

Madonna and Child with Four Saints

Goodhart Ducciesque Master, 1310–20

Egg tempera on cradled wood panel

Central panel 30 × 19 1/2 in. (76.2 × 49.5 cm);

side panels, each 24 1/8 × 13 5/8 in. (61.3 × 34.6 cm)

Birmingham Museum of Art, Birmingham, Alabama

61.104 (K-592)



FIG. 1. *Madonna and Child with Four Saints*, before cleaning and restoration.



FIG. 2. *Madonna and Child with Four Saints* (fig. 1), after cleaning and restoration.

A New Leaf: Recent Technical Discoveries in the Goodhart Ducciesque Master's *Madonna and Child with Four Saints*

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THIS STUDY FOCUSES ON A Trecento five-panel polyptych, *Madonna and Child with Four Saints* by the Goodhart Ducciesque Master, an accomplished follower of the Trecento Sienese artist Duccio, whose unique hand has been recognized in a small corpus of works (figs. 1 and 2). Technical study of this altarpiece from the collection of the Birmingham Museum of Art enabled us to learn new information about its original appearance, the decorative gilding materials and techniques utilized, and to discover more about its conservation history.

Richard Offner identified this anonymous Sienese master and named him for a *Madonna and Child* then in the collection of Mr. and Mrs. A.E. Goodhart of New York.¹ That panel, bequeathed to Robert Lehman, became a part of Lehman's bequest to the Metropolitan Museum of Art (1975.1.24). The Goodhart Master was active from around 1310 to 1330. This painter has not been linked directly through any specific evidence to Duccio or his workshop, but judging from stylistic and iconographic considerations, his work is strongly influenced by the precedents established by the great Sienese master. Other important Sienese artists who influenced him are cited in the literature on the Goodhart Master and include Ugolino da Siena, Segna Bonaventura, and Simone Martini.² It would appear that the Goodhart Master worked in and around Siena, and was commissioned to provide paintings for some of its provincial environs.³ From the limited number of extant works attributed to this artist, it is clear that he excelled when working on a small scale; most of

his surviving paintings are panels from diptychs or other small portable devotional objects. The Goodhart Master delighted in the finer details of these miniature paintings, and there is a tender reverence and naturalistic charm that comes across in the smaller scale that is somewhat lacking in his larger works. The Birmingham altarpiece is the largest commission convincingly attributed to the Goodhart Master.⁴ Although there are many charming elements in the Birmingham polyptych, as well as some extraordinary details, there is a general stiffness in the figures in the larger scale that is absent in his more diminutive paintings. Despite this minor shortcoming, the Birmingham altarpiece is regarded as one of the most accomplished (as well as ambitious) examples of the Goodhart Master's production.

The known provenance of the polyptych is rather scant and relatively recent. F. Mason Perkins notes that it had "long remained, comparatively unheeded, in the seclusion of an ancient Tuscan villa."⁵ Samuel H. Kress acquired the altarpiece in 1941 from Count Alessandro Contini-Bonacossi in Florence, and in 1952 the Kress Foundation gave it to the Birmingham Museum of Art in Alabama.

The altarpiece is comprised of five panels with semicircular arched tops. The central panel depicting a half-length Madonna and Child is taller and wider than the four flanking panels. This format, which may have included triangular gables above each panel, was established in the first decade of the Trecento.⁶ From left to right, the side panels represent an unidentified bishop saint, Saint John the Baptist, the Archangel Michael, and a saint tentatively identified as Dionysius the Areopagite. The frame dates to the twentieth century.

Each of the five panels was made from a single plank, presumably of poplar; no joins are evident in any of the panels. Numerous irregularities in the wood grain of the panels have resulted in chronic flaking of the gesso and paint layers in localized areas. Thin wood strips have been applied all around each panel, obscuring the original edges. The panels were thinned and cradled sometime

around 1941,⁷ so no technical information can be gleaned by examining the backs. However, there are X-radiographs in the Kress Archives that were taken prior to the thinning and cradling.⁸ The report notes that "plaster" had been applied to the backs of all the panels, and that the X-radiographs reveal more about the plaster than the planks themselves. It is clear that the *Madonna and Child* panel had suffered from considerable worm tunneling, and the damage subsequently filled with this "plaster." Dowel holes used to align the panels are evident in the early "shadowgraphs," linking the bishop saint to Saint John, and the Archangel Michael to Dionysius, confirming the correct sequence of the panels. Although dowel holes are evident in the adjacent sides of the two saints flanking the Madonna, no dowel holes can be seen in the "shadowgraph" of the Madonna panel. X-radiographs taken by the author in 1994 (well after the panels had been thinned) do not reveal any evidence of the doweling. A faint pattern discernible in the recent X-radiographs confirms that all of the panels were covered with fabric prior to application of the ground layer.

