

The Treatment and Technical Study of a Painted Crucifixion by Lorenzo di Bicci



Kristin Robinson

The Conservation Center, Institute of Fine Arts, New York University

Abstract

The technical examination of a gold ground Crucifixion from the workshop of Lorenzo di Bicci brings into focus several aspects and problems surrounding the study of workshop practice in Florence during the late trecento and early quattrocento. The examination of the panel before and after the removal of discolored varnish and overpaint revealed several interesting features. The cross, which had been repainted brown, was originally bright blue, prompting further research into the history, origin, and examples of blue crosses during this period. The painting technique of the angels is different from the Christ figure, allowing insight to the division of labor within the workshop, and along with the inscription, possibly implies the employment of manuscript illuminator. The deciphering and reconstruction of the nearly illegible inscription reveals the absence of two words, which, in conjunction with the configuration of the joins, allows us to hypothesize about the original size, shape, and function of the tondo. This study also deals with the construction and original appearance of this Crucifixion, in the context of the creation and subsequent dismemberment of complex altarpieces, and the making and meaning of religious panel paintings in Florence during this period.



Introduction

A late trecento gold-ground Crucifixion by Lorenzo di Bicci (figure 1) entered the Kress Collection in 1936 and is owned by the Allentown Art Museum in Pennsylvania. The painting was selected for conservation primarily because discolored varnish and retouching obscured the clarity and tone of the egg tempera paint as well as the brilliance of the gold ground.



Figure 1 Lorenzo di Bicci, Crucifixion, c. 1400, Allentown, 43 cm x 1 1/4 cm. Before treatment

The aim of the conservation treatment was to bring the painting closer to its original aesthetic, but in order to do so a number of challenging decisions had to be made regarding the removal of old overpaint and the extent to which the painting should be restored. The examination and treatment provided a deeper understanding of the painting's historical context, and several interesting features worthy of further investigation were revealed. These include the discovery of different paint handling techniques used to create the Christ figure and the angels, as well as the original color of the heavily overpainted cross and the deciphering of a nearly illegible inscription, which brought into question the original format of the panel.

Though biographical data on Lorenzo di Bicci is limited, he is known to have owned a workshop in Florence from the last quarter of the 14th century until his death, presumably during the second decade of the 15th century. His workshop prospered for over a century as it passed through the hands of his son Bicci di Lorenzo and his grandson, Neri di Bicci. His style remained highly traditional throughout his career, with a focus on simple compositional structures and pure, luminous colors, and shows the influence of Taddeo Gaddi, Andrea di Cione, called Orcagna, Jacopo di Cione, and Niccolo di Pietro Gerini.¹

Fern Rusk Shapley's catalogue of the Kress Collection dates the Allentown Crucifixion to c. 1400, due to its similarities with his Crucifixion in the Museo della Collegiata di Sant'Andrea in Empoli, for which Lorenzo received payment in 1399.²

The Christ figure and angels in the Allentown Crucifixion are compositionally very similar to the Empoli panel and are painted in the same delicate manner. Stylistic similarities are also seen in the Christ figure of a large Crucifix by Lorenzo di Bicci at the Musée du Petit Palais in Avignon, dated to the last quarter of the 14th century.³

The Allentown Crucifixion depicts Christ on the cross, flanked by angels gathering his spilt blood and making signs of sorrow and prayer. The cross nearly fills the composition and two inscribed rays, now missing, extend out and downward from Christ's head. The letters INRI, identifying "Jesus of Nazareth The King of the Jews," are displayed on the red headpiece above the cross. The design is simple, two-dimensional, and constructed with solid craftsmanship and attention to detail, especially in the angels, the tooling of the halos, and the gold background.



Materials and Technology

The support is a round, wood panel, estimated to be poplar, and x-radiation reveals the presence of four pieces of wood and a vertical grain pattern (figure 2). The largest addition, with a width of 13 cm, constitutes the right side of the panel and displays the finest of the three joins present. Two smaller pieces have also been joined to the top and left sides of the main piece of wood.

The x-radiograph also reveals the presence of a textile embedded in the preparatory layers of the panel. This is not uncommon and was described by Cennini in *The Craftsman's Handbook*.⁴ A similar canvas layer was also observed in Lorenzo di Bicci's Crucifix in Avignon.⁵ This textile layer can easily be seen spanning the join on the left side of the panel. Interestingly, the textile does not appear to be present in the small join at the top, opening up the possibility that this small piece was a later addition to the panel.

