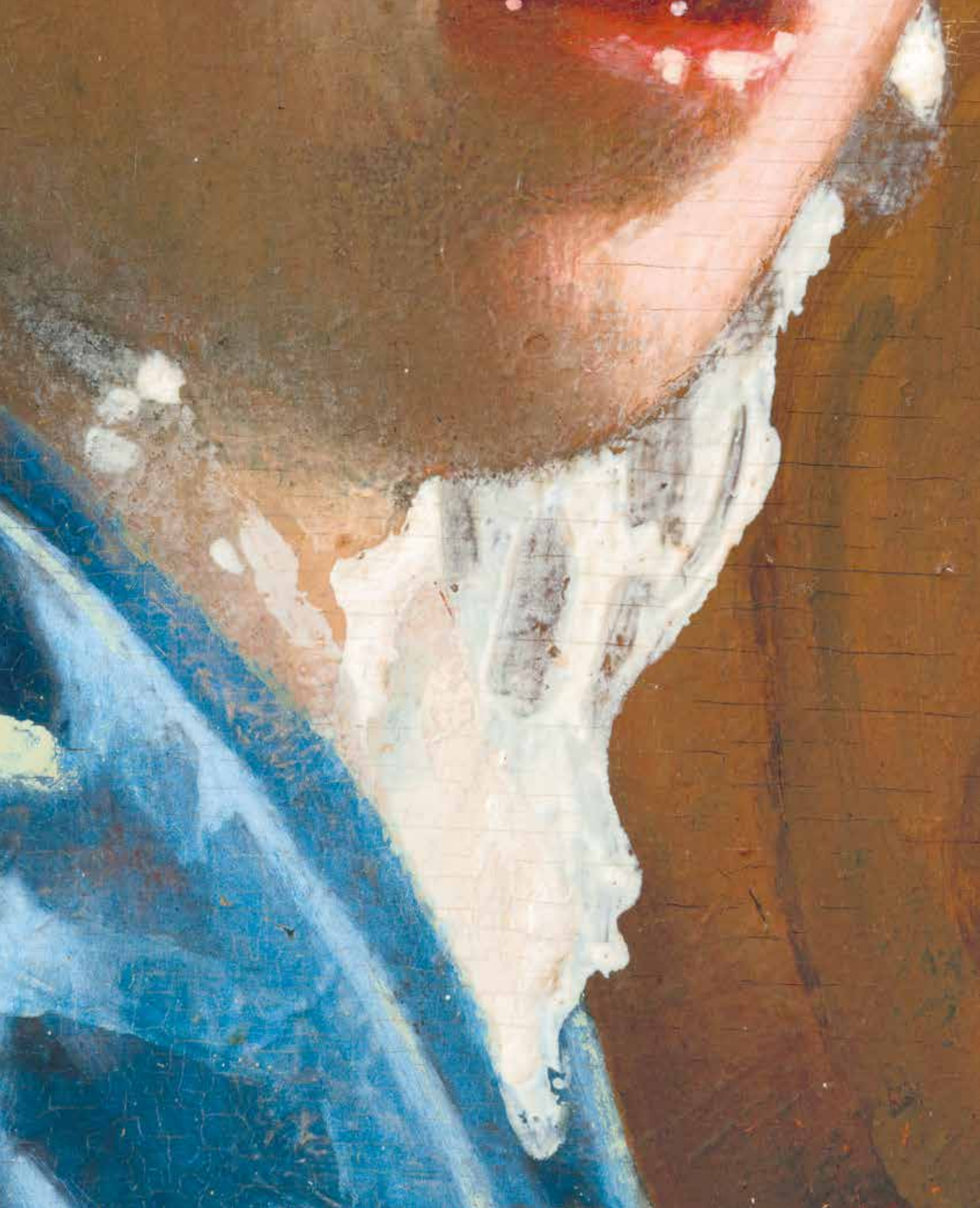

CLOSER TO VERMEER

NEW RESEARCH ON THE PAINTER AND HIS ART

EDITED BY

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RIJKS MUSEUM HANNIBAL

CAT. 1

Christ in the House of Mary and Martha c. 1654–1655
Oil on canvas, 158.5 × 141.5 cm
Edinburgh, National Galleries of Scotland, inv. no. NG 1670;
presented by the sons of W.A. Coats in memory of their father 1927

pp. **6**, **54–58**, 89, 98–100, 110, 114, 238, 240–**241**, 246, 248, 251, 258, 282, 287–288, 388