The gesso preparation is fairly thick, as is typical for tempera panels of the period. In the X-radiographs it is clear the panels had many knots and other irregularities in the wood grain which were subsequently filled with gesso to provide a smooth surface. In spite of this preparation, some areas remained problematic, and gesso and paint losses (subsequently filled) and several consolidation campaigns were evident in these locations.

The backgrounds of the panels were water gilded, and the haloes of the saints were punched and tooled. Although the thick, discolored varnish obscured the gold grounds to some degree, it was apparent that some of the cracks in the gesso beneath the leaf were quite old, and that many of these cracks extended into the original paint layer and were, thus, original. Numerous localized campaigns of repair and regilding of the plain gold backgrounds were evident (fig. 3). The areas of regilding are particularly obvious at the joins where the wood strips had been added to the edges of the panels. The punched and tooled



FIG. 3. *Madonna and Child with Four Saints* (fig. 1), Bishop Saint, detail of gold ground and tooled halo, before restoration.



FIG. 4. *Madonna and Child with Four Saints* (fig. 1), detail of Madonna's and Christ Child's heads with surrounding gilding, after cleaning.

haloes appeared to be in remarkably good condition, the tooling crisp and well preserved, with only a few minor exceptions. In some areas within the haloes the gilding was a bit abraded, exposing the underlying red bole.

The egg tempera paint layer was built up in the traditional manner of the period. Local areas of color were applied in thin layers consisting of fine, hatched strokes. In general, each area of color was kept fairly pure, with variations in modeling for the lighter tones being achieved by the addition of lead white to the local color, and shadow by either the absence of white and/or with deeper, transparent glazes of local color. A green *verdaccio* was applied as a base color for the flesh tones. The flesh tones applied on top of the *verdaccio* are a mixture of yellow ochre, vermilion and lead white. The brushwork is delicate and fine, and the transitions between dark and light are soft and smoothly rendered.

With the exception of some areas of localized loss, the paint layers of the five panels are in a remarkably good state. The subtle modeling of the flesh tones has survived almost intact with little abrasion. In addition, some of the finest brushwork, such as the delicate whiskers of Dionysius's beard, remain beautifully preserved and are a testament to the Goodhart Master's refined sensibility, as well as his miniaturistic predilections.

Despite the overall good state, there is consistent paint loss along the contours of the painted image where the paint had been applied on top of the metallic ground. A later, clumsy restoration extended beyond the original contours and over the edges of the metal leaf ground, enlarging the silhouette of each figure (fig. 4). Another significant type of paint loss corresponds to irregularities in the poplar planks, evident both as linear losses related to irregular wood grain and larger, broader losses related to knots. A third type of paint/ground loss is noted in patches along the bottom of each panel; these appear to be from some sort of water damage.

There was much decorative gilding applied to the painted draperies and attributes of the saints,

some consisting of a yellow metal leaf, some of a white metal leaf, and some appearing to be a combination (perhaps an alloy) of yellow and white metal leaf. We observed that some of the brighter yellow and white metallic mordant leaf gilding appeared to be a later restoration. These additions were found on the medallion and border of the bishop saint's cope (fig. 5), as well as his miter, and on the archangel's sword and brooch (figs. 6 and 7). All of these overgilded areas had a distinctive thickness and texture as well as a slightly gaudier appearance that distinguished them from the more subtle original mordant gilding. (For comparison, note the border of the bishop saint's mantle along the right edge of the panel. This is the only remaining area of the original unrestored mordant gilding on this panel.) The handling is less refined in these areas of overgilding, and there is a rather crude attempt at incising pattern into the leaf in the restored areas that is not observed on the original mordant gilding. This campaign of restoration is distinguished

from a later stage of restoration in which shell gold (powdered gold in an aqueous medium) is used in lieu of metal leaf. Shell gold is obvious in these passages, as the individual particles of the ground gold are visible under the microscope. The areas from this more recent campaign include the star on the mantle of the Madonna's proper right shoulder, the cuff of her sleeve and the top of the mantle's border directly above it, as well as on some abraded areas of the lining of her mantle below her neck. The gold quatrefoils of the bishop saint's cope were also reinforced with shell gold.

