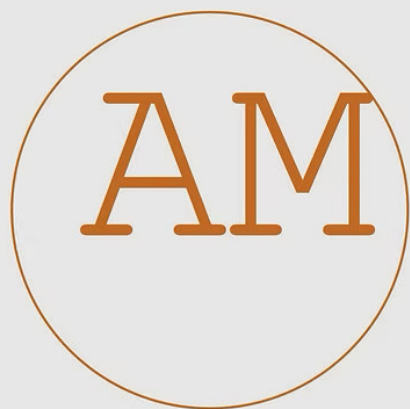




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THE FEMALE HAND



EDITED BY
PAUL J.C. VAN LAAR, ERMA HERMENS, AND PETRIA NOBLE

EDITORIAL

This special issue of *Art Matters*, our third, grew out of a session at the 2024 Historians of Netherlandish Art (HNA) conference, held in Cambridge from 10 to 13 July 2024. That session, “Technical Art History: Material Stories – Object Itineraries,” called for interdisciplinary work combining technical and contextual approaches to Netherlandish art, with a particular focus on the skill and status of female artists from the sixteenth to eighteenth centuries.

Where the original call singled out female painters and their status, training, and skill, the papers that emerged move well beyond the painter’s studio, into the workshops of goldsmiths and manuscript illuminators, and into the trade in artists’ materials itself. That a session framed around female skill in painting should draw in work on so many other crafts is telling: it points to a broader reorientation now underway in the field exemplified by recent exhibitions such as ‘Michaelina Wautier (1604–1689): Glorifying a Forgotten Talent’ in Antwerp (2018) and, ‘*Michaelina Wautier, Painter*’, in 2026, at the Kunsthistorisches Museum, Vienna, and the Royal Academy, London, as well as ‘*Unforgettable: Women Artists from Antwerp to Amsterdam, 1600–1750*’ (National Museum of Women in the Arts, Washington, D.C, September 2025–January 2026, and Museum voor Schone Kunsten, Ghent, March–May 2026), which presented women artists and artisans across disciplines, many previously unknown.

Every study pairs close material or technical analysis with archival research. The guild rolls, inventories, and workshop documents that underpin our histories of early modern making were kept by institutions that rarely admitted women to master status, and a woman’s hand tends to survive in these records only at the margins: named in passing, folded into a husband’s or father’s entry, or visible only through the object itself.

Hanne Schonkeren investigates the work of female goldsmiths and silversmiths in sixteenth-century Antwerp, where the Saint Eligius guild barred women from registering as masters. Drawing on rediscovered documents in Antwerp’s city archive on the *parelgaterambacht* (the pearl-drillers’ craft), she argues that pearl-drilling was largely women’s work.

Louisa Smieska, Ruth Mullett and Brittany Rubin study an illuminated leaf from a fifteenth-century Dutch Book of Hours held at Cornell University Library. Using synchrotron X-ray fluorescence and diffraction, conventional X-ray fluorescence, and fibre-optic reflectance spectroscopy (FORS), they identify its pigments, among them lead-tin yellow and an unusual antimony-rich grey, and set these findings beside illuminated leaves attributed to the Convent of St Ursula in Delft.

Marleen Puyenbroek reattributes a seventeenth-century Rotterdam paint shop, moving its authorship from Abraham van Bubbesson to his wife, Ermtgen van Putten. Newly found archival sources, she argues, show that van Putten, not her husband, ran the business and prepared the paint herself.

Kirsten Derks, Koen Janssens, Katlijne Van der Stighelen and Geert Van der Snickt examine Michaelina Wautier’s (c. 1614–1689) *Flower Garland with Butterfly* (1652), one of only two flower paintings known by her. Combining micro-X-ray fluorescence scanning (MA-XRF) with analysis of a paint cross-section, they read her materials and layer build-up for evidence of her training.

Across metalwork, manuscript illumination, the paint trade, and easel painting, the four studies recover women as makers whom the guild rolls and inventories left under-recorded. Where documents and the dominant art-historical narrative fall silent, the objects and their materials carry what evidence survives. It is precisely at this point, where the paper trail runs out, that technical art history has the most to offer. By bringing technical research and close contextual reading together rather than keeping them apart, it can recover makers that neither approach would find alone, and start to put a woman’s hand back into the picture.

We thank our four talented young scholars for their excellent papers, and our reviewers for their generous and careful attention. We also take this opportunity to issue an open call for further contributions on the theme of the female hand, which we hope to add to this Special Issue in the future.

Paul J.C. van Laar, Erma Hermens, Petria Noble

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‘WERELDLIJCKE ENDE GEESTELIJCKE DOCHTERS, HET PEERLEGATEN DOENDE’: THE FEMALE HAND IN EARLY MODERN ANTWERP GOLD AND SILVERWORK

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ABSTRACT During the sixteenth century, Antwerp became an epicentre for skilled gold and silversmiths, who organised themselves into the Saint Eligius guild. This guild excluded women from registering as masters and, therefore, from working as goldsmiths. However, women did enjoy certain privileges in early modern Antwerp—wives of goldsmiths were authorised by their husbands to conduct business, and widows administered the atelier of their deceased husbands. Although the unique status of women in the city has been recognised, their contributions as makers remain underexplored in art historical research. Rediscovered archival sources preserved in the *FelixArchief* in Antwerp, discussing the establishment of a *parelgaterambacht*, reveal that the craft of pearl-drilling was mostly a female occupation. Apart from a small publication in 1924, these documents have hardly been studied, and neither has the technique of pearl-drilling, especially in relation to the objects containing pearls. By revisiting these archival sources and close analysis of gold and silversmithing techniques, such as drilling and setting pearls into precious metalwork, this article demonstrates the complex role of women in the early modern silversmith’s atelier, where they participated in the technical and creative processes of object-making.

KEYWORDS Antwerp, early modern period, women artisans, luxury crafts, pearl drilling, craft guilds

1 Introduction

During the sixteenth century, Antwerp emerged as a commercial and creative hub that held great attraction for skilled craftsmen who came from far and wide to settle in the city on the Scheldt. When Lodovico Guicciardini (1521–1589), the Italian merchant and writer of *Descrittione di tutti i Paesi Bassi* (1567), visited the Low Countries during this prosperous period, he marvelled at the behaviour of women and the freedom they enjoyed. He noted that the position of women in society, particularly in Antwerp, was exceptional and that they held many privileges, including engaging in trade. Guicciardini praised several

female artists, such as the Antwerp painter Catharina van Hemessen (1527/28–after 1567).¹ He also looked with admiration at the gold and silversmiths present in Antwerp, of whom he counted over 120 working in the city.²

Antwerp’s harbour, where raw materials such as silver, gold, pearls and gemstones arrived, and its wealthy merchant class, eager for precious luxury products, enabled the city to become an epicentre of gold and silversmithing during the sixteenth century. Gold and silversmiths were grouped into the Saint Eligius guild, whose preserved archival sources, including its ledger, provide valuable insight into the organisation of the craft and the processes of the making of precious objects. Although several

studies on the Antwerp guild of gold and silversmiths have pointed out the administrative role that women often fulfilled when their spouse, working as a gold or silversmith, passed away—they were allowed to manage the atelier, overlook production of the employees of the workshop, purchase materials and even take on apprentices—their contribution to the making of these luxury goods remains understudied.³

The Saint Eligius guild excluded women from the craft and forbade them from registering as masters.⁴ However, archival documents regarding early modern pearl-drilling in the city, held in the FelixArchief in Antwerp, demonstrate that this task was mostly carried out by women. These documents are the only surviving archival sources that explicitly identify women as makers. Apart from a small publication in 1924, the records have hardly been studied.⁵ This article seeks to reconstruct the multifaceted role of women in pearl work conducted in the early modern silversmith's workshop by revisiting these archival sources and considering the required gold and silversmithing techniques, such as drilling and setting pearls, in these precious objects.

2 The (in)visible female figure in a sixteenth-century gold and silversmithing workshop

In the century since Alice Clark's pioneering article 'Working Life of Women in the Seventeenth Century', art historical interest in women artists has continued to grow significantly. In recent decades, this has been reflected in the numerous blockbuster exhibitions and scholarly publications dedicated to the subject.⁶ Scholars have explored the roles of early modern women in various artistic traditions—from sculpture to portrait painting—uncovering the sophistication of female artisanship. In his recent article, Stefan Hanß examined the artisanal skills of early modern women through a body-centred approach, with a particular focus on the court of Württemberg.⁷

Nonetheless, little is known about whether sixteenth-century women worked as gold or silversmiths. LaJean Chaffin examined the extensive archives of the London Goldsmiths' Company, providing the first statistical analysis of female apprentices and mistresses in the Goldsmiths' Company from the sixteenth to the eighteenth centuries.⁸ However, the female enrolments in the Company—as apprentice or mistress—date mostly from the seventeenth and eighteenth centuries, and there is a conspicuous absence of such records from the sixteenth century. Giorgio Vasari (1511–1574) makes a rare mention of the Bolognese female artist Properzia de' Rossi (c.1490–1530) in his influential *Le vite de' più eccellenti pittori, scultori, e architettori* (first published in 1550). Although not descending from a family of artists, de' Rossi was trained in painting, music, literature and poetry, and eventually chose sculpting and goldsmithing as a career.⁹ Vasari described her as 'an excellent woman [...] causing not only many women but also men were envious

of her'.¹⁰ Properzia started out carving fruit stones, such as cherry pits, peach and apricot stones, which, according to Vasari:

She executed so well and with such patience, that they were singular and marvellous to behold, not only for the subtlety of the work but also for the grace of the little figures that she made in them and the delicacy with which they were distributed.¹¹

Properzia de' Rossi is among the few female goldsmiths whose names are preserved today. Women did not have access to the makers' guilds and were prohibited from obtaining master status.

Preserved engravings and prints from early modern gold and silversmithing workshops offer another source of information. These show a mainly male-dominated environment. Prints and sources based on first-hand experience, such as the writings of the Italian goldsmith and sculptor Benvenuto Cellini (1500–1571), testify to the tense and at times downright dangerous atmosphere in the workshop, undoubtedly caused by the hierarchical differences in skill and dominance between master, journeymen and apprentice within the workplace. In his autobiography *Vita di Benvenuto Cellini*, the author describes multiple violent confrontations with peers or apprentices, which even resulted in the murder of a rival goldsmith in 1534.¹² Early modern goldsmith workshops by Martin Schongauer (c.1430–1481), himself the son of a goldsmith, and Jean de Gourmont I (c.1483–1551) depict fighting apprentices within grimy ateliers, their fire tongs used as weapons.¹³ These ateliers, where men control fire and heat, hammer large pieces of precious metal into shape—all under the watchful eyes of talkative passers-by—do not seem to be appropriate spaces for early modern women. However, women are sometimes present in early modern renderings of workshops. A punched engraving dated 1540–1580 depicts a crowded, rowdy and animated gold and silversmithing workshop.¹⁴ Men of various ages are depicted hammering, filing, handling the fire or carousing, toasting what seems to be a glass of liquor while a musician plays the violin. A woman stands by the door, her curiosity evident as she peeks into the vibrant atelier. In a print dated c.1440–1460 depicting Saint Eligius, patron of gold and silversmiths, hammering a chalice (Fig. 1), the worker at the table on the right employing a hammer appears to be a woman with long hair, feminine facial features and a long, flowing garment. Her unusual presence raises questions about female involvement in the early modern gold and silversmithing ateliers. Women are also depicted in Georgius Agricola's *De Re Metallica* (1556). In book VII on methods of assaying metal ores, we see them examining and sorting workable ores and separating metals from sediment using a sluice and a wooden scrubber.¹⁵

In Antwerp, it seems that women were sometimes active members of crafting enterprises. The Italian Lodovico Guicciardini noted that, 'From an early age, the women deal freely with everyone and engage in trade themselves.



Figure 1 Attributed to the Master of Bileam, *Saint Eligius in his workshop*, 1440–1460, engraving, h 115 mm × w 185 mm, Rijksmuseum Amsterdam, inv. N° RP-P-OB-963.

They are diligent with hand and tongue, in matters that should really be done by men.¹⁶ Guicciardini's observation is supported by *Het Grootwerk*, the ledger of the Saint Eligius guild.¹⁷ While women were excluded from registering as masters in the guild, these archival sources show that they were often working alongside their maker-husbands, forming collaborative partnerships, a phenomenon referred to as *working couples*.¹⁸ For instance, Katelijne Colozy (active 1569–1583), the wife of Francois van Aelst (1513–before May 1569), was clearly involved in his jewellery business. On 31 January 1559/60, husband and wife received prizes for the upcoming lottery of 1561, which included several pieces of gilded silverwork and jewellery. The entry in the ledger specifies that both carried the responsibility of safekeeping and exhibiting the pieces, and in case of theft, they could both be held accountable. Furthermore, after his death, she inherited his atelier and continued to operate it for at least 6 years. In 1571, she apprenticed Victor Fictor (active 1571–1593), and in 1575, she took on Melsen Thienpont (b. 1561) as a pupil. It is unclear if she trained the apprentices herself, which would imply that she possessed the requisite skills of a gold and silversmith. For reasons unknown, her son Francois Van Aelst II did not enter his mother's atelier but apprenticed in 1569 with silversmith Hans van de Broeck.¹⁹

Antwerp's sixteenth-century gold and silversmiths also sometimes authorised their wives to conduct business, inspect and trade raw materials such as silver and gemstones, and to complete work on silverware.²⁰ In 1561/62, Elisabeth van Triest, the spouse of the goldsmith Jehan de Molleda, received a collection of jewels and precious stones for safekeeping. Tanneken Marchant, wife of goldsmith Jan Lossyn (b. c.1521), testified in 1577 regarding several jewels presented to her by another woman, Tanneken Broeckmans. It also appears that certain (married) women held the autonomy to pursue business and financial transactions independently. In 1555, several affluent members of the Saint Eligius guild, including Cornelis van Eekeren (1487–1559), mint master of Brabant, and Joris Veseler (c.1492–1574), general of the mint, testify in favour of Anna van de Velde, wife of goldsmith Everaert

Everdeys (d. before 1564), confirming that her husband is, in fact, the author of a document in which he authorises her to sell a collection of jewellery for her personal profit. Furthermore, in the city accounts of Antwerp, a transaction involving a woman named Magdalena Wevers is documented. On 18 March 1577, Wevers sold a gilded silver ornamental cup, intended as a gift from the city for the Spanish auditor, for 52 guilders and 18 schillings.²¹ It is unclear, however, whether she created the cup herself or was primarily responsible for managing the financial and commercial aspects of her husband's business.

Sixteenth-century visual culture and archival sources from Antwerp thus confirm the participation of females in the craft of gold and silversmithing. Furthermore, we may be able to pinpoint particular aspects of the craft in which women specialised.

3 Female pearl drillers and the establishment of a guild

Pearls are commonly associated with early modern female adornment, symbolising purity, virtue and wealth. However, little attention has thus far been given to female agency in cultivating and crafting pearls. A painting by Antonio Tempesta (1555–1630), executed in oil on an expensive piece of lapis lazuli, was presented as a gift by Pietro Strozzi (c.1510–1558) to Grand Duke Cosimo II de' Medici (1590–1621) for the Uffizi Tribuna.²² The work illustrates the intense and tumultuous process of pearl diving in India. The scene features men emerging from the water with oysters, which are handed to women at the shoreline, who open the oysters and collect any pearls found within.

Through the harbour of Antwerp, pearls found their way to the city from the Americas and Asia. Archival sources and preserved objects demonstrate the popularity of pearls among the Antwerp gold and silversmiths. *Het Grootwerk* documents hundreds of pearls bought from foreign merchants, inventoried in estates and incorporated in jewellery and silverware. While pearls do not require complex interventions such as polishing or cutting after harvesting, they have to be prepared for mounting and assemblage.²³ In early modern Antwerp, the task of pearl-drilling was predominantly performed by women, as can be deduced from an archival record demonstrating an attempt to establish a *pearl drillers guild* (*een parelgatersambacht*). In 1599, eight pearl drillers submitted a formal petition to establish a guild that would unify their profession and subject its members to a set of regulations under an official ordinance.²⁴ The petitioners emphasised the superior quality of pearl-drilling skills in Antwerp compared to other regions and expressed concern that foreign individuals were able to acquire these skills in a relatively short period, subsequently leaving the city and taking with them the secrets of the craft.²⁵ As the craft of diamond cutting was protected since 1582 by the establishment of a guild, the pearl drillers aspired

to a similar solution.²⁶ In September 1599, their request was denied.²⁷ Ten years later, in 1609, a group of pearl drillers ventured a second attempt to establish a guild. This time, an *ordonnance* was drafted, which mandated a period of apprenticeship, followed by a year of work as a journeyman, culminating in the creation of a master-piece. Registration as a master was restricted to citizens of Antwerp, and the process required the payment of an entrance fee. In an effort to ensure the quality of drilled pearls, pearl drillers were no longer permitted to be compensated based on piecework or weight. Furthermore, the ordinance addresses the subject of women drilling pearls. The document does not explicitly state that women were prohibited from working as pearl drillers; however, these new regulations made this nearly impossible. They were barred from taking on apprentices, allowed to work only if they remained unmarried and were required to abandon everything not related to household duties.²⁸ Opponents of the reform, led by the Antwerp jeweller and merchant Diego Duarte (c.1544–1626), argued that the contribution of women as pearl drillers was indispensable. According to the documents, the guild would lead to diversion and reduction of the industry, and to the oppression of many widows and daughters who had always earned their living through pearl-drilling.²⁹ Moreover, the document stated that the group facing exclusion were precisely those most skilled in the craft, as they possess the keen visual acuity and delicate gestures (*scheepicheijt van gesichte ende delicate handelinge*) essential for executing the task with precision.³⁰ Duarte, one of the foremost dealers in jewellery and gemstones active in Antwerp, had also attempted to prevent the founding of the diamond cutters' guild, hoping that by preventing incorporation into a guild, he could continue to benefit from cheaper, unregulated labour and to maintain his influence within the Antwerp gemstone industry.³¹ A document dated 29 April 1610 eventually sided with the merchants who opposed the guild. Pearl-drilling was not regulated into a guild, and women remained at liberty to pursue this craft.³²

As women had no access to training in the workshop, their skill in pearl-drilling may be related to their experience in needlework. Stitching, embroidery and weaving were part of the curriculum of middle- and upper-class girls and required the same visual acuity and delicate hand coordination described for pearl-drilling.³³ The intricate gestures required to create small components of larger artworks require specialised and highly technical skills, but have not received much attention in traditional art history. Vasari already claimed that female art was 'small in scale and modest in ambition'.³⁴ The Antwerp letter of 1609, opposing the establishment of the pearl drillers guild, similarly diminishes the complexity of pearl-drilling, stating that it can be mastered within a short period of six to seven weeks.³⁵ Other voices, however, appreciated the high technical skill required to make miniature artworks. Significantly, Erasmus of Rotterdam (1466–1536) wrote to young John More (1509–1547) in 1523 that the scale of a piece was irrelevant, as small-scale works

required more technical skills and, therefore, should evoke greater admiration.³⁶

4 A closer look at the technical incorporation of pearls into precious objects

While the documents in the Felix Archives indicate the importance of wives and daughters of gold and silversmiths drilling the pearls, they do not describe the craft of pearl-drilling or the engagement of women with this technique in further detail. We attempted to mitigate this lacuna in documentary evidence by undertaking a visual analysis of the drilled and mounted pearls on Antwerp-made objects, attempting to highlight the (in)visible contribution of the female maker.³⁷

When an object was completed in an early modern Antwerp atelier, the master of the workshop applied his master stamp. The piece was then submitted to the Saint Eligius guild, where the precious metal was assayed by the deans. In the event of any issues with the piece, the responsible silversmith could be readily identified through the master stamp.³⁸ In contemporary contexts, an object is typically attributed to a single maker. However, these complex pieces were often the result of collaborative practices within the atelier, where many hands contributed to the final product. A detailed analysis of these objects, specifically examining how pearls were drilled and connected to precious metals, provides valuable insights into the technical and creative processes of pearl drillers and the involvement of women in the smithing atelier.

Several preserved ornamental cups have suspension rings, indicating that they were once embellished with now-lost pearls.³⁹ Goldsmith's inventories distinguish several types of pearl: droplet-shaped or pendant pearls (*hangpeerlen*); large, irregular baroque pearls (*barokes peirlen*); button pearls (*knoppeerlen*), which are round pearls with a flat side; and rare, Scottish pearls, which were collected from Scottish rivers.⁴⁰ These pearls were either purchased undrilled, packaged in paper, or drilled and threaded in strings.⁴¹ The undrilled pearls were drilled inside the atelier and incorporated by the gold and silversmith into these precious objects. Petrus Christus (c.1410–1475/76) depicts raw materials in *A Goldsmith in his Shop*: wolf's teeth, a large branch of coral, gemstones and lots of undrilled pearls (Fig. 2). A package of undrilled pearls can also be observed in the painting *The Moneylender and His Wife* by Quinten Metsys (c.1466–1530).⁴²

The process of pearl-drilling is described by the twelfth-century monk Theophilus (fl. c.1070–1125) in his manual *On divers arts*, the foremost medieval treatise on painting, glassmaking and metalwork. He writes:

They [the pearls] are pierced with a fine steeled drill fixed into a wooden spindle having on it a small lead wheel and another piece of wood in which it can turn. A strap is attached by means of which it can be rotated.⁴³



Figure 2 Petrus Christus, *A Goldsmith in His Shop*, Netherlandish, 1449, Oil on oak panel, 100.1 × 85.8 cm, The Metropolitan Museum of Art, inv. N° 1975.1.110.

Theophilus describes a pump drill—a simple but effective hand drill that came into use in the Roman period and was replaced with modern tools around the nineteenth century. A pump drill is composed of a wooden shaft, which has a flywheel and a drill chuck at the bottom, and a wooden drill handle, which is connected to the shaft with a textile strap. To start, the rope has to be double-twisted around the shaft. To drill, the drill handle is rhythmically pushed down. The flywheel then rotates the shaft in reverse, coiling the rope back up and bringing the drill handle back up. The drill is set in a back-and-forth motion by a rope winding up and down around a spindle. To prevent overheating, the pearl had to be regularly doused with water.

Pump drills are often depicted in early modern visual culture. The earliest portrayal is found in a fifteenth-century illuminated copy of the *Naturalis Historia* (AD 77–79) by Pliny the Elder (AD 23/24–79), in which a craftsman is drilling pieces of coral (Fig. 3). Caspar Luyken (1672–1708) included in his series of crafts *Het Menselyk Bedryf* (1694) a pearl driller or *Peerelgaater*.⁴⁴ Here, a large block of soft wood is used to fix the pearls in place. Pump drills can also be spotted in several prints and paintings of early modern gold and silversmithing ateliers. They appear to be essential tools in the pre-industrial workshop. A pump drill made around 1570 is preserved in the Staatliche Kunstsammlungen in Dresden (Fig. 4). This exemplar, with intricate wood carvings and etchings, was clearly never used but served as a collector's item.

To further investigate the technique of pearl-drilling and the female engagement with the tools, we conducted experiments in drilling using a modern reconstruction of



Figure 3 Pliny the Elder, *Historia Naturalis*, in Latin, Illuminated Manuscript, Ink, pigments and gold on parchment. Leather binding, c.1460–1470 (made), V&A, library N° MSL/1896/1504.



