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14th-Century Stained-Glass Production for the Transept Chapels of Santa Croce in Florence, Italy: Collaboration and Workshop Practice

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La production de vitraux du XIV^e^ siècle pour les chapelles du transept de Santa-Croce à Florence, Italie : collaboration et pratique en atelier – Résumé
L'étude explore la conception et la fabrication de vitraux pour des premières chapelles familiales construites à Santa-Croce et offre des observations préliminaires sur la collaboration et la pratique autour du premier quart du XIV^e^ siècle. Il intègre les données d'un projet de recherche interdisciplinaire collaboratif de 2018 sur la chapelle Bardi de Santa-Croce, qui a été réalisé par R. K. Burnam, historienne de l'art, A. Corallini et V. Bertuzzi, conservateurs et propriétaires du Studio Fenice, Snc., à Bologne, et des chimistes des instituts italiens pour la conservation et la valorisation du patrimoine culturel (ISPC-CNR) et pour la physique appliquée (IFAC-CNR), feu S. Bracci et G. Bartolozzi.

14th-Century Stained-Glass Production for the Transept Chapels of Santa Croce in Florence, Italy: Collaboration and Workshop Practice – Abstract
Stained-glass is marvelously luminous, inherently fragile, and one of the least accessible of all artistic mediums. These qualities—luminosity, fragility, and inaccessibility—hamper on-site analysis, further complicated by restoration, corrosion, and limited direct access to the recto and verso, not to mention candle soot and, particular to Florentine windows, impaired legibility due to a widespread, undocumented use of cold paint that has blackened over time. Transmitted light obliterates tiny glaziers' marks and idiosyncrasies in painting technique. All of these factors have impeded research on the design and production of the stained-glass windows that were fabricated to embellish the earliest family chapels constructed in the transept of the Franciscan Basilica of Santa Croce in Florence during the first three decades of the 14th century. However, an extraordinary research opportunity occurred when in 2018 the stained-glass window in the Bardi Chapel – attributed to Jacopo del Casentino and dated 1321–1330 – was dismounted for conservation by the Opera di Santa Croce, which facilitated a collaborative, interdisciplinary research project including Americo Corallini and Valeria Bertuzzi (conservators, Studio Fenice), the late Susanna Bracci and Giovanni Bartolozzi (chemists, Institute for the Conservation and Valorization of Cultural Heritage-ICVBC-CNR and Institute for Applied Physics-IFAC.CNR), and Renée K. Burnam (art historian, Corpus Vitrearum, United States and Italy). The window attributed to Jacopo del Casentino, originally glazed for the Velluti chapel and sheltered by a bell tower until it was moved to the Bardi Chapel in 1958, is in exceptional condition. The well-preserved glass reveals elements not before verified in Florentine stained glass nor mentioned in 14th-century stained-glass treatises. The study benefits from a body of data gleaned from recent glass restorations in Santa Croce and expands an understanding of stained-glass workshop practices in 14th-century Florence. The project contributes to the ongoing development of a "catalogue" of data, such as maker's marks and the chemical composition of particular glasses, instrumental for making connections, defining artists and glaziers, and identifying workshops.

Excavations confirm the testimony of the chronicler Giovanni Villani (1280–1348), that construction on the basilica of Santa Croce commenced in 1295, starting with the east end.[1] The axial chapel, or *Cappella Maggiore*, forms the centerpiece for a series of transept chapels. These spaces were granted to prominent Florentine families to embellish with frescoes, altarpieces, funerary monuments, and stained-glass windows.