Originally the decorative leaf consisted of a mordant gilt metal leaf with a tone somewhere between gold and silver, and toned or glazed with translucent pigments to enrich its effect (fig. 8). A sample of this leaf was analyzed with scanning electron microscopy—energy dispersive spectrometry (SEM/EDS).⁹ The results confirmed that the material contained both gold and silver, with a proportionately higher amount of silver. Examination by SEM revealed that the leaf was a



FIG. 5. *Madonna and Child with Four Saints* (fig. 1), detail of later restoration of incised and glazed mordant gilding on the clasp on the bishop saint's cope; note the use of white metal leaf.

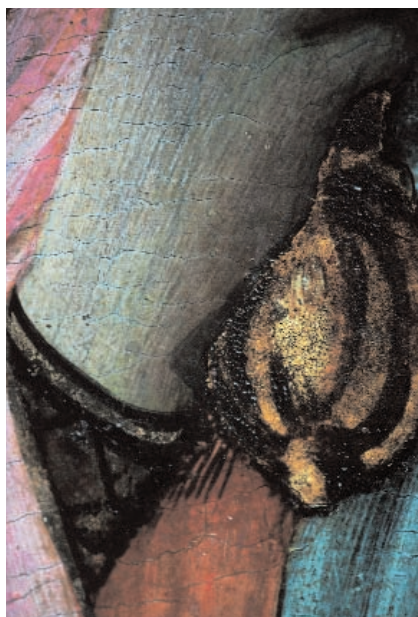


FIG. 6. *Madonna and Child with Four Saints* (fig. 1), detail of the archangel's hand holding sword; compare the original mordant gilding on the cuff with the clumsy, thick regilding on the sword handle; note also the pentimento left from the tarnished *zwischengold* on the archangel's hand.



FIG. 7. *Madonna and Child with Four Saints* (fig. 1), detail of the archangel's proper right hand with crude regilding of sword elements; note the use of a white metal for the sword blade and yellow gold for the hilt.



FIG. 8. *Madonna and Child with Four Saints* (fig. 1), detail of well-preserved *zwischgold* from the archangel's diadem.

laminate comprised of a thicker silver substrate, upon which a very thin layer of gold had been applied. This material is what was commonly referred to in Northern artists' treatises as *zwischgold*, or, in Italy as *oro di metà* (fig. 9). This laminate leaf is distinctive in its appearance, being neither bright gold, nor cool silver, but a rich, understated bronzy tone. It should be noted, however, that the tarnishing of the silver component undoubtedly has contributed to the overall darkening of this leaf; when newly applied, the *oro di metà* would have been closer in appearance to gold leaf.

Traditionally, *oro di metà* was used as an economical alternative to gold leaf.¹⁰ It is mentioned in treatises in three basic forms: one using thin gold leaf hammered into the silver substrate; another in which a mordant of some sort was used to bind the two layers together; and a third that uses a mordant between the two layers, which are then hammered together. The terms *zwischgold* or *oro di metà* appear to be used interchangeably to describe any of these techniques. It was not determined which method was used for the *oro di metà* on the Goodhart Master polyptych.

Each of the panels has a gold ground, with a tooled halo decorated with a simple circular punch. The gold grounds have undergone numerous campaigns of repair and regilding. The many repairs and patches are easily identified by their different metallic sheens and in some cases colors,

as well as by the interruptions of the old craquelure where losses to the gesso had been filled. In many areas the gilding lying over the old gesso cracks appears to have been patched with an additional layer of gold leaf, perhaps at a later time, with characteristic streaks left by the burnisher as the leaf was rubbed over an already-compressed gesso preparation.