Figure 4 Pump drill (*Rennspindel*), Germany, c.1570, Iron, brass weight, wood, leather strap, L. 30.4 cm, W. 23 cm, Flywheel d. 3.9 cm, Rüstammer, inv. N° P 0224.

a pump drill. These experiments suggested that the main challenges were avoiding damage to the pearl from overheating during the drilling process and ensuring that the perforations followed straight trajectories through the pearl. Pearls cannot tolerate heat, as this can cause them to discolour or crack. Therefore, we could conclude that the early modern silversmith had to ingeniously incorporate the pearls into the objects in an attractive manner using cold connection methods. To connect pendant pearls, a wire was formed into a headpin by fusing one end into a ball with heat. The ball, which had to be larger than the drill hole in the pearl, supported the pearl from below, while a loop was formed at the top of the pearl, which could be connected to the object by means of a small metal ring. The pearl thus could dangle freely, adding movement to the design (Fig. 5).

Similar headpins were used to connect button pearls to objects (Fig. 6). As cups and other precious metalwork objects were handled and admired for their craftsmanship, it was imperative to conceal the backs of the pearls

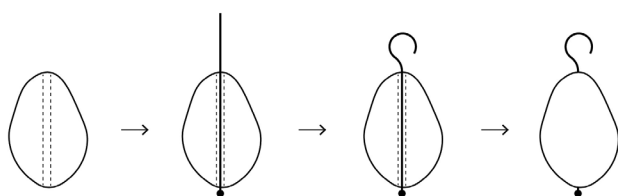


Figure 5 Diagram showing the connection of a pendentive pearl. (Drawing by the Author.)

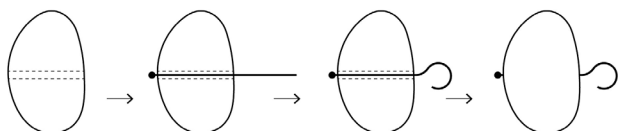


Figure 6 Diagram showing the connection of a button pearl. (Drawing by the Author.)



Figure 7 Reinier van Jaersvelt, *Detail of: Goblet with cover*, 1546–1547, fire-gilded silver, glass, pearls, 27.1 × 11.7 cm, Rijksmuseum Amsterdam, inv. N° BK-KOG-2465.

from which the other side of the headpin protrudes or to seamlessly incorporate the pearl into the metal object. One way of concealing the back was to add a decorative element. In a silver, fire-gilt goblet made by Reinier van Jaersvelt (1504–1575) and preserved at the Rijksmuseum Amsterdam, a pearl is attached to a flower, forming the pistil while also cleverly hiding the other side of the wire (Fig. 7). In the 1552 pax table preserved at the *Hofkirche* in Innsbruck, van Jaersvelt applied different colours of enamel on the petals, disguising them as realistic flowers (Fig. 8). In the pax table—a liturgical object used for conveying peace through a ceremonial kiss—the craftsman experimented with incorporating half-drilled pearls, to



Figure 8 Reinier van Jaersvelt, *Paxtable of Averbode*, 1552, partly fire-gilded, enamel, rubies, pearls, H. 28.5 cm; W. 17.5 cm, Innsbruck, Hofkirche.

conceal the metal wire that connected the pearls with the object. A row of larger pearls on the lower half of the pax table seems to be suspended without pins, as no holes or headpins are visible on the front side of the pearls. Close examination of an area where some pearls are missing revealed the drilling and attachment techniques used. Where one pearl is missing at the end of the row of the pax table, a single hole is visible in the metal. This suggests that a rigid pearl pin was soldered or pressure-fit into the hole; the half-drilled pearl was fixed on the pin and further secured with glue or resin.

A pectoral cross with 13 pearls made in 1562 by the Antwerp goldsmith Jeronimus Jacops (d. 1576) also demonstrates various techniques for the attachment of pearls to metal (Fig. 9). Eight pearls are attached to the arms of the cross. These pearls are fully drilled and suspended in groups of two, each pair connected by means of a gold wire, which has been drawn through two holes drilled in the metal. In addition, five pendant pearls are suspended from the cross, and one large droplet-shaped pearl, the latter of which is half-drilled, concealing the pearl pin.⁴⁵

The so-called Saint Michael's Cup, made by the silversmith Joris Vezeleer (1492–1574) for the French king Francis I (1494–1547), is lavishly embellished with over 100 pearls (Fig. 10). The arrangement of the pearls is not arbitrary but rather the result of careful planning. Various drilling techniques are utilised to incorporate different pearl shapes, contributing to the overall design of the cup. Button pearls, drilled from their long side, were



Figure 9 Hieronymus Jacobs, *Pectoral cross*, 1562, gold, enamel, pearls, gemstones, H (without pearls): 11.6 cm, W: 8.8 cm, Kunstgewerbemuseum Berlin, inv. N° F 3783.



Figure 10 Joris Vezeleer, *Ornamental Cup, so-called Saint Michael's Cup*, 1532, gold, enamel, diamonds, emeralds, rubies, pearls, 51.7 × 16.8 cm, Kunsthistorisches Museum Vienna, inv. N° Kunstammer, 1120.

strategically placed on the lid and foot of the cup, as their flat side made them particularly well-suited for this positioning. In several places, button pearls, drilled across the short side, were disguised as a flower, with the pinhead

forming the pistil. On the cast ram heads and satyrs, pendant pearls, drilled from their long side, have been attached with pinheads, creating lively movement in the design.

5 Conclusion

Although later alterations can complicate the interpretation of the pearls and their methods of attachment to silver and goldsmith objects, archival sources such as *Het Grootwerk* testify to an abundant trade in pearls and the use of pearls on precious metal objects in early modern Antwerp. The documents regarding *het parelgatersambacht* shine a light on the delicate skills of the Antwerp pearl drillers and the superior quality of their work compared to that found in other regions. They also support the idea that women had a pivotal role in this craft, although their involvement in the atelier remains invisible.

Understanding how these pearls were incorporated into the objects reveals the necessity of buying undrilled pearls, since the method of drilling a pearl influences its setting in the metal object. The pearl could be drilled from different sides; for instance, for the flower pearls, a button pearl was drilled on the short side, while for other connections, the pearls were drilled on the long side, and pendant pearls could be either half-drilled or fully drilled, depending on the specific requirements of the design. Therefore, this article contends that, despite the perception that pearl-drilling is a simple and perhaps inconsequential task, the women engaged in drilling pearls for ornamental cups collaborated intimately with the silversmiths in both the creative and technical aspects of the making process. They would need to examine the objects and determine the correct drilling technique for the pearls, based on their intended placement, a task probably performed in the atelier, in close collaboration with the silversmith.

Early modern Antwerp objects required a master stamp upon finishing, enabling the deans of the guild of the gold and silversmiths to identify the responsible maker whenever an issue arose during the inspection of the piece. As a result, these objects are today associated with one name or maker. However, it is clear that many hands were involved in the making processes required of a complex piece. By combining archival research with technical examination of the works themselves, this article endeavoured to make one of these invisible hands, the female hand, visible.

Notes

1. Aristodemo 2020: 83.
2. In 1566, he counted: 'goudtsmeden hondert vier en twintich, sonder alle de stekers, snyders ende slypers van juwelen ende andere costelycke gesteenten'; Baudouin 1988: 31.
3. For instance: Schlugleit and Van Roey 1969; Baudouin 1988.
4. Schlugleit and Van Roey 1969.
5. Goris 1924.

6. See: Clark 1919. For instance: the travelling exhibition 'By Her Hand: Artemisia Gentileschi and Women Artists in Italy, 1500–1800', or 'Sofonisba Anguissola: Portraitist of the Renaissance' at the Rijksmuseum Twenthe in Enschede.
7. Hanß 2023.
8. Bashforth *et al.* 2023.
9. Straussman-Pflanzer and Tostmann 2021.
10. Bondanella 1998: 399–444.
11. D'Apuzzo 2007.
12. Cellini 1969.
13. Schongauer, Martin, Apprentices Fighting, c.1485, Engraving, Fine Arts Museums of San Francisco; Jean de Gourmont I, Two Apprentices Fighting, Rosenwald Collection, inv. N° 1980.45.625.
14. Print, German, c.1540–1580, British Museum, inv. N° 1853.0312.241.
15. Agricola 1986: 268, 326.
16. Aristodemo 2020: 81.
17. The various records that make up *Het Grootwerk* are preserved in the Felix Archives (Antwerp) and between 2005 and 2008 were transcribed and made available online by the late researcher Godelieve van Hemeldonck (1933–2023).
18. Hanß 2023: 4.
19. Van Hemeldonck 2005–2008: BE SA 7484. Hans van de Broeck is also mentioned as: Hans ten Broecke III, b. 1524.
20. Gelderblom 2007: 22.
21. Van Hemeldonck 2005–2008: BE SA 7484.
22. Koeppe and Giusti 2008: 174. The painting is held in the Louvre, Paris: Antonio Tempesta, Pearl Fishing in the Indies, c.1610, oil on lapis lazuli, inv. N° MR suppl. 243.
23. Ogden 1996.
24. These endeavours were documented and preserved in the Felix Archives in Antwerp, offering a unique view of female activities, see Perelgaters, 01/01/1609 – 31/12/1610, Felix Archives Antwerp, inv. N° GA#4520.
25. 'ongelijck beter ende proffijtelijcker opmaeckende dan men die in Sincen placht te gaten'; Goris 1924.
26. Under the guidance of Elias Boudean, a request was filed to establish a diamond cutters guild in 1577, which they were allowed in 1582; Baudouin 1988: 28.
27. Perelgaters, 01/01/1609 – 31/12/1610, Felix Archives Antwerp, inv. N° GA#4520.
28. Perelgaters, 01/01/1609 – 31/12/1610, Felix Archives Antwerp, inv. N° GA#4520.
29. '[...] tenderende tot diversie ende verminderinghe van denselve neijringhe, ende tot oppressie van veele eerlijcke weduwe als van werellicke, ende geestelijcke dochters die henen cost vermeer altijts hebben gewonnen'; Perelgaters, 01/01/1609 – 31/12/1610, Felix Archives Antwerp, inv. N° GA#4520.
30. '[...] uuyt redenen van scheepicheijt van gesichte ende delicate handelinge diemen daertoe moet gebruijcken'; Perelgaters, 01/01/1609 – 31/12/1610, Felix Archives Antwerp, inv. N° GA#4520.
31. Goris 1924.
32. Perelgaters, 01/01/1609 – 31/12/1610, Felix Archives Antwerp, inv. N° GA#4520.
33. Straussman-Pflanzer and Tostmann 2021
34. Straussman-Pflanzer and Tostmann 2021
35. Perelgaters, 01/01/1609 – 31/12/1610, Felix Archives Antwerp, inv. N° GA#4520.
36. Rublack 2016: 9; 'whether he makes a colossal statue or a statue of half a foot, whether he paints Jupiter or Thersites, whether he carves an image in bronze and in ordinary stone or in precious stones or in gold; only the admiration for his craftsmanship is greater when he works in material of little value or of small size'; Slitz 2012: 114.
37. The author notes that these pearls may have been replaced later due to loss, damage or a change in stylistic preferences. This study forms part of a larger PhD project 'Ingenious Craftsmanship: a performative and art historical study of gold and silversmithing in sixteenth-century Antwerp' (funded by the Research Foundation – Flanders [FWO], file number 1184525N) that researches Antwerp sixteenth-century ornamental cups by means of Reconstruction, Replication and Re-enactment (RRR), an approach that aims to deepen our understanding of these historical artefacts through the creation of reconstructions, and thus to reveal making techniques, materiality and cultural significance. For more context on this innovative research method, see: Dupré *et al.* 2020.
38. Baudouin 1988: 26–7.
39. Schroder 2007: 142.
40. Van Hemeldonck 2005–2008: BE SA 7484; Warsch 2018: 203–4.
41. Inventory of Nicolaes Cathamenen in 1526: 'XLVIJ peerlen onder middelbaer in zesse papierkens'; Van Hemeldonck 2005–2008. Loan of a batch of pearls and jewels in 1588: Daniël de Bruyne II as lender against Anthonis Millich: 'een snoer met twintich cleyn schotte perlen', Van Hemeldonck 2005–2008: BE SA 7484.
42. Metsys 1514.
43. Theophilus 1979: 125–6.
44. Caspar Luyken, after Jan Luyken, *Peerelgaater*, 1694, Rijksmuseum Amsterdam, inv. N° RP-P-OB-44.537.
45. This commission is documented in a contract, preserved in the Averbode Abbey (Scherpenheuvel-Zichem, Belgium), which specifies the purchase of eight pearls to be incorporated into the cross, so it remains uncertain which pearls were connected during the original making process; Lefèvre 1932: 308.

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HER DEVOTIONAL: TECHNICAL ANALYSIS OF AN ILLUMINATED MANUSCRIPT LEAF FROM A DELFT CONVENT

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ABSTRACT This article presents a technical study of an illuminated leaf from a fifteenth-century Book of Hours in Dutch held in the Cornell Library Rare and Manuscript Collections. We have performed synchrotron X-ray fluorescence (SR-XRF) and X-ray diffraction (XRD) mapping, as well as noninvasive point analysis with X-ray fluorescence (XRF) and fiber optic reflectance spectroscopy (FORS). We report on the diversity of pigments identified, including mineral pigments, lead-tin yellow, mosaic gold, and an unusual antimony-rich gray. These findings are compared with point XRF measurements of pigments in stylistically similar leaves in the Pitts Theology Library at Emory University, which have been attributed to the Convent of St. Ursula in Delft. Based on comparisons between imagery and penwork styles especially, we propose that the Cornell leaf may also belong to this corpus of work created at the Convent of St. Ursula, potentially expanding known examples of manuscripts created by female hands. However, while related, the palettes of the Cornell leaf and the Emory leaves are not identical, complicating our understanding of pigment use within and among medieval workshops, especially those run by women artisans.

KEYWORDS Illuminated manuscripts, Pigments, Antimony, X-ray fluorescence, X-ray diffraction, Synchrotron, Delft, the Netherlands

1 Introduction

This study presents a technical examination of a colorfully decorated manuscript leaf from a Dutch Book of Hours, housed within the Division of Rare and Manuscript Collections of Cornell Library (Ithaca, New York, Carl A. Kroch Library, collection 6532 MS fragment 4.18; Fig. 1). Like many surviving illuminated manuscript leaves, it has been separated from its original context, and little is known about its creation. Throughout the fifteenth century, Dutch Books of Hours were produced across a wide

range of workshops and levels of luxury, even as book printing began to expand. Prayer books were commonly owned by laypeople, not just by those following a religious life. In Delft, manuscript production flourished, at least two centers of which were based in convents: the Augustinian Convent of St. Agnes and the Franciscan Convent of St. Ursula.

The workshop at St. Ursula produced Books of Hours both for internal use and for use by others. Compared with the oeuvres of their contemporaries, including the workshop of St. Agnes, the St. Ursula workshop generally



Figure 1 Leaf from a Book of Hours. Dutch, late fifteenth/early sixteenth century. Attributed to Convent of St. Ursula in Delft. MS 6532.4.18, Division of Rare and Manuscript Collections, Cornell University Library. (a) Recto, (b) verso, (c) area scanned with synchrotron XRF and XRD, (d) detail highlighting architecture in the background. (e) detail of angel holding the *arma Christi*.

produced prayer books with relatively simple decorations. Kathryn Rudy has described how both the Convents of St. Agnes and St. Ursula also engaged in adding prayers and embellishment to plain, modular Books of Hours.¹

We will explore whether the Cornell leaf can possibly be attributed to the female workshop of the Franciscan Convent of St. Ursula through stylistic similarities with other leaves attributed to the convent. Through technical analysis of the materials used to create this leaf, we will show that even this supposedly simple decoration contains a rich palette of pigments, both furthering and complicating our understanding of manuscript illumination in a single medieval women's workshop.

2 Description and stylistic discussion

The text on this leaf, written in a Northern Textualis Formata hand dating from the late fifteenth to early sixteenth century, contains a passage from the Office of the Holy Cross in Geert Groote's translation.² The verso includes the hymn *Patris sapientia* beginning on the second line. The rubric, consisting of the top four lines in red on the recto, states that those who read this prayer daily are without mortal sin, are deserving, and will earn 1-year indulgence. A nearly identical rubric may be found preceding the Short Hours of the Cross in a c.1460 prayer book produced by the Convent of St. Agnes in Delft, supporting the dating of the Cornell leaf to the late fifteenth century.³

A large, 11-line historiated initial "h" on the recto is filled with an image of Christ crucified, attended by the Virgin Mary and another saint (Fig. 1c). Christ is nailed to a tau cross rising from a gray, rocky mound, with an

"INRI" plaque above his head. Atop the plaque is a pelican pecking at its breast to feed its young with blood, a common metaphor for Christ's sacrifice for mankind. The initial itself is filled with blue and red decoration, flourished with fine red and blue penwork. The fine penwork continues in an intricate red and blue border design, featuring symmetrical flowers and gold balls. Six small vine features, painted in green, blue, gold, and red, are spaced equally throughout the border. In the right margin, a scroll with text in blue is crossed behind an angel holding elements of the *arma Christi* (a column, a scourge, and a bundle of reeds; Fig. 1e).

Stylistic comparison of the Cornell leaf with four leaves from the Pitts Theology Library at Emory University (Atlanta, Georgia; Pitts Theology Library, collection RG 020-2) demonstrates a range of similarities (Fig. 2). Kathryn Rudy attributes these four leaves from Emory to Delft manufacture, and at least two can be linked to the Franciscan Convent of St. Ursula in Delft, based on records of the intact parent manuscript, which shows St. Ursula listed as first among the virgins.⁴ The script on each leaf is a compact Northern Textualis, and the margins are decorated with florid red and blue penwork, often dotted with metallic accents. Red and blue penwork continues from the margins to form lacy webs around the historiated initials. A painted figure of an angel or symbolic animal such as a lamb or pelican, with a lettered banner, frequently also appears in the margins. While these features are typical of Delft workshops generally, the details such as the specific shapes and patterns of penwork, the degree and hue of shading in the banners, and the handling of the figures' faces are indistinguishable between this group of leaves. These features lead



Figure 2 Leaves from Dutch Book of Hours attributed to the Convent of St. Ursula in Delft (Rudy 2011). (a) Leaf with illumination: Christ as Man of Sorrows, surrounded by the *arma Christi*, (b) leaf with illumination: the Holy Face of Christ, (c) leaf with illumination: the Five Wounds of Christ, (d) leaf from calendar (November). (e) Detail of illuminations in (a). (f) Detail of illuminations in (b). (g) Detail of marginal illumination in (c). Courtesy Pitts Theology Library, Emory University, Atlanta, Georgia.

us to propose that the Cornell leaf (Fig. 1) could also be attributed to the Convent of St. Ursula in Delft. A clue within the initial may support the Cornell leaf's attribution as well. During close examination, we were able to discern a faint cathedral spire looming on the horizon above Mary's head (Fig. 1d). This spire, which especially emphasizes an elongated pitched roof, bears a striking resemblance to the fifteenth-century silhouettes of Delft-style ecclesiastical architecture.⁵

The decorations created by the workshop at St. Ursula have been characterized as modest and simple.⁶ Compared with the highly luxurious, gold-embellished, densely illuminated decoration by the St. Agnes workshop on the Fagel Missal, for instance, the St. Ursula leaves are surely more humble; however, this does not mean that they are plain. The Cornell leaf, for instance, boasts multiple shades of greens, reds, blues, and lustrous metallic pigments.

To better understand the richness of this colorful palette, we turned to technical analysis. In particular, high-energy synchrotron X-ray fluorescence (SR-XRF) mapping and X-ray diffraction (XRD) mapping yielded rich insights into the material properties of illuminated manuscript pigments.⁷ Point XRF (pXRF) and fiber optic reflectance spectroscopy (FORS) measurements, which could be performed on-site at collections, provided an important complement to the synchrotron-based imaging.

3 Technical analysis methods

3.1 Point XRF

Point XRF was performed with a Bruker Tracer III-SD operating at 40 kV and 10 μ A. The manuscript leaf was positioned on a sheet of Plexiglas mounted between two tables, and the measurement head was pointed downward toward the fragment to avoid unwanted background excitation.⁸ The measurement head was positioned <1 mm above the fragment surface, avoiding direct contact with the object, and the typical measurement time was 180 seconds. Point XRF data were obtained from the Cornell leaf and the four Dutch manuscript leaves at Emory University (Pitts Box 1 Folders 2, 3, and 5; Box 2 Folder 2). Point XRF data were analyzed using PyMCA software.⁹

3.2 Synchrotron XRF + XRD

Synchrotron XRF and XRD were performed at the Cornell High Energy Synchrotron Source (CHESS) located on the Cornell University campus in Ithaca, NY. Synchrotron XRF and XRD measurements were collected simultaneously at each point in the scan. Measurements were carried out at station A2 with a 39.05 keV incident X-ray energy and 100 $\times$ 100 μ m spot size, employing a Maia

XRF detector and a PILATUS 300K XRD detector operating in transmission mode, as previously reported.¹⁰ X-ray fluorescence data were analyzed using GeoPIXE and XRD data were analyzed using XRDUA software.¹¹

3.3 Fiber optic reflectance spectroscopy

Fiber optic reflectance spectroscopy was performed in the visible–near infrared (NIR) range (350–1040 nm) using an SR4 spectrometer (SR-4VN500-10, Ocean Optics, USA), a 400 µm core fiber optic reflectance probe, and a 20 W halogen light source. Calibration was performed with a spectralon standard and spectra were collected using OceanView software. The apparent absorbance ($\log(1/R)$) and first derivative were computed for comparison with FORS databases.¹²

4 Results: The Cornell Leaf

4.1 White

The sky of the historiated initial is filled with a lead white background, inferred from XRF and confirmed by XRD (Fig. 3a,b). Flesh tones and white garments are also painted with lead white. Reserves are left for the cross, the figures' garments, and the dark green hill. Faint lines resembling Christ's outstretched arms are visible below the cross in the lead map, suggesting that the position of the figure may have been adjusted during painting.

4.2 Reds

From the mercury distribution, it is clear that vermilion (mercury sulfide) was used extensively in this leaf. Vermilion is present in the rubric, the red-orange in the large initial, the red penwork, and in the blood of both the pelican and Christ. Vermilion is also present in the red robe of the saint in the historiated initial (Fig. 3c,d).

However, not all red hues were painted with vermilion. There are no significant metals detected by XRF in the darker red and red-brown hues, including the shoulder garment of the saint wearing red, the red garment Mary wears, the dark red border dividing the penwork marginalia, and the larger flowers in the penwork border. These reds appear more transparent than the opaque vermilion and emit a pink-orange glow under UV light. The reflectance data from the dark red robe of Mary show two apparent absorption features around 530 and 560 nm (Fig. 4a). Together with the lack of metals in this region, this evidence suggests the presence of an organic red dye. Specifically, these wavelengths are similar to the characteristic features for animal-based red dyes such as cochineal.¹³

4.3 Blues

All the blues in this leaf contain copper as the major element and are therefore likely azurite, an assignment confirmed by XRD (Fig. 5a,b). All the azurite in the leaf contains significant trace elements, especially iron and barium (Fig. 5d,e), as is commonly observed.¹⁴ The dark blue in the historiated initial and in the smaller initials in the text is distinguished not just by its large-grained texture but also by its relatively higher barium content,

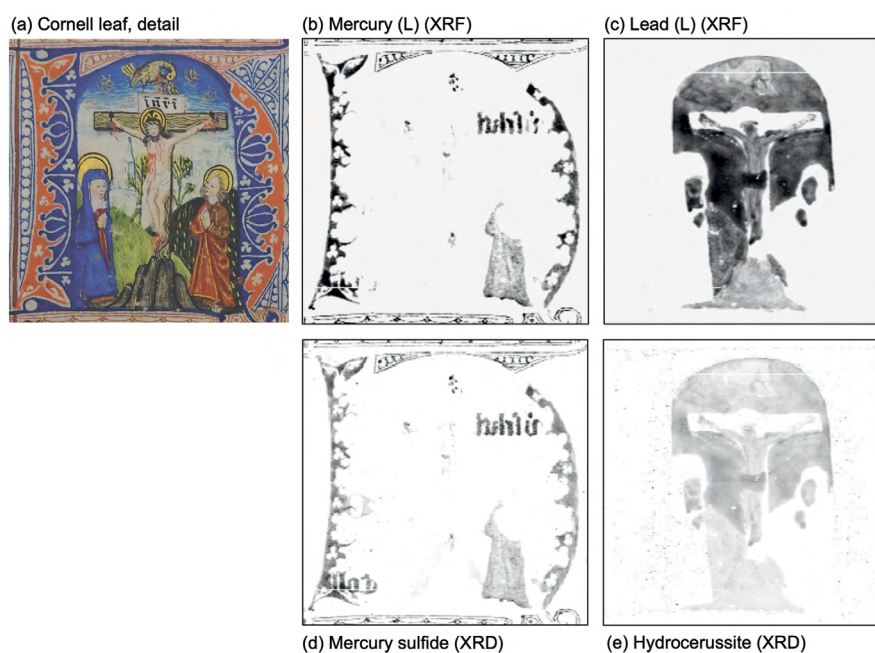


Figure 3 XRF and XRD maps for Cornell leaf. (a) Detail of the scanned area. (b) Mercury (L) XRF. (c) Lead (L) XRF. (d) Mercury sulfide XRD. (e) Hydrocerussite XRD.