(✝) *This article is offered in tribute to the late Dr. Susanna Bracci, who passed too young from life in April of 2021 before our collaborative research appeared in print. She was the cherished wife and collaborator of Giovanni Bartolozzi and the esteemed colleague and friend of the members of the Italian committee of the Corpus Vitrearum Medii Aevi who had the privilege of partnering with her on this and other projects. Her expansive congeniality and indomitable spirit made it a pleasure and inspiration to work with her. An eminent scientist in many fields of cultural heritage and in Italy among the most expert in problems related to medieval glass and stained glass conservation, Dr. Bracci set a high bar by her exceptional dedication to rigorous study and leaves a rich legacy in her pioneering work in the field of diagnostic investigation and stained glass conservation.*

[1] Luca Giorgi and Pietro Matracchi, "La chiesa di Santa Croce e i precedenti insediamenti francescani. Architettura e resti archeologici", in Andrea de Marchi and Giacomo Piraz (ed.), *Santa Croce. Oltre le apparenze*, Gli Ori, Pistoia, 2011, pp. 13-31. Giovanni Villani, *Cronica*, Ignazio Moutier and F. G. Dragomanni (ed.), Sansone Coen, Florence, 1845, 2, VIII, VII, p. 13.

Historically, studies on collaboration in Italian stained-glass production have drawn from documentation and treatises by the Tuscan-born painter Cennino Cennini and the glazier Antonio da Pisa.[2] That painters typically prepared designs and master glaziers translated those models into glass became a prevailing assumption, though not without exceptions.[3] Now, a growing corpus of evidence demonstrates that stained-glass commissions were accomplished through a whole range of different arrangements.[4] The application of technology to stained-glass study is confirming and augmenting written sources. Recent conservation of Santa Croce's stained-glass windows brings new insight, particularly in the context of collaborative research projects organized by conservators Americo Corallini and Valeria Bertuzzi, the proprietors of the Studio Fenice, Snc., in Bologna. The present article draws from a 2018 interdisciplinary study on window sIII, glazed for the Velluti Chapel.[5] The project was carried out by the Studio Fenice with the participation of art historian Renée K. Burnam and two chemists at Italy's Institute of Science for Cultural Heritage (ISPC-CNR) and for Applied Physics (IFAC-CNR), Susanna Bracci and Giovanni Bartolozzi, who analyzed the window's glass by uniquely integrating non-invasive and micro-invasive techniques, including X-ray fluorescence (XRF), fiber optic reflectance spectroscopy (FORS), and the analysis of micro-samples with a scanning electron microscope, coupled with elemental analysis (SEM-EDS). Material is also taken from a 2017 collaborative project on the window above the Bardi Chapel, SII, and above the Tosinghi Spinelli Chapel, NII;[6] the conservation of windows in the Bardi di Vernio Chapel at the end of the north transept (nVIII, nX);[7] and on-site examination of window sIV, glazed originally for the Giugni Chapel.[8] Utilizing data from these initiatives, this article explores the design and fabrication of stained-glass windows for some of Santa Croce's transept chapels and offers preliminary observations about collaboration and glazing practice during the first decades of the Trecento.

The double-lancet, stained-glass window sIII was glazed originally for the Velluti Chapel, the fifth from the *Cappella Maggiore* in the south transept (fig. 1). In 1845, a bell tower was built adjoining the chapel's exterior wall.[9] Despite an aperture in the tower, devised to indirectly light the glass, the window was rendered dark and consequently unappreciated. Paradoxically, the window's recent conservation reveals it to be highly luminous, its

Fig. 1. Florence, Basilica of Santa Croce, Bardi Chapel, sIII, "Apparitions of Angels", attributed to Jacopo del Casentino, c.1320-30.
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[2] Cennino Cennini, *The Craftsman's Handbook*, D. Thompson, Jr. (ed.), Dover, New York, 1960, pp. 111-112; Salvatore Pezzella, *Arte delle vetrate col trattato di Antonio da Pisa*, Editalia, Roma, 1977. For an overview, Brigitte Kurmann-Schwarz, "Medieval Textual Sources on Stained Glass: from Theophilus to the Monk of Zagan", in Elizabeth Pastan and Brigitte Kurmann-Schwarz (ed.), *Investigations in Medieval Stained Glass: Materials, Methods, and Expressions*, Brill, Leiden, 2019, pp. 337-349.

[3] Giuseppe Marchini, "Le vetrate", in Umberto Baldini and Bruno Nardini (ed.), *Il complesso monumentale di Santa Croce*, Nardini, Florence, 1983, pp. 307-327.