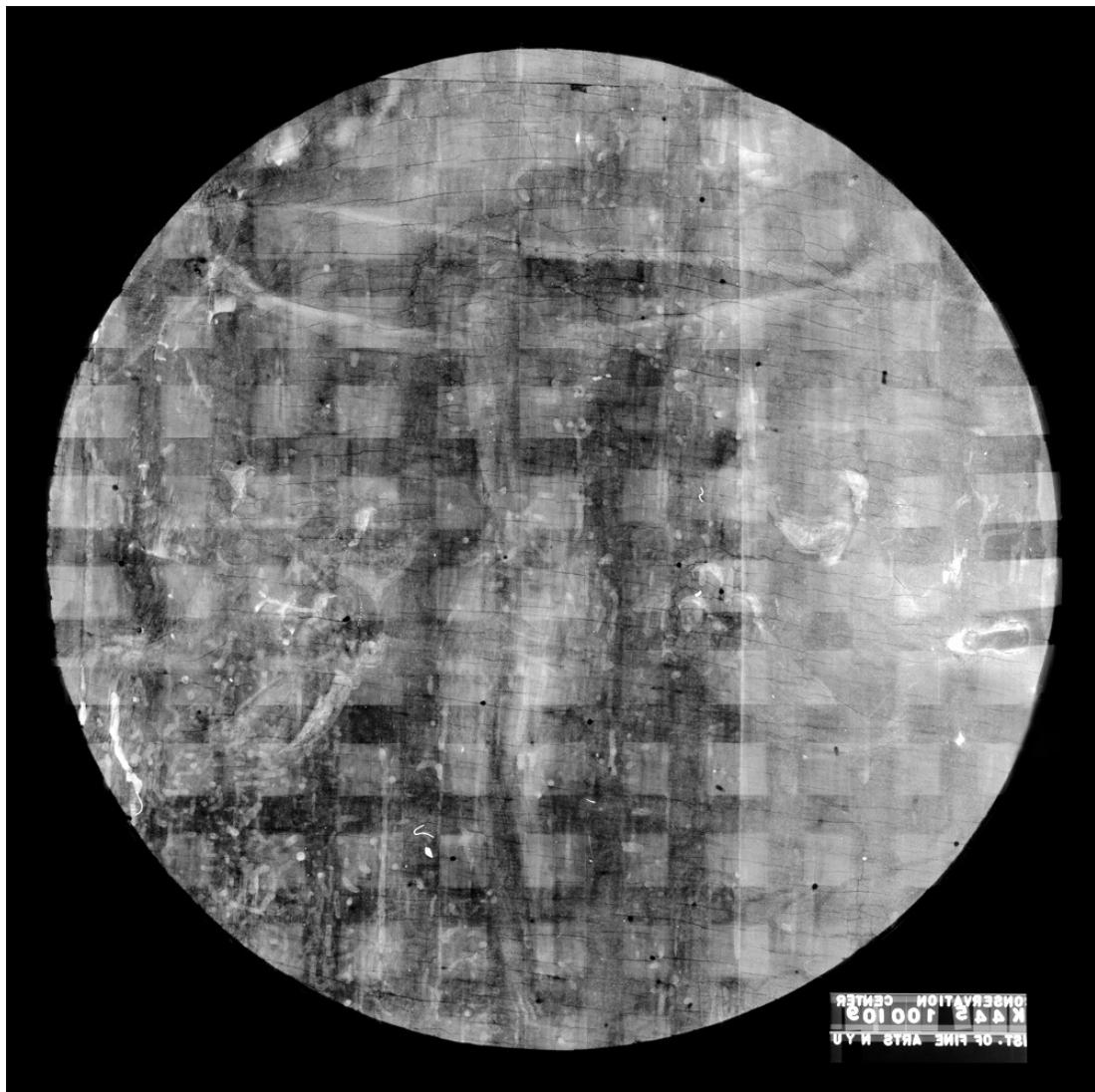


Figure 2 Lorenzo di Bicci, Crucifixion, Allentown. X-radiograph

The ground layer is composed of a traditional calcium sulfate gesso, and cross sections reveal a double ground (figure 3). Though imaging of the underdrawing was unsuccessful with infrared reflectography, a brush-applied underpainted sketch can be seen with the naked eye, especially around the face and chest of the Christ figure (figure 4). Following the preparation of the panel, the composition was incised into the ground layer, the background was water gilded and tooled, and the egg tempera paint was laid in with short, parallel brushstrokes.

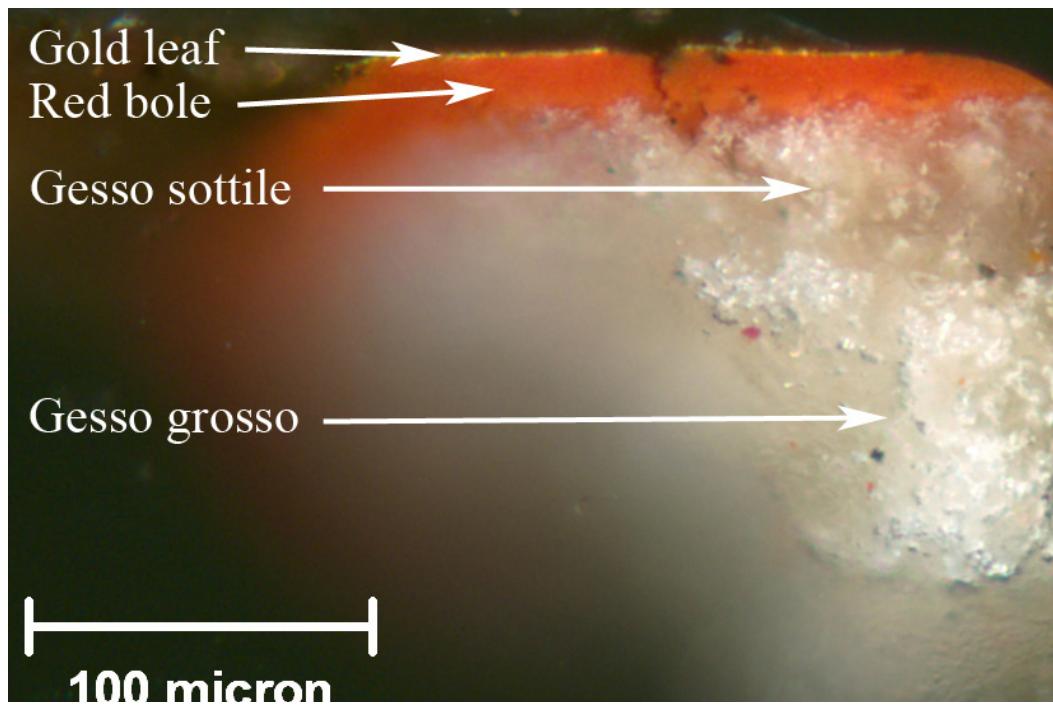


Figure 3 Lorenzo di Bicci, Crucifixion, Allentown. Cross section of gold ground and preparatory layers

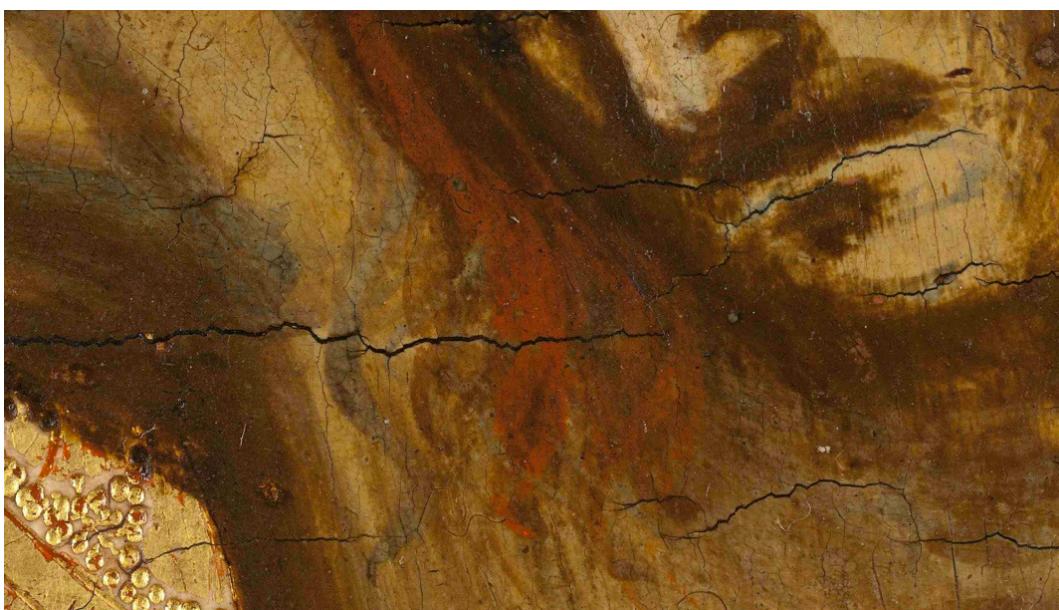


Figure 4 Lorenzo di Bicci, Crucifixion, Allentown. Detail of Christ figure showing underpainted sketch

Cleaning

The painting arrived at the Conservation Center with a thick layer of discolored varnish over the entire surface, including the gold ground. UV radiation and solubility testing revealed a layered varnish system typical of Stephen Pichetto, the original Kress conservator, consisting of coats of dammar resin interlayered with shellac or “French varnish,” presumably applied during the 1937 treatment that also included thinning the panel and the addition of the cradle (figure 5).⁶



Figure 5 Lorenzo di Bicci, Crucifixion, Allentown. Ultraviolet light

The decision was made to remove the discolored varnish, which was easily solubilized along with some of the old retouching (figure 6). The varnish was successfully removed from the gold ground, however it was decided that as there were still discolored residues on the paint layer, it would benefit from further cleaning. This additional step significantly brightened the painted passages, revealing the luminous, jewel-like tones of the angels' robes (figure 7).



Figure 6 Lorenzo di Bicci, Crucifixion, Allentown. During cleaning by the author



Figure 7 Lorenzo di Bicci, Crucifixion, Allentown. During cleaning.
The angels on the right have been cleaned, while those on the left have not.

After this phase of the cleaning, the areas comprising the cross remained covered with an uneven, dark brown overpaint, which was estimated to be oil. Patches of the original dark blue paint could be seen beneath the overpaint, and it was clear that most of this original blue layer was now lost (figures 8 and 9).