The gilded and tooled haloes, demonstrating typical Trecento Siense craftsmanship and design, appeared to be in a remarkably good state in comparison to the general condition of the gold grounds. Clearly there were some minor repairs and abrasion in the haloes, but overall, they appeared to be beautifully preserved, with crisp definition in the incised patterns.

Microscopic examination of the gold grounds of all five panels revealed several minute metal leaf fragments that appeared to be silver. Most were located along contours of the painted images. Some were completely blackened, and others had the brownish cast of partially tarnished silver (silver sulfide) (fig. 10). When scratched, white



FIG. 9. *Madonna and Child with Four Saints* (fig. 1), cross-section (200×) of *zwischgold* from the decorated border of the Madonna's mantle.



FIG. 10. *Madonna and Child with Four Saints* (fig. 1), cross-section (200×) from central panel showing the silver ground along the left edge of the mantle below the shoulder; note the restored gold layer directly on top of silver leaf.

metal leaf was exposed on these fragments. We wondered whether these whitish metallic fragments noted throughout each panel were stray bits of some of the decorative gilding from the garments and attributes of the saints, or whether, at some point, the panels could have had a white metal background. During cleaning more silvery fragments were noted (fig. 11), especially along the contours of the figures, underneath old restoration. Further examination with the stereobinocular microscope enabled us to find more silver fragments hidden beneath old restoration and gilded repairs. Elemental analysis (SEM/EDS) of a few samples located in representative areas confirmed that these fragments were indeed silver.¹¹ It gradually became evident that the “gold grounds” that we now see had originally been silver.



FIG. 11. *Madonna and Child with Four Saints* (fig. 1), detail of blackened silver fragments from silver ground after cleaning (from bottom left corner of Saint John the Baptist).

If silver grounds were part of the artist's original conception, the polyptych takes on a whole new aspect. It seems to me that the artist's palette was clearly designed to complement the cooler, more subtle silver background. If we envision the altarpiece with a more subdued silver ground, rather than the brighter, brassier yellow-gold ground, combined with the rich, subtle contrast in metallic tone with the mordant-gilt *zwischen*gold decorative elements, we can appreciate what a brilliant colorist the Goodhart Master was (fig. 12). The cool silver ground set against the rich interplays of gradations of warm and cool tempera color, coupled with the subtle subdued tones of the *oro di metà* must have created a stunningly harmonious and sublime effect. And what a glorious impression the whole ensemble would have made when it first left the artist's studio, before oxidation began to alter the tone of the silver.

Silver leaf is mentioned in medieval artists' treatises, but usually with a caveat about the tarnishing and blackening of silver that inevitably spoils the splendid effect of the painting set against a precious metal background. While silver grounds for panel paintings are known to exist, they are somewhat rare (see Appendix). However, silver leaf is frequently used in Sienese painting for decorative purposes on spandrels and framing elements, as well as for specific details within the painted composition. The incorporation of combinations of precious metals, often glazed with translucent pigments to simulate enamel or to create other effects, is an important feature of Sienese painting. The aesthetic of the Sienese School is characterized by elegance, sinuous line, jewel-like color, rich patterning, and skillful manipulation of precious materials.

There are several reasons why silver-ground paintings are rarely encountered: first, the tarnishing of the silver detracts from the magnificent effect of the painting against a precious metal ground. It is important to note, however, that more silver-ground paintings may have been created than the small number remaining extant would lead us to believe. Easily darkened, even disfigured, by exposure to sulfur in the atmosphere,



FIG. 12. *Madonna and Child with Four Saints* (fig. 1), digitally re-colored with silver ground.

silver grounds most probably would have been rubbed down and gilded with the non-tarnishing yellow gold leaf. The second reason is that gold is a more precious metal and thus regarded as a more suitable material for use in sacred works. Inherent in the preciousness of gold is its cost, so commissions of a more humble economic origin often stipulate the use of silver as an alternative to the more costly gold leaf. However, at any time after the altarpiece was finished, a parish might have raised funds to replace the tarnished silver ground with the more precious gold. Finally, in the early twentieth century, when collecting Italian primitives became fashionable, dealers routinely replaced or camouflaged the damaged silver and gold backgrounds, sometimes with paint, but usually with gold, often clumsily applied.