[4] Renée K. Burnam, *Le vetrate del duomo di Pisa* (Corpus Vitrearum Medii Aevi Italia, II), Pacini, Pisa, 2003, pp. 73-79; Takuma Ito, *La vetrata nella Toscana del Quattrocento*, Olschki, Florence, 2010, pp. 63-85; Nancy M. Thompson, "The Creation of Stained Glass in Central Italy, 1250-1400", in E. Pastan and B. Kurmann-Schwarz (ed.), 2019, pp. 350-361.

[5] Conservation financed by the Opera di Santa Croce Onlus. Sincere appreciation to Dr. C. Timossi, Archivio dell'Opera di Santa Croce, for assistance with documents and photographs.

[6] Susanna Bracci, Renée K. Burnam, Americo Corallini, Marcello Picollo, Muriel Vervat, "The Conservation of Stained-Glass Windows Attributed to the Master of Figline in Florence, Italy", *Kermes*, 100, 2017, pp. 133-148.

[7] By the Studio Fenice, Snc., Bologna.

[8] Conducted by Americo Corallini and Valeria Bertucci.

[9] Pietro Ruschi, "I campanili di Santa Croce", in AA.VV., *Santa Croce nel'800*, Alinari, Florence, 1986, pp. 19-35.

superior preserved state attributable directly to the tower that sheltered it for more than a century.

Study of the Velluti window, initially hampered by the effect of the tower, was further hindered by post World War II trends affecting restoration in the basilica. The artist Giotto di Bondone painted frescoes on the walls of four transept chapels between 1320 and 1335.[10] Two chapels retain Giotto's wall paintings, though only partially: the Bardi, next to the axial chapel in the south transept, depicting the Life of St Francis, and the adjacent Peruzzi, dedicated to Sts John the Evangelist and John the Baptist. During the 1950s, 19th-century repainting was removed from the Bardi and Peruzzi frescoes in order to recover Giotto's original work.[11] The initiative generated an atmosphere of rediscovery surrounding the celebrated painter that must have played a decisive role in the redistribution of stained-glass windows. 14th-century windows from other transept chapels were installed in the Bardi and Peruzzi chapels—neither of which had retained their original stained glass and, in the case of the Peruzzi, not even the stonework of its medieval window, truncated by 1839.[12] Since Santa Croce's windows had been dismounted during the war and were in the studio of Giovanni Tolleri for summary restoration, reinstalling them according to revised criteria was well within the realm of possibility, even if it meant modifying stonework, readapting stained-glass panels, and severing windows from what remained of their decorative ensembles. The Bardi Chapel's 19th-century stained-glass window was installed in the Giugni Chapel, the third from the axial in the south transept. The Velluti window was moved to the Bardi Chapel. The Giugni Chapel's stained-glass window was transferred to the Peruzzi Chapel.

The Velluti window is typical of Italian, and particularly Tuscan, stained glass in its retention of the vestiges of a cold paint that was apparently applied routinely and on-site to the *recto* of windows, covering glass and leads in broad strokes, enveloping candle soot and even spiderwebs. It is not known precisely when this cold paint was in general use, nor its exact chemical composition. Analysis has identified the binder as an oil, probably linseed oil.[13] Presumably intended to modulate brightness, the cold paint must have been semi-transparent originally. It has altered over time, becoming dark and opaque, dry and brittle. The paint tends to adhere strongly to original grisaille but there is a wide range of exfoliation. This process has been expedited by repeated abrasion by restorers who, in attempting to return transparency to the glass, have eliminated original vitreous paint along with the cold paint residue. The protocol that was proposed by the Studio Fenice and approved by the Opera di Santa Croce and the Soprintendenza stipulates retaining cold paint that has bonded to authentic grisaille.[14]

Study of Tuscan windows is challenged by both the persistence of the cold paint residue and the grisaille loss that has resulted from its removal. The residue is quantitatively less on sIII, possibly because the window's brightness had been diminished by the impinging bell tower. The cold paint application predates the Velluti window's late 19th-century restoration by Ulisse De Matteis, who imitated the patchy effect of the residue on his replacement pieces with vitreous paint. De Matteis remade entirely the lower part of the archangel Michael, either missing or damaged, replaced a limited number of individual glass pieces, and releaded the window. The window's decorative base panels and its outer perimeter of uncolored fillets were eliminated when Tolleri reinstalled the Velluti window in the narrower and shorter lancets of the Bardi Chapel. The fillets were reintroduced during the recent conservation.