The only reference to the brown overpaint that could be found was in a condition report found in the Kress Foundation file dated 1937, shortly after the acquisition of the painting by Kress, which vaguely

refers to the reconstruction of the cross as “recent.” A similar brown overpaint was removed from the Avignon Crucifix in 1976 at the Louvre.⁷ Though the exact date and origin of the brown overpaint on the Allentown panel is unknown, historical significance seemed unlikely. However, removal of the brown paint would be difficult, and reunification of the cross would require significant restoration.



Figure 8 Lorenzo di Bicci, Crucifixion, Allentown. Detail of brown overpaint, before cleaning



Figure 9 Lorenzo di Bicci, Crucifixion, Allentown.
Detail of brown overpaint, before cleaning

After much deliberation, it was decided that the aesthetic and historical benefits of removing the overpaint outweighed the risks (figure 10). The overpaint drastically altered the original aesthetic and meaning of a blue cross, and obscured what remaining original paint was left.



Figure 10 Lorenzo di Bicci, Crucifixion, Allentown. After overpaint removal

The next step in the cleaning involved removing the dark brown deposits built up in the depressions of the intricate punch work of the halos (figure 11). No indication of an original glaze was present on the gold, and the dark build-up prevented the halos from achieving their intended play of light. The dark deposits were softened with a solvent mixture applied to the punch work with a small brush under magnification, and a tiny tool was used to break up and remove the deposits. This method, though extremely time consuming, reestablished the visual relationship between the painted figures and their tooled halos.⁸



Figure 11 Lorenzo di Bicci, Crucifixion, Allentown. During cleaning of punchwork

The cleaning of the Allentown Crucifixion revealed a number of interesting features, and allowed for a greater understanding of the different layering techniques used to create the flesh of the angels versus the Christ figure. It also enabled analysis of the original pigment used for the cross, and encouraged a closer look at the remains of the missing inscription and the tooling used to configure the halos.

Painting Technique

While the modeling of all the figures is built up with the fine hatch strokes typical of egg tempera, the handling and layer structure of the flesh tones of the Christ figure is different from that of the angels. The angels' flesh is built up in the traditional method exploited by trecento painters and described by Cennini as well as the anonymous author of *De Arte Illuminandi* (figure 12).⁹ This method involves the layering of flesh colors over a green terre verte underlayer, which was left partially uncovered to render the middle tones. Red dots of vermillion were then added to the lips and noses of the angels, while white and black were used to define the eyes.

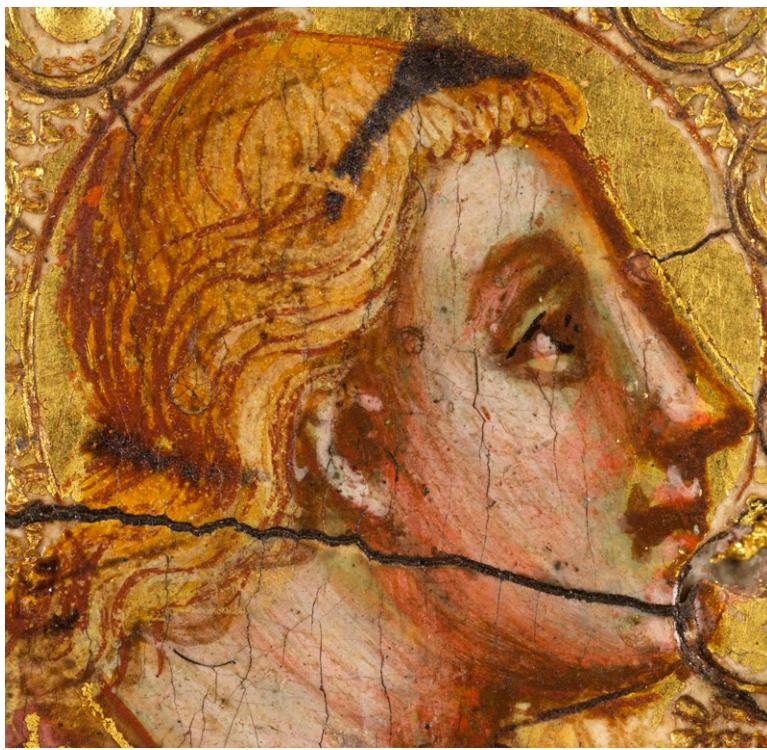


Figure 12 Lorenzo di Bicci, Crucifixion, Allentown. Detail of angel

The flesh of the Christ figure, however, was not built up over the traditional terre verte underpaint. A cross-section from a shadow in the torso of Christ shows a light flesh colored underlayer, which serves as the light tone throughout the figure with subsequent darker tones layered over it to model the shadows (figures 13 and 14).

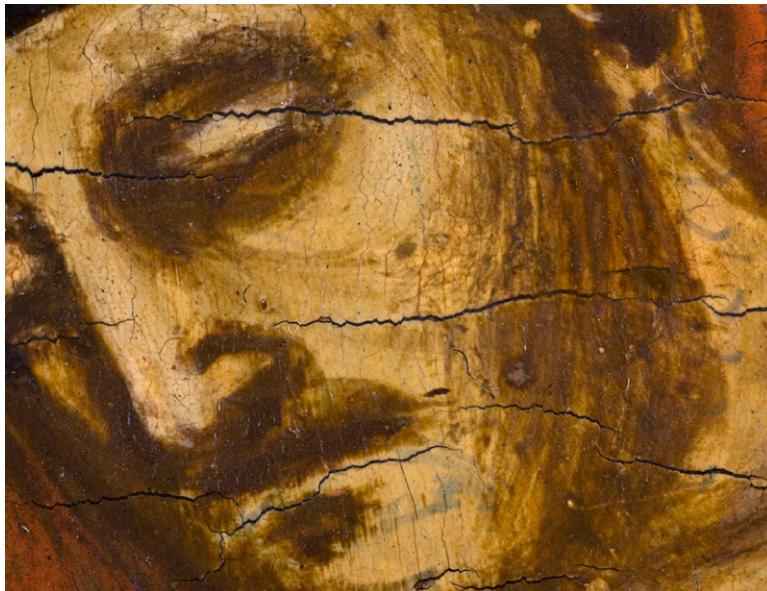


Figure 13 Lorenzo di Bicci, Crucifixion, Allentown. Detail of Christ

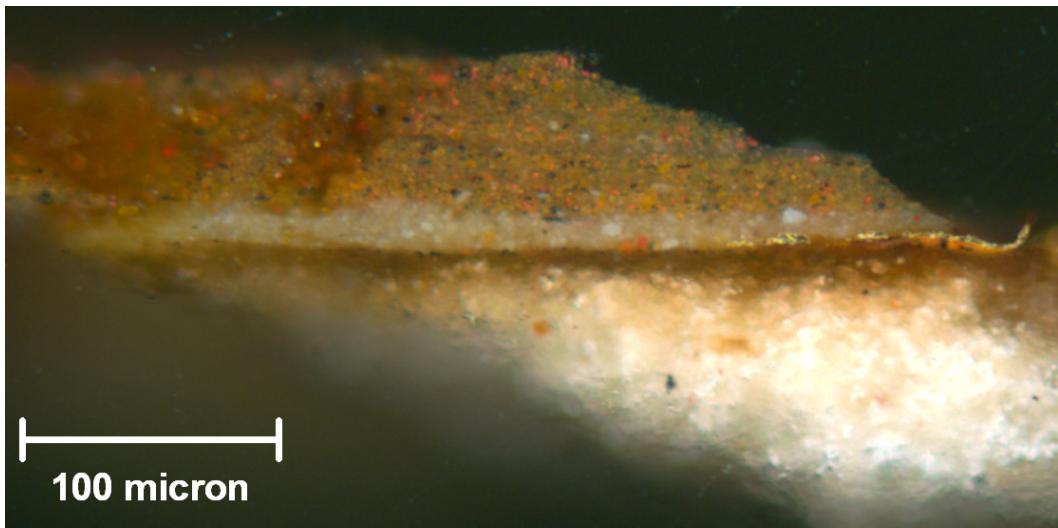


Figure 14 Lorenzo di Bicci, Crucifixion, Allentown. Cross section from Christ's torso