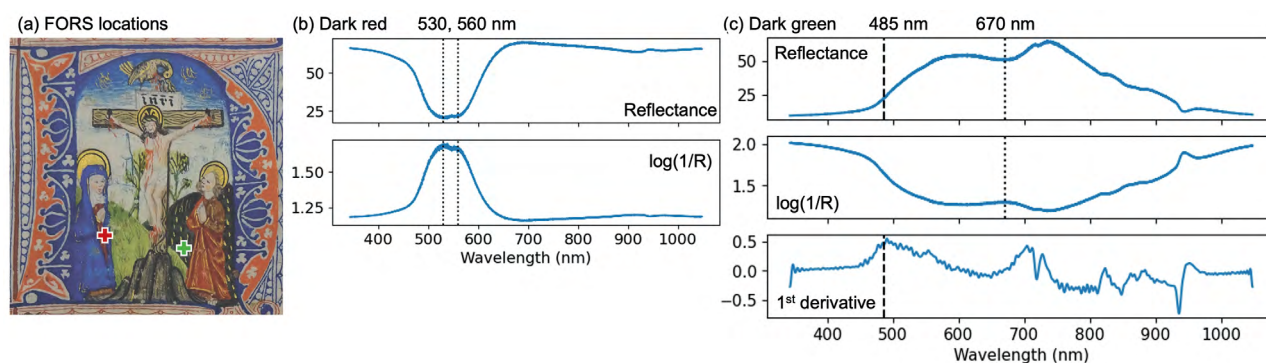


Figure 4 FORS for Cornell leaf. (a) Detail showing the FORS measurement locations. (b) Raw reflectance data (top) and $\log(1/R)$ (bottom) from dark red saint's robe. (c) Raw reflectance data (top), $\log(1/R)$ (middle), and first derivative of reflectance (bottom) from dark green hill.

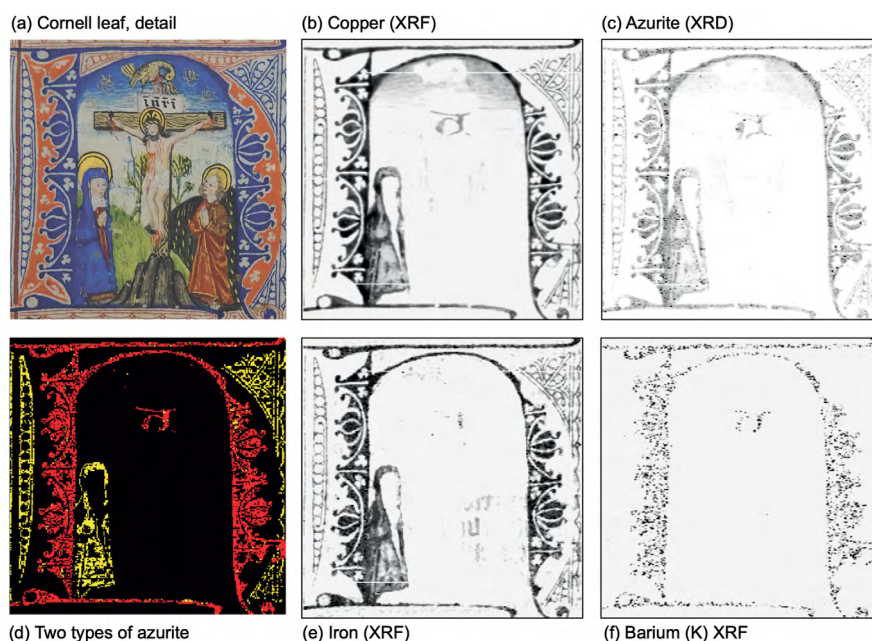


Figure 5 XRF and XRD maps for Cornell leaf. (a) Detail of the scanned area. (b) Copper XRF, (c) azurite XRD, (d) two types of azurite as differentiated by particle size and trace element composition, (e) iron XRF, (f) barium (K) XRF.

giving rise to the speckled appearance in the barium XRF map. The other instances of azurite, including the blue penwork, Mary's robe, and the sky in the historiated initial, are finer-grained and contain relatively lower concentrations of these trace elements. These observations suggest the use of two different types or grades of azurite pigment on the leaf (Fig. 5c).

In the historiated initial, lead white is present throughout the sky, and azurite appears to be layered or mixed with it to produce a gradient of blue hues. Azurite is also used in the outline of a building behind the cross and the hills (Fig. 1d), described above.

4.4 Greens and yellow

The two hills in the background of the scene are different shades of green: the hill behind Mary is a lighter, opaque green, while the hill behind the saint is a darker, more transparent blue-green. The lighter green hill is comprised of lead-tin yellow, inferred from XRF and

confirmed with XRD as lead-tin yellow type I (Fig. 6a–c). X-ray fluorescence, XRD, and FORS analysis in this yellow-green region did not identify an additional colorant that could explain the greenish hue. One possibility could be the use of an organic black pigment to darken the yellow, which would not be detectable by any of these methods. The crown across Christ's brow, which appears yellow, is also found by scanning XRF and XRD to be lead-tin yellow type I.

The darker green hill does not contain major inorganic components, suggesting that it is primarily composed of an organic material. The reflectance spectrum from this region is shown in Figure 4b, along with the apparent absorbance ($\log(1/R)$) and numerically computed first derivative. An absorption band around 670 nm, present as a peak in the apparent absorbance, is marked with a dotted line, suggesting the presence of a plant-based blue dye such as indigo or woad.¹⁵ Indigo has been previously reported as a pigment in medieval manuscripts, including in combination with different yellow pigments to yield green hues.¹⁶ An inflection point, present as a peak in the first



Figure 6 XRF and XRD maps for Cornell leaf. (a) Detail of the scanned area. (b) Tin (K) XRF. (c) Gold (L) XRF. (d) Overlay of lead (L) in red, tin (K) in green, and antimony (K) in blue, with color key to the left. (e) Lead-tin yellow type I XRD. (f) Gold XRD.

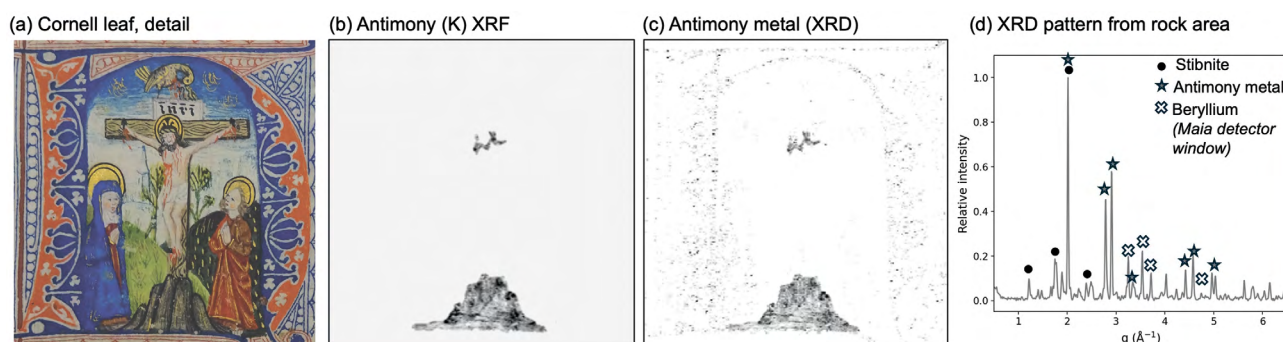


Figure 7 XRF and XRD maps for Cornell leaf. (a) Detail of the scanned area. (b) Antimony (K) XRF. (c) Antimony metal XRD. (d) Average XRD pattern from antimony-rich rock showing peaks for stibnite and antimony metal, as well as beryllium arising from the Maia detector window.

derivative, around 485 nm, is consistent with the presence of lead-tin yellow type I. We believe this pigment appears in the reflectance data since the measurement size is large relative to the dark green area measured, which borders the light green hill; lead and tin are not observed by XRF in the dark green area. We did not observe absorption features of any other yellow pigments or organic yellow dyes. If the only colorant present is indigo, perhaps this area skews green because of the warm color of the parchment substrate beneath: XRF and XRD show that there is no lead white in this area.

4.5 Metallic hues

Many features in the leaf, including the halos, the cross, the pelican, and several round and geometric accents in the border, have a metallic appearance with varying golden hues. In the historiated initial, scanning XRF and XRD showed that the halos, the pelican, the dots accentuating the dark green hill, and the metallic highlights on the robes all contain gold (Fig. 6d,e). These regions do

not appear to be gold leaf, based on a lack of overlapping flakes in the gold XRF map, as well as the slightly matte appearance. These regions could be composed of shell gold, a finely ground gold powder that was applied with a brush like other dry pigments.¹⁷

The cross, although metallic, does not contain gold. Instead, both the cross and the saint's hair were found via scanning XRF to be rich in tin, and no other major elements (Fig. 6a–c). These areas are inferred to be tin sulfide, also known as mosaic gold.¹⁸ Mosaic gold has previously been found in the same volume as gold leaf in a fifteenth-century Flemish Book of Hours, which has been interpreted as evidence that mosaic gold was chosen for its own properties rather than as a cheaper substitute for gold.¹⁹

4.6 Antimony gray

XRF data show that antimony is the major element in the gray stone at the base of the cross (Fig. 7a). Christ's hair and beard are also antimony-rich and have a similar gray hue. From the elemental composition and the visual

appearance alone, one might infer that the pigment was stibnite, a dark gray antimony sulfide mineral pigment (Sb_2S_3), which has been previously identified in Italian and German sixteenth-century paintings and sixteenth-century French grisaille miniatures.²⁰ However, scanning XRD data showed that the gray stone and Christ's hair are *not* stibnite alone, but rather a mixture of stibnite and antimony metal (Fig. 7b,c). Although bismuth metal has previously been reported as a gray pigment, to the best of our knowledge this is the first reported instance of the unusual antimony metal present in a painted pigment.²¹ As antimony sulfide is a naturally occurring mineral alongside other sulfide minerals used for pigments, one possible explanation for this mixture could be that both stibnite and antimony metal were present in an antimony ore that was processed into a pigment.²²

5 Results: Point XRF analysis of additional leaves

Because we had identified some fairly unusual materials in the Cornell leaf, we were curious whether we might find material links between our leaf and the Emory leaves. While stylistic similarities led us to propose a connection between the Cornell leaf and the corpus of Ursuline manuscripts, a chemical comparison of the pigments would shed light on any material similarities. If the Cornell and Emory manuscripts were created by the same workshop, we would in theory expect to find similar palettes used in their illumination. We performed point XRF analysis to sample the multicolored palettes of the four Emory leaves.

We summarize similarities and differences in the materials of the Cornell and Emory leaves in Table 1. The two leaves marked with an asterisk (Holy Face of Christ and Five Wounds of Christ) are the two that have been linked directly to the Convent of St. Ursula.²³ The color of the rows indicates degree of similarity: the darker blue is strong similarity, with the same major and minor components. The lighter blue rows have the same major components but not identical trace elements. Much of the table is blue, showing that there are many similarities in the palette between these leaves. For instance, the red and blue penwork and lettering, which are so characteristic of Delft production, are consistently mercury- and copper-rich, respectively, across all the leaves. All blues are copper-rich, although they may not have identical levels of trace elements; this is difficult to evaluate with a few point measurements. A dark red pigment containing no major metals and exhibiting pink-orange UV fluorescence was present on all illuminated leaves. Lead-rich white, iron-rich ink, and gold appear on multiple leaves as well.

The light gray rows indicate colors that were not repeated between the two leaves and so could not be directly compared. For instance, the Emory leaf depicting Christ as Man of Sorrows has a purple that does not appear on the Cornell leaf, and none of the Emory leaves has a dark green like the Cornell leaf. The table also indicates one instance where a visually similar color, a bright green, has

a very different chemical composition between the Cornell leaf and the Emory leaves (lead-tin-yellow rich versus calcium rich).

6 Discussion and interpretation

It is unknown whether colorful figural decorations were made in the St. Ursula Convent or outsourced, but it is clear that the decorators of the Cornell and Emory leaves were able to source a variety of pigments for their illuminations.²⁴ The colorful palette reflected here includes multiple reds, greens, blues, yellow, purple, gray, and a variety of lustrous metallic materials. This pigment diversity aligns with previously established workshop practice of male painters whose palettes have been extensively studied, perhaps giving credence to a theory that availability rather than preference fueled early modern pigment purchasing, regardless of gender.²⁵

However, while related, the palettes of the Cornell leaf and the Emory leaves are not identical. Several pigments, including vermilion, lead white, gold, and azurite, are shared between the leaves, but these materials are found on vast numbers of illuminated manuscripts, reducing their value in linking fragments to a single workshop. Comparing the Cornell leaf with the two Emory leaves, which are firmly linked with the Convent of St. Ursula, there are no unusual, diagnostic hues found in all three leaves that would signal a direct and unambiguous material link. Different shades of green made with different materials were used on the Cornell leaf and the Emory leaves, and some hues like gray and purple appear on one leaf but not others. We do not observe a highly unique material signature across this small set.

Our observations raise several possibilities. First, the leaves could have been made in the same, highly colorful workshop. If the St. Ursula Convent did make the Cornell leaf, our findings would show that the scriptorium did not have a uniform palette for every illumination. This would be an important and provocative finding because it suggests that material palette alone is insufficient to link such fragments back to a single workshop. From this limited study, it does appear that a similar green pigment is used in the two Emory leaves from the same parent manuscript. Did the Convent of St. Ursula workshop employ a palette that varied between, but not within, a single manuscript? Second, this diversity in pigment also raises the possibility that despite their stylistic similarities, the manuscript leaves studied here could come from two or more different scriptoria with access to diverse materials. We recognize that the present study has examined a small corpus of manuscript cuttings, and as such, more study is needed to clarify trends in pigment use across individual manuscripts and Delft production centers.

Within this rich palette, one pigment stands out for its unique, and perhaps symbolic, usage within the Cornell illumination. Our data showed that a mixture of antimony metal and antimony sulfide, or stibnite, has been used

Table 1 Comparison of XRF major and minor elements found in Cornell leaf (Fig. 1) and four leaves from Emory (Fig. 2)

Analysis findings	Cornell MS	Holy Face of Christ*	Five Wounds of Christ*	Christ as Man of Sorrows	Calendar
Rubric	Hg—vermilion	Hg—vermilion	Hg—vermilion	Hg—vermilion	Hg—vermilion
Red penwork in margins	Hg—vermilion	Hg—vermilion	Hg—vermilion	Hg—vermilion	Hg—vermilion
White	Pb—lead white	Pb—lead white	Pb—lead white	Pb—lead white	n/a
Dark red	No Hg, pink fluorescence under UV	No Hg, pink fluorescence under UV	No Hg, pink fluorescence under UV	No Hg, pink fluorescence under UV	n/a
Blue in illumination	Cu, trace Pb—azurite with lead white	n/a	Cu, Pb	Cu, Pb	n/a
Ink	Fe, trace Cu, Zn	Ca, Fe, Zn, Cu	Ca, Fe, Zn, Cu	Ca, Fe, Cu, Zn	Ca, Fe, Cu, Zn
Gold in margins	Au	Au, Cu, Ca, Fe, Pb	Au, Cu, Pb	Au, Cu, Hg, Ca	n/a
Blue lettering, penwork	Cu + trace elements—azurite, Fe, Ba(K)	Cu, trace Pb, Ca, Fe	Cu, trace Ca, Fe, Pb	Cu, trace Ca, Fe, Zn, Pb	Cu, trace Ca, Fe, Zn, Pb
Gold in illumination	Au, trace Pb, Fe, Ca	n/a	n/a	Au, Cu, Pb	n/a
Red in illumination	Hg + Pb—vermilion + lead white	n/a	n/a	n/a	n/a
Dark green	No major metallic components	n/a	n/a	n/a	n/a
Cool gold	Sn—mosaic gold	n/a	n/a	Complex, trace Sn	n/a
Gray	Sb—antimony metal/stibnite	n/a	n/a	n/a	n/a
Purple	n/a	n/a	n/a	Pb, Cu, no Hg	n/a
Brown	n/a	Pb, Cu, Sn, Ca, trace Fe, Zn	n/a	n/a	n/a
Medium green	n/a	Cu, opaque in UV	Cu, Pb, opaque in UV	Cu, opaque in UV	n/a
Underdrawing	Pb, trace Sn	n/a	n/a	n/a	n/a
Bright or light green	Sn, Pb, trace Cu—lead-tin-yellow	n/a	n/a	Ca	n/a

*Linked directly to the Convent of St. Ursula.

Darker blue—same major and minor elements; light blue—same major but different trace elements; gray—no direct comparison; orange—same appearance but different composition. Note that the Holy Face of Christ and Five Wounds of Christ leaves are understood to come from the same *codex discissus*, or original volume [4].

to create the rocks supporting Christ's crucifix. Stibnite has been identified in sixteenth-century Northern Italian paintings.²⁶ Stibnite is also reported as an important black pigment in a set of sixteenth-century grisaille miniatures in the Fitzwilliam Museum, Cambridge, but the style of these images is entirely different from the Cornell leaf.²⁷ Our identification of an antimony-rich gray pigment in a fifteenth-century painted surface predates these previously reported examples. However, these instances discuss stibnite in particular: the naturally occurring mineral sulfide of antimony. What we detected seems chemically distinct: in our XRD, we found both metallic antimony and stibnite present.

Barbara H. Berrie notes that early modern antimony pigment was sometimes created using discarded or recycled metalcut letters for movable press.²⁸ This offers another tantalizing explanation for the unusual mixture of materials—both pure antimony metal and antimony sulfide—that we observe. Thus, the use of antimony within the Cornell leaf could be a nod to the emerging method of book production, or multiple incarnations of the “Holy Word.”²⁹

Further, if the leaf was created by the St. Ursula Convent, the use of antimony-stibnite by female artisans would have held a gendered significance. As Lawrence Principe notes, stibnite was gendered as a “female” element if it

contained no gold veining, aligning with the belief that the color silver was more appropriately “feminine.”³⁰ However, the preparation of stibnite for pigments aligns with the humoral theory that processes that “multiplied” into a larger quantity using roasting techniques introduced a male (or “hot, dry”) element to the “female” pigment.³¹ It is plausible that the humoral theories accepted as fact in the early modern world could add a layer of meaning to the meditative process of manuscript production from female artisans. DeVun notes that the Philosopher’s Stone was often compared to Christ’s body as a perfect humoral, and therefore gendered, balance.³² As such, the Cornell rock of Golgotha could discursively use this period knowledge to express a female artisan’s point of view.

7 Conclusions

We have examined the colorful palette of a fifteenth-century Dutch illuminated manuscript leaf from the Carl A. Kroch Library at Cornell University with SR-XRF and XRD mapping, and compared its materials with other leaves attributed to the Convent of St. Ursula in Delft. While some features, such as the characteristic red and blue penwork, contain the same materials across the group of leaves, the figural decorations employ a wide palette that is not an exact match between individual leaves. The diverse palette of the Cornell leaf also includes an unusual gray pigment consisting of a mixture of stibnite with antimony metal. To clarify manufacturing practices, for instance, whether the palette of figural illuminations is highly variable within the same workshop or even within the same volume, further technical analysis of leaves both attributed to this workshop and to other Delft production centers would be required. Regardless, the vivid and varied palette of this selection of manuscript leaves, including those attributed to the St. Ursula workshop, testifies to the ingenuity of its artisans, who created complex illuminations using a diverse set of pigments.

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Notes

1. Rudy 2016.
2. Groote *et al.* 1940.
3. Rudy 2017.
4. Rudy 2011.
5. Rosenberg *et al.* 1966; Hurx 2024.
6. Rudy 2016.
7. Smieska *et al.* 2017; Vanmeert *et al.* 2018a, 2018b; Smieska *et al.* 2019.
8. Trentelman *et al.* 2012.
9. Solé *et al.* 2007.
10. Smieska *et al.* 2017.
11. For GeoPIXE, see: Ryan and Jamieson 1993. For XRDUA, see: De Nolf *et al.* 2014.
12. Aceto *et al.* 2014; Cosentino 2014.
13. Aceto *et al.* 2014.
14. Aru *et al.* 2014; Smieska *et al.* 2017.
15. Aceto *et al.* 2014.
16. Nastova *et al.* 2012; Vieira *et al.* 2024.
17. Seehafer 2021.
18. Ross 1973.
19. Ross 1973.
20. For paintings, see: Spring *et al.* 2003; Cotte *et al.* 2007. For grisaille miniatures, see: Rose-Beers and Ricciardi 2016.
21. Spring *et al.* 2003.
22. Boulboulle and Dupré 2022.
23. Rudy 2011.
24. Rudy 2016.
25. Baker *et al.* 2015.
26. Spring *et al.* 2003.
27. Rose-Beers and Ricciardi 2016.
28. Berrie 2015.
29. Rudy 2016.
30. Principe 2008.
31. Filipczak 1997.
32. DeVun 2008.

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A WOMAN IN THE ART SUPPLY TRADE: THE BUSINESS AND SKILLS OF ERMPTGEN VAN PUTTEN IN SEVENTEENTH-CENTURY ROTTERDAM

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ABSTRACT This article corrects the long-standing misattribution of a seventeenth-century Rotterdam paint shop, revealing that it was not run by Abraham van Bubbesson, but by his wife Ermtptgen van Putten. Drawing on newly discovered archival sources and a “reading against the grain” of existing documents, this study demonstrates that van Putten successfully managed a shop that offered a wide range of painting materials to a diverse clientele, from renowned painters to artisans. She likely possessed extensive material knowledge, maintained a broad supplier network, strategically tailored her inventory to meet market demands, and had technical expertise in preparing ready-mixed “wet” paint. The case of van Putten challenges traditional perceptions of Dutch seventeenth-century paint sellers and broadens our understanding of women’s roles in the art market by highlighting their involvement in a crucial yet understudied step of the artistic supply chain.

KEYWORDS paint trade; women in the art market; seventeenth-century Dutch Republic; artists’ materials; archival research; ready-made paint

1 Introduction

In the second half of the seventeenth century, Rotterdam’s Westewagenstraat was home to a specialized paint shop. Brushes, canvases, and panels in various shapes and sizes were sold here, alongside a wide range of pigments, glues, and other materials for painting. Art historians have repeatedly attributed this business to Abraham Lambertz van Bubbesson (1619/1621–71), overlooking his wife, Ermtptgen Pieters van Putten (1614–before 1680).¹ Only Xenia Henny briefly mentions van Putten in her catalog contribution on the Rotterdam paint trade, describing her merely as a widow who continued the business after her husband’s death.² Yet archival sources reveal that the

shop did not belong to van Bubbesson, but to van Putten, who was active as a paint seller not only after her husband’s death but also during their marriage.