There are few documents for dating the decoration of Santa Croce's transept chapels. A series of payments suggests that the transept was roofed in the autumn of 1310, furnishing a *terminus post quem.*[15] The Velluti Chapel's decoration could have been completed as early as 1322.[16] According to the chronicle of Donato Velluti, written between 1367 and 1370, the Velluti chapel's decoration was commissioned by Gemma de' Pulci, the widow of Filippo Velluti, in memory of their son Alessandro, who died in 1321.[17] The

[10] Lorenzo GHIBERTI, *I Commentari*, 1, Julius VON SCHLOSSER (ed.), Vero Verlag, Berlin, 1912, p. 36.
[11] Umberto BALDINI, "Giotto", in U. BALDINI and B. NARDINI (ed.), 1983, pp. 77-78.
[12] F. FRANCOLINI and A. CAPPIARDI, "Interior of the church of Santa Croce", after 1839, engraving, Kunsthistorisches Institute, Florence.
[13] S. BRACCI *et al*. 2017, pp. 138-139.
[14] Until a solution is found for removing cold paint without damaging grisaille.
[15] Gaetano MILANESI, *Nuovi documenti per la storia dell'arte toscana dal XII al XV secolo*, Dotti, Florence, 1901, pp. 18-19.
[16] Andrew LADIS, "The Velluti Chapel in Santa Croce, Florence", *Apollo*, 120:272, October 1984, pp. 238-245.
[17] Isidoro DEL LUNGO and Guglielmo VOLPE (ed.), *Cronaca Domestica di Messer Donato Veluti*, Sansoni, Florence, 1914, pp. 106-107. On the Velluti Chapel, A. LADIS (1984); Nancy M. THOMPSON, *The Fourteenth-Century Stained Glass of Santa Croce in Florence*, dissertation, Indiana University, 1999, pp. 126-134; Silvia DE LUCA, "La cappella Velluti-Zati in Santa

Velluti window depicts archangels appearing to persons in the earthly realm: Gabriel visiting the Virgin Mary, Raphael giving a fish to Tobias so that he can break a curse and marry his beloved Sara, and Michael assuring the emperor Constantine that he will be victorious in battle (fig. 1). The coat of arms at the apex of the window displays the arms of the Morelli family, the chapel's 18th-century patron. The chapel's partly preserved frescoes narrate the stories of the Archangel Michael.

The Velluti window is dominated by animated figures, richly attired in multi-colored and extensively embroidered apparel, conversing over the central mullion of the window's stonework (figs. 1, 2a). Solid and yet ethereal, the figures float in a brilliant blue expanse from which they seem simultaneously to emerge. In the left lancet, the archangels move freely across shallow space, defined by insubstantial podiums and narrow, geometric compartments. The compartments are created by a boldly-conceived, running cornice painted with rather large-scale elements, pearls in the left lancet and dentils in the right. The cornice forms an upward-climbing open-work. Where the cornice crosses upon itself, the blue expanse is glimpsed through diamond-shaped "portholes". These are surrounded by alternating brilliant emerald and bright red glass embellished with foliate motifs. The emerald, red, and blue contrast with the muted tonality of the window's border, composed of alternating squares of two glasses of unusual color, a light violet and a light, lime green. The squares are painted with two alternating types of leaves on cross-hatched grounds. The Velluti window's decorative repertoire is drawn from the vocabulary of medieval stained glass. In the Upper Church of St Francis in Assisi variations of the border can be found; for example, in apse window VIII (c.1255), where yellow and blue squares alternate with red bands.[18] Cross-hatching was used for foliate decoration in Assisi's Lower Church; for example, in the St Anthony Chapel (V, c-d, 1320–35),[19] but the elements are worked into a fussy, monotone design. A precedent for the unusual palette of the Velluti border has not been found.

