide; these materials were also identified as the primary components of the clay through electron-beam microprobe analysis, carried out in 1998 by David Lange at Harvard University as part of a separate research project. SEM confirmed the other analyses and showed the terracotta to be a heterogeneous mixture with particles ranging in size from approximately 1-20 $\mu$ m.

The ground is composed of calcium sulfate anhydrite and dihydrate in a protein binder<sup>10</sup>. The sample of gilding seen in Figure 2, viewed in SEM, illustrates the use of *gesso grosso* and *gesso sottile*, a practice very much consistent with other works from this time, and one which is described in Cennino Cennini's late 14th c. treatise, *Il libro dell'arte*<sup>11</sup>.

Analysis of samples of gilding and polychromy not only provided information about their composition, but also revealed that no additional pigment or gilding layers were

Indeed, based on the analytical information presented so far, the sculpture appears similar to many polychrome terracotta sculptures produced during the Renaissance<sup>12</sup>. But perhaps the most important information to emerge from this investigation regards the presence of the wooden backing and its role in the construction of the sculpture. To date, no other sculpture created in the same manner has been identified.

The wood employed for the backing is poplar<sup>13</sup>, a wood which was readily available and was commonly used for panel paintings. The presence of gilding and polychromy on the edges of the wood, the same as that found on the terracotta relief, is evidence that the backing is original, and was not a later addition. Furthermore, we now know that the wooden backing was not added to remedy damage during firing, as had been suggested in the past, but that in fact it was conceived as an integral part of this sculpture.

### Manufacturing Technique

Using the information collected during the study, it was possible to ascertain a probable construction method for the sculpture, which was not previously understood, and which implies that the artist had a clear idea at the outset of the many steps involved.

As was common practice, the sculpture was probably built up and finished on a wooden support, probably with several pieces of paper between the clay and the board<sup>14</sup>. The paper acted as a separator, aiding in the removal of the sculpture from the board once the clay was leather-hard. Excess clay

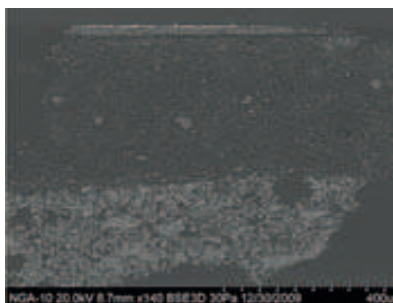


Fig. 2. Cross-section of gilding, seen in SEM. © Simona Cristanetti.

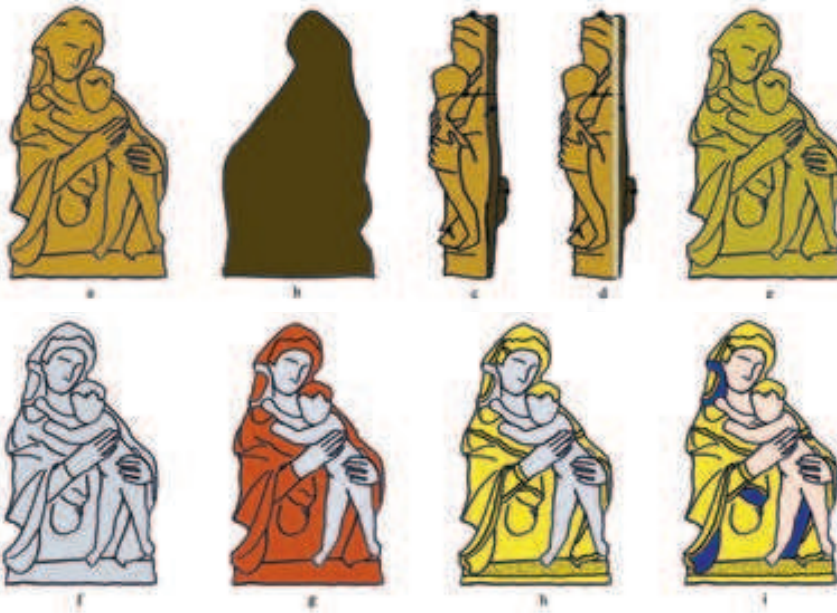


Fig. 3. Construction method of the *Kress Madonna*. Schematic by Simona Cristanetti.

50

was then removed from the reverse to minimize the possibility of cracking or breakage during firing. Tool marks and fingerprints are visible on the interior of the work through an opening in the wooden backing<sup>15</sup>. The overall thickness of the clay is difficult to measure due to the presence of the backing, but in one area the thickness can be measured at approximately 10mm. There is no evidence for the use of a mold, and in fact the depth of modeling and the marks on the interior indicate the sculpture was in all likelihood hand-modeled.