Van Putten’s shop is of considerable art historical importance, as evidenced by the detailed inventory drawn up in 1673.³ This document reveals that painting supplies were purchased there not only by shoemakers, glaziers, and ship carpenters but also by notable artists such as Cornelis Saftleven (1607–1681), Egdon van der Neer (c.1635–1703), and Anthonie de Lorme (1610–1673). Furthermore, the inventory constitutes an important source for technical research into the production and use of painters’ canvases, including studies such as the *Counting Vermeer* project.⁴ It lists rolls of fabric—both untreated

and primed—indicating that priming was not always applied to individual stretched canvases but to entire fabric rolls that were later cut to size. As Xenia Henny has noted, this supports Ernst van de Wetering's 1986 hypothesis that small-scale commercial production of prepared canvases was already underway in the seventeenth century.⁵ It also helps explain why some paintings from this period lack cussing on their shorter sides. Despite the significance of the shop, earlier scholarship has focused more on its products and clientele than on its management, leading to a misattribution of ownership.

The overlooking of van Putten and other women in the paint trade can be understood in light of the current state of research and prevailing ideas about paint sellers, in which women do not seem to fit. While much attention has been given to the production and use of painting materials in the seventeenth-century Northern Netherlands, the trade itself has received less focus, with only two valuable publications from the 1990s by Koos Levy and Xenia Henny.⁶ As a result, few paint sellers, male or female, are known by name. When the shop owner is mentioned at all, it is often just a single name, creating the impression of a male-run sole proprietorship. Art historians may have unconsciously imagined a scene akin to Job Berckheyde's (1630–1693) painting of a pigment seller's interior, where a spectacled man carefully weighs pigments at a table (Fig. 1). This motif of a learned man in his study was a recurring theme in seventeenth-century Dutch art, but as this case study will show, it does not necessarily reflect reality.

This article examines the management of the Rotterdam paint shop, as well as the knowledge and skills involved in

running it. These insights are drawn not only from new archival research but also from a reinterpretation of already known sources—a method akin to what historians like Natalie Zemon Davis would call “reading against the grain.”⁷ A more detailed analysis of the 1673 inventory confirms that the shop belonged to van Bubbesson's wife, Ermpngen van Putten, who must have had an understanding of various materials, an extensive network of suppliers, a strategic ability to tailor her stock to meet market demand, and technical expertise in the preparation of “wet” paint.

2 Management of the paint shop: a painter, mason, cooper, and paint seller

Inventories are often seen as *snapshots* that provide insight into possessions at a specific moment in time, but these sources can also reveal long-term developments. By studying the 1673 inventory of the paint shop in combination with other archival sources, this section presents a picture of the management of the business and the roles played by Ermpngen van Putten and other family members.

The 1673 inventory of the Rotterdam paint shop, drawn up after the death of Abraham van Bubbesson, provides insight into the situation 20 years earlier, when van Bubbesson married Ermpngen van Putten. According to their 1653 prenuptial agreement, the inventory carefully lists which belongings were brought into the marriage by each spouse.⁸ Van Bubbesson brought into marriage not only his furniture, clothing, and a house on the Leuvenstraat but also numerous masonry tools, including two wheelbarrows and thousands of whole and half-baked bricks and tiles, as well as outstanding accounts for unpaid masonry work and debts for materials like lime and roof slates. This confirms his profession as a mason, as stated in earlier documents.⁹ In contrast, among the goods Ermpngen van Putten contributed were her household items, a bond worth 800 guilders, a house on the Westewagenstraat, and:

the shop goods consisting of dry and wet paint, paintings, and panels (...) valued at 150 guilders, including the shop tools consisting of shelves, paint barrels, bowls, and grindstones.¹⁰

The paint shop inventory, which in 1653 was worth no more than the modest sum of 150 guilders, was therefore not contributed by van Bubbesson but by van Putten.

Van Putten's paint shop predated her marriage to van Bubbesson. Prior to this, van Putten had been married to the painter Cornelis Symonsz Vermeulen (1606–1653).¹¹ When they drew up their will in 1645, one of the witnesses was Jacobus de Colonia, an apothecary.¹² Both professions are relevant, as in the seventeenth century, paint materials were commonly sold by both painters and apothecaries, who acted somewhat like grocers, and sold not only (medicinal) herbs and spices but also pigments.¹³ Painters' workshops and apothecary businesses were not always individual enterprises, but, like other crafts, could



Figure 1 Attributed to Job Berckheyde (1630–1693), *Interior with a Pigment Seller*, 1645–1693. Oil on panel, 33.7 × 27.8 cm. Germany, Leipzig, Museum der Bildenden Künste, cat. no. 988. (Photo: RKD.)

function as family-run businesses. Wives often fulfilled assisting tasks, playing an active role in financial administration and in selling goods in shops and markets; in some cases, they continued running the business as widows.¹⁴ This pattern of spousal collaboration is reflected in paintings such as the studio scene by Andries Both (Fig. 2), portraying a frequently repeated archetype of the impoverished painter, assisted by his wife who is grinding pigment with a muller in the background. A similar scene can be found in the apothecary shop attributed to Emanuel de Witte (1617–1692) (Fig. 3), where the wife standing behind the counter appears to be in charge of sales. In my dissertation, I study 13 more women, mostly widows of painters or paint sellers, who likely participated in the paint trade during their marriages and continued afterward. An example is Aeltgen van Brekelenkam (c.1622–1667), the sister of the painter Quirijn van Brekelenkam (after 1622–c.1669), and the wife of Leiden painter Johannes van Oudenrogge (1622–1653). After Oudenrogge's passing, Aeltgen van Brekelenkam ran a store in Haarlem that sold "wares, paints, canvases and more."¹⁵ Their connections to painters and paint sellers gave these women access to the paint trade, allowing them to build on the experience, material knowledge, and networks they had developed during their marriages. The same likely applies to van Putten. Although the exact origins of her paint shop are unknown, it is probable that her involvement in the paint trade began during her first marriage to a painter and that she continued the business as a widow.¹⁶



Figure 2 Andries Both, *The Poor Painter and His Family*, c.1634–1635. Oil on oak panel, 31.8 × 24.8 cm, New Haven, Yale University Art Gallery. (Photo: Yale University Art Gallery.)

Van Putten did not remarry within the network of painters, apothecaries, or paint sellers. Her second husband, as previously mentioned, was a mason. In the prenuptial agreement between van Bubbesson and van Putten from 1653, it was stipulated that all profits and losses during the marriage would be shared “half and half,” meaning that the paint supply shop—which grew significantly in size and value during their marriage—became largely part of their joint estate.¹⁷ Although van Bubbesson had a financial interest in the paint shop, it remains unclear to what extent he was actually involved in its operations. The masonry tools that van Bubbesson brought into the marriage in 1653 were no longer present when the inventory was drawn up in 1673. This could indicate that he had sold them in order to devote himself to the paint shop, although they may equally have been sold in the period between his death and the inventory's compilation. Two notarial loan deeds of 1659, however, describe van Bubbesson as both mason and paint seller, making it plausible that he had by then become involved in the paint trade.¹⁸ At the same time, a legal dispute from 1663 refers to him only as a mason, suggesting that he continued to work in that capacity as well, perhaps alongside his activities in the paint business.¹⁹

After the death of van Bubbesson, Ermpngen van Putten remarried once again Jacob Abrahamsz van Koperen (c.1622–after 1683), who is referred to as a cooper in documents dated 1656 and 1682.²⁰ In a 1674 tax register, van Koperen is listed for 2 stuivers as “cooper and paint seller” (*cuijper en verfuvercooper*), though this does not necessarily mean that he practiced both trades; tax registers typically list only the head of the household, without mentioning the specific activities of other family members.²¹ After van Putten's death, van Koperen sold the business in February 1680.²² During the interim, the business remained open and generated 167 guilders, but with only 7 guilders in expenses, indicating no new purchases. His quick sale of the shop suggests little involvement during their marriage. It was probably the combination of their two professions that allowed the couple to achieve



Figure 3 Anonymous, attributed to Emanuel de Witte, *Interior of an Apothecary with Three Figures*, 1650–1690. Oil on canvas, 100 × 130 cm, Stockholm, Apotekarsocieteten Museum. (Photo: Apotekarsocieteten.)

a relatively high income, which was estimated in the 1674 tax register at between 730 and 1105 guilders annually.²³

Although the exact division of labor in the shop is unknown, it is clear that van Putten did not run the business alone. She signed with a mark rather than her name, suggesting that she could not write and therefore likely needed help with bookkeeping.²⁴ This important task was probably entrusted to a family member, possibly her husband, stepchildren, or sister Maertge Pieters, as suggested by a 1680 document. After van Putten's death, her widower van Koperen claimed that Maertge had stolen goods from the shop. At his request, their maid Maria Oosterings testified that: "(speaking with the aforementioned Ermpge Pieters about the business, which she ran as a paint seller) she frequently told Ermpge Pieters: this or that (indicating certain shop goods) is starting to run out."²⁵ "According to Oosterings, Ermpgen van Putten had responded that she believed her sister had stolen goods to deprive van Koperen of the full benefit of the inheritance. This testimony provides a glimpse into those working in the shop, including van Putten, her maid, and likely her sister. An earlier maid was also owed 12 guilders in wages in 1673, indicating she may have helped with both household and shop duties.²⁶ Despite this assistance, van Putten was referred to as the "paint seller" in the 1680 statement and she brought the shop into two marriages. With her last two husbands working in other professions, both the shop's inventory and tools, as well as the experience and expertise required to run such a business, must have come from her.

3 Dealing with shop goods: material knowledge, trade network, and strategic specialization

Inventories are generally used to provide insight into the available goods, but these sources can also offer insight into how these goods were handled. The 1673 inventory reveals the shop's daily operations, suppliers and customers, and stock changes. This enhances our understanding of van Putten's knowledge, network, and strategic choices in running her business.

Figure 4 shows two of the five pages from the 1673 inventory that detail the shop's stock. While this inventory does not include valuations, it does list all goods present along with their quantities, providing a comprehensive overview of the store's extensive assortment and organization. The listed colors, lacquers, glues, and oils, as well as gum, wax, varnish, resin, and turpentine, along with their recorded weights, can be found in Appendix A. The materials present in the largest quantities were packed in 38 numbered barrels, boxes, and sacks. These include, among others, yellow ochre (500 lb), lead white (325 lb), brown ochre (280 lb), *maseroens* red (red ochre, 216 lb), brown red (200 lb), umber (180 lb ground and 21 lb whole), galls (183 lb), yellow wood (114 or 140 lb), and *provinciehout* (logwood, 114 lb).

Smaller, but still substantial quantities included smalt (58 lb), *schijtgeel* (yellow lake, 40 lb), Brazilwood (38 lb), Spanish green (40 lb), and red litmus (40 lb). Beyond these numbered storage units, the inventory also lists numerous unnumbered coloring agents in much smaller amounts, including, for example, Cologne earth (5.5 lb), *strooiblauw* (strew blue, coarsely ground smalt, 3 lb), and *gedestilleerd groen* (distilled verdigris, 1.5 lb). In addition, the inventory records large amounts of materials related to painting preparation and production, such as 225 lb of resin, 198 lb of gum, 39 lb of wax, 120 lb of alum, 134 lb of glue, 25 lb of varnish and turpentine, and 58 *stoop* oil (*stoop* = 2.4 L). The inventory almost brings the shop to life: one can imagine Ermpgen van Putten or one of her maids standing behind the counter or climbing the ladder (*winkelleer*) mentioned in the document to reach the requested pigments, carefully scooping the powders into one of the seven copper bowls, and weighing them with the large scale (*een groote balans*) before handing them over to a customer. Customers may have purchased pigments and painting materials both in bulk quantities and in small, precisely measured amounts, depending on the customer's needs. Van Putten's involvement in buying and selling these goods indicates her understanding of this wide range of materials. She must have been skilled at assessing their qualities and prices, storing them properly, and knowing where and how to source them.

In addition to pigments, other painting supplies were sold, such as brushes and supports. The inventory lists 10 pieces of "narrow linen," with lengths varying from 90 ells (approx. 63 m) to 13 ells (approx. 9.10 m), which could be cut into any desired size. Additionally, there was a remarkably large stock of wood consisting of 993 panels and planks in various (standard) sizes, including 46 "*tien-cent* pieces," 88 "*gulden* sizes," 136 "*stuivers*," and no less than 566 "*salvators*." Interestingly, aside from this stock of wood in the shop, there were also 1459 panels stored "at the house of Joost Abrahams." Joost van Bubbesson (1647–1706) was the son of Abraham van Bubbesson from his previous marriage to Gooltje Joosten (d. 1653).²⁷ When van Putten's shop was sold after her death in 1680, Joost was the one who appraised the panels, indicating that he had been trained as a panel maker.²⁸ The fact that panels stored in his workshop were part of the stock belonging to his (step)parents' shop suggests a specialized division of labor, where van Putten handled the sales while Joost manufactured the panels, and perhaps even sold them himself—an effective collaboration as a family business.

Another noteworthy entry in the inventory is the "four hundred and forty-one sawn pieces lying on a certain lead white mill."²⁹ It does not appear that van Putten owned this lead white mill herself. The only real estate mentioned in the 1673 inventory is the house and an adjacent parcel on the Westewagenstraat by the water of the Delftsevaart. There is no mention of a mill or of other tools that suggest lead white production. The large quantity of wooden pieces was probably stored at one of the lead

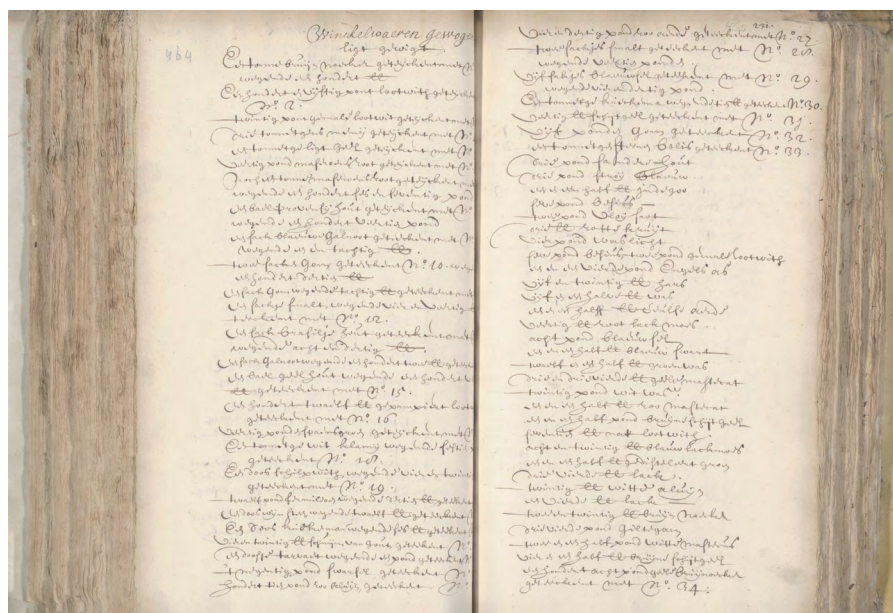


Figure 4 Two pages from the 1673 estate inventory of Abraham Lambertz van Bubbesson and Ermpngen Pieters van Putten. (Photo: Stadsarchief Rotterdam.)

white factories in the city. In the second half of the seventeenth century, Rotterdam produced lead white on a large scale, and several lead white mills were located around the waters of the Schie and the Rotte.³⁰ In 1647, Adriaentje Rochusdr (van Steenhuizen) purchased a plot of land on the Schie for a lead white factory, from which she supplied lead white to Ermpngen van Putten, who in 1673 still owed Adriaentgen Roeckers 59 guilders for “delivered lead white.”³¹ It is likely that van Putten’s 400 sawn wooden “pieces,” which were lying on or in a mill, had been cut to size by one of the mills and were either sold in bulk from there or, as Xenia Henny suggests, used for the production of panels.³²

The 1673 inventory offers insight not only into the shop’s range of goods but also into its suppliers. For “supplied paint,” 148 guilders were owed to Johannes van Hardenberg, and 178 guilders to Adriaen Willems. A little over 7 guilders were owed to the *rasphuis* (a prison for men), likely for wood from the Brazilwood tree, which was rasped there as penal labor and then sold to the paint industry to make red paint.³³ Other debts included 46 guilders to Pieter Nooij from Leiden for glue, and 19 guilders to Antwerp merchant Jan Routs for canvases. The largest sum, over 400 guilders, was owed to a merchant in West-Zaandam for wood. Compared to glue, canvases, and other goods, the amounts owed for paint and wood were by far the highest. Combined with the significant stock of pigments and panels in the inventory, this confirms that the paint and wood trade were the most important parts of the shop. Van Putten’s ability to source goods from a range of institutions and individuals, both locally and internationally, underscores the breadth of her supplier network.

The inventory also contains a list of outstanding debts. Among the debtors, we find numerous painters, primarily from Rotterdam. These included Adam Colonia (1634–1685), Gerrit Maes (1641/61–1709/29),

Hendrick de Meijer (1620–1689/98), Cornelis Picolet (1626/28–1679), Jan Sonjé (1625–1697), Willem Hendricksz Verboom (1630/1650–1718), Lieve Verschuier (1627–1686), Jan Wijnants (1631/2–1684), and Claes van der Willigen (c.1630–1676). Through her first marriage to the painter Vermeulen, van Putten had direct ties to the painting community. Many painters lived near her shop, in the Westewagenstraat and around the Delftsevaart, Lombardstraat, Oppert, and Hoogstraat.³⁴ A large part of her customers, however, were professionals from other trades, such as shoemakers, hat makers, glaziers, (silver) smiths, bakers, schoolteachers, leatherworkers, cloth shearers, sailmakers, and ship carpenters. Such a wide-ranging customer base raises questions about the exact destination and use of the shop’s goods. This applies not only to the colorants but also to the supports. The large rolls of canvas, for instance, may have been used for purposes other than fine painting or even interior decoration, such as for festivities, weddings, or ceremonial events that required temporary ornamentation. Similarly, the many wooden boards and panels may not all have been destined for painters, but perhaps also for carpenters, cabinetmakers, or other artisans. To serve such a diverse clientele, van Putten must have possessed extensive knowledge of the various applications of the materials she sold.

Comparing the 1673 inventory with the record from 1653 and the 1680 sale shows how the shop’s stock evolved. Although no inventory has survived from the period of her first marriage, the paint store is described in 1653, when van Putten brought the shop into her second marriage, as cited in the first part of this article. Notably, this description does mention paintings, likely by van Putten’s first husband, but by 1673 and 1680, these were gone. Without training as a painter and with no painter among her subsequent husbands, van Putten focused on selling painting supplies. As we have seen, however,

van Putten's clientele extended well beyond the community of painters. Her second marriage may have played a role in this development. While her first marriage to a painter likely connected her to the art world and the pigment trade, her second marriage to mason Jan Bubbesson may have introduced her to new networks and forms of demand—particularly for materials used in large-scale applications linked to the construction industry such as decorative wall painting or architectural finishes. This could explain why some base pigments, such as yellow ochre (500 lb) and lead white (325 lb), were present in such substantial quantities in the shop's 1673 inventory.

After van Putten's death, her widower van Koperen sold the paint store in 1680. A detailed, appraised inventory of the shop compiled at the time has survived and is included as Appendix B. By that time, the shop specialized more in paints, with fewer brushes, and a significant reduction in the stock of supports compared to 1673—the number of wooden boards and panels fell from over 1500 to just 253, and the amount of canvas from more than 150 ells to around 15. The large quantities of certain base materials, such as lead white (reduced from 325 lb to just under 160 lb) and yellow ochre (from over 500 lb to only 45 lb), were replaced by a broader and more varied pigment assortment. The shop's color palette expanded from 56 to 92 entries, often in much smaller quantities, but with more variation: for instance, a wider range of blacks (including ivory black and bone black), greens (such as sap, mountain, and sea green), and reds (including king's red, goat's blood, and copper red). More pigments appeared in both coarse and finely ground forms, such as ochre, Spanish green, and orpiment. There was also a marked increase in the number of lakes—including red, blue, purple, and Florentine—and new products were added such as *gold paint*, East Indian ink, and drawing paper. The addition of ultramarine, the most expensive pigment in the inventory at 98 guilders, highlights the increasingly specialized and diverse character of van Putten's trade. These strategic adjustments proved profitable. The 1673 inventory showed 489 guilders in cash and a 15-page-long list of debtors, while the shop's value grew from 150 guilders in 1653 to 794 guilders, 9 stuivers, and 3 pennies at its sale in 1680. By adapting the stock to market demand and changing circumstances—including her various marriages—and through her knowledge of the materials and her extensive network of suppliers and customers, van Putten managed to thrive and significantly increase the shop's value over the years.

4 Technical skills in priming canvas and the production of “wet” paint

The 1673 shop inventory indicates that van Putten not only sold panels and pigments in their raw form, which painters still needed to prime, grind, or mix before use, but also offered them ready-to-use. This raises the question of to what extent van Putten possessed technical

skills in priming panels, processing pigments, and producing “wet” paint.

The shop's inventory included 10 rolls of canvas. Three are described as “linde,” likely untreated linen, while the other seven are listed as “primed canvas” (*geplamuert doeck*). These canvases were presumably coated with a layer of glue, followed by one or more layers of oil-based priming, though it is unclear who applied the priming.³⁵ It is conceivable that they were primed in the shop itself using the available materials, perhaps by her stepson, the maid, or by van Putten herself. This, however, raises the question of why none of the panels in the shop's inventory were primed, unlike the canvases. Another possibility is that the canvases sold by van Putten were primed by external professionals. In the seventeenth century, various cities like Leiden and Haarlem had panel makers, frame makers, and specialized primers who sold prepared canvases and panels.³⁶ Antwerp, the city from which (part of) the canvases sold by van Putten originated, also had so-called “whiters.”³⁷ The Florentine Raffaello Borghini (1537–1588), in his 1584 art treatise, praised the Flemish method of using glue and oil primers, noting that canvases prepared this way were easier to roll up and transport compared to the flour-based primings used in Southern Europe.³⁸ It is therefore likely that primed canvases were traded both nationally and internationally, and that van Putten acquired the canvases in their primed form.

The paint shop sold not only primed canvases but probably also ready-mixed paints. When van Putten brought the shop into her second marriage in 1653, both “dry” and “wet paint” were mentioned, and in the 1673 inventory, “50 pounds wet oil paint” (*natte oly verw*) is explicitly listed.³⁹ Lead white was also sold in several forms, including normal “lead white” and the purer “shell white,” as well as ground, papered, and “wet lead white” (17 lb). Xenia Henny suggests that these “wet” forms indicate that pigments were offered not only as dry powders but also premixed with oil.⁴⁰ However, this contrasts with current knowledge about seventeenth-century workshop practices, which maintains that pigments were only processed into usable paint in the painter's workshop.⁴¹ Workshop scenes and apprentice contracts show that it was typically the painter, or more often his apprentices, who was responsible for grinding and mixing pigments. Since ready-mixed paint had a limited shelf life, only the necessary colors for each part of a painting were prepared, which meant that the palette was often limited to four or five colors per session. This raises the question of what exactly the “wet oil paints” sold by van Putten were and who used them.