Fig. 2 a-b. Florence, Basilica of Santa Croce. a) Bardi Chapel, sIII, "Tobias", detail, attributed to Jacopo del Casentino, c.1320-30. ©Archivio dell'Opera di Santa Croce-photo Studio Fenice b) Velluti Chapel, fresco, "Saint Michael", detail, attributed to Jacopo del Casentino, c.1320-30. ©Sailko,https://commons.wikimedia.org/wiki/File:Maestro_della_cappella_velluti,_San_Michele_Arcangelo_combatte_il_drago_02.JPG, detail.

The Velluti window was attributed to Jacopo del Casentino in 1967 by Giuseppe Marchini, who considered the figures so remarkably close to Jacopo's style that he surmised the painter's participation in its production. His criticisms of the window ranged from design to execution: an emphasis on the figures "at the expense of all else", "violent accents of color" in the borders, decorative motifs "derived from outdated Germanic models" and inferior to those in the basilica of St Francis in Assisi.[20]

In light of a study published by Andrew Ladis in 1984, the Velluti window can be seen as carefully conceived and unexpectedly intriguing. Ladis re-examined Jacopo del Casentino's artistic personality and attributed to him the Velluti chapel frescoes as well as a panel painting of St Michael in a Florentine collection, which he identified as the chapel's missing altarpiece.[21] Art historians had long debated the frescoes' authorship, considering them "archaic" with respect to the style that became popular after the

Croce fra giottismo e arcaismi (1321 circa)", *Ricerche di storia dell'arte*, 3, 2010, pp. 25-36.

[18] Giuseppe Marchini, *Le vetrate dell'Umbria* (Corpus Vitrearum Medii Aevi Italia, I,) De Luca, Rome, 1973, pl. III-IV.

[19] G. Marchini (1973), pl. LXXXVIII.

[20] Giuseppe Marchini, "Le vetrate", in AA.VV., *Primo Rinascimento in S. Croce*, Città di Vita, Florence, 1968, p. 64.

[21] A. Ladis (1984).

advent of the painter Giotto.[22] But Ladis characterizes Jacopo del Casentino's work as embodying a legitimate, parallel artistic vision that is marked by decorative movement and expressive gestures rather than Giotto's penchant for concrete action and charged emotions. Jacopo's is a lyrical style that contrasts sharply with the drama, monumentality, and spatial investigation that occupied Giotto and his followers. In this context, Jacopo del Casentino emerges as an artist who explores the expressive possibilities of color, variety, and detail, often at the expense of spatial illusion; in short, qualities that make the Velluti window extraordinary. Certainly, relocated in the Bardi Chapel and flanked by Giotto's frescoes of solid, subdued figures in spacious, pastel-colored niches, the Velluti window's celestial beings, interacting in a kaleidoscope of color and pattern, can hardly be appreciated on its own merits.

Recent conservation furnishes data for a reassessment of the Velluti window and Jacopo del Casentino's collaborative role in its production. Particularly important is the discovery of a semi-transparent, rose-colored vitreous paint that was employed selectively to color the cheeks, the lips, and the tip of the nose without interfering with the translucency of the glass (fig. 2a). Dense brushstrokes of rose grisaille were used to depict the pink flesh inside Tobias' fish. The grisaille's pink coloration and the manner in which it was used relate it to a type of glass paint that was called *carnation* in France from the 16th century and is commonly known as *sanguine*, a French word meaning, literally, "of hematite", an iron oxide with the formula Fe_2O_3 that was used to pigment the paint.[23] The high iron component of the Velluti sanguine[24] and the fine quality of its granulation links it to historic recipes for obtaining a reddish paint that could range from yellowish to brownish and from translucent to opaque, depending on the particle size of the iron oxide and the presence of trace cations.[25]