After firing, the terracotta and wooden backing were joined by means of several iron nails (fig. 3c). The rounded edges of the nail holes, visible from the reverse (fig. 4), indicate that the holes were made while the clay was still moist, when the piece was initially being formed. This critical detail establishes that the backing was part of the artist's fundamental conception of the work, and not an afterthought to rectify a firing mishap<sup>16</sup>.

Next, a linen strip was applied to cover the join between the wood and the terracotta (fig. 3d). Its presence here recalls the technique used for the construction of large panel paintings. Textile is also present in the *Kress Madonna* where a fold in the mantle at the Madonna's right shoulder meets the wooden panel. The fold is built up in cloth, extending it visually and physically onto the edge of the panel (fig. 5).

Glue size was applied (fig. 3e) to seal the porous surface of the terracotta before the application of the ground (fig. 3f). In at least two areas – on the veil at the top of the Madonna's forehead, and on the fold in the cloak in the lower proper right corner – the modeling of the clay was modified through the



Fig. 4. Nail hole, seen from the interior reverse of the sculpture. © Simona Cristanetti.





Fig. 5. Detail of the fold in the Madonna's mantle, where textile was used to continue the fold onto the edge of the wooden backing.  
© Simona Cristanetti.

addition of a *gesso* or plaster-like material. Though it is not clear at what point this modification was done, it certainly would have been after firing. There can be no doubt that this is an original change by the artist, as the layers above these additions are consistent with surrounding original material.

Areas to be gilded received a layer of red bole (fig. 3g) before the application of the gold leaf and the execution of the punchwork (fig. 3h). The polychromy was applied only after the gilding (fig. 3i). Evidence of this sequence was present at the sides of the Madonna's head, where small losses to the flesh color revealed gilding below.

The technical investigation also made possible the identification of materials added at a later date. In addition to allowing a more accurate interpretation of the work, the differentiation of newer materials from the original ones used in its manufacture served to inform many decisions during the conservation treatment.

### Treatment

Previous treatment campaigns were evidenced by the presence of fills and inpainting throughout, as well as of consolidant within some cracks. The aim of the conservation treatment carried out during 2007-2010 was to improve the appearance of the sculpture through cleaning as well as surface and structural repairs. This treatment consisted primarily of cleaning, consolidation of cracks and loose

polychromy and gilding, removal of unstable or uneven previous fills and inpainting areas of loss.

After vacuuming to remove loose surface dirt, testing with a variety of cleaning solutions was carried out on both gilded and painted areas to determine the best approach to removing the tenacious surface grime and darkened surface coating. The presence of the coating over an area of previous repair on the Madonna's head indicated that it was not original.

After testing and after consultation with other conservators in the Objects Conservation Department, cleaning proceeded using Surfonic® JL-80X<sup>17</sup> in deionized water, as well as with saliva, since the latter seemed to be somewhat more effective overall. Cotton swabs dampened with the solutions were rolled over the surface applying slight pressure. Cleaned areas were then cleared using deionized water on a swab.

As treatment continued, an additional solution consisting of equal parts deionized water, ethanol and acetone was tested. Because this solution was found to be as effective as the Surfonic® solution, with the additional advantage of not requiring clearing, treatment proceeded with the solvent solution.

Areas of lifting polychromy and gilding were consolidated using a dilute solution of Paraloid® B72<sup>18</sup>, fed by brush into the affected areas. Where planar distortion of lifted portions impeded good contact with the terracotta, the consolidant was bulked with glass microballoons and injected with a syringe into the affected areas. The glass microballoons served to create volume, ensuring adhesion between the two parts. Cracks which affected the structural stability of the sculpture were also consolidated with Paraloid® B72, both alone and bulked.

Most of the fills from previous treatments appeared to be composed of plaster, spackling compound or a similar material; many were uneven and higher than the surrounding original areas. Furthermore, it was noted that portions of some fills covered extant original surface and it was therefore decided to remove these. Removal of the old fills proceeded mechanically using a scalpel under magnification. The wax fills in the gilding were retained, however, as their removal would have threatened the stability of adjacent original areas.