Xenia Henny suggests that in the seventeenth century paints premixed with oil were more commonly sold, but it is questionable how well this is supported by the available sources.⁴² She refers to Leendert Volmarijn (c.1612–1656), who in the early 1640s planned to open a shop in Leiden offering “all kinds of prepared and unprepared paints, panels, canvases, brushes, and all other tools useful to the art of painting.”⁴³ It remains unclear whether “prepared

paints” in this context refers to ready-mixed paints or simply finely ground pigments as opposed to unprocessed ones. For instance, van Putten also sold both whole and ground umber. A related example can be found in Gerard ter Brugghen’s *Verlichtery Kunst-Boeck* (1616), a manual on watercolor illumination. According to Koos Levy, ter Brugghen advised his readers to purchase “ready-made paints.”⁴⁴ A closer reading of the text, however, suggests that he was referring to processed pigments, not premixed paint. In the opening pages of the book, ter Brugghen recommends buying pigments instead of attempting to “alchemize” them oneself, but in later chapters he provides detailed instructions for mixing these pigments with water, gum, and other substances such as alum or vinegar.⁴⁵ These examples indicate that pigments sold in retail were at least partially processed—through steps like washing, grinding, or other treatments—so that they required little further preparation by the painter. Whether the pigments were already mixed with oil or other “wet” vehicles cannot be determined from these sources, though it cannot be entirely ruled out either.

While the exact nature of the paints sold in the Dutch Republic remains unclear, more conclusive evidence for oil-based premixed paints can be found in English sources. In *The Art of Painting in Oyl* (1678), John Smith states: “Those that list not to be at the trouble of grinding Colours themselves, may have of any sort, or quantity, ready ground, at the Colour Shops, at reasonable rates.”⁴⁶ This statement appears in a chapter titled *How to grind colors with oil*, which suggests that Smith was referring to pigments already ground in oil. In the following chapter, Smith explains that such paints were still too thick to use and needed to be diluted with more oil or other substances—a practice closely resembling the paint sold by the Emerton family in the eighteenth century intended specifically for house painting. In *Palladio Londinensis, or the London Art of Building* (1734), William Salmon highlights advertisements from the colorman Alexander Emerton and later his widow Elizabeth Emerton, who offered various colors, ground in oil into a paste form.⁴⁷ These could be used by any gentleman’s servants or laborers to paint the house, simply by following the printed instructions (see Fig. 5 for an example): to each 6 lb of paint, one quart of oil was to be added to achieve the desired consistency. Especially in the final decades of the seventeenth century, when more amateurs and commercial studios emerged—many using prepared canvases—it is conceivable that a similar development took place in the paint trade of the Northern Netherlands.

Although wet oil paint was listed in the 1673 inventory, it represented only a small fraction of van Putten’s stock, which otherwise consisted mainly of pigments in either whole or ground form. This suggests that pigments were only occasionally processed into a ready-to-use form—likely for specific colors or customers. Van Putten may have mixed paint on demand, or kept small amounts of ready-made stock, relying on the shelf life of the paint and the market demand to avoid spoilage. It is possible that

“wet paint” was produced especially for house painters and decorators, who were known to require large quantities of paint on a daily basis. While artists producing, for example, portrait or religious works would have wanted to control the precise fineness of the pigment and handling properties of the paint, painters of arguably less prestigious types of painting, such as shop signs, carriages, interior decorative schemes, shutters, or entire houses, may have followed different practices, perhaps including the use of premixed paints. However, this remains difficult to verify, as historical research has largely focused on painters whose work is represented in museum collections. Attention to interior decoration may help shed light on the materials and methods used by *kladschilders* as well.

Although van Putten was primarily a retailer who sourced her materials from suppliers rather than producing them herself, the ground and wet paints she sold were likely processed in her shop. In the seventeenth-century Northern Netherlands, pigment manufacturing was highly developed, with specialized companies like the Pekstok family business in Amsterdam processing raw materials on an industrial scale into pigments such as vermilion and red lake, which they then sold to apothecaries and specialized paint sellers.⁴⁸ While little is known about the exact activities of these retailers, Koos Levy and Arie Wallert suggest that they may have further refined pigments, for example, by grinding mineral-based raw materials into a more usable form for painters.⁴⁹ This probably applies to van Putten’s case, after all, she had access to all the essential ingredients and tools. Van Putten owned a variety of grinding equipment, including “two millstones, a mortar, and a copper mortar.”⁵⁰ These tools may have been intended for sale, but it is also possible that she used them herself. The two millstones might have been part of a hand-operated paint mill, which some painters are known to have owned for mechanically grinding pigments. For instance, Gillis van Coninxloo’s (1544–1607) estate inventory from 1607 mentions a paint mill in the attic, and the 1702 inventory of Vincent Laurensz van der Vinne (1628–1702) refers to “a paint mill, various paints both wet and dry.”⁵¹ That at least some of these pigments were presumably further processed into a ground or wet form on-site underscores the significant material knowledge and technical skills present in van Putten’s workshop.

5 To conclude

This case study has revealed that the Rotterdam shop in painting supplies traditionally attributed to Abraham van Bubbesson was, in fact, brought into the marriage by his wife, Ermptgen van Putten. Through new archival research and a reinterpretation of known sources, van Putten emerges from the shadow of her husband as a skilled retailer. With her material knowledge, broad network of suppliers, and strategic specialization, she appears to have managed and expanded the shop successfully for years, increasing its value from 150 to nearly 800

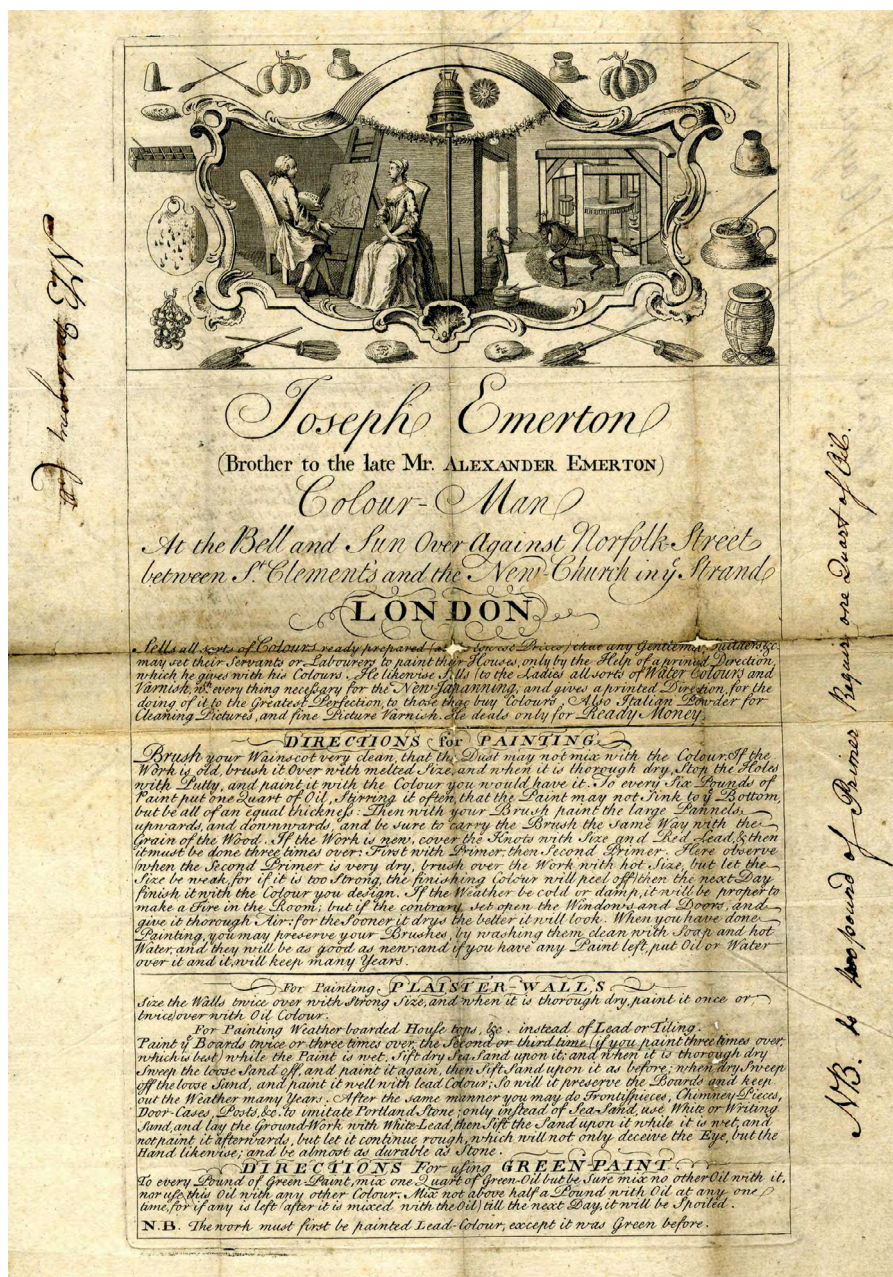


Figure 5 Trade card Joseph Emerton, colorman. Verso: a manuscript bill made out to Charles Hayne Esqr., dated July 6, 1744. Etching and engraving on paper, 378 × 208 mm. London, The British Museum, registration no. Heal, 89.55. (Photo: © The Trustees of the British Museum.)

guilders. As such, this case broadens our understanding of women's roles in the seventeenth-century art market, showing that women contributed not only to the well-studied area of art production but also to other stages of the artistic supply chain.

Van Putten's story challenges traditional views of Dutch seventeenth-century paint sellers, revealing not only that they could be managed by women but also that the operation was complex and dynamic. The shop also benefited from contributions by others: her maid, likely her sister, and her stepson, a panel maker. Moreover, her husbands' professions brought advantages that shaped the business's reach and clientele. While painter Cornelis Vermeulen may have introduced her to the paint trade and laid the foundation for her knowledge and contacts

in the artists' world, mason Abraham van Bubbesson possibly connected her with clientele in the construction sector. This blend of support and influence illustrates that paint shops, like van Putten's, were not solely proprietor-led but often family ventures where roles and strategies adapted over time.

Additionally, van Putten's inventory not only brings her contributions to light, but also raises new questions regarding the sale of "wet" paint. Van Putten sold pigments in various forms, including raw, ground, and mixed with oil, suggesting she possessed knowledge in processing them. Yet, the exact nature of these wet paints remains unclear. Little is known about the production and preservation of ready-to-use paint in the seventeenth-century Netherlands, or about its users—whether primarily house

painters or also fine artists. Further research in this area could deepen our understanding of the interconnections among various paint-consuming sectors and shed light on the material knowledge and technical expertise required by paint sellers like van Putten.

Acknowledgments

This article stems from my doctoral research as part of the NWO-funded Vidi project, *The Female Impact: Women, the Art Market, and Household Consumption in the Dutch Republic, 1580–1720*. This project aims to map, measure, and analyze the impact of women on the Dutch art market in the seventeenth century by studying the household as an economic site. More information can be found on the project's website: <https://www.thefemaleimpact.org>. Ermtgen van Putten is one of the case studies central to my forthcoming dissertation, and I have presented my preliminary results at the symposium *Women and the Visual Arts in the Early Modern Low Countries* (Het Noordbrabants Museum, November 30, 2023) and at the *Historians of Netherlandish Art Conference* (London & Cambridge, July 10–13, 2024). I would like to express my gratitude to the *Female Impact* research team, Judith Noorman, Frans Grijzenhout, Piet Bakker, and Anna Lawrence, for their valuable feedback and support. I am also grateful to the anonymous peer reviewers and editors for their insightful comments.

Notes

- See, for example, Levy-van Halm 1998: 139; Schavemaker 2009: 22; Wallert 2010: 134; Franken 2017: paragraph 3.5; Landsman 2019: 67.
- Henny 1994: 49–50.
- Rotterdam City Archives (RCA), Archive of the Orphan Chamber (OC) 16/461, ff. 220–40/pp. 443–83, 24 February 1673.
- Franken 2017: paragraphs 3.5–3.6.
- Van de Wetering 1986: 32–33; Henny 1994: 49–50; Van de Wetering 2009: 116.
- Recent scholarship has increasingly focused on the trade in artists' materials in other regions, see, for example, Kirby *et al.* 2010; Haack Christensen and Jager 2018. For the seventeenth-century Northern Netherlands, key studies are: Henny 1994; Levy 1994; Levy-van Halm 1998 (based on her unpublished 1983 master's thesis).
- Davis 2013: xi.
- RCA, Baptism, Marriage, and Burial Registers (BMB) 1-02/61, f. 128, 5 October 1653; Old Notarial Archive (ONA) 18/554, p. 321, 16 October 1653.
- RCA, ONA 18/153, deed 522, 18 February 1647; ONA 18/451, deed 381, pp. 688–9, 18 April 1649.
- Inventory 1673 (n. 3), pp. 450: 'de winkel waren bestaende in drooge en natte verff, schilderijen en paneelen (...) ter somme van hondert en vijftig gulden: daer onder begrepen de winkel gereetschappen bestaende in plancken, verff tonnen, schalen en vrijfstenen'.
- RCA, BMB 1-02/59, f. 61v, 26 April 1643; 86, p. 114, 2 March 1653.
- RCA, ONA 18/333, deed 1, ff. 1–2, 2 January 1645. Jacobus de Colonia also acted as a witness in: RCA, ONA 18/554, deed 156, ff. 282–3, 299, 10 September 1653; prenuptial agreement 1653, n. 6.
- Henny 1994: 47; Levy-van Halm 1998: 138–9.
- For more on spousal collaboration in the art market, see: Puyenbroek (2025). This topic will be explored further in my forthcoming dissertation.
- Bredius 1915–1922, vol. 4: 1873; Levy 1994: 634–5; North Holland Archives, ONA 1617/260, 9 August 1668.
- It is also possible that van Putten was already active in the trade of painters' materials before her marriage to Vermeulen. However, no information is known about Van Putten's background.
- Prenuptial agreement 1653, n. 6.
- RCA, ONA 18/510, deed 215, p. 229, 6 June 1659; deed 314, p. 229, 9 June 1659.
- RCA, ONA 18/537, deed 133, pp. 251–2, 3 April 1663.
- RCA, BMB 1-02/64, f. 185, 9 October 1672; ONA 18/508, deed 466, p. 349, 16 August 1656; 1045, deed 147, pp. 512–3, 24 August 1682.
- RCA, Old City Archives 1-01/4166, 'Kohier van het klein-familiegeld', scan 224.
- RCA, ONA 18/1044, deed 64, pp. 161–79, 26 February 1680.
- Peltjes 1995: 11.
- RCA, ONA 18/554, deed 156, pp. 282–3, 299–300, 10 September 1653; prenuptial agreement 1653, n. 6.
- RCA, ONA 18/1044, deed 49, pp. 124–5, 19 January 1680: '(sprekende met de voorn. Ermpge Pieters van de neeringe, die sij als verw verkoopster was doende) dikwijls tegen de voornoemde Ermpge Pieters heeft gesegt: dit, of dat (uijt-druckende daer mede ijets vande gemelte winkelwaren) begint te ontbreken.'
- Inventory 1673 (n. 3): 482.
- According to Xenia Henny, van Putten had two children with van Bubbesson (Henny 1994: 49), but this is incorrect. Van Bubbesson was married to Neeltgen Pieters in 1639 and remarried in 1641 to Gooltge Joosten, with whom he had six children, two of whom were still alive at van Bubbesson's death in 1671: Joost and Martigen. RCA, BMB 1-02/58, f. 40v, 13 February 1639; f. 139, 17 March 1641; 6, 23 March 1642; 18 March 1643; 12 October 1644; 7, 21 February 1647; 26 January 1649; 8, 7 February 1651; 86, 104, 26 January 1653.
- Sale 1680 (n. 20).
- Inventory 1673 (n. 3): 467: 'Vierhondert een en veertig gesaegde deelen leggende op sekere lootwith moolen'. The inventory does not specify the type of mill used. Lead white mills varied in type and function; for instance, Styntge van der Hocht's 1693 business in Rotterdam had both a wet grinding mill and a fine mill (Hazewinkel 1934: 71). The mention of over four hundred sawn wooden pieces suggests it was a large facility, likely wind- or horse-powered.
- Hazewinkel 1934: 66–75; De Vlieger and Homburg 1992: 14–21.
- Hazewinkel 1934: 70–1; Inventory 1673 (n. 3): 482: 'Adriaentgen Roeckers comt over gelever lootwith de summa van negenenvijftig gul. sestien st. twaelf pen'.
- Henny 1994: 49.
- Hermens and Wallert 1998: 276–80; Inventory 1673 (n. 3): 482: 'Het rasphuijs deser stad comt over drie jaren gilde gelt tot twee gld. en tien st. 's jaers de somme van seve gld. en tien st. ommegeleslagen in den jaren 1669, 1670, 1671'. Why the term 'guld fees' is used in this case is unclear to me.
- Roelofs 1994: 17.
- Kirby 1999: 25, 28–9; Stols-Witlox 2017: 50–5. It remains unknown whether the canvases sold were provided with a double ground, or whether the second oil layer was applied by the artist in the studio, allowing the color and texture to be adjusted to the painting above it (Kirby 2006: 24).

36. Bredius 1915–1922, vol. 2: 531, vol. 4: 1392; Miedema 1980, vol. 1: 94–5, 333–4, 337, 364, vol. 2: 422; Levy-van Halm 1998: 138–9, Van de Wetering 2009: 109, 302, n. 63; Stols-Witlox 2017: 141–2.
 37. There must have been female primers as well. The joiner guild's 1617 ordinance, which stipulated that panels had to be inspected by the dean before they could leave the workshop or be 'whitened', explicitly applied to all 'whiters, of whatever quality they may be, be it man or woman' (Wadum 1998: 165–6; Moortgat 2024).
 38. Stols-Witlox 2017: 50.
 39. Inventory 1673 (n. 3), pp. 450, 464–6.
 40. Henny 1994: 48–50.
 41. See, for example, Kirby 2006: 25–6; Van de Wetering 2006: 31–6.
 42. Henny 1994: 48–50; Wallert 2010: 135–6.
 43. Martin 1901: 86; Henny 1994: 49: 'allerleij geprepareerde en ongeprepareerde verwen, panelen doucken, pincelen ende alle andere gereetschappen tot de schilderconste dienstig'.
 44. Levy-van Halm 1998: 138, 141.
 45. Ter Brugghen 1667: 2: 'Want de verwe vintmen meest al te koope, ende al veel beter, dan men die selve met Neus-wijse Imaginatie soude meynen te Alchimeeren: want soo sy op de eene plaetse niet goet en is, op een ander oort vindt men se beter: Sulcks dat den kostighen Liefhebber hem niet en derf bekommerende, zijnen tijdt ende sinnen daer aen verquisten, ofte te koste legghen.'
 46. Smith 1687: 35; Bristow 1977: 246–7; Henny 1994: 47.
 47. In the first edition of 1734, only Alexander Emerton is mentioned, but in the second edition from 1738, his widow Elizabeth Emerton is named. Later, other members of the Emerton family were also active in the color trade, including his brother and their son. Salmon 1734: 57–9, 1738: 59–61; Bristow 1977: 247.
 48. Hermens and Wallert 1998.
 49. Levy van Halm 1998: 138–9; Wallert 2010: 135–6.
 50. Inventory 1673 (n. 3), p. 466: 'twee molesteenen, een vijsel, een koperen ditto'.
 51. De Roever 1885: 44; Bredius 1915–1922, vol. 4: 1261: 'een verruw molen, verscheyde verruwen soo natte als drooge', Kirby 2006: 26.
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Appendix A: Inventory 1673

Transcription of the inventory of the shop belonging to Ermptgen van Putten and Abraham van Bubbesson, drawn up in 1673. Canvases and panels are not included here, but are discussed in the main text. All weights are given in pounds (lb), unless otherwise indicated.

Shop goods	Translation	Quantity
<i>Bruijn naecker</i> (bruine oker)	Brown ochre	100
<i>Lootwith</i>	Lead white	150
<i>Gemale lootwit</i>	Ground lead white	20
<i>Menij</i> (menie)	Minium (red lead)	3 barrels
<i>Ligt geel</i>	Light yellow	1 barrel
<i>Maseroens root</i>	<i>Maseroens</i> red (red ochre)	40
<i>Maseroens root</i>	<i>Maseroens</i> red (red ochre)	176
<i>Provensij hout</i> (provinciehout)	Campeche wood, log wood	114
<i>Blauwe galnoot</i>	Blue galls	81
<i>Gom</i>	Gum	113
<i>Gom</i>	Gum	80
<i>Smalt</i>	Smalt	44
<i>Brasilje hout</i> (brazielhout)	Brazilwood	38
<i>Galnoot</i>	Galls	102
<i>Geel hout</i>	Yellow wood	140 or 114
<i>Gepampiert Loot[wit]</i>	Lead white (presumably packed in paper)	112
<i>Spaens groen</i>	Spanish green (verdigris)	40
<i>Wit klamij</i> (witte klamei)	Album græcum (white dog dung) or zinc sulfate?	16
<i>Schulpwith</i>	Lead white (in flakes, pure)	24
<i>Fermiljoen</i>	Vermilion	13

Shop goods	Translation	Quantity
<i>Wijnsteen</i>	Cream of tartar	12
<i>Kuekema</i> (kurkuma)	Turmeric	6
<i>Schuijm van gout</i>	Gold (refining) foam/dross	24
<i>Tarvaet</i>	Likely: resinous substance (varnish material), identification uncertain; otherwise terra verde/green earth?	1
<i>Swarsel</i> (Zwartsel)	Black pigment	90
<i>Roo aluijn</i>	Red alum	100
<i>Roo aerde</i>	Red earths	34
<i>Smalt</i>	Smalt	14
<i>Blauwsel</i>	Smalt	34
<i>Kueckema</i> (kurkuma)	Turmeric	10
<i>Schijtgeel</i>	Yellow lake	40
<i>Gom</i>	Gum	5
<i>Steenen bolis</i> (Bolus)	Bole	1 barrel
<i>Sandere hout</i> (Sandelhout)	Sandalwood	3
<i>Stroij blauw</i> (strooiblauw)	Strew blue, coarsely ground smalt	3
<i>Indegoo</i>	Indigo	1½
<i>Besius</i>	Possibly berries for yellow lakes	7
<i>Vloijsaet</i> (vlooiizaad)	Psyllium	2

Shop goods	Translation	Quantity
<i>Rotte kruijt</i>	Madder?	3
<i>Was licht</i>	Wax light	4
<i>Besius (or Beseus)</i>	Possibly berries	7
<i>Gemale lootwith</i>	Ground lead white	2
<i>Engels as</i>	English ash, blue ash	1 ³ / ₄
<i>Hars</i>	Resin	25
<i>Was</i>	Wax	5 ¹ / ₂
<i>Ceulse aerde</i>	Cologne earth	1 ¹ / ₂
<i>Root lack moes</i>	Red litmus	40
<i>Blauw sel</i>	Smalt	8
<i>Blauw swart</i>	Charcoal	1 ¹ / ₂
<i>Groen was</i>	Green wax	12 ¹ / ₂
<i>Geele mastecat</i>	Yellow massicot (lead oxide yellow, or lead-tin yellow)	3 ³ / ₄
<i>Wit was</i>	White wax	20
<i>Roo mastecat</i>	Red massicot	1 ¹ / ₂
<i>Bruijne schijtgeel</i>	Brown yellow lake	1 ¹ / ₂
<i>Nat lootwith</i>	Wet lead white	17
<i>Blauw lackmoes</i>	Blue litmus	28
<i>Gedistilleert groen (Gedestilleerd groen)</i>	Distilled green, verdigris recrystallized from vinegar	1 ¹ / ₂
<i>Lack</i>	Lake	³ / ₄
<i>Witte aluijn</i>	White alum	20
<i>Lack</i>	Lake	¹ / ₄
<i>Bruijn noecker (bruine oker)</i>	Brown ochre	22
<i>Geltegam</i>	Guttegom: Gamboge	³ / ₄
<i>Witte mastecus</i>	White massicot	2 ¹ / ₂
<i>Bruijne schijtgeel</i>	Brown yellow lake	4 ¹ / ₂
<i>Bruijnoecker (Bruine oker)</i>	Brown ochre	108
<i>Keulse aerde</i>	Cologne earth	4
<i>Spaense seep</i>	Spanish soap	15.5
<i>Engelse lijm</i>	English glue	70
<i>Vis lijm</i>	Fish glue	7
<i>Leijtse lijm</i>	Glue from Leiden	57
<i>Swarsel (Zwartsel)</i>	Black pigment	28 barrels
<i>Swarsel (Zwartsel)</i>	Black pigment	50
<i>Bruijn noecker (Bruine oker)</i>	Brown ochre	50

Shop goods	Translation	Quantity
<i>Bruijn root</i>	Brown red (earth)	200
<i>Gemale omber</i>	Ground umber	180
<i>Heele omber</i>	Whole umber	21
<i>Natte olij verruw (natte olieverb)</i>	Wet oil paint	50
<i>Boecken teijcken ...</i>	Drawing books	8 pieces
<i>Vernis en terpentijn</i>	Varnish and turpentine	25
<i>Vissepinceelen</i>	Fish brushes	24 dozen
<i>Swaenen vessen</i>	Swan brushes	5.5 dozen
<i>Treck pinceelen</i>	Drawing brushes	40 dozen
<i>Ganse treckers</i>	Goose brushes	40 dozen
<i>Gesorteerde pinceelen</i>	Sorted brushes	55 dozen
<i>Swane ditto (penselen)</i>	Swan brushes	3 dozen
<i>Gansen ditto (penselen)</i>	Goose brushes	6 dozen
<i>Stockpinceelen</i>	Stick brushes	6.5 dozen
<i>Bostels (Borstels)</i>	Brushes	13 dozen
<i>Gout schulpen (goudschelpen)</i>	Shell gold	27 pieces
<i>Silvere schulpen (Zilvereschelpen)</i>	Shell silver	31 pieces
<i>Olije</i>	Oil	22 stoop
<i>Een aeijn olije</i>	Unknown oil	
<i>Blauw sel</i>	Smalt	150
<i>Stijfel (stijfsel)</i>	Starch	181
<i>Stijfel (stijfsel)</i>	Starch	183
<i>Stijfel (stijfsel)</i>	Starch	195
<i>Stijfel (stijfsel)</i>	Starch	177
<i>Geel noecker (Gele oker)</i>	Yellow ochre	500
<i>Stijfel (stijfsel)</i>	Starch	700
<i>Olije</i>	Oil	36 stoop
<i>Spongje</i>	Sponge	³ / ₄
<i>Twee molesteen</i>	Two millstones, grinding stones	
<i>Een vijzel</i>	A mortar	
<i>Een kopere ditto (vijzel)</i>	A copper mortar	
<i>Hars</i>	Resin	200
<i>Provens hout (Proviciehout)</i>	Campeche wood, log wood	...