Recipes for sanguine date as early as the 14th century,[26] but it seems to be the general consensus that the true use of sanguine, to color glass selectively and artistically with a hematite-rich glass paint, did not begin until the late 15th century. Nevertheless, data obtained under laboratory conditions make a convincing case for dating the application of the Velluti sanguine to the time of the window's fabrication, and not centuries afterward as a later addition. During conservation it was observed that when the glass was being painted (on the *recto*), a droplet of sanguine fell, possibly accidentally, on the uncolored glass of Tobias' fish. A line of black grisaille was painted subsequently on top of the droplet, and then the piece of glass was fired. The droplet of sanguine can still be seen by looking through the glass support from the *verso.*[27] The Velluti sanguine gives context to its use in 1453–54, in the nave windows of the cathedral of Pisa by a glazier trained at the cathedral of Florence, Leonardo della Scarperia. To endow his figures with physiological naturalism, Leonardo acid-etched pink flashed glass and used a combination of black grisaille and sanguine to create the facial expressions. Micro-analysis has shown that the composition of the Pisa sanguine—reddish with an orange cast—is iron (6.5%), copper (8.5%), and mercury (10.9%).[28]

The Velluti window's rose-colored grisaille demonstrates that Jacopo del Casentino manipulated the glass medium in order to obtain the same delicate, pictorial effects that he achieved in his frescoes and altarpiece for the Velluti Chapel, where he applied similar touches of a rose-colored pigment to the cheeks, lips, and noses of his figures (fig. 2a-b). Jacopo del Casentino's direct participation in the production of the Velluti window can also be discerned in the sensitive modeling of the figures. During conservation, backpainting was discovered on the window. Doubtless, it was Jacopo who applied the deft and spontaneous strokes of grisaille to the *verso* of the window to enhance the design.

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[22] Ornella Casazza, "Gli affreschi della cappella Velluti", in U. Baldini and B. Nardini (ed.), 1983, pp. 122-125.

[23] Olivier Schalm, Koen Janssens, Freddy Adams, J. Albert, K. Peeters, Joost Caen, "Une étude historique et chimique de peinture de verre "rouge Jean Cousin", *Dossier de la Commission royale des monuments, sites et fouilles, 3.* (Forum pour la conservation et la restauration des vitraux, Liège, 19-22 June 1996), Liège, 1996, pp. 155-162.

[24] Ascertained in situ with XRF.

[25] Ângela Santos and Marcia Vilarigues, "Sanguine Paint: Production, Characterization, and Adhesion to the Glass Substrate", *Studies in Conservation*, 64:4, 2019, pp. 221-239. O. Schalm et al. 1996, p. 155.

[26] Joost Caen, *The Production of Stained glass in the County of Flanders and the Duchy of Brabant from the XVth to the XVIIth Centuries: Materials and Techniques*, Brepols, Antwerp, 2009.

[27] In reflected light.

[28] Renée Burnam (2003), pp. 12-13, 41-42, 82-83, 90-91; Andrea Orlandi, Filippo Olmi, Gloria Vaggelli, Mauro Bacci, "The Medieval Stained Glasses of Pisa Cathedral Italy: Their Composition and Alteration Product", in *The Analyst*, 121, April 1996, pp. 553-558.

Micro-analysis reveals that the light, lime green glass that was used extensively in the Velluti window for the border is composed of six alternating layers of different thicknesses of potash based, yellow and blue glasses.[29] Variation in the thickness of the layers accounts for its striking graduations in color, from cool to warm (fig. 4c). The window's dark violet glass is also multi-layered, composed of violet and blue, and is similar but not identical to a flashed violet used in 14th-century windows in Assisi.[30] The selection of these remarkable, flashed glasses and the unlikely juxtaposition of light violet and lime green in the border distinguishes the Velluti window from other stained-glass commissions (figs. 1, 2a). Window sIII exhibits a wide range of color variations and a penchant for incorporating especially beautiful glasses, including a potash-lime, emerald green whose clarity derives from a very high lead content (PbO 25.23%). Emerald and red glasses impart an overall structure that is embellished profusely with three other shades of green; bright, cool (*verde erba*), bright, warm (*verde acido*) and multi-layer, lime green. Soda-lime-silica glasses expand the palette with light yellow, three shades of blue—turquoise (with the main chromophore being Cu[II]) and two intensities of a blue glass colored with cobalt—and uncolored glass. Also incorporated are two other yellows, intense yellow and amber (orange), light violet, and multi-layer, dark violet. The glass medium's capacity for chromatic opulence must have attracted Jacopo del Casentino, whose collaboration likely extended to glass selection.