After considering that these panels originally had silver grounds, we were forced to confront the issue of the “remarkably well-preserved” punched and tooled haloes, executed in gold leaf. While the punched and tooled haloes appeared to be well preserved and their motifs stylistically in keeping with other Sienese works of the period, we were unable to explain why the tiny crack pattern in the original gesso, present in the rest of the background, disappeared in the areas circumscribed by the incised outline. The transition

between the background and the haloes was seamless and the tooling had clearly been done after the gold leaf had been applied and burnished. The absence of cracks in the gesso within the contours of the haloes made them suspect. Ultimately, after much examination under the binocular microscope and consultation with Mario Modestini, we postulated that, in the areas of the haloes, the original gesso had been carved out and replaced with a fresh preparation that would allow the gold to be burnished and tooled. This new gesso was made perfectly level with the rest of the background and then, over this hybrid ground, new bole and leaf were applied. After burnishing, the new haloes were incised and punched in the manner of a Ducciesque Trecento artisan; the leaf applied to the freshly gessoed preparation took on an even, mirror-like burnish, unlike the surrounding gilded areas which were streaky. The restorer might have copied the original haloes although there are numerous contemporary examples that might have served as patterns.

The question still remained as to how the oldest cracks in the background, which continued into the paint layer and seemed to be in the gesso preparation, would still be present if the original silver grounds had been subsequently gilded with yellow gold. After studying the yellow gold

grounds of each panel it appeared that the present gold leaf was applied to the original gesso and successfully burnished in a masterful, if inexplicable, way. The jagged edges of the contours of the figures bore witness to the removal by scraping of the tarnished silver and underlying bole. Gradually we formed a hypothesis to account for the technical evidence: the original gesso grounds, after the silver and bole had been scraped off, had been smoothed down, followed possibly by the application of a thin layer of new gesso and bole before regilding. After drying, the underlying craquelure reasserted itself. The burnisher, as noted earlier, had left streaky marks because the underlying gesso preparation had already been compacted by the burnishing of the original silver ground. These marks were noted in all areas where the gesso appeared to be original.

The procedure described above to create a new gold background is extremely difficult to execute with convincing results because even the slightest surface variation is magnified during the gilding process. It would take an extremely skilled technician to accomplish such a feat and we tried to understand when and where this skillfully deceptive regilding had been done. A number of gifted and knowledgeable restorers and artisans working in Italy toward the end of the nineteenth century and into the first half of the twentieth had great success replicating early Italian painting and gilding techniques for use in restoration and in the creation of complete paintings “in the antique style.” The most famous of this group is Icilio Federico Ioni (also spelled Joni).

Ioni, who was born in Siena in 1866 and lived there for his entire life, first learned gilding and painting techniques at the hand of his uncle, Giovacchino Corsi, whose important workshop in Siena produced antique-style frames, tabernacles and other decorative works. Ioni quickly mastered gilding techniques, and his precocious drawing talents soon led him to study tempera painting technique. These skills enabled him to produce copies of paintings from the Pinacoteca Nazionale di Siena, as well as concoctions for the art market. His mastery and knowledge of



FIG. 13. *Virgin and Child*, Ambrogio Lorenzetti, late 1330s–early 1340s, tempera on wood panel, 29 ³/₄ × 17 ⁷/₈ in. (75.5 × 45.4 cm). Museum of Fine Arts, Boston, MA. In its present state.



FIG. 14. *Virgin and Child* (fig. 13), as restored by Icilio Federico Ioni.

traditional painting techniques attracted the attention of many prominent collectors, scholars, and dealers specializing in early Italian painting. In his autobiography, Ioni describes numerous examples of battered early Italian paintings he was commissioned to restore. Along with the legitimate restorations, many of his “antique-style” paintings ended up on the international art market. During the last half of the twentieth century, Ioni’s paintings were identified in collections of many prominent museums in Europe and the United States.

Some of Ioni’s activities have been identified with individual paintings, forgeries, and so-called *quadri antichi*. Both Frinta and Skaug have connected several paintings with Ioni, based on evidence found through examination of the punchwork. Kanter, Pope-Hennessy and Mazzoni have documented numerous examples of Ioni’s production, both original works in the “antique style” and restorations.