In consultation with conservators and sculpture curators, the decision was reached to leave most areas of exposed terracotta visible, rather than filling these losses to the paint and ground layers, as such losses do not detract from a viewer's overall appreciation of the work, and are indicative of the sculpture's age and condition history. Areas where there was loss to the polychromy and gilding but the ground was extant were inpainted using fluid acrylic colors over a barrier coat of Paraloid® B72. After testing different inpainting strategies, the technique of *rigatino* was chosen, as it allowed



*Fig. 6.* Detail of Child's head, on left, before loss compensation, on right, after loss compensation. © Simona Cristanetti.

the most control in simulating the original surface. Using this technique, individual fine lines ranging from 2-5 mm in length were painted in the area to be filled, taking care that the lines did not bleed into each other. One to three colors, either mixed or pure, were applied in multiple layers until they blended visually to create the desired tonal and textural effect (fig. 6 and 8).

### New Findings

An intriguing feature became apparent during the treatment of the sculpture, adding to the questions surrounding this work. After the heavy layer of dirt was carefully removed from the painted surface, a series of fine lines was revealed in certain areas of the flesh tones. Initially appearing to be abrasion, when viewed with a binocular microscope it became clear that these lines in fact are painted on the surface.

The lines are clearly evident on the interior of the Child's left leg (fig. 7), and upon close examination are visible also in other areas, such as the underside of the Madonna's right hand and the Child's back and shoulders. All of the lines are painted as single, dark, parallel strokes, and are only present in the flesh-toned portions. The placement of the lines suggests shading, and seems aimed at accentuating the three-dimensionality of the figures, similar to the way that hatch marks create depth in a two-dimensional representation such as a print or painting. This feature might prove to be an important clue to identify the artist or workshop if other polychrome terracotta sculpture with similar marks and a firm attribution can be identified.



*Fig. 7.* Fine lines painted on the surface of the sculpture, perhaps to enhance the three-dimensionality of the work. © Simona Cristanetti.



Fig. 8. From left to right, before, during, and after treatment. © Courtesy of the National Gallery of Art, Washington, DC.

## Conclusion

Through a combination of conservation treatment, visual observation, art historical investigation and scientific analysis, the project provided insight into the artist's working process, and allowed for the discovery of several important features heretofore unknown about the *Kress Madonna*'s manufacture. Yet other questions still remain, for example: "What was the reason for including the wooden backing? Where was the sculpture originally located?" and of course, "Who conceived and created such an extraordinary work?" It is hoped that through the information presented here some of these questions may be answered in the not too distant future.

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## Notes

1. For information regarding the inscription, please refer to Cristanetti 2010, pp. 224-225.
2. See Bode, 1928, pp. 61-70 and Seymour, 1949, p. 174 for Lorenzo Ghiberti; Gentilini, personal correspondence 24.05.2008 for Donatello; Krautheimer, 1936, pp. 5-8 for Jacopo della Quercia; Planiscig, 1930, p. 82 for Nanni di Bartolo; del Bravo, 1970, pp. 74-75 and Natali, 1974, pp. 61-67 for Antonio Federighi. The more reserved attribution of "Florentine" has also been proposed by Pope-Hennessy, 1955, pp. 215-216 and Middeldorf, 1976, pp. 13-14.
3. With the assistance of J. Klaar Walker, Leisher Fellow, NGA, and P. Ricciardi, Samuel H. Kress Fellow, Scientific Research Department, NGA.
4. With the guidance of Barbara Berrie, Senior Conservation Scientist, and Michael

Palmer, Conservation Scientist, Department of Scientific Research, NGA.

5. With the assistance of Palmer.
6. Carried out by Christopher Maines, Conservation Scientist, Department of Scientific Research, NGA.
7. Janet Douglass, Conservation Scientist, Freer Gallery of Art (2008), and Palmer, NGA (2010).
8. Suzanne Lomax, Organic Chemist, NGA.
9. Stoneham, Analysis Report, 22 June 2007.
10. Protein was detected when samples were stained with Amido black III, then II, solutions. Solutions were prepared by Palmer, NGA, based on recipes by Elizabeth Marten.
11. Cennini, 1971 [c. 1390], chapters 15-18.
12. See for example, the discussions on the *Madonna della Mela*, Giusti and

Venticonti, 1986, pp. 87-90, and the *Madonna di Fiesole*, in Speranza and Moradei, 2008.

13. Identification was carried out using PLM by M. Palmer, NGA.
14. Rees-Jones, 1978, p. 99.
15. This opening is not original to the sculpture; it was made in the 1970s to gain access to the reverse. This was not done by any current member of the Objects Conservation Lab.
16. Cristanetti, 2010, pp. 222-223.
17. Surfonic JL-80X is a fluid, water-soluble, biodegradable, nonionic surfactant manufactured by Huntsman Corporation, The Woodlands, TX.
18. Paraloid® B-72 is a clear, colorless, thermoplastic acrylic resin composed of an ethyl methacrylate and methyl acrylate copolymer manufactured by Rohm & Haas.

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