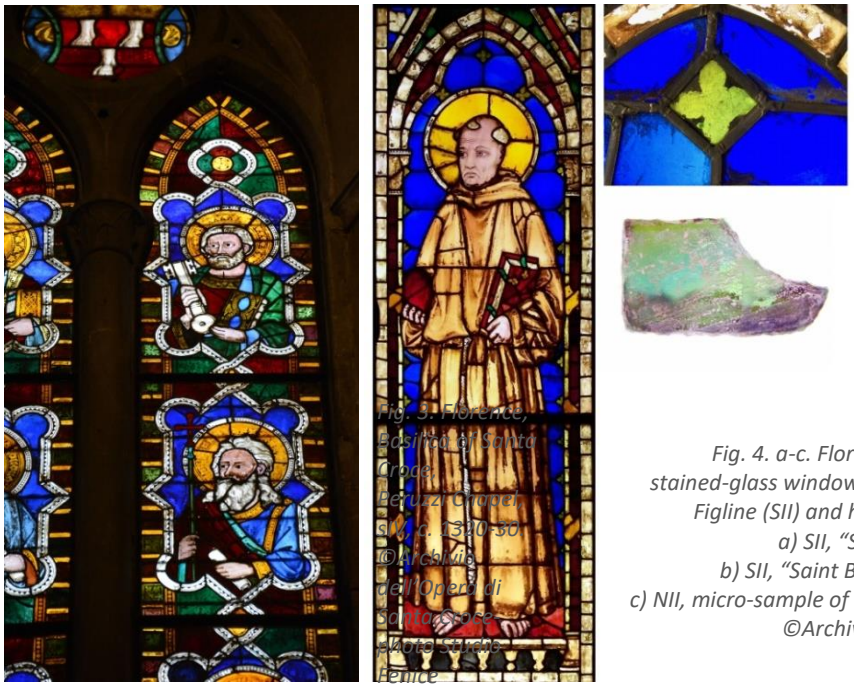

Fig. 4. a-c. Florence, Basilica of Santa Croce, stained-glass windows attributed to the Master of Figline (SII) and his workshop (NII), c.1320-30. a) SII, "Saint Francis of Assisi", detail. b) SII, "Saint Boniface", detail of quatrefoil. c) NII, micro-sample of multi-layer, lime-green glass. ©Archivio dell'Opera di Santa Croce, photo Studio Fenice.

The identity of the Velluti window's glazier is not documented, neither is the activity of his workshop. Close-range examination of the Giugni Chapel's stained-glass window (sIV), now located in the Peruzzi Chapel and preserved in the upper part, offers some new data, though close analysis awaits conservation. The figural style of the Velluti window does not resound with the Giugni's Giottesque busts. Nevertheless, scholars have noted a resemblance in decorative repertoire.[31] There is an analogous open-work of geometric compartments formed by cornices of pearls and dentils, elements rendered with more detail in the Giugni window. The overall visual impact of the Velluti window's open-work is not matched in the Giugni window, where the Velluti "portholes" to the sky are filled in with ornament (figs. 1, 3). The two windows have a similar foliate border of light violet and green squares; these alternate with gold bands and some are glazed with multi-layer lime glass in the Giugni window. The Giugni foliate motifs were

[29] Susanna Bracci, Giovanni Bartolozzi, Renée K. Burnam, Americo Corallini, Valeria Bertuzzi "Integration of both non-invasive and micro-invasive techniques for the archaeometric study of the stained-glass window *Apparizione degli Angeli* in the basilica of Santa Croce in Florence, Italy", in *Journal of Cultural Heritage*, 30/40 (2020), pp. 1-10 (http://ees.elsevier.com).

[30] Marco Verità, Paola Santopadre, Alberto Conventi, "Studio dei materiali costitutivi di vetrate medievali dal complesso basilicale di San Francesco in Assisi", *Bollettino ICR*, 20-21, 2010, pp. 17-45.