The Boston Museum of Fine Arts’ *Virgin and Child* by Ambrogio Lorenzetti (39.536) was restored by Ioni (fig. 13). Kanter states that photographs of the painting after its early nineteenth-century restoration document its state prior to Ioni’s restoration, and he published a photograph of the painting after Ioni’s restoration when it was acquired by Daniel Platt (fig. 14).¹² The photographs make it possible to compare the various states of the painting and to gain an understanding of Ioni’s approach toward restoration and to appreciate his considerable skill. In the nineteenth century this picture had a rectangular contour and punched borders in its regilt ground.¹³ Ioni removed the old retouching and regilding and altered the shape of the panel by adding a curiously conceived steep gable set within a pointed arch. He then regessoed and regilded the background, leaving the original punched and tooled haloes intact, and added an elaborate foliate incised design in the narrow areas between the outside of the steep gable and the created contour of the panel. The paint layer was restored with a fairly liberal hand, reinforcing the facial features of the figures with a linear emphasis. From this

example, we can see that Ioni freely altered dimensions and shapes of paintings so that they would appear less like fragments of a mutilated altarpiece and more like whole works in their own right. He was confident enough of his own skill to remove all of the regilding surrounding the tooled haloes and regesso and regild right up to the edges of the original *nimbi*, with extremely successful and convincing results.

Ioni’s hand has been identified in the restoration of the Metropolitan Museum of Art’s poorly preserved Blumenthal *Madonna and Child*, given to Ambrogio Lorenzetti (41.190.26) (fig. 15). In this case only a fragment of the original punched and



FIG. 15. *Madonna and Child*, Ambrogio Lorenzetti (the Blumenthal Madonna), tempera on wood panel, 37 × 22 1/8 in. (94 × 56.2 cm), The Metropolitan Museum of Art, New York, NY.

tooled haloes survives, located between the heads of the two figures. The rest of the gold ground has been entirely regessoed and regilded. Here again, we see how Ioni's bravado in applying new gesso and leaf up to the fragmentary remains of old tooled gilding met with considerable success. Ioni provided the "missing" tooled decoration on the rest of the haloes and borders in a manner consistent with other examples of Ambrogio's production. In the case of the punch noted in the restored portion of the Christ Child's halo, Ioni actually recreated a punch design based on the Ambrogio *Madonna and Child* from the Pinacoteca Nazionale in Siena (no. 605).¹⁴



FIG. 16. *Madonna and Child with Two Angels, Saint Francis, and Saint Louis of Toulouse*, Paolo di Giovanni Fei, ca. 1375, tempera and silver gilding on cradled wood panel, 70¹/₈ × 50⁵/₈ in. (178.2 × 128.6 cm). High Museum of Art, Atlanta, GA.

Another example of Ioni's restoration work can be found in the *Madonna and Child with Two Angels, Saint Francis, and Saint Louis of Toulouse* by Paolo di Giovanni Fei in the collection of the High Museum in Atlanta (fig. 16). The halo of the angel on the left was restored. Frinta claims that the design of the modern punch used to form the "formal cluster" in the restored halo is based on the design of the original punch used in the better-preserved areas of tooled gilding from the same painting. He identified this particular punch in several paintings documented as having been restored by Ioni, concluding that Ioni restored the Atlanta painting. In this panel, it is evident that Ioni has gone to the effort of manufacturing a tool that imitates the surviving distinctive original punchwork, a telling indication of his skill and initiative.

After examining some of the work known to have been executed or extensively restored by Ioni, it is not unreasonable to suggest that he, or someone in his circle of talented artisans, could have restored the gold-ground haloes of the Birmingham altarpiece. Mario Modestini, who visited Ioni in his studio and saw many of his productions first-hand, holds the opinion that the tooled haloes may, indeed, have been executed by this clever restorer and artist.¹⁵ Coming across the anomalous "clues" during the early phase of treatment forced us to stop periodically and hypothesize about what the significance of these bits of evidence might be. Ultimately we came to understand that the color of the gilded background of the polyptych had been radically changed, and that the haloes were masterfully regilded, punched and incised, sometime in the early twentieth century by a bold and skillful restorer. These conclusions added a fascinating and unexpected dimension to the restoration of this altarpiece. It is hoped that future discoveries of this type—finding evidence of silver grounds, or examples of individual restorers making significant changes to a work of art—will be published and shared with the conservation community.