It is certainly possible that the artist used a simplified layering technique in order to intensify the death-like pallor of the Christ figure and to make his features appear less animated in comparison to the angels. This is rather unusual, however, as a terre verte or verdaccio underpaint is the traditional method for rendering pallid or dead flesh and many artists increased the amount of green added to their dead Christ figures, including Lorenzo di Bicci himself.¹⁰

Another possible explanation for the different layering and paint handling techniques employed in the figures is the presence of two different hands in the panel, which was not uncommon in trecento paintings. This may also explain the miniaturist quality of the angels. Lorenzo's son Bicci would have been in his late 20s by the year 1400 and working in the family business, and it is possible to imagine that he or another assistant may have been partially involved in the creation of this painting.

Punchwork

The halos of the angels and of Christ were incised before being intricately punched with four different tools (figure 15). A small circle punch defines the perimeter of the angels' halos. Inside, a simple ring shape encloses a larger circle punch, and the remainder of the space is filled with a five-part flower motif punch. The elaborate halo surrounding the Christ figure was heavily incised prior to tooling, and employs the same punches as the angels' halos with the exception of the ring punch.



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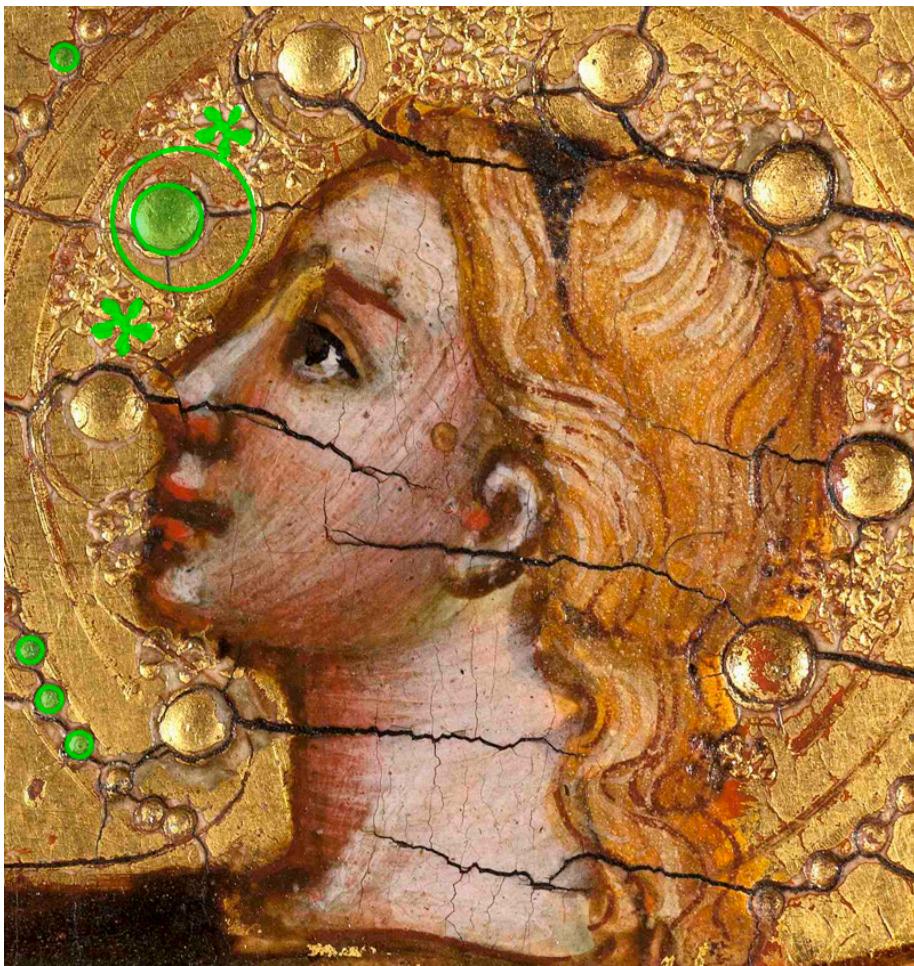
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Kress Paintings Research

Figure 15 Lorenzo di Bicci, Crucifixion, Allentown.
Detail of punchwork with four tools highlighted

The five-part flower motif punch closely resembles a punch identified by Erling Skaug in a triptych by Taddeo Gaddi depicting the Madonna and Child from 1334.¹¹ It is the same size and shape, and it is possible that Lorenzo di Bicci adapted this punch from Taddeo's son, Agnolo Gaddi, with whom di Bicci is known to have worked.

Interestingly, the halo of one of the angels to the left of Christ was incised but never tooled. This angel is largely obscured, however this is a surprising omission on such a small panel.

Investigation of the Blue Cross

Removal of the brown overpaint from the cross revealed small patches of a thick, granular, blue paint (figure 10). Remnants of this original paint survive in all four sections of the cross, though the majority of it is preserved at the foot of the cross. It was initially assumed that the blue paint was azurite, due to its appearance, texture, and degree of darkening. However, polarized light microscopy of dispersed samples from two locations on the cross clearly identified the pigment as natural ultramarine blue (figures 16 and 17). Lazurite, the mineral responsible for the blue color of ultramarine, is seen throughout

the samples. Since lazurite is extracted from the semi-precious stone, lapis lazuli, it is typically associated with the minerals calcite and pyrite, which are also present in both samples. Interestingly, a single azurite particle was discovered in the dispersed sample from the foot of the cross (figure 18).