CAT. 8

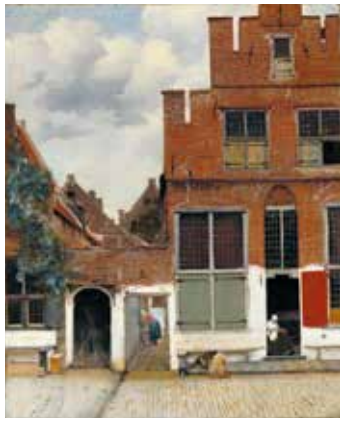
The Milkmaid c. 1658–1659
Oil on canvas, 45.5 × 41 cm
Amsterdam, Rijksmuseum,
inv. no. SK-A-2344; purchased with the support of the Rembrandt Association

pp. **10**, 32–38, 42, 44–45, **47**–48, 54, **68–69**, 80, 89, 110, 114, 128, 131–132, 156, 207, 224–**225**, 228–229, 238–240, **242**, 246, **248**, 251, **253**, 258, 262, 282, 286, 288, 326, **331–333**, 387–388, 403

CAT. 10

View of Delft c. 1660–1661
Oil on canvas, 96.5 × 115.7 cm
The Hague, Mauritshuis, inv. no. 92

pp. **10**, 44, **74–76**, 110, 114, 146, 216, 240, **245**, 258, 282, 286, 288, 364, 374, **376**–377, 382, 387–389, **390**, 403



CAT. 9

View of Houses in Delft known as **The Little Street** c. 1658–1659
Oil on canvas, 54.3 × 44 cm
Amsterdam, Rijksmuseum, inv. no. SK-A-2860; gift of Mr H.W.A. Deterding, London

pp. **10**, 36–**37**, 42, 54, **70**–74, 89, 100–101, 110, 114, 240, **244**–246, 258, 282, 287–288, **382**, 388

CAT. 11

The Glass of Wine c. 1659–1661
Oil on canvas, 67.7 × 79.6 cm
Berlin, Staatliche Museen zu Berlin, Gemäldegalerie, inv. no. 912C

pp. **10**, 78, 110, 114, 140–141, 326, 331

CAT. 25

Girl with a Pearl Earring c. 1664–1667
Oil on canvas, 44.5 × 39 cm
The Hague, Mauritshuis, inv. no. 670; bequest of Arnoldus Andries des Tombe, The Hague, 1903

pp. **14**, 29, 35, 44–45, 48, 50, 78, 105, 112, 114, 139–**140**, 176, 189–190, 193, 207, 224–**225**, 227–229, 240, 246–**247**, 251, 257–258, **264–265**, **267**–268, 275, 282, 286–288, 296–**297**, 301–302, 382, **385**, 387–389, 392, **394**–399, 403

CAT. 26

Girl with a Veil also known as
Study of a Young Woman c. 1664–1667
Oil on canvas, 44.5 × 40 cm
New York, The Metropolitan Museum of Art, inv. no. 1979.396.1; gift of Mr. and Mrs. Charles Wrightsman, in memory of Theodore Rousseau Jr.

pp. **14**, 28, 45, **96**, 101–**102**, 105, 111–112, 114, 182, **189**–194, 257, 384–**385**

CAT. 27

The Lacemaker c. 1666–1668
Oil on canvas on panel, 24.5 × 21 cm
Paris, Musée du Louvre, Dépôt du Musée des Arts Décoratifs, inv. no. MI 1448

pp. **14**, 17, 31, 45, **96**, 99, 101, **103**, 105, 112–114, **128**, **139**, 146, 254, 257, 380

CAT. 28

The Art of Painting c. 1666–1668
Oil on canvas, 120 × 100 cm
Vienna, Kunsthistorisches Museum, Picture Gallery, inv. no. 9128

pp. **14**, 28, 45, 112, 114, 125, 176, **186**–187, **212**–216, **218**–229, 246, 254, 257, 262, **266**–268, 272–273, 275, 320, 336, 338–**339**, 348, 388, 403

NOTE FROM THE EDITORS

This overview encompasses the 37 paintings that most art historians currently attribute to Johannes Vermeer. The works are shown at 1:10 scale, making it possible to follow the artist's progress directly: from the large history pieces, which date from shortly after Vermeer had become a master painter in 1653, via the transition to smaller depictions of everyday scenes and experimental *tronies* (faces), to the late allegories, once again in larger dimensions.

Each painting in the overview bears a catalogue number, so that the reader can easily find an illustration of the works cited in the essays; under each illustration, the page numbers where the work in question is discussed or pictured in this publication are listed.