Shop goods	Translation	Quantity
<i>Een nooteboom</i>	A nut tree, possibly walnut tree	
<i>Een groote balans met een paar schaelen</i>	A large balance with a pair of weighing scales	
<i>Seve paer koopere schaelen</i>	Seven pairs of copper bowls	
<i>Seve pletten</i>	Seven palettes	

Shop goods	Translation	Quantity
<i>Een partije doosen</i>	A batch of boxes	
<i>Een partije tonnetgens</i>	A batch of small barrels	
<i>Een hoeckbanck</i>	A corner bench	
<i>Een winckelleer</i>	A shop counter or ladder	

Appendix B: Sale 1680

Transcription of the sale inventory drawn up in 1680 at the request of Jacob Abrahamsz van Koperen, widower of Ermpgtgen Pieters van Putten. The stock was appraised by Joannes Virulij and Francois de Frens, dealers in dry pigments; Joost Abrahamsz Bubbesson, panel maker; and Jacobus de Hoogh, the buyer of the shop. All prices are listed in guilders, stuivers, and penningen, and all weights are given in Dutch pounds (lb), unless otherwise indicated.

Shop goods	Translation	Price	Quantity	Total
<i>Groen wasch</i>	Green wax	0:8:0	5½	2:4:0
<i>Spaensche Zeep</i>	Spanish soap	0:5:0	1⅞	0:9:6
<i>Stock-Pinceelen</i>	Stick brushes	0:7:8 per dozen	4 dozen	1:10:-
<i>Smalt blauw</i>	Smalt blue	0:7:0	5¾	2:0:4
<i>Wit teijcken-goet</i>	White drawing materials	0:6:0	¼ ⅛, 1 lood	0:2:7
<i>Keulsche aerde</i>	Cologne earth	0:5:8	4½	1:4:4
<i>Mastekot</i>	Massicot	0:14:0	4½	3:0:4
<i>Groene Assche</i>	Green ash	2:0:0	3 oz	0:7:8
<i>Gedestilleert groen</i>	Distilled green (distilled verdigris)	2:19:0	1, 1 oz	3:2:11
<i>Gitte gom</i>	Gamboge	2:4:0	7 oz, 1 lood	1:0:10
<i>Ruijs geel</i>	Orpiment	0:8:0	3	1:4:0
<i>Schijt-geel</i>	Yellow lake	0:7:0	7¾	2:11:4
<i>Blauwe assche</i>	Blue ash	2:15:0	1¼	3:8:12
<i>Bruijne schijtgeel</i>	Brown yellow lake	2:0:0	20½ lood	1:10:-
<i>Heele fermilioen</i>	Whole vermilion	1:19:0	1¾	3:9:4
<i>Rood lack</i>	Red lake	5:0:0	¼ ⅛ lb, 1/2 lood	3:2:8
<i>Paersche lack</i>	Purple lake	5:10:0	¼ ⅛	2:1:4
<i>Florentijnsche lack</i>	Florentine lake	1:10:0 per oz	2½ ¼ lood	2:0:4
<i>Slechte assche</i>	Inferior quality ash	0:6:0	4¼ ⅛ lb, 1 oz	1:6:-
<i>Gemeene Engelsche assche</i>	English ash (blue ash)	0:7:0	3 oz	0:1:5
<i>Beste dito</i>	Best quality English ash	1:4:0	2¾	3:6:-

Shop goods	Translation	Price	Quantity	Total
<i>Nogh een soort van assche</i>	Another kind of ash	1:0:0	2	2:0:-
<i>Noch een soort van assche</i>	Another kind of ash	1:10:-	1/2 1/8	0:18:12
<i>Groene assche</i>	Green ash	1:10:-	1/4	0:7:12
<i>Een doosge met pot-loot-pennen</i>	A little box with lead-pencils	...	...	3:0:-
<i>Duijtsche assche</i>	German ash	1:10:-	6 1/8	9:3:12
<i>Wit wasch</i>	White wax	0:12:0	2 1/8	1:14:8
<i>Sap-groen</i>	Sap green	0:12:0	3 oz	0:2:4
<i>Blauw lack</i>	Blue lake	3:10:0	1/2	1:15:-
<i>Groene schijtgeel</i>	Green yellow lake	1:16:0	1 1/4	0:13:8
<i>Ouweltgens</i>	Ouweltgens	0:14:-	1/8	0:1:12
<i>Koninkx rood</i>	Kings or Royal Red (red lake)	0:4:8:	1/2 lb, 3 oz	0:2:12
<i>Gebranden omber</i>	Burnt umber	0:3:0	1/2	0:1:12
<i>Bruijne schijtgeel</i>	Brown yellow lake	0:14:0	1/4	0:3:12
<i>Schijtgeel</i>	Yellow lake	0:8:0	5 1/2	2:4:-
<i>Een mande met borstels, en daer in:</i>	A basket of brushes:	0:11:0 per dozen	4 dozen and 1 piece	2:4:14
		0:9:0 per dozen	3 dozen	1:7:-
		0:7:0 per dozen	11 dozen	3:17:0
		0:5:0 per dozen	1 1/2 dozen	0:7:8
<i>Bolus</i>	Bole	2:0:- per 100	177	3:10:12
<i>Heel operiment</i>	Whole orpiment	0:6:0	3 1/8	0:18:12
<i>Bergh groen</i>	Mountain green	1:4:0	2 1/8	2:14:-
<i>Roode wijnsteen</i>	Red wine tartar	0:2:8	5	0:12:8
<i>Gemale swavel</i>	Ground sulfur	...	10	1:5:-
<i>Gemale kurkema</i>	Ground turmeric	0:10:0	20 1/2	10:15:-
<i>Blauw-teijken-swart</i>	Blue drawing black	...	...	2:8:-
<i>Ijvoor-swart</i>	Ivory black	0:8:0	2 1/4	0:18:-
<i>Rood-aerde</i>	Red earth	0:4:0	3 1/2	0:14:-
<i>Witte klemij (witte klamei)</i>	Album græcum (white dog dung) or zinc sulfate?	0:6:0	7	2:2:-
<i>Schulp-wit</i>	Lead white (in flakes, pure)	0:4:0	4 1/4	0:17:-
<i>Schuijm van goud</i>	Gold (refining) foam/dross	0:2:8	8 1/2	1:1:4
<i>Been-swart</i>	Bone black	0:5:0	7/8	0:4:6
<i>Platte lack</i>	Flat lake pigment	0:16:0	3/4	0:12:-
<i>Roose-rood</i>	Rose red	0:6:0	1 7/8	0:11:4
<i>Oostind[ische] Inkt</i>	East Indian ink	...	3 pieces	1:4:-
<i>Geele besiën</i>	Yellow berries	0:13:0	3 7/8	2:10:6
<i>Spaans potlood</i>	Spanish lead pencil	0:5:0	3 1/4	0:16:0
<i>Ratte-kruijd</i>	Rat herb	0:3:0	1 oz	0:0:5
<i>Vloo-saet (vlooziaad)</i>	Psyllium	0:6:0	1	0:6:0

Shop goods	Translation	Price	Quantity	Total
<i>Was-light</i>	Light-colored wax	. . .	3	1:16:-
<i>Gemale spaens groen</i>	Ground Spanish green (verdigris)	1:5:0	1 $\frac{7}{8}$	2:7:-
<i>Floers</i>	Safflower	0:15:-	$\frac{3}{4}$	0:11:4
<i>Ruijs geel</i>	Orpiment	0:8:0	1 lood	0:0:4
<i>Menij</i>	Minium (red lead)	9:0:0 per 100	27	2:8:8
<i>Geel en bruijn hars</i>	Yellow and brown resin	6:0:0 per 100	143	9:1:4
<i>Orliaen</i>	Orliaen yellow pigment	0:17:0	1 $\frac{1}{8}$	0:19:2
<i>Swart kruid</i>	Black powder	0:6:0	4 $\frac{3}{4}$	1:8:8
<i>Spaens groen</i>	Spanish green (verdigris)	0:19:0	10 $\frac{1}{4}$	9:14:8
<i>Geel wasch</i>	Yellow wax	0:14:0	7 $\frac{3}{4}$	5:1:8
<i>Heele tervae</i>	Whole tervae [Likely: resinous substance (varnish material), identification uncertain; otherwise terra verde/green earth?]	0:8:0	5 $\frac{1}{2}$	2:4:-
<i>Fermilioen</i>	Vermilion	2:2:0	$\frac{1}{4}$ $\frac{1}{8}$	0:15:-
<i>Gom dragan</i>	Tragacanth	0:4:0	$\frac{3}{4}$	0:3:0
<i>Operiment</i>	Orpiment	0:7:0	1 $\frac{1}{2}$ $\frac{1}{8}$	0:11:6
<i>Engelsche assche</i>	English ash (blue ash)	2:0:0	. . .	3:6:-
<i>Stroo-blauw</i>	Strew blue (coarsely ground smalt)	0:6:0	1 $\frac{1}{2}$	0:9:-
<i>Sandel-hout</i>	Sandalwood	0:4:0	1 $\frac{3}{4}$	0:7: -
<i>Indigo</i>	Indigo	2:2:0	1 $\frac{1}{2}$	3:3:-
<i>Gom</i>	Gum	18:0:0 per 100	132	23:15:-
<i>Witte galnoten</i>	White galls	35:0:0 per 100	75	26:5:-
<i>Blauwe galnoten</i>	Blue galls	45:0:0 per 100	65	29:5:-
<i>Bruijnen oker</i>	Brown ochre	5:15:0 per 100	54	2:9:11
<i>Slecht rood</i>	Inferior quality red	0:30:0 per 100	89	1:6:8
<i>Slegten ligten oker</i>	Inferior quality light-colored ochre	0:1:0	44	2:4:-
<i>Beste ligten oker</i>	Best quality light-colored ochre	0:4:0	10 $\frac{1}{2}$	2:2:-
<i>Japans hout</i>	Japan wood	11:0:0 per 100	54	5:15:12
<i>Provintie hout</i>	Campeche wood, log wood	8:5:0 per 100	114	9:7:-
<i>Smak</i>	Smak	0:1:0	20	1:0:-
<i>Geel hout</i>	Yellow wood	5:10:0 per 100	151	8:6:-
<i>Blauw lakmoes</i>	Blue litmus	0:6:0	5 $\frac{3}{4}$	1:14:8
<i>Bruijnen oker</i>	Brown ochre	0:1:0	14	0:14:-
<i>Aluijn</i>	Alum	0:2:0	15	1:10:-
<i>Goud-schulpen</i>	Shell gold	0:4:0 per piece	27	5:8:-
<i>Silver-schulpen</i>	Shell silver	0:2:0 per piece	18	1:16:-
<i>Gom-lack</i>	Gum lac	11:0:0	$\frac{1}{2}$ lood, less than $\frac{1}{2}$ lb	5:5:-

Shop goods	Translation	Price	Quantity	Total
<i>Gemalen omber</i>	Ground umber	8:0:0 per 100	97	7:15:3
<i>Swavel</i>	Sulfur	6:10:0 per 100	36	2:6:0
<i>Rooden aluijn</i>	Red alum	11:0:0 per 100	56	6:3:3
<i>Rood</i>	Red	1:16:0 per 100	100	1:16:0
<i>Noot-olij</i>	Walnut oil	0:6:0	9	2:14:-
<i>Fernis</i>	Varnish	0:2:8	50	6:15:-
<i>Swartsel</i>	Black pigment	8:10:0 per 100	60	5:1:4
<i>Beste potlood</i>	Best quality lead pencil	0:6:0	2¾	0:16:0
<i>Leijdse lijm</i>	Glue from Leiden	24:0:0 per 100	54	12:9:8
..	..	0:6:0	6	1:16:0
<i>wit</i>	White	1:4:0 per 100	130	1:11:0
<i>Sesentwintig maet</i>	26 size panels		1 piece	1:2:-
<i>Guldens maeten</i>	Gulden size panels	0:15:0 per piece	8 pieces	6:0:-
<i>Groote soorten</i>	Large-size panels	0:9:0 per piece	20 pieces	9:0:-
<i>Over-maeten van een stuck</i>	Oversized panels for a single piece	0:9:8 per piece	13 pieces	6:3:-
<i>Uts. [over-maeten van een stuck]</i>	Oversized panels for a single piece	0:5:0 per piece	10 pieces	2:10:-
<i>Seve stuijvers</i>	Seven-stuiver panels	0:5:0 per piece	14 pieces	3:10:-
<i>Salvators</i>	Salvator panels	0:3:12 per piece	79 pieces	12:19:8
<i>Admiralen</i>	Admiraal panels	0:2:4 per piece	4 pieces	0:10:0
<i>Stooters</i>	Stooter panels	0:1:4 per piece	9 pieces	0:11:4
<i>Thientgens</i>	Thientgen panels	0:8:0 per piece	109 pieces	2:14:8
<i>Doecken</i>	Canvas	0:16:0 per piece	2 pieces	1:12:-
<i>Een raem</i>	Wooden frame			0:13:-
<i>Vier paletten</i>	Four palettes			1:0:0
<i>Veneetts Tarpentijn</i>	Venetian turpentine	0:4:0:	50	10:0:-
<i>Tarpentijn-water</i>	Turpentine water	0:17:0 per stoop	1 stoop, 3½ pinten	1:11:14
<i>Treckers</i>	Brushes	0:2:8 per dozen	23 dozen	2:17:8
<i>Enden</i>	Duck (quill) brushes	0:2:8 per dozen	8 dozen	1:0:0
<i>Endo-visschen</i>	Duck (quill) brushes	0:2:8 per dozen	12 dozen	1:10:0
<i>Swane-visschen</i>	Swan (quill) brushes	0:10:0 per dozen	5 dozen	2:10:-
<i>Groote gansen</i>	Big goose (quill) brushes	0:4:0 per dozen	7 dozen	1:8:-
<i>Halve swanen</i>	Half swan (quill) brushes	0:5:1 per dozen	20 pieces	0:8:0
<i>Goud pinceeltgens</i>	Gold brushes	0:4:0 per dozen	4 dozen	0:16:0
<i>Outemarijn</i>	Ultramarine	...	3 oz, 1 Eng. 20 Alen.	98:12:10
<i>Traen</i>	Train oil	0:7:9 per stoop	42 stoop	15:4:8
<i>Olij</i>	Oil	...	42 stoop	24:0:-
<i>Witte stijfsel</i>	White starch	11:0:0 per 100	62	6:14:6
<i>Teijcken-papier</i>	Drawing paper	0:6:0 per book	5 books	1:10:0

Shop goods	Translation	Price	Quantity	Total
<i>Bocke-bloed</i>	Goat's blood (red lake)	0:1:0	2	0:2:0
<i>Zee-groen</i>	Sea green	0:18:0	1/2	0:9:0
<i>Gom-lack</i>	Gum lac	0:8:0	1	0:8:0
<i>Sanderacq</i>	Sandarac, resin	0:6:0	1	0:6:0
<i>Noot-olij</i>	walnut oil	...	1 jug	1:4:-
<i>Goud-verw</i>	Gold (colored) paint	...	3 pots	3:0:0
<i>Fernis</i>	Varnish	...	a little bottle	0:10:-
<i>Mastekot</i>	Massicot	...	...	0:6:0
<i>Spongien</i>	Sponge	2:10:0	1/8	0:6:4
<i>Noot-olij</i>	Walnut oil	0:6:0	2	0:12:-
<i>Een weijnig rommeling van verw</i>	A small jumble of paint materials			0:6:0
<i>Schrijf-lak</i>	Writing lacquer (sealing wax)	...	...	0:1:0
<i>Lood-wit</i>	Lead white	9:10:0 per 100	20	1:18:-
<i>Selgte lichte schijtgeel</i>	Inferior quality light-colored yellow lake	0:4:0	9	1:18:-
<i>Italiaenschen oker</i>	Italian ochre	...	...	0:0:12
<i>Oostind[ischen] inkt</i>	East Indian ink	...	...	0:12:0
<i>Schoorsteen swart</i>	Chimney soot black	...	...	1:11:4
<i>Swartsel</i>	Black pigment	...	...	1:0:-
<i>Krijt</i>	Chalk	...	...	0:12:-
<i>Koper-rood</i>	Copper red	...	...	0:3:-
<i>Gemale loodwit</i>	Ground lead white	...	4	0:8:-
<i>Slegten tervaet</i>	Inferior quality tervaet (see above)	...	3	0:3:-
<i>Douck (Doek)</i>	Canvas	0:10:0 per ell	14 1/2 ells	7:5:-



GARLAND GALORE: EXPLORING MICHAELINA WAUTIER'S UNIQUE APPROACH TO FLOWER STILL LIFE PAINTING

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ABSTRACT This article presents results from the technical examination of *Flower Garland with Butterfly* (1652) by Michaelina Wautier (c.1614–1689), one of only two flower paintings known to be made by her. The painting was examined through detailed visual analysis and macro X-ray fluorescence (MA-XRF) scanning, complemented by microscopic analysis of a single paint cross-section. Painted only a decade after the emergence of the sub-genre of autonomous flower garlands in Antwerp, Wautier's composition adheres to the conventions of flower garland painting while simultaneously introducing innovative motifs. This interplay of traditional and experimental approaches is also reflected in her use of materials and paint layer build-up. The results of the technical examinations contribute to our understanding of Wautier's artistic training, revealing an influence of Antwerp-based specialized flower painters in both iconography and technique.

KEY WORDS Technical Art History; flower still lifes; Michaelina Wautier; MA-XRF scanning; artistic influences

1 Introduction

Since Nochlin's 1971 essay, 'Why Have There Been No Great Women Artists?', interest in women artists has grown considerably.^{1,2} Nevertheless, most technical studies to date have continued to focus on the work of male artists, leaving the potential of this approach for studying women artists largely underexplored. Studying the material and technical aspects of paintings can give valuable insights into an artist's studio practice, artistic influences and professional networks. As Powell-Warren has suggested, technical analysis might be used to understand studio collaborations (and the role of women within them) on single artworks, or how works by different artists may be related through the

use and supply of materials.³ In this way, technical studies may be useful in uncovering artists of whom very little is known due to the lack of archival or documentary sources, as is the case for many early modern female artists.

The use of material-technical research for a deeper understanding of early modern women painters, using Michaelina Wautier's *Flower Garland with Butterfly* (1652, oil on panel, private collection; see Fig. 1) as a case study, has recently been explored by Derks *et al.*⁴ This article can be considered a follow-up study, contextualizing the results of the technical examinations of this painting and exploring to what extent Wautier may have been influenced by Antwerp-based specialized flower painters in terms of iconography as well as painting techniques.



Figure 1 Michaelina Wautier, *Flower Garland with Butterfly*, 1652, oil on panel, 52 × 47 cm, private collection, on loan to the Noordbrabants Museum ('s-Hertogenbosch, the Netherlands). (Photo by Peter Cox, courtesy of the Noordbrabants Museum.)

Although very little is known about Michaelina Wautier's (c.1614–1689) life or work, recent scholarship has put considerable effort into reclaiming her position in art history.⁵ The latest endeavours are presented in the 2025–2026 monographic exhibition organized by the Kunsthistorisches Museum in Vienna and the Royal Academy in London and published in the accompanying catalogue.⁶ Wautier distinguishes herself from other female artists of the time through her remarkable versatility. She did not limit herself to a single genre, but rather explored a wide range of subjects and painting genres, including mythological scenes and large-scale altarpieces.⁷ Wautier was active in Brussels between c.1645 and 1660, a period during which she shared a house, and most likely also a studio, with her brother Charles (1609–1703), who was also a painter.⁸ Both siblings can be linked to the artistic circles surrounding Archduke Leopold Wilhelm (1614–1662) and his court.⁹

As Wautier is mostly known for her portraits and history pieces, *Flower Garland with Butterfly* holds a special position within her oeuvre as one of only two known flower paintings.¹⁰ The other flower piece by her hand, *Flower Garland with Dragonfly* (1652, oil on panel, private collection), is considered its pendant (see Fig. 2a).¹¹ This is quite exceptional as only a few pendant flower pieces are known.¹² The fact that these two are pendants combined with the highly original bucranium motif in both compositions suggests that they may have been commissioned for a specific context.¹³ The viewer's perspective in *Flower Garland with Dragonfly* further implies that the paintings were intended to be displayed high on a wall. Both flower pieces are fully signed and dated: *Michaelina Wautier fecit 1652*.