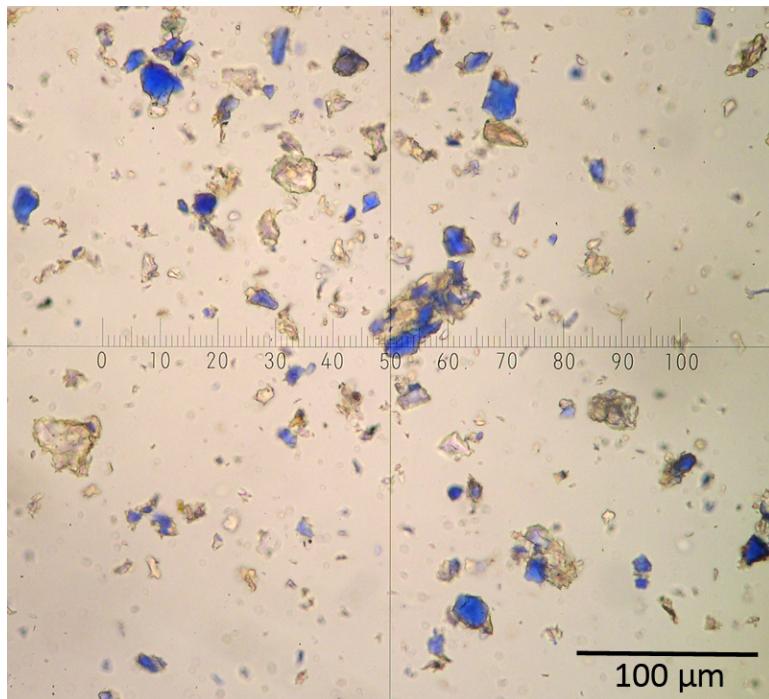


Figure 16 Sample of original paint from cross. Plane-polarized light

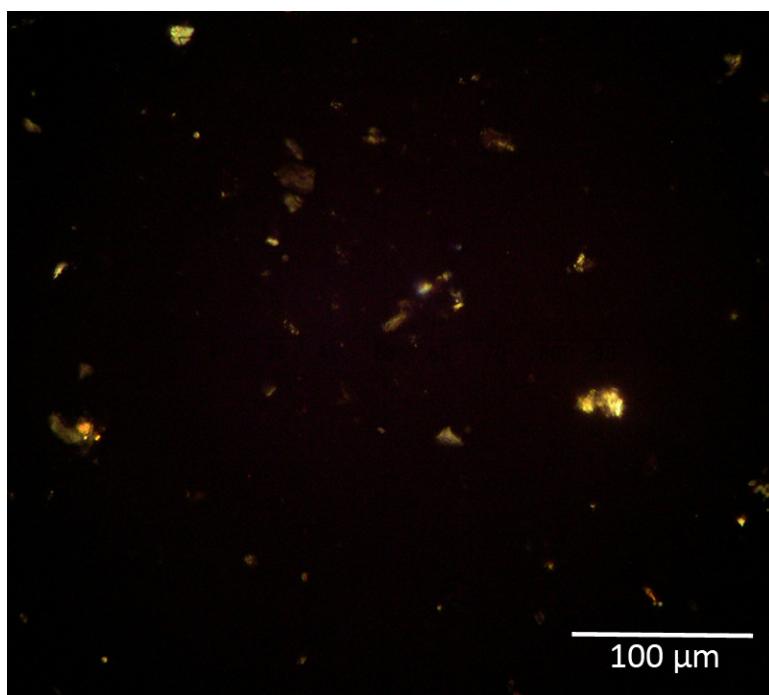


Figure 17 Sample of original paint from cross.
Cross-polarized light, showing that the blue particles
are isotropic and therefore consistent with lazurite

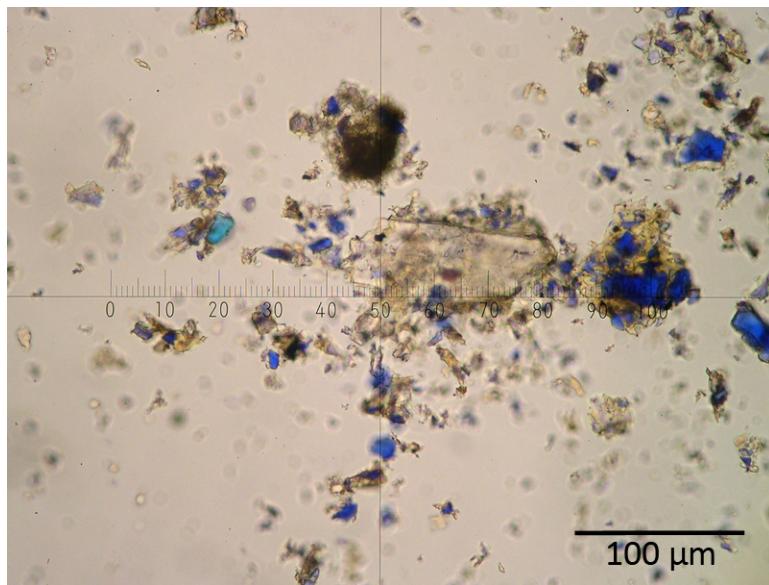


Figure 18 Sample of original paint from cross.
Plane-polarized light with the greenish blue azurite particle in the upper left quadrant.

It is likely that this azurite particle was the result of workshop contamination since no others were found, but it is also possible that a thin layer of azurite was laid below the ultramarine, a technique described by Cennini for wall painting and sometimes used to economize on the precious ultramarine pigment.¹² However, analysis of the cross-section does not support this hypothesis.

A cross-section does reveal the presence of brilliant blue particles surrounded by a dark, discolored medium (figure 19). Red pyrite and white calcite particles are visible throughout the blue layer. The brilliant vermillion particles depicting the blood from Christ's wounded feet are visible above the blue layer. Raman spectroscopy was performed on the cross section to verify the presence of ultramarine and to search for azurite particles. While lazurite and pyrite particles were successfully identified, azurite was not detected (figures 20 and 21). This still does not decisively rule out the possibility of an azurite underlayer, as the sample does not include the underlying gesso and azurite particles could have been missed during Raman spectroscopy due to the small spot size of the laser beam.

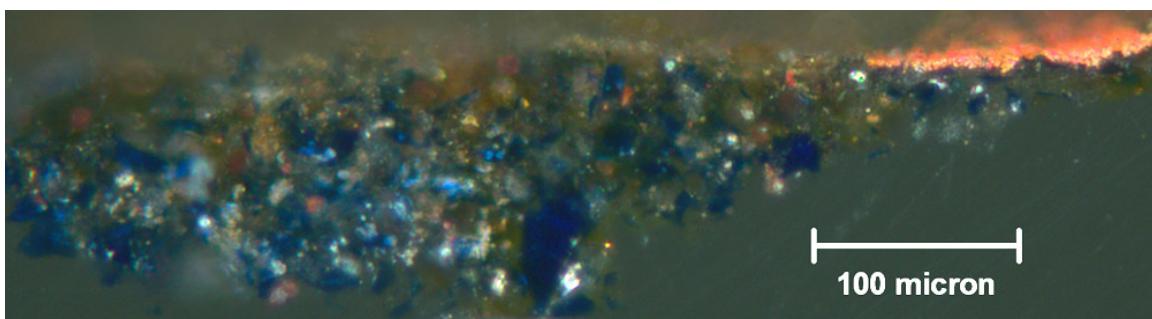


Figure 19 Cross section from foot of cross

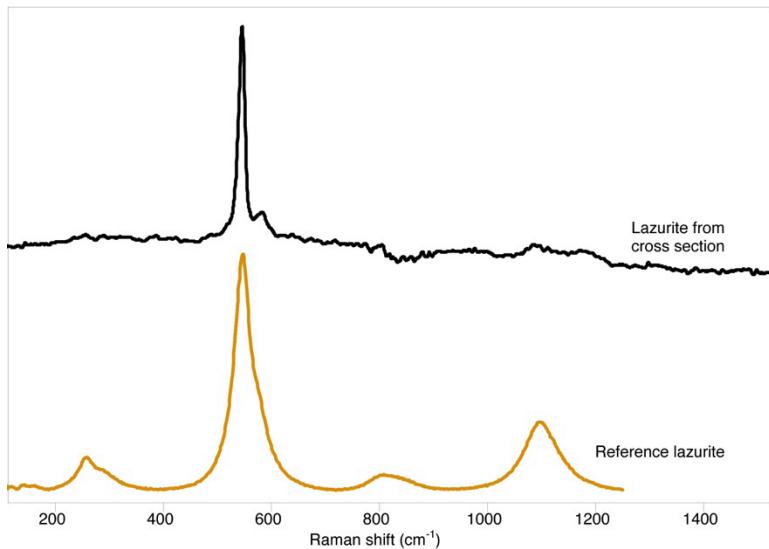


Figure 20 Raman spectra of known lazurite reference (yellow) and particle from the Allentown Crucifixion (black)