[31] G. Marchini (1968), p. 69.

apparently copied from the same pattern as the Velluti and created with similar techniques but they vary in execution. These observations suggest a common workshop with multiple glaziers. This is confirmed by the two windows' assembly marks. These were used to sort painted glass pieces after firing, especially decorative elements, in order to facilitate assembly. The Giugni glazier used Arabic numerals, a common method. The Velluti glazier's system seems to be one of his own devising based on a wide range of inventive symbols, such as spirals, hooks, snakes and the like (fig. 5). Lacking the sequential advantage of numbers, the symbols surely corresponded to indications on a pattern. Like the Velluti window, the Giugni was backpainted, a technique that was not always employed for the transept windows. The reuse and readaptation of patterns and decorative components, especially leftover elements already painted and fired, and the consumption of a glass supply already on hand, were all labor-saving and economic considerations that drove decisions within glazing workshops.

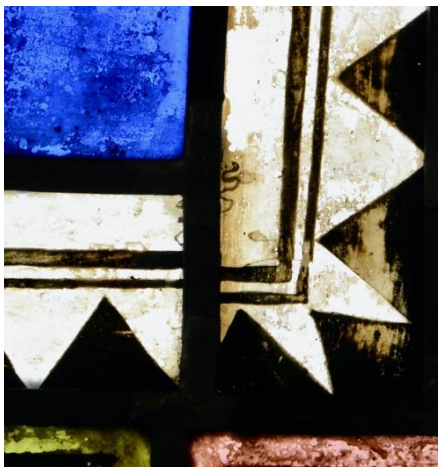

Fig. 5. Florence, Basilica of Santa Croce, sIII, detail showing assembly marks. ©Archivio dell'Opera di Santa Croce photo Studio Fenice.

Conservation provides new information about the double-lancet window SII, located above the Bardi Chapel on the south transept wall and considered an autograph work of the Master of Figline (fig. 4a).[32] This artist embraced selectively the innovations of his contemporary Giotto in the context of his own expressive and eccentric vision, wherein "archaism" played a definite and deliberate role. Although nothing is documented about his origin or preparation, Figline was most likely a Franciscan friar whose artistic formation was at the basilica of St Francis in Assisi, and perhaps he can be identified with the glazier Giovanni di Bonino. A wall painting in the sacristy of Assisi's Lower Church is considered the Master of Figline's earliest known work, and stained glass in two of Assisi's chapels have been attributed to him.[33] The Master of Figline worked simultaneously in panel painting, fresco, and glass. His glass painting on both the *recto* and *verso* of SII consists of a series of closely-laid, fine brushstrokes, a painstaking and time-consuming application that attests to the extraordinary sensibilities of the Master of Figline, who demanded a high degree of subtlety and veracity from the stained-glass medium. The artist's connection with the glass material is seen in his careful choices; a delicately-colored rose glass for the flesh, and a seldom-seen brown for the Franciscan habits. Assisi's early windows surely constituted for him an encyclopedia of stock repertoire, such as lattice grounds of interlocked quatrefoils. The Master of Figline transformed the motif by leading single, lime green quatrefoils in deep blue fields, like citrine stars in a cobalt sky (figs. 4a-b). Using the same multi-layer lime glass used in sIII, Figline created a splendid foil for three-dimensional figures of flesh and blood, suspended in a spiritual realm deliberately devoid of spatial illusion.

14th-century stained-glass production in Florence was accomplished through a variety of arrangements. The Master of Figline, an artist apparently competent in all phases of stained-glass production, seems to have exerted control over the fabrication of SII from design to execution. The painter Jacopo del Casentino approached the decoration of the Velluti Chapel as a synergistic, multi-media ensemble. Besides executing the chapel's altarpiece and frescoes, he played a significant role in the production of its stained-glass window—doubtless drawing from a master glazier's technical expertise in order to achieve his artistic vision for the Velluti chapel within the context of a stained-glass workshop.

[32] G. Marchini (1968), pp. 64-66. See S. Bracci *et al*. (2017).

[33] Frank Martin and Gerhard Ruf, *Le vetrate di San Francesco in Assisi*, Francescana, Assisi, 1998, pp. 148-158. See also N. Thompson 2019.