Unfortunately, nothing is known about Wautier's artistic training. It is generally assumed that she learned to paint from her brother Charles; however, we do not know any flower pieces by his hand. This raises the question of where or with whom Michaelina developed the skill to paint flower still lifes of such high quality. In order to shed more light on this question and learn more about

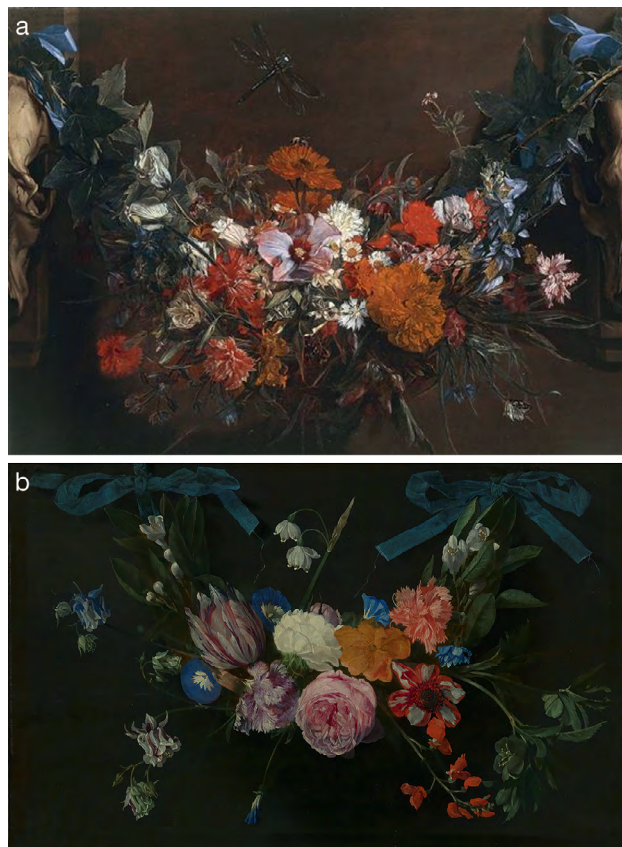


Figure 2 (a) Michaelina Wautier, *Flower Garland with Dragonfly*, 1652, oil on panel, 52 × 47 cm, private collection. Image in the public domain, via Wikimedia Commons. (b) Daniël Seghers, *Flower Garland*, c.1650, oil on panel, 36 × 56 cm, Royal Museums of Fine Arts of Belgium (Brussels), inv. no. 183. (Image courtesy of the Royal Museums of Fine Arts of Belgium.)

Wautier's artistic training and technical influences, *Flower Garland with Butterfly* underwent a thorough technical analysis.¹⁴ This included visual examination using a head loupe and monocular,¹⁵ and macro X-ray fluorescence (MA-XRF) scanning.¹⁶ One paint sample was prepared as a cross-section¹⁷ and studied with optical microscopy and scanning electron microscopy equipped with energy-dispersive X-ray spectroscopy (SEM-EDX) to gain a better understanding of the paint layer build-up and pigments present in the paint layers.

2 Iconography

Flower still lifes were an immensely popular genre in seventeenth-century Netherlandish painting. The development of independent flower pieces has been discussed in depth by Segal and Alen,¹⁸ who place its genesis early in the century with artists such as Jan Brueghel the Elder (1568–1625) and Ambrosius Bosschaert the Elder (1573–1621). In the second quarter of the century (1620–1650), Daniël Seghers (1590–1661) was one of the most influential painters. He developed several sub-genres of flower pieces, including the cartouche still life and autonomous flower garlands.¹⁹

The earliest known flower garland is *Virgin and Child in a Garland of Flowers* by Brueghel the Elder

and Hendrick van Balen (1575–1632) and can be dated c.1607 (oil on panel, Pinacoteca Ambrosiana, Milan).²⁰ These early garlands were developed from devotional images depicting the Virgin Mary encircled by flowers. The flower garlands were decorative elements in a devotional piece and as such enhanced the significance of the images they framed.²¹ This motif gained popularity in Antwerp, but artists soon abandoned its devotional function and focused on the trompe l'oeil qualities of the garland itself. This meant that independent flower garlands, without religious motifs, emerged as a distinct sub-genre of painting. The earliest examples of such autonomous garlands by Seghers date from the 1640s, and possibly as early as the 1630s (see Fig. 2b).²²

Wautier's *Flower Garland with Butterfly* shows a floral wreath suspended from two animal skulls. The garland is set against a dark brown, undefined background. The two animal skulls, likely from horses, are integrated into architectural elements, referring to the Antique bucranium motif.²³ This reference is unique in seventeenth-century flower pieces²⁴ and shows Wautier's eagerness to experiment with her compositions. The inclusion of the skulls also carries strong *vanitas* or *memento mori* symbolism.²⁵

The garland itself consists of ivy intertwined with a rich variety of flowers (see Fig. 3). Among them are no less than nine roses (both pink and white), pot marigolds, carnations, common broom, sweet williams, larkspur, feverfew, common jasmine, a calla lily²⁶ and two small pansies. Above the garland, a white butterfly is hovering, while

a small fly rests upon the central pink rose. Compared with its pendant painting, *Flower Garland with Butterfly* contains relatively larger flowers: *Flower Garland with Dragonfly* is made up of more and much smaller flowers, which have been identified as carnations, daisies, cornflowers, marigolds, sweet peas and one centrally placed hibiscus. As argued by Meijer, this painting shows clear influences from Seghers's flower pieces, particularly with this emphasis on the smaller flowers.²⁷ Also visible in *Flower Garland with Dragonfly* are blue ribbons securing the garland to the skulls. Although such ribbons do not appear in *Flower Garland with Butterfly*, MA-XRF scanning has revealed that Wautier initially included them in an earlier stage of the painting (see Fig. 7d).²⁸

In flower pieces, artists often combined various flowers that do not bloom at the same time. Painters such as Ambrosius Bosschaert the Elder and Jan Brueghel the Elder, for example, included flowers from different seasons within a single composition. Similarly, in the work of Rachel Ruysch (1644–1750), tulips (which flower in April–May) and sunflowers (flowering in July–September) appear together.²⁹ Wautier's *Flower Garland with Butterfly*, however, departs from this convention: the flowers included in this composition all bloom at a similar time, namely in summer between June and September. Only the common broom blooms slightly earlier: between May and June. The same holds true for the species depicted in the pendant painting, *Flower Garland with Dragonfly*, where all flowers also bloom between June and September. This shared flowering period suggests that Wautier could have painted her flowers from life.

Perhaps more significantly, Wautier included both species that grew in the open garden and plants typically cultivated in orangeries or greenhouses (such as the common jasmine and the calla lily). This combination seems to suggest that she studied specimens in botanical collections.³⁰ Earlier in the century, the garden of Archdukes Albert (1559–1621) and Isabella (1566–1633) offered artists the opportunity to study a wide variety of exotic flowers firsthand. Although no evidence survives of Wautier's connections with horticulturalists, her association with the Brussels court of Archduke Leopold Wilhelm may have provided her access to such rare and exotic blooms.

Most flowers included in Wautier's garlands were either native to Europe or commonly available there by the mid-seventeenth century. The only exceptions are the calla lily in *Flower Garland with Butterfly* and the hibiscus in *Flower Garland with Dragonfly*.³¹ According to MacDougall and Knaap, seventeenth-century flower painters generally focused on a relatively narrow range of flowers, despite the large number of plants and species available. As a result, only a handful of rare flowers became popular.³² Wautier appears to have adopted a similar approach in her flower garlands, introducing a single exotic bloom amid more familiar European flowers. This seems to be the case for *Flower Garland with Dragonfly*, in which the hibiscus takes the central position in the composition, drawing all the attention from the viewer.

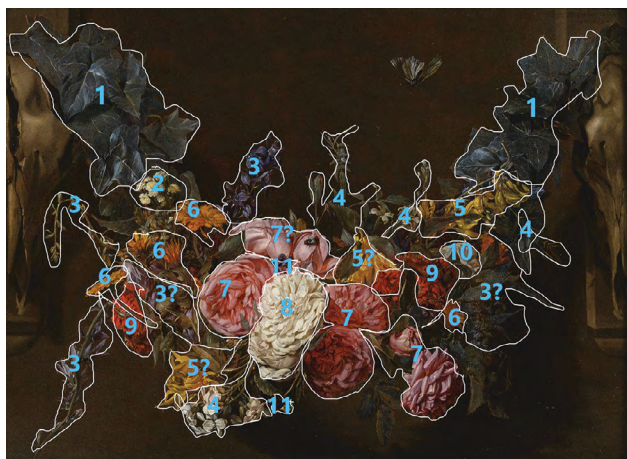


Figure 3 Schematic overview of the identification of the flowers in *Flower Garland with Butterfly*. The number corresponds with the following varieties:

1. *Hedera helix* or common ivy
2. *Tanacetum parthenium* or feverfew: possibly the variety 'Flore pleno'
3. *Consolida ajacis* or larkspur
4. *Jasminum officinale* or common or white jasmine
5. *Cytisus scoparius* or broom
6. *Calendula officinalis* or marigold
7. *Rosa centifolia* or cabbage rose
8. *Rosa × alba* or white rose
9. *Dianthus barbatus* or sweet williams
10. *Zantedeschia aethiopica* or calla lily
11. *Viola tricolor* or pansy

(Image and identification courtesy of Paul van den Breemt.)

The other flowers in this painting seem to serve a supportive role, making the hibiscus stand out even more as an exotic species. However, this hypothesis is less convincing for *Flower Garland with Butterfly*, where the calla lily is almost hidden in the garland, while the roses take the central position and draw most of the viewer's attention.

Wautier painted her *Flower Garland with Butterfly* roughly a decade after Seghers introduced the sub-genre, and her work fits seamlessly within its development. At the same time, Wautier adds original motifs, such as the bucranium motif, and shows an innovative take on the genre, as she blends classical symbolism with natural observations. Nevertheless, further research is needed to fully comprehend Wautier's iconographical approach.

3 Panel support

Michaelina Wautier painted her *Flower Garland with Butterfly* on a wooden panel measuring 42 × 57 cm. The support consists of two planks of approximately equal width (c.20–21 cm), most likely oak, although no material analysis was carried out to confirm the wood type. All sides of the panel have a bevelled edge of c.2–3 cm, indicating that the panel has probably retained its original format. The use of a panel support is noteworthy, as Wautier typically worked on canvas. Only four of her known paintings are on panel: *A Boy with Tobacco* (c.1650–1655, oil on panel, private collection), *Study of an Old Man* (c.1655, oil on panel, Museum M Leuven, Belgium) and the two flower garlands. As canvas seems to have been Wautier's preferred support, her choice to work on panel was likely a deliberate one, made either by herself or by the person who commissioned the painting. This choice may be related to the subject matter of the painting: while canvas had become the most common support for oil painting by the mid-seventeenth century,³³ many specialized flower painters (most of whom were based in Antwerp) continued to favour panel for their compositions. Panels (either of wood or copper) provided artists with a smoother surface to work on, which was important to achieve the level of detail, precision and subtlety needed to create life-like bouquets and flowers.³⁴

By opting for a panel support, Wautier may have consciously placed herself in the Antwerp artistic tradition of flower painting, carefully studying and adopting the materials of specialized flower painters. This hypothesis is strengthened by the fact that the panels of both flower pieces originate from Antwerp. All panel makers in Antwerp were members of the guild and had to conform to specific production standards, such as the prescribed standard size of panels. One such standard size was the so-called *stooter*,³⁵ measuring approximately 40 × 55 cm. This format closely corresponds with the size of Wautier's panels. Moreover, on the back of both *Flower Garland with Butterfly* and *Flower Garland with Dragonfly*, a stamp from the panel makers' guild is present (see Fig. 4).³⁶ The branding of Antwerp panels for easel painting was described in the Joiners' Guild regulations of 1617, which were first published by Van Damme in 1987.³⁷ According to these regulations, all joined panels had to be checked and branded by the guild's dean before they could be sold. The stamps varied in shape and design related to the tenure of the dean, which allows for approximate dating.³⁸ The stamp on the panel of *Flower Garland with Butterfly* is one of the designs used by the Antwerp Joiners' Guild between c.1632 and 1638.³⁹

The panel ended up in Wautier's studio some 15 years later, in 1652. It remains unclear if Wautier travelled to Antwerp to acquire a set of panels or if they were provided as part of a commission for the pendant flower garlands. Although there is no documentary evidence that Wautier's flower garlands were commissioned, their ambitious character and the costly pigments employed (most notably the extensive use of ultramarine)⁴⁰ strongly suggest that the flower garlands were created for a patron.

4 Preparation of the support

The panel of *Flower Garland with Butterfly* is prepared with a light-coloured ground common to panel paintings from this period.⁴¹ Analysis showed that the ground layer – visible in the paint cross-section (see Fig. 5b) – is a chalk and glue ground.⁴² On top of this is a thin, grey *imprimatura* or priming. Based on visual inspection, this

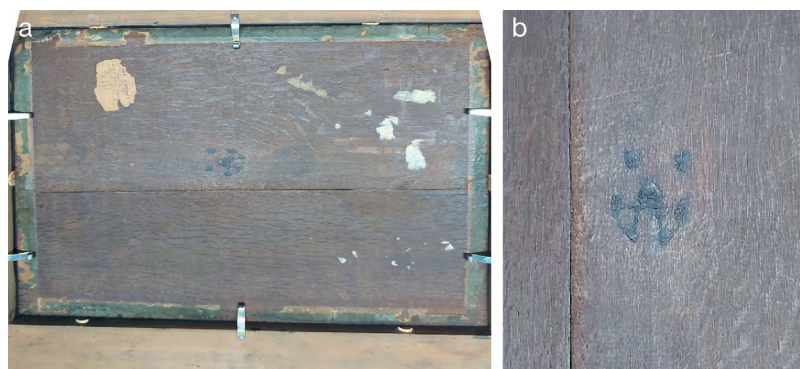


Figure 4 (a) Reverse of the panel of Wautier's *Flower Garland with Butterfly*. In the centre, the stamp can be seen. Photograph by Kirsten Derks. (b) Detail of the stamp. (Photograph by Kirsten Derks.)

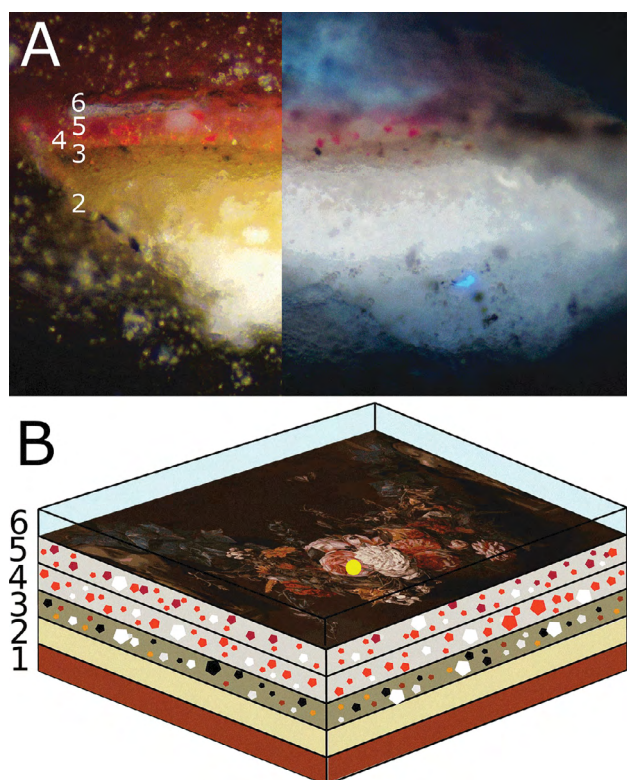


Figure 5 (a) The yellow dot in (b) indicates the area where the paint sample was taken 50×. (b) Schematic overview of the layer build-up of *Flower Garland with Butterfly*. Layer 1 is the wooden panel support. Layer 2 corresponds with the chalk and glue ground. Layer 3 is the imprimatura, consisting of lead white, some earth pigments and a little carbon black. Layer 4 corresponds with the bright orangey-red underpaint, consisting of lead white and vermillion, and possibly also some red lake. Layer 5 is a deeper red paint layer, consisting mostly of red lake pigment. This was applied to work up the monochrome lay-in of layer 4. Layer 6 is a varnish layer.

imprimatura was applied relatively evenly, providing a neutral mid-tone during the painting process.

We find subtle variations in the preparation layers of the four works on panel by Wautier that have come down to us. The panel for *Study of an Old Man* does not seem to be prepared with a ground layer at all. In this painting, Wautier seems to have applied the paint layers directly on the bare wood.⁴³ By contrast, the panel of *A Boy with Tobacco* is most likely prepared with a chalk and glue ground layer, upon which a very streaky imprimatura was applied. This imprimatura remains visible through the upper paint layers and has a significant impact on the visual appearance of the finished painting. These small variations in preparatory systems for the panel supports all fall within the range of commercially available ground layers.

In contrast, Wautier's works on canvas show a much wider variety in preparatory layers, which reflects her experimental approach when it comes to grounds.⁴⁴ Technical analysis of her works on canvas has shown that it is likely that Wautier prepared her canvases in her own studio, rather than purchasing pre-primed canvas from a local supplier. While the majority of her canvases have been prepared with a buff-coloured ground layer, much like the depicted canvas in her *Self-Portrait* (c.1650, oil on canvas, private collection; see Fig. 6),⁴⁵ about a third of Wautier's



Figure 6 Michaelina Wautier, *Self-Portrait*, c.1645, oil on canvas, 120 × 102 cm, private collection (USA). (Image courtesy of the Museum of Fine Arts, Boston.)

known oeuvre on canvas shows a different ground colour and layer build-up.⁴⁶ Wautier also worked on canvases prepared with reddish-brown grounds (*Triumph of Bacchus*, before 1659, oil on canvas, Kunsthistorisches Museum Vienna; and *Mystic Marriage of Saint Catherine*, 1649, oil on canvas, Grand Séminaire, Namur); a double grey over red ground (*The Five Senses*, 1650, oil on canvas, Rose-Marie and Eijk van Otterloo Collection); and a double red over grey ground (*Saint John the Baptist as a Boy*, c.1650–1655, oil on canvas, Museo Lázaro Galdiano, Madrid). These examples show that Wautier did not seem to have a set way of preparing canvases, but rather seemed to have experimented with preparatory layers.

For her flower garlands, however, Wautier most likely opted for commercially available panels, pre-primed with a traditional chalk and glue ground. While she primed her own canvases, she may not have been familiar with priming panels. This task was typically undertaken by professional panel makers anyway: in seventeenth-century Antwerp, panel makers were also responsible for applying the ground layers, and most panels were thus sold ready-primed.⁴⁷ Finally, Wautier's choice of panels with a traditional chalk and glue ground may also reflect a technical influence of Antwerp-based flower specialists: they most often used panels primed with a chalk and glue ground, and Wautier may have considered this to be the support and ground combination most suitable for flower pieces. This shows that Wautier deliberately adapted her working methods according to the genre and composition, demonstrating both technical awareness and creative flexibility.

5 Pigments and painting techniques

The palette used by Wautier to create her colourful *Flower Garland with Butterfly* is remarkably extensive. Analysis has identified the following pigments: lead white, carbon black, earth pigments (including ochres and umbers), vermilion, ultramarine, organic red and yellow pigments, and both blue and green copper-based pigments.⁴⁸ Wautier did not always use such an elaborate palette: she employed a rather limited range of pigments for her portraits and genre pieces. With its elaborate palette, *Flower Garland with Butterfly* can be grouped with Wautier's highly ambitious history scenes, such as *Triumph of Bacchus* and *Education of the Virgin* (1656, oil on canvas, private collection), all painted with a wide variety of pigments.⁴⁹

In terms of pigment use and painting techniques, *Flower Garland with Butterfly* appears to correspond closely with the working practice of Antwerp-based flower specialists, such as Seghers and de Heem. In the following sections, we discuss some of the most prominent of these aspects focusing on Wautier's use of local underpaintings and her use of orpiment and/or realgar.

5.1 Painting roses

Macro-XRF scanning and a paint sample extracted from one of the pink roses gave more insight into her palette, the way Wautier built up her composition and prepared the individual flowers in the garland. Wautier prepared her roses using a flat vermilion-based underpainting. In the mercury (Hg-L) map (see Fig. 7c), this underpainting

is visible as rounded shapes evenly distributed along the garland, indicating the intended placement and general shape of each rose. The same rounded forms are also visible in the lead (Pb-L) map (see Fig. 7b), suggesting that this underpainting consists of a reddish or pink paint containing vermilion mixed with some lead white. These areas were subsequently worked up in later stages of the creative process.

A paint sample extracted from one of the roses confirms this build-up (see Fig. 5a). The paint cross-section shows that on top of the *imprimatura* (layer 2, see Fig. 5b), Wautier applied a reddish or pink underpaint for the roses (layer 3), composed of vermilion and lead white. On top of this underpainting, she applied the pictorial layer (layer 4), consisting of mostly red lake, some lead white and (see Fig. 5b). This upper layer, with a deeper red colour, was applied to work up the rose and deepen the shadows.

This technique of underpainting individual flowers with brightly coloured, flat patches has been observed in seventeenth-century still life paintings before, most notably in the work of Daniël Seghers and Jan Davidsz. de Heem (1606–1684).⁵⁰ Seghers is generally credited with the introduction of this technique, which was subsequently adopted by other specialized flower painters.⁵¹ The technique is best understood by looking at an unfinished painting by Seghers: the verso of his *A Vase of Flowers* (c.1650, oil on copper, Fitzwilliam Museum, Cambridge) shows the exposed underpainting stage.⁵² Here it can be seen that the flat patches have roughly the same shape and colour as the final flowers.

To understand the particular painting techniques used by Brussels-based specialized flower painters – and how their approaches differed from those of Antwerp

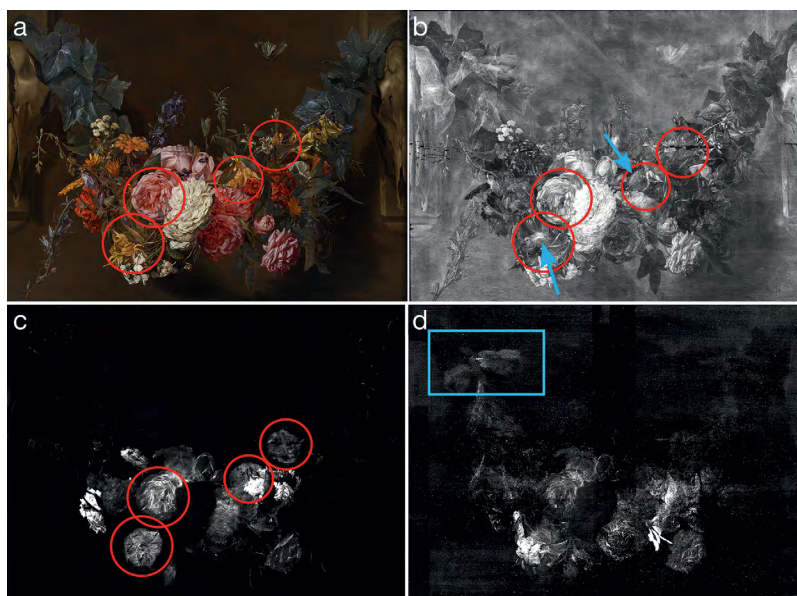


Figure 7 (a) Michaelina Wautier, *Flower Garland with Butterfly*. (b)–(d) MA-XRF maps of *Flower Garland with Butterfly*. (b) Pb-L or lead map. (c) Hg-L or mercury map. The red circles indicate where a locally applied red underpainting is present, which was used to prepare the roses in the garland. This underpainting is not always visible in the Pb-L map: the blue arrows indicate where it can be seen. (d) Cu-K or copper map. In the blue rectangle, a preparation for a blue ribbon can be seen. The shape is reminiscent of the ribbons in the pendant, *Flower Garland with Dragonfly*.

specialists – we examined a flower piece from a Brussels specialist using MA-XRF scanning.⁵³ Only a handful of specialists were active in Brussels, among whom Jan Anton van der Baren (1615–1686/7) may have been one of the most prominent. Van der Baren, also a priest at the court of Leopold Wilhelm, painted mainly flower garlands around cartouches, as well as autonomous flower still lifes and bouquets.⁵⁴ His *Mystic Marriage of Saint Catherine* (1641, oil on canvas, Royal Museums of Fine Arts of Belgium, Brussels) was selected for this study (see Fig. 8). We were particularly interested in learning whether van der Baren employed the same technique as Seghers, using local flat patches to underpaint individual flowers. If so, it could indicate that Wautier may have learnt about this technique within the borders of her own city.