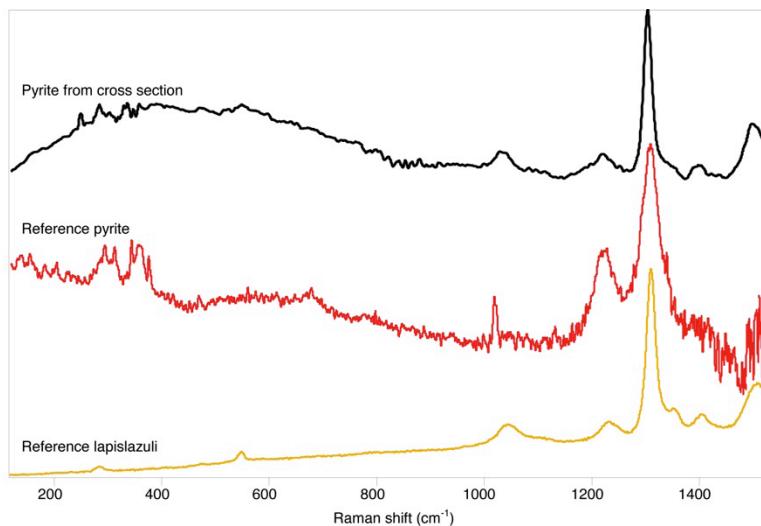


Figure 21 Raman spectra of known lapis lazuli reference (yellow), known pyrite reference (red) and particle from the Allentown Crucifixion (black)

Scratches present in the gesso and gilding underneath the cross suggest that the blue layer was intentionally scraped off the painting. The scratch marks appear to be limited to the horizontal member of the cross and the small vertical section above Christ's head. It is possible that the precious pigment was scraped off at some point for reuse, but it seems more likely that a restorer removed the ultramarine because it had become darkened and discolored with age.

The use of the color blue to depict the cross in images of the crucifixion was common during the 13th and 14th centuries in Italy (figure 22).¹³ Azurite and ultramarine were the two predominant blue pigments available, and they were far more expensive than any other color. Ultramarine was even more expensive than pure gold, and Lorenzo di Bicci's grandson, Neri di Bicci, is documented as having paid ten to fifteen times more for high quality ultramarine than for azurite.¹⁴



Figure 22 Tuscan School, Crucifixion, c. 1330-50,
Lowe Art Museum, Kress Collection.
After treatment image, Courtesy of Sandhya Jain,
Conservation Center, IFA, NYU

From the middle of the Thirteenth century, ultramarine became increasingly expensive and difficult to obtain.¹⁵ The pigment acquired a mystical and devotional association, and was typically reserved for the most iconographically significant subjects in religious panel painting, including the Virgin's mantel and the cross on which Christ was crucified. The quantity of ultramarine and gold found in the Allentown Crucifixion indicate the value of the commission and the importance of the panel in its intended religious setting.

The Inscription Revealed

The next interesting discovery concerned the deciphering of the nearly illegible inscription extending downward from the Christ figure. Lines incised into the gesso and covered by a continuous layer of gold indicate that the incisions were made prior to gilding and that the inscription was part of the original conception of the panel.



Figure 23 Lorenzo di Bicci, *Crucifixion*, Allentown. Detail of missing inscription

The gold ground displays a crack pattern that outlines the original shape of each letter, enabling the lost inscription to be identified as a partial quote from the Gospel of John 19: 26, 27, recounting Jesus' final words on the cross spoken to the Virgin Mary and St John the Evangelist and written in Gothic majuscules (figure 23). "MULIER, ECCE FILIUS TUUS," ("Woman, behold your son,") was directed to the Virgin Mary and is written on the left side of the cross, and "DISCIPULO, ECCE MATER TUA," ("Disciple, behold your mother"), was spoken to St John the Evangelist and is written on the right side of the cross.

Extant paint in the inscription was discovered to be the same ultramarine blue found in the cross (figure 24). The inscription was painted directly over the gold and seems to have flaked off naturally over time, which is not surprising as paint adheres less successfully to gold as it does to gesso, and similar flaking is observed in the angels where the gold leaf extends under the paint. In addition, no scratch marks were found on the gold surrounding the inscription, further indicating paint loss due to age rather than an intentional removal as seems to be the case with the cross.

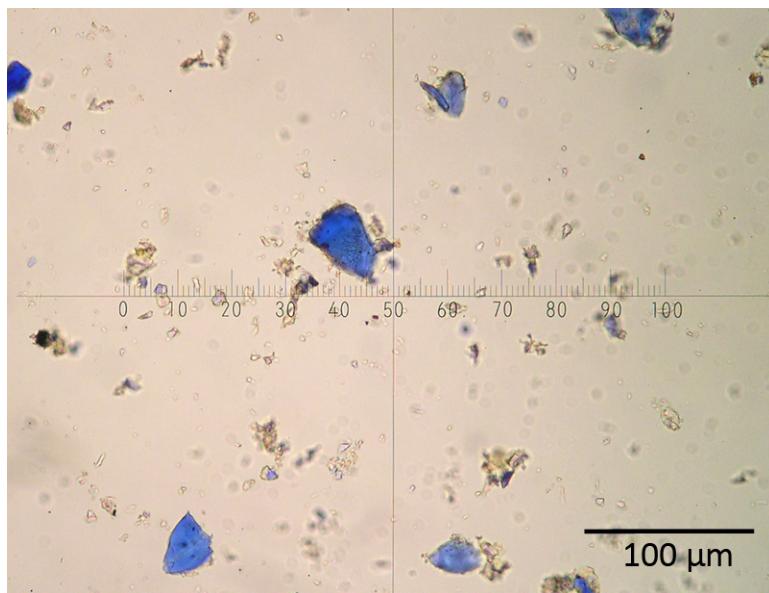


Figure 24 Sample of original paint from inscription.
Plane-polarized light showing lazurite particles

Compensation

The compensation phase of the treatment was primarily limited to the cross and the inscription, as the figures and gilding remained largely intact and required only minimal retouching and regilding. An isolating varnish was applied to areas of original paint, and the cross was retouched to match the remaining areas of original, darkened ultramarine. Great care was taken to mimic the crack pattern in the underlying gesso and to match the texture, thickness and matte surface of the original paint.

The decision to reconstruct the lost lettering was challenging because of the difficulty in deciphering the archaic script and because of the prominence of the inscription in the composition. Aware of the striking visual change it would create, many discussions and mock-ups were carried out before deciding to restore it. Once the inscription was intelligible, it proved critical in developing an understanding of the original format and function of the panel. The very good state of preservation of the figures and gilding also helped to justify the restoration. The inscription was reconstructed under low magnification with the same materials used for the cross (figure 25).



Figure 25 Lorenzo di Bicci, Crucifixion, Allentown. After treatment

Conclusions

Inscription

In deciphering the inscription, it became immediately apparent that the panel had been reduced in size, as the final word from each phrase is missing. A digital reconstruction of the image was made in order to visualize the entire inscription and the enlarged panel (figure 26). By measuring the width of the letters and the average spacing between them, it was estimated the panel might have been reduced by approximately 13.5 cm in diameter.



Figure 26 Digital reconstruction of Allentown Crucifixion with expanded dimensions and completed inscription

Another interesting feature of the inscription is its directionality. The inscribed rays emanate from the Christ figure and read outward from him, a device commonly used to enhance the narrative value of an image. Therefore the words and letters on the left side are written backwards, and read from right to left. The letter E in the word MULIER is the only exception (figure 27). Likely a mistake by the artist, it is written from left to right.

The depiction of words spoken between figures was typical in religious panel painting and is most common in depictions of the Annunciation or in portrayals of Intercessions. However, a *Crucifixion* by Bernardo Daddi painted approximately 50 years prior to the Allentown *Crucifixion* displays the same passage on the left side of the composition, but with an additional phrase spoken by the Centurion written upwards towards Christ on the right side.¹⁶



Figure 27 Detail of restored inscription, showing the word “MULIER” written from right to left, with the exception of the letter “E.”