The works are presented in chronological order, as established in the 2023 exhibition at the Rijksmuseum (see exh. cat. Amsterdam 2023, p. 17). However, the latest technical research conducted between 2020 and 2025, both at the Rijksmuseum and in other institutions, suggests revisiting this chronology at some points. As A. van Loon et al. argue in this publication, shifts in Vermeer's use of blue and green pigments throughout his career suggest that *Girl with a Flute* (**CAT. 23**), *Girl with the Red Hat* (**CAT. 24**) and *The Lacemaker* (**CAT. 27**) could perhaps be dated later than proposed. This aligns with A. Libby et al. 2022 dating *Girl with the Red Hat* around 1669.

Next pages: **DETAILS** *Girl with a Flute* (cat. 23); *The Geographer* (cat. 30); *The Astronomer* (cat. 29); *The Art of Painting* (cat. 28)

CONTENTS

FOREWORD

In December 1675, Johannes Vermeer died at the age of 43 in his home town of Delft. Over a period of about two decades, the Dutch master created a small yet exceptionally evocative oeuvre of just a few dozen paintings. Fewer than forty of these works have survived the ravages of time, yet with their high level of illusionism, their tranquillity and their introvertedness, all of them continue to inspire and amaze the public to this day.

Johannes Vermeer is intrinsically connected to the Rijksmuseum, which in 2023 organized *Vermeer*, the first fully monographic exhibition on the Delft painter in its history. The generosity of lenders from Europe, the United States and Japan made it possible to gather more than three-quarters of his surviving oeuvre in the country where these artworks had been created over three and a half centuries ago. With his paintings, under the motto 'Closer to Vermeer', the Rijksmuseum gave over 650,000 visitors an unforgettable experience of beauty and contemplation.

Vermeer spurred new research both in the Netherlands and internationally. Extensive research preceded the exhibition, continued throughout its duration, and extended beyond it. At the Rijksmuseum, a team of conservators, scientists and curators, in collaboration with colleagues from the Mauritshuis and the University of Antwerp, conducted extensive research into the artist and his painting technique, examining no fewer than twelve works by Vermeer from several collections with new, non-invasive imaging technology. The generosity of the National Galleries of Scotland in Edinburgh, the Städel Museum in Frankfurt am Main, The Frick Collection and The Leiden Collection in New York, the Mauritshuis in The Hague and Kufu Company Inc./the National Museum of Western Art in Tokyo in making their paintings available for research was essential to the realization of this endeavour.

In parallel and in conjunction with this, our colleagues from the National Gallery of Art in Washington, DC, The National Gallery in London, The Metropolitan Museum of Art in New York and the Kunsthistorisches Museum in Vienna investigated the Vermeer paintings in their collections. Topics such as the material world in his paintings, his clients, and the exhibitions devoted to his work were studied, and seventeenth-century sources on his art were reinterpreted. In addition, several new documents about Vermeer were uncovered in Dutch archives. All of this produced new insights not only into the way Vermeer worked, his techniques and his materials, but also into his life, the environment within which he was working, the meaning of the scenes he depicted and the appreciation of his work.

A substantial part of the results of these technical and art-historical investigations into Vermeer was presented at a two-day symposium at the Rijksmuseum in March 2023. Research then continued into 2025 and will continue in the near future. An impressive range of new findings and insights is presented in this book, conceived as a pendant to the 2023 catalogue and intended to pique the interest not only of specialists but also of a broad international audience.

The Vermeer exhibition was made possible in part by Ammodo, Blockbusterfonds, Rijksmuseum Fonds, Rijksmuseum International Circle, Rijksmuseum Patrons and the Ministry of Education, Culture and Science, to whom we offer our sincere gratitude. Our thanks also go to the lenders who, over the last few years, afforded the research team the opportunity to conduct research into so many of Vermeer's paintings, to the organizers of the symposium, to the many authors who contributed to *Closer to Vermeer* with their research and to the editors and the peer reviewers of this book. Together they offer us a chance to gain a deeper understanding of the work and the life of Vermeer.