Macro-XRF mapping and microscopic examination of *Mystic Marriage of Saint Catherine* revealed that van der Baren did not use such local, brightly coloured flat patches for underpainting the flowers. Instead, he worked from background to foreground, first completing the architectural elements before adding the flowers. Microscopic observations show that most flowers were painted over the (already dried) paint layers of the architecture. The largest and most important flowers in the garland and bouquets are left in reserve, but are not prepared with a local underpainting. For the roses, van der Baren left a circle in reserve where each rose would go. They were then painted directly onto the light buff-coloured ground layer, which is still visible through the pink paint layers. Moreover, van der Baren painted his flowers using only one paint layer. He mixed the colours on his palette and applied the desired tone directly to the canvas. In some cases, he also worked wet-in-wet on the canvas to create smooth transitions between different colours and hues.

While most flowers in van der Baren's painting were not prepared with a local underpainting, an exception occurs in the treatment of the bright orange flowers. These were prepared with a local underpainting in a yellow colour, upon which a paint layer containing an arsenic sulphide pigment (orpiment or realgar) was applied. It is likely that van der Baren considered this local underpainting necessary to prevent discolouration of the orpiment/realgar in these flowers (see also the next section). Macro-XRF scanning confirmed the presence of iron in this area (see Fig. 8d), suggesting that the underpainting was likely made with iron-based earth pigments, probably ochres.⁵⁵

Van der Baren's approach in *Mystic Marriage of Saint Catherine* thus appears to differ fundamentally from the techniques of Antwerp specialists: he did not employ the sophisticated multi-layer build-up characteristic of Seghers's work. However, since only one of van der Baren's works has been examined to date, these findings may not be representative for his overall painting practice. Further study of Brussels-based flower painters is needed to determine whether the use of coloured underpainting was a distinctly Antwerp phenomenon or a more widespread method.⁵⁶

Based on our – albeit limited – research results, it seems unlikely that Wautier learned about this specialized technique using flat, coloured underpaintings in the confinement of her own studio or the city of Brussels. Instead, *Flower Garland with Butterfly* shows a clear influence of Antwerp flower painters. It is possible that Wautier learned about this technique through her connections at the court of Archduke Leopold Wilhelm of Austria. She may have had the chance to study the work of Seghers, or even meet the artist himself.⁵⁷



Figure 8 (a) Jan Anton van der Baren, *Mystic Marriage of Saint Catherine*, 1641, oil on canvas, 176 × 123 cm, Royal Museums of Fine Arts of Belgium (Brussels), inv.no. 4197. Image courtesy of the Royal Museums of Fine Arts of Belgium. The yellow square indicates the location of detail b. (b) Detail of (a), which has been examined with MA-XRF scanning. (c)–(g) MA-XRF maps. (c) Pb-L or lead map. The roses marked with the blue rectangle were left in reserve in background paint and were only worked up and are only worked up with a lead-based paint layer. (d) Fe-K or iron map. (e) As-K or arsenic map. (f) K-K or potassium map. (g) Sb-L or antimony map. The red circle indicates the orange flower. In the Fe-K map, it can be seen that it was prepared with an iron-based underpainting. The flower was worked up using an arsenic-based paint (orpiment/realgar). Details were added with an antimony-based paint, and shadows were painted using a potassium-based paint.

5.2 Painting marigolds

The most surprising discovery in the technical examination of *Flower Garland with Butterfly* was the presence of the pigment orpiment and/or realgar, pigments that – so far – have not been found in any other works by Wautier.⁵⁸ These pigments, however, were extensively used by specialized flower painters, suggesting again that this may be a technical influence of Antwerp-based specialists. Macro-XRF scanning revealed the presence of these arsenic sulphide pigments in the orange and yellow flowers.⁵⁹ The main components of these pigments, arsenic and sulphur, were both detected in these flowers, implying that a form of orpiment was used for the yellow flowers. For the orange flowers, either realgar or a paint mixture including orpiment and/or realgar could have been used. Additional elements identified in the yellow and orange flowers include lead, mercury, iron and a minor peak for potassium, indicating the presence of lead white, vermilion and earth pigments. To determine the exact pigments would require (invasive) pigment analysis, which is outside the scope of this research.

Employing these arsenic sulphide pigments is not straightforward, yet it seems that Wautier had the knowledge and skills to use them successfully. This is evidenced by the excellent preservation of the orange and yellow flowers in *Flower Garland with Butterfly*, even though orpiment and realgar have the tendency to discolour severely. Indeed, many seventeenth-century flower still lifes exhibit significant discolouration or degradation in areas painted with these pigments.⁶⁰ Contemporary art technological sources also warn readers of the difficulties of working with orpiment/realgar and provide practical advice on how to work with the pigments to avoid discolouration. Several of these sources even include recipes on how to paint certain flowers, like marigolds. One such example is Willem Beurs's *De Groote Waereld in 't Kleen Geschildert* of 1692,⁶¹ a treatise dedicated to four of his (female!) students, which offers step-by-step instructions for painting marigolds. Beurs described that they should be painted in the following way: pure orpiment should be used for the lit 'day side' of the flower, and a mixture of orpiment and yellow and red lake should be used for the shadowed areas. For the reflection within the flower, the artist should use a mixture of orpiment, yellow lake, red lake and vermilion.

While other researchers have found clear parallels between the practices described by Beurs and the observed painting techniques of specialized flower painters, such as de Heem and Abraham Mignon (1640–1679),⁶² Wautier appears to have deviated from this practice. Macro-XRF scanning combined with visual examination showed that she did not prepare the orange and yellow flowers with a local underpainting as she did with her roses (see Fig. 9e), and as was described by authors such as Beurs. Other artists, including Mignon and de Heem, typically prepared the marigolds in their compositions with local underpaintings, likely made with iron-based pigments (probably ochre) as they show up clearly in the iron (Fe-K)

maps.⁶³ In *Flower Garland with Butterfly*, iron is also detected in the marigold, but it is not related to the underpainting. Instead, it occurs in individual brushstrokes in the upper paint layers, applied to refine details in the flowers. This was confirmed during the visual examination of marigolds: no local underpainting was visible in this area. The marigolds were painted directly onto the imprimatura and worked up with different coloured brushstrokes.

Similarly, lead was detected in the marigolds as well (see Fig. 9b), implying that Wautier also used a lead-based pigment (lead white, minium or a combination) in the execution of her orange flowers. Again, the signal detected for lead corresponds with the pale yellow highlights, suggesting that the lead-based pigment is only used in the upper paint layers of the flower. Macro-XRF scanning also detected a faint signal for potassium in the marigolds, indicating that a lake pigment (an organic dye precipitated on alum) might be present (see Fig. 9f). Potassium was identified in some of the individual petals of the marigolds, where Wautier appears to have used the pigment to intensify the colours and create more depth in the flower.

From the analysis, it has become clear that Wautier did not follow the step-by-step instructions as described by authors like Beurs or de Lairese, but seems to have found her own way of painting marigolds and handling the challenging arsenic sulphide pigments. She began with an orange, arsenic-based paint layer and subsequently worked up the flowers using a range of different pigments, including earth pigments, lead-based pigments and organic lake (see Figs. 9b, c, d, e and f). Perhaps Wautier's technical skill or this specific combination of pigments and layer build-up contributed to the excellent preservation of the arsenic sulphide pigments in *Flower Garland with Butterfly* – a hypothesis that requires further investigation.

6 Conclusion

The technical examination of *Flower Garland with Butterfly* has yielded a wealth of information about Wautier's artistic practice when painting flower still lifes, a genre of painting in which she most likely did not receive training from her brother Charles. We were able to contribute to a deeper understanding of Wautier's artistic influences. Based on the iconography of the painting and the materials and painting techniques employed by Wautier, we conclude that she may have been influenced by specialized flower painters from Antwerp, and more specifically by Daniël Seghers.

In terms of iconography, the painting fits into the development of flower garlands as an independent sub-genre of flower still life painting, which was probably invented by Seghers and became a popular subject in Antwerp painting. At the same time, Wautier added her own distinctive touch by incorporating the bucranium motif. Her selection of flowers – mostly commonly available species that bloom at the same time in late spring and summer and the inclusion of a few more exotic flowers – further

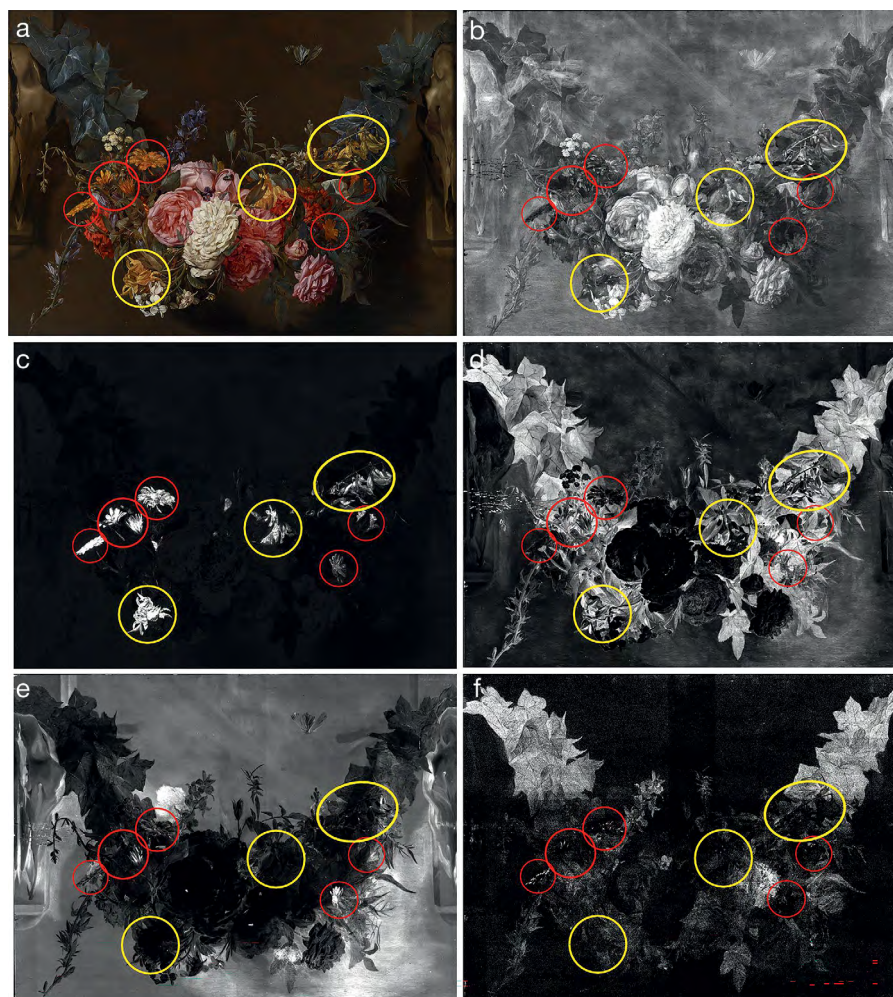


Figure 9 (a) Michaelina Wautier, *Flower Garland with Butterfly*. (b)–(f) MA-XRF maps. (b) Pb-L or lead map. (c) As-K or arsenic map. (d) Ca-K or calcium map. (e) Fe-K or iron map. (f) K-K or potassium map. The red circles indicate the position of the orange flowers, while the yellow circles indicate the position of the yellow flowers, painted with orpiment. In all flowers, arsenic is present, but Wautier used different paint mixtures to work up the flowers. For the orange flowers, she used potassium-based and iron-based paints to work up the flowers. The yellow flowers were worked up using calcium-based paints.

distinguishes her approach. The inclusion of species that grew only in greenhouses might suggest that Wautier may have studied living specimens, possibly in botanical gardens or private collections.

The materials and painting techniques employed by Wautier to create her *Flower Garland with Butterfly* also show the strong influence of Antwerp-based specialized flower painters. Wautier may have wanted to place herself in the Antwerp artistic tradition of flower pieces by carefully looking at and adapting the materials and working methods of specialized flower painters. This is evidenced by her choice of materials, including the panel support, which originates from Antwerp and was most likely ready-primed, as well as the use of arsenic sulphide pigments. These materials align with the seventeenth-century Antwerp tradition of flower still life painting. With this approach, she demonstrated her technical awareness and creative flexibility.

Wautier's preparation of individual flowers further demonstrates the influence of Antwerp-based specialized

flower painters. Her use of local, coloured patches to underpaint the roses follows a technique introduced by Seghers and subsequently adopted by his followers. To date, this technique has not been documented in the work of flower painters active in Brussels, like Jan Anton van der Baren. Further research is therefore needed to determine if this painting technique was a particular Antwerp phenomenon. For now, Wautier's evident awareness of this specialized painting technique suggests that she may have had direct or indirect contact with Seghers or artists in his circle.

Overall, the technical examinations of *Flower Garland with Butterfly* not only deepen our understanding of Michaelina Wautier's artistic methods, training and network but also position her more firmly within the broader context of seventeenth-century Flemish painting. This study underscores how technical analysis can illuminate the practices of artists for whom documentary evidence is scarce, opening new perspectives on their artistic practice and professional connections.

Acknowledgements

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Notes

1. Nochlin 1971.
2. Kloek 1998 noticed an acceleration of women's studies, particularly of women in the Dutch Republic. This trend has continued in recent years, with several exhibitions and publications on early modern women. Prime examples include the book series *Illuminating Women* (published by Lund-Humphries) and several exhibitions, such as *Making Her Mark* (organized by the Baltimore Museum of Art and Art Gallery of Ontario in 2023–4) and *Ingenious Women* (organized by the Kunstmuseum Basel and Bucerius Kunst Forum in 2023–4). Recent relevant scholarly literature includes Moran and Pipkin 2019; Sutton 2019; Powell-Warren 2023; Noorman *et al.* 2024; Schindler *et al.* 2024; Treanor and Van Dam 2025; Gruber *et al.* 2025; Lamal *et al.* 2025. Older, but pivotal studies include Hofrichter 1989; Honig 1998; Van der Stighelen and Westen 1999; Honig 2002; Van der Stighelen 2010.
3. Powell-Warren 2025: 233.
4. Derks *et al.* 2025.
5. Katlijne Van der Stighelen has made substantial efforts to bring Wautier and her work back to our collective memories and into the art historical canon. See Van der Stighelen 1996, 1997, 2005; Van der Stighelen and Westen 1999; Sanzsalazar 2014, 2018; Van der Stighelen 2018; Gruber *et al.* 2025; Griesser *et al.* 2025.
6. The monographic exhibition 'Michaelina Wautier. Painter' takes place at the Kunsthistorisches Museum Vienna between 30 September 2025 and 22 February 2026, after which it travels to the Royal Academy in London. The exhibition is accompanied by a scholarly catalogue: Gruber *et al.* 2025.
7. Van der Stighelen and Westen 1999; Van der Stighelen 2018.
8. Vlieghe and Van der Stighelen 2005; Van der Stighelen 2018; Bastiaensen 2025.
9. For more on the relationship between the Wautiers and Leopold Wilhelm, see Vlieghe and Van der Stighelen 2005.
10. Wautier most likely made more flower pieces, which are now unfortunately lost. In the 1811 catalogue of Marie-Antoine Didot, for example, two flower garlands by Wautier appear. Their dimensions differ considerably from *Flower Garland with Butterfly* and *Flower Garland with Dragonfly*, indicating that it is a different pair of flower pieces by her hand. See Gruber and Domercq 2025: 15–6.
11. Bol *et al.* 1981: 52; Van der Stighelen 2018: 254.
12. Meijer 2024: 63.
13. Roosen 2025.
14. *Flower Garland with Butterfly* was examined in the context of a PhD research project funded by the FWO as project no. GoD2618N. This project resulted in Derks's doctoral dissertation: Derks 2023. For more information about the project, see: <https://researchportal.be/en/project/screening-michael-sweerts-en-michaelina-wautier-added-value-advanced-imaging-characterising/>.
15. The visual examination was carried out by Kirsten Derks, using a head loupe and a handheld monocular. The head loupe is of the type OptiVISOR DA-10, with a magnification of 3.5 times. The monocular is an Eschenbach VarioPLUS Prism monocular, type 1674-820, with a magnification of up to 25 times. The monocular was converted to a stand magnifier using a plastic stand.
16. MA-XRF examination was carried out by Kirsten Derks in June 2021, using the AXIL scanner. This is a mobile MA-XRF scanner built in-house by the AXIS research group at the University of Antwerp. This scanner consists of a 50 W molybdenum anode microfocus X-ray tube (XOS X-Beam Powerflux), a fixed polycapillary lens and a silicon drift diode (SDD) detector. This is all mounted on an X and Y motorized stage. The maximum scan area measures c.57 by 57 cm in a single scan. The X-ray source is generally operated at 50 kV voltage and 1 mA current. The working distance between the surface of the painting and the X-ray tube was generally set at c.20–25 mm. The data collected with the AXIL scanner were processed into elemental distribution maps using the data analysis software packages PyMca (Python Multichannel Analyzer) and Datamuncher Gamma 1.4.
17. The paint sample was taken by Susanne Stangier (conservator of the Noordbrabants Museum), embedded into Epofix resin and made into a cross-section by Kirsten Derks.
18. Segal and Alen 2020.
19. Van Dorst 2018: 13–4; Segal and Alen 2020: 337.
20. Merriam 2012: 2.
21. Freedberg 1981: 123.
22. Mertens and Aumann 2003: 167, 288–9; Meijer 2018: 256, 2024: 43.
23. For more on Wautier's engagement with and use of Antique motifs, see Roosen 2025.
24. Meijer 2018.
25. For more about the Bucranium motif, see Roosen 2025. Roosen argues that the bucrania in Wautier's painting resemble those found in a funerary context. The roses in the garland, frequently cited in funerary inscriptions, might have symbolized the idea of a never-ending spring season in the afterlife.
26. Identification of the flowers was carried out by Paul van den Brecht, research scientist in historical ecology at the Flemish Heritage Institute in Brussels. He identified the white flower on the right side of the garland as a calla lily (email correspondence with Paul van den Brecht, 30 December 2022). If this identification is correct, Wautier's painting may be the earliest depiction of this flower in Northern European art. The plant was imported from South Africa to France in the period between 1607 and 1644. The earliest known calla lily in Europe was one growing in the garden of the King of France in 1644. However, based on the not so prominent position of this flower in the garland, it should be considered that it might be another flower: perhaps a *Convolvulus arvensis* or white morning glory.
27. Meijer 2018: 256.
28. The presence of these ribbons in the underpainting stage has also been discussed in Derks (2023).
29. See, for instance, Rachel Ruysch's *Flower Still Life* from 1710, oil on canvas, 89 × 71 cm, collection Janice and Brian Capstick. Flowers in Ruysch's paintings often do not flower simultaneously, either in their native ranges or in cultivation

- in Europe. For more on the diversity in flower species in Ruysch's oeuvre, see Davis 2024: 117.
30. In the context of works by Rachel Ruysch, a similar approach has been described. Ruysch too painted more common flower species, like tulips and roses, as well as rare and exceptional species that she had to study in greenhouses. See Davis 2024: 113.
 31. The hibiscus was imported to Europe by the end of the sixteenth century and became a popular plant in the Low Countries in the course of the seventeenth century. It was increasingly included in flower pieces between c.1620 and 1650. See Segal and Alen 2020: 264, 375.
 32. MacDougall 1989; Knaap 2024: 82.
 33. Kirby 1999: 17; Hermens 2011: 89–91.
 34. In the course of the seventeenth century, panels were largely replaced by canvas as a support for oil painting. However, still life painters continued to prefer panels as a support, as it provided the artist with a firm and smooth surface. Moreover, the general advantages of canvas over wooden panel (weight, ease of handling and transport) were less significant for still lifes as they are generally smaller in size than, for instance, history paintings. See Wallert 1999: 7; Mateu 2021.
 35. Mateu 2021: 24.
 36. See Van der Stighelen 2018: 136, n. 5. While both panels are marked with a stamp from the panel makers' guild as proof of their quality, no panel maker's mark is present on either of the panels.
 37. Van Damme 1987.
 38. Wadum 1998.
 39. Based on communication with panel expert Jørgen Wadum (Wadum Art Technological Studies, or WATS), 11 July 2024.
 40. Derks 2023: 185–7.
 41. For more on grounds, see Stols-Witlox 2017.
 42. Calcium was identified with SEM-EDX as the main component of the ground layer. No lead was detected in the ground layer.
 43. This is based on a visual and microscopic examination of the painting by Kirsten Derks. The curator of Museum M Leuven and a conservator and researcher of IPARC have also, independently, suggested the possibility that no ground layer is present in this painting. However, more research is needed to confirm this as ground layers can be very thin.
 44. Derks and Limb 2025a, 2025b.
 45. The depicted canvas within the composition is an artistic trick of Wautier: she left the preparatory layers of *Self Portrait* exposed in this area.
 46. For more on Wautier's use of coloured grounds, see Derks and Limb 2025a, 2025b.
 47. After inspection by the guild's dean, the panel makers were responsible for applying the white ground of chalk mixed with animal-skin glue. This could be done by the panel maker himself, or he could employ a *witter*. See Kirby 1999: 19–20.
 48. A copper-based blue pigment was used to prepare for the (blue) ribbons near the skull on the left. In the other areas where copper was detected, Wautier used a green copper-based pigment, most likely verdigris.
 49. Wautier's oeuvre can be roughly divided into two groups corresponding to her two modes of working. The highly ambitious history paintings were made with a more elaborate palette and contain a greater number of pentimenti, as opposed to her tronies, portraits and genre pieces, which are generally made with a more limited palette and often contain fewer pentimenti. Her flower garlands fit in with the group of history paintings. See Derks and Limb 2025b.
 50. Van Dorst 2015, 2016; De Keyser *et al.* 2017; Van Dorst 2018; De Keyser *et al.* 2022.
 51. So far, the technique has not been observed in paintings by Seghers's predecessors, such as Brueghel the Elder. The technique was adopted by Jacob van Hulsdonck, Jan Philip van Thielen and Jean Baptiste Morel, among others. See Albrecht *et al.* 2023.
 52. Van Dorst 2016, 2018.
 53. The painting was examined in situ in May 2022, using the same set-up as detailed in note 7. For more on the results of this examination, see Derks 2023, vol. 2: cat.no. 22.
 54. Segal and Alen 2020: 568.
 55. Derks 2023, vol. 2: 193–5.
 56. Theodoor Van Loon's (1581–1649) *Assumption of the Virgin* (c.1622, oil on canvas, 356 × 237 cm. Royal Museums of Fine Arts of Belgium, inv.no. 229) was also examined. While Van Loon was not a specialized flower painter, he did include flowers in several of his compositions. MA-XRF scanning of the flowers in *Assumption of the Virgin* revealed no coloured underpainting in the flowers. See also Derks 2023, vol. 2: 359–68.
 57. Mertens and Aumann 2003: 90–1; Derks *et al.* 2025.
 58. It is suspected that orpiment may be present in her *Triumph of Bacchus* (Note 50).
 59. Orpiment and realgar have similar elemental compositions, and MA-XRF scanning is not able to distinguish between the two.
 60. De Keyser *et al.* 2022.
 61. Beurs 1692.
 62. Technical research into their paintings showed that they painted flowers and foliage, including marigolds, as described by Beurs or other authors, such as Gerard De Lairese (1641–1711). Wallert 2012; De Keyser *et al.* 2017.
 63. De Keyser *et al.* 2017, 2022.

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