Original Format

During the 18th and 19th centuries, as the demand for panel paintings grew, sections of altarpieces were frequently thinned, reformatted, and reduced in size in order to increase salability, eliminate areas of damage, and to hide irregular contours that would mark a panel as a fragment from a larger altarpiece, and it seems likely that the Allentown Crucifixion is a fragment from a larger construction.¹⁷ Independent tondi were an invention of the Florentine Renaissance but did not become common until later in the 15th century, and the vertical grain direction of the panel might indicate that it was not originally round.¹⁸ Unfortunately any evidence of the original woodwork was obstructed from the sides and reverse of the panel either during or prior to the addition of the cradle.

Technical information gathered from the Allentown panel in conjunction with art historical research has led to two likely scenarios for the original format and function of the painting. The first hypothesis locates the panel in the central pinnacle of an altarpiece and retains the circular composition, while the second proposes an elongated format with the Virgin and St John the Evangelist depicted below.

The Kress Catalogue describes the Allentown panel as a fragment that may have been featured at the top of an altarpiece.¹⁹ An identical configuration is seen in Lorenzo di Bicci's altarpiece depicting the Madonna and Child with Saints located in Empoli.²⁰ Lorenzo's son Bicci di Lorenzo is also known to have employed similar configurations.

While the composition of the crucifixion would have remained round, it likely would have been painted on the same large wooden panel as the main section of the altarpiece below, with a circular reveal cut in the decorative gable overlay to expose the Crucifixion (figure 28). The locations of the main joins may support this hypothesis, as the Allentown Crucifixion alone is small enough that it would have fit on a single plank of wood, however the presence of multiple joins makes more sense in the context of the large altarpiece. The joins are located slightly off center, and may have been intentionally placed to avoid the faces of the primary figures originally located below.

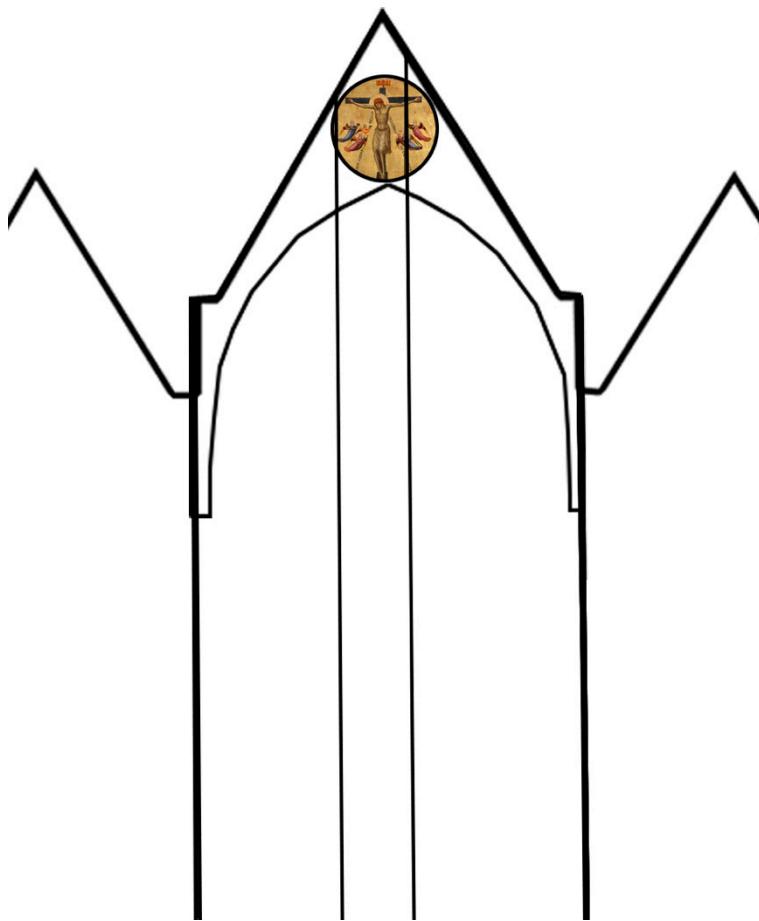


Figure 28 Diagram hypothesizing the location of the Allentown Crucifixion in an altarpiece with two vertical lines showing the location of the joins

However, the location of joins was not always well considered in panels used by Lorenzo di Bicci, and damage has occurred in the face of the Madonna in the central panel of the Empoli Altarpiece due to the painter's lack of foresight regarding the placement of his joins.

The other, more likely, hypothesis is that the Allentown Crucifixion was cut from a larger, rectangular panel with additional figures below and possibly a pelican's nest above the cross, similar to a [portable triptych by Lorenzo in Empoli](#) in which the crucifixion scene is the central panel. The inscription supports this hypothesis as it seems to demand the presence of the Virgin Mary and St. John the Evangelist below to receive the final words spoken by Christ, and the joins easily could have fallen to the sides of these figures (figure 29).

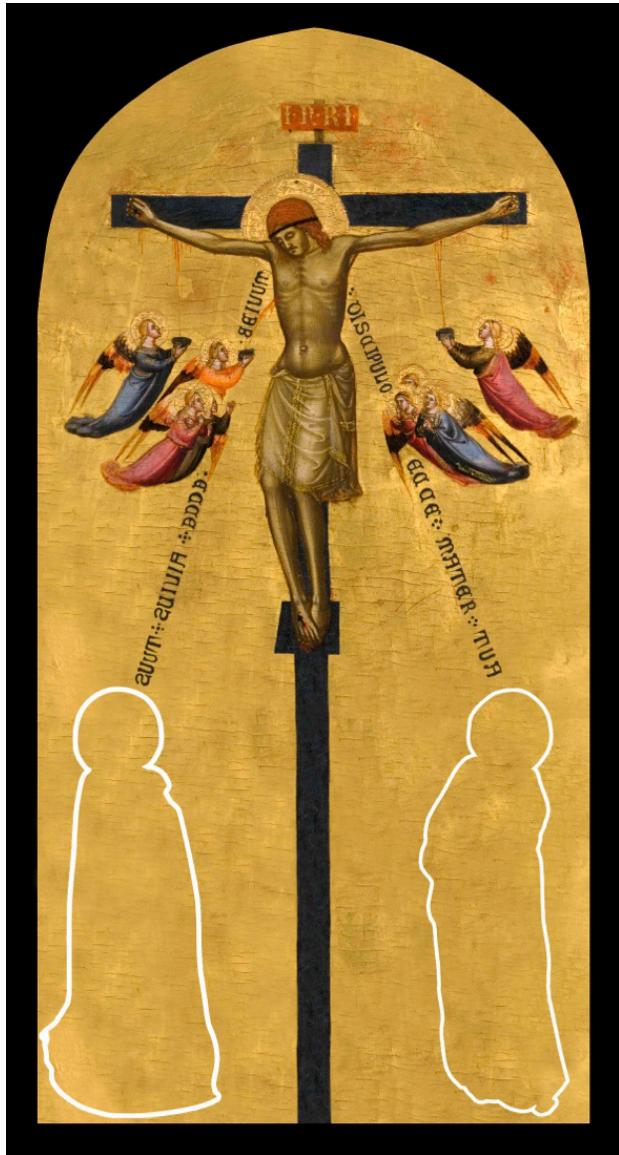


Figure 29 Digital hypothesis of the Allentown Crucifixion as a larger panel with the figures of the Virgin and St John the Evangelist below

In other examples of paintings depicting spoken words, the inscriptions extend directly to the speaker and the receiver, and an engaged frame or decorative gable would have disrupted this connection. In fact, if the original format was round, the Virgin and St John would have either been represented on separate panels altogether or not at all, leaving the inscription to stand alone.