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NOTES

1. The name was coined by R. Offner, the first scholar to isolate and identify paintings by this Sieneese master (see Wehle 1940, p. 71).
2. For a review of literature on the Goodhart Ducciesque Master and works attributed to him, see Zeri (1980), Kanter (1994), Coor-Achenbach (1955), Shapley (1966), Pope-Hennessy (1987) and Stubblebine (1979).
3. Stubblebine (1979), Vol. 1, p. 106.
4. The altarpiece at Monterongriffoli has been given to the Goodhart Master by Coor-Achenbach (1955), pp. 163–4 and Stubblebine (1979), pp. 109–10. Suida (1959, p. 11) also cites this polyptych. Kanter (1994, p. 81) convincingly argues that although there are similarities between the Birmingham and Monterongriffoli altarpieces, the latter is “clearly dependent in style on the Goodhart Ducciesque Master.”
5. (Undated) manuscript opinion of Perkins on reverse of photograph of κ-592, Kress Foundation Archives.
6. See, for example, Duccio's Polyptych No. 28, Siena Pinacoteca Nazionale. Maginnis (2001), p. 104.
7. Condition and Restoration Record, κ-592, Kress Foundation Archives.
8. X-ray “shadowgraphs” and report, Alan Burroughs n.d., κ-592, *ibid.*
9. My thanks to Christopher McGlinchey, now scientist at the Museum of Modern Art and to Mark Wypyski of the Metropolitan Museum of Art, both of whom were at the Metropolitan when they assisted in carrying out the analysis.
10. Skaug (1994), Vol. 1, p. 57, and Theophilus (1979), p. 156.
11. My thanks, again, to Mark Wypyski and Christopher McGlinchey for the analysis carried out at the Metropolitan Museum of Art.
12. Kanter (1994), p. 90.
13. *Ibid.*, p. 90.
14. Frinta (1978), pp. 7–10.
15. Personal communications with M. Modestini throughout the course of treatment of the polyptych.

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APPENDIX: PANEL PAINTINGS WITH SILVER GROUNDS

This list is hardly exhaustive, and it would be worthwhile to identify other examples in an attempt to understand whether in some cases the motive for using silver instead of gold was aesthetic rather than purely economical as is usually supposed. Future technical study and conservation treatments of gold-ground panels may bring to light more pictures that originally bore silver grounds.

- Goodhart Ducciesque Master, *Madonna and Child with Four Saints* (κ-592), Birmingham Museum of Art, Birmingham, Alabama (61.104). See Shapley (1966), p. 18.
- Master of the Grosseto Madonna, *Madonna and Child with Saint Peter and Saint John the Baptist* (κ-577), Museo de Arte de Ponce, Ponce, Puerto Rico (62.0255). See Shapley (1966), p. 15.
- Niccolò di Segna (?), *Young Male Saint*, art market, whereabouts unknown. Not seen by the author, but by Mario and Dianne Dwyer Modestini and, according to them, identified by Everett Fahy as one panel of a polyptych, part of which remains in Montalcino.
- Paolo di Giovanni Fei, *Madonna and Child with Two Angels, Saint Francis, and Saint Louis of Toulouse* (κ-187), High Museum of Art, Atlanta, GA (58.42). See fig. 16 of this paper.
- Pietro Lorenzetti, *Madonna and Child*, Pieve dei SS. Stefano e Degna, Castiglione d'Orcia (Siena). See *Mostra di Opere d'Arte Restaurate nelle Province di Siena e Grosseto*. Genoa: Sagep Editrice (1979), pp. 49–51.
- Bernardo Daddi, *The Nativity and the Annunciation to the Shepherds*, Museum of Fine Arts, Boston. See Kanter (1994), pp. 54–7.
- Florentine School (Giovanni Bonsi?), *Saint Onufrius*, Acton Collection, Villa La Pietra, Florence.
- Sano di Pietro, *Madonna and Child*, Acton Collection, Villa La Pietra, Florence.
- Workshop of Ugolino da Siena (Olena Master?), *Madonna and Child with St. Peter and St. John the Evangelist*, Olena, near Barberino in Chianti, San Pietro. See Stubblebine (1979), Vol. 1, p. 91.

PHOTOGRAPHY CREDITS

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