Taco Dibbits
General Director, Rijksmuseum

DETAIL *View of Delft* (cat. 10)

PRELUDE
JOHANNES VERMEER 350 (1675–2025)

'If it were possible to gather all his paintings in a public exhibition, van der Meer of Delft would soon rise to the first rank of the Dutch school', wrote the French political journalist, art critic and historian Théophile Thoré in 1866, under his pseudonym W. Bürger, in the *Gazette des Beaux-Arts*.[1] To Thoré, credited with the rediscovery of Johannes Vermeer, gathering together the seventeenth-century Dutch master's painted oeuvre was a utopian ideal he could merely dream of.[2] Until midway through the nineteenth century, Vermeer was known only to a limited group of artists, collectors and connoisseurs. While the Parisian painter and gallerist Jean-Baptiste-Pierre Lebrun, in 1794, and the British art dealer John Smith, in 1833, were among the first whose writings contributed to broader recognition for the Delft master, it was Thoré who genuinely breathed new life into Vermeer's reputation as a significant seventeenth-century Dutch artist.[3] His groundbreaking research, along with the catalogue he compiled of Vermeer's paintings, remains a crucial foundation for our knowledge and appreciation of the painter to this day. More than twenty of the paintings Thoré identified, which he tracked down in various collections across Europe, are still considered part of what is now accepted as Vermeer's surviving oeuvre. An impressive number – all the more when we realize that, today, only about three dozen paintings can be attributed to the Delft master.

Just as Théophile Thoré could not imagine that it would ever be possible to share the majority of Johannes Vermeer's paintings with the public in a single exhibition, all in one location, it is difficult for us now to imagine that this world-famous painter was, for almost two centuries, known only to a relatively modest group of initiates. After all, Vermeer has long been counted not only among the 'first rank of the Dutch school', as Thoré put it, but also, since the latter half of the twentieth century, as one of the greatest painters in Western art history. Even three and a half centuries after his death, he holds an undiminished fascination for art lovers – of all ages – as well as for scores of academics and scholars.

In the spring of 2023, more than a century and a half after Théophile Thoré's pioneering work, the Rijksmuseum presented *Vermeer*, the largest-ever monographic retrospective exhibition of Vermeer's paintings. Thanks to the generous lending of works by museums and private collectors in the Netherlands and abroad, it was possible to bring together about three-quarters of his surviving oeuvre. A record number of people of more than one hundred nationalities visited the exhibition, and a new generation was able to discover the art of this exceptional Dutch master. Now that it was possible to see more Vermeer works side by side than ever before, researchers had the opportunity to study and discuss the individual paintings in a cohesive context. The exhibition provided significant impetus for research, both in the Netherlands and much further afield.

Vermeer also served as a catalyst for an in-depth technical study of the artist's paintings. From 2020 to 2025, the Rijksmuseum, in collaboration with the Mauritshuis and the University of Antwerp, conducted extensive technical research. Thanks to the generosity of their owners, twelve paintings by the Delft master from different collections were examined, using new, advanced, non-invasive chemical imaging techniques, including macroscopic X-ray fluorescence imaging spectroscopy (MA-XRF), macroscopic X-ray powder diffraction imaging (MA-XRPD) and reflectance imaging spectroscopy (RIS). These techniques not only provide chemical information about the paint materials and their degradation products throughout the entire painting, but also offer improved visualization of underlying paint layers and compositions compared to traditional infrared and X-ray forms of investigation. This was the first time such non-invasive imaging techniques have been applied to these paintings. The present volume includes a glossary explaining the relevant scientific research methods and their application in the study of Vermeer's paintings. Similar research was carried out not just at the Rijksmuseum, but also at the National Gallery of Art in Washington, DC, The Metropolitan Museum of Art in New York, the National Gallery in London and the Kunsthistorisches Museum in Vienna. Across these institutions, researchers employed the same methods, yielding exciting new insights into the artist's creative process and his specific use of materials and techniques.

New art-historical and technical research into the oeuvre of Johannes Vermeer has now been collected in *Closer to Vermeer*, which presents an engrossing analysis of the recent work carried out by international specialists before, during and after the Vermeer exhibition in Amsterdam. The majority of its texts are based on contributions presented during the two-day Vermeer symposium held at the Rijksmuseum on 28 and 29 March 2023, which offered an intriguing variety of perspectives in contextual synergy.

Closer to Vermeer takes the 2023 Vermeer show as its starting point, with the first essay by Pieter Roelofs dedicated to the exhibition, its origins, concept, layout, objectives and impact. The contribution by Anna Krekeler, Francesca Gabrieli, Annelies van Loon and Ige Verslype investigates Vermeer's starting point: the development of his compositions. It uncovers previously unknown compositional changes and offers a far more detailed visualization of the alterations we thought we already understood. Tracing these changes provides valuable insight into Vermeer's thought process,