In conclusion, the goals of the conservation and technical study of the Crucifixion by Lorenzo di Bicci



located in Allentown, Pennsylvania were to bring the remarkably well-preserved panel closer to its original appearance and to develop a better understanding of the panel's initial format and religious function. Difficult decisions were made regarding the extent to which the painting should be cleaned and restored, and it was eventually decided that removing the brown overpaint from the cross and restoring the inscription and the original color of the cross were necessary steps to achieving the conservation goals. The panel now better represents the devotional object it was intended to be. Although questions about its original format remain, the technical examination, together with comparisons to other, more intact, Tuscan devotional paintings and altarpieces, allowed for new insights into the panel's historical context and function.

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Notes

1 Miklos Boskovits, Pittura Fiorentina alla vigilia del Rinascimento 1370-1400 (Firenze: Edam, 1975), 108, 331.
Giulia Sinibaldi, "Note su Lorenzo di Bicci (Con 3 illustrazioni)," *Rivista d'arte* 26 (1950): 202.

2 Fern Rusk Shapley, *Paintings from the Samuel H Kress Collection: Italian Schools XIII-XV Century* (London: Phaidon Press, 1966), 46-47.

Rosanna Caterina Proto Pisani, *Museo della Collegiata di Sant'Andrea a Empoli: guida alla visita del museo e alla scoperta del territorio* (Florence: Polistampa, 2006), 213.

Image of Lorenzo di Bicci, Crucifixion, 1399, Empoli, published in: Pisani, *Museo della Collegiata di Sant'Andrea a Empoli*, 69. Also available at: http://fe.fondazionezeri.unibo.it/catalogo/scheda.jsp?decorator=layout_S2&apply=true&tiposcheda=OA&id=5630&titolo=Lorenzo+di+Bicci%0a%09%09%09%0a%09%09%09++++%2c+Crocifissione+di+Cristo

3 Image of Lorenzo di Bicci, Crucifix, last quarter of the 14th c., Avignon available at: [http://fr.wikipedia.org/wiki/Crucifix_peint_\(Lorenzo_di_Bicci,_Avignon\)](http://fr.wikipedia.org/wiki/Crucifix_peint_(Lorenzo_di_Bicci,_Avignon))

4 Cennino d'Andrea Cennini, *The craftsman's handbook: the Italian 'Il libro dell'arte,'* trans. Daniel V. Thompson, Jr. (New York: Dover Publications, Inc, 1933), 70.

5 Elizabeth Mognetti, "Marks of Devotion: Case Study of a Crucifix by Lorenzo di Bicci," in *Italian Panel Painting of the Duecento and Trecento*, ed. Victor M. Schmidt (Washington: National Gallery of Art, 2002), 362.

6 For more information about Stephen Pichetto, see: Ann Hoenigswald, "Stephen Pichetto, Conservator of the Kress Collection, 1927-1949," in *Studying and Conserving Paintings: Occasional Papers of the Samuel H. Kress Collection*, 30 – 41 (London: Archetype Publications, Ltd., The Conservation Center of the Institute of Fine Arts, New York University, 2006).

7 Mognetti, "Marks of Devotion," 359.

8 More information on the cleaning of gold grounds, see: Dianne Dwyer Modestini, "Techniques for Restoring Gold Ground and Other Types of Gilding," in *Early Italian Paintings: Approaches to Conservation. Proceedings of a Symposium at the Yale University Art Gallery*, ed. Patricia Sherwin Garland, 220 – 224 (New Haven: Yale University Press, 2002).

9 Cennini, *The craftsman's handbook*, 44 – 47, 93 – 95.

Daniel Varney Thompson Jr. and George Heard Hamilton, trans., *An Anonymous Fourteenth-Century Treatise: De Arte Illuminandi* (New Haven: Yale University Press, 1933), 21.

10 Mognetti, "Marks of Devotion," 365.

11 Erling S. Skaug, *Punch marks from Giotto to Fra Angelico: attribution, chronology, and workshop relationships in Tuscan panel painting: with particular consideration to Florence, c 1330 – 1430* (Oslo: IIC, Nordic Group, the Norwegian section, 1994), 92 and vol II section 5.2. Typological Index punch #384. An image of the triptych by Taddeo Gaddi is published in: Andrew Ladis, *Taddeo Gaddi: Critical Reappraisal and Catalogue Raisonne* (Columbia and London: University of Missouri Press, 1982), 128.

12 Cennini, *The craftsman's handbook*, 55.

13 Another example of a blue cross by Orcagna, 1350-59, The Walters Art Museum, Baltimore. Image available at: <http://art.thewalters.org/detail/34649>

14 David Bomford et al., *Art in the Making: Italian Painting before 1400* (London: National Gallery Publications Ltd, 1989), 35. Cathleen Hoeniger, "The Identification of Blue Pigments in Early Sienese Paintings by Color Infrared Photography," *Journal of the American Institute for Conservation* vol. 30, no. 2 (Autumn, 1991): 116.



15 For a discussion of the prices of ultramarine blue and azurite, see: Unn Plahter, "The Trade in Painters' Materials in Norway in the Middle Ages. Part 2: Materials, Techniques and Trade from the Twelfth Century to the Mid-Fourteenth Century," in *Trade in Artists' Materials: Markets and Commerce in Europe to 1700*, ed. Jo Kirby et al. (London: Archetype Publications Ltd., 2010), 69; Susanne Kubersky-Piredda, "The Market for Painters' Materials in Renaissance Florence," in *Trade in Artists' Materials: Markets and Commerce in Europe to 1700*, ed. Jo Kirby et al. (London: Archetype Publications Ltd., 2010), 225; and Hoeniger, "The Identification of Blue Pigments," 122 – 123.

16 Bernardo Daddi, Crucifixion, 1345-48, Altenburg. Photo published in: Oertel, *Fruhe Italienische Malerei in Altenburg*, Tafel 37. Also available at: <http://www.lindenau-museum.de/index.php?id=731>

17 Wendy Partridge, "Philosophies and Tastes in Nineteenth-Century Paintings Conservation," in *Studying and Conserving Paintings: Occasional Papers of the Samuel H. Kress Collection*, (London: Archetype Publications, Ltd., The Conservation Center of the Institute of Fine Arts, New York University, 2006), 21.

18 Roberta J. M. Olson, "Lost and Partially Found: The Tondo, a Significant Florentine Art Form, in Documents of the Renaissance," *Artibus et Historiae*, vol. 14, no. 27 (1993): 35.

19 Shapley, *Paintings from the Samuel H Kress Collection*, 46.

20 Lorenzo di Bicci, Madonna and Child with Saints, 1400-10, Empoli. Photo published in: Giusti, *Empoli: Museo della Colegiata Chiese di Sant'Andrea e S. Stefano*, 7. Also available at: http://fe.fondazionezeri.unibo.it/catalogo/scheda.jsp?decorator=layout_S2&apply=true&tipo_scheda=OA&id=5626&titolo=Lorenzo+di+Bicci%0a%09%09%09%0a%09%09++++%2c+Madonna+con+Bambino+e+santi+%3b+Crocifissione+di+Cristo+%3b+Santi+%3b+Episodi+della+vida+di+san+Martino%2c+sant%26%23039%3bAndrea%2c+sant%26%23039%3bAgata+e+san+Giovanni+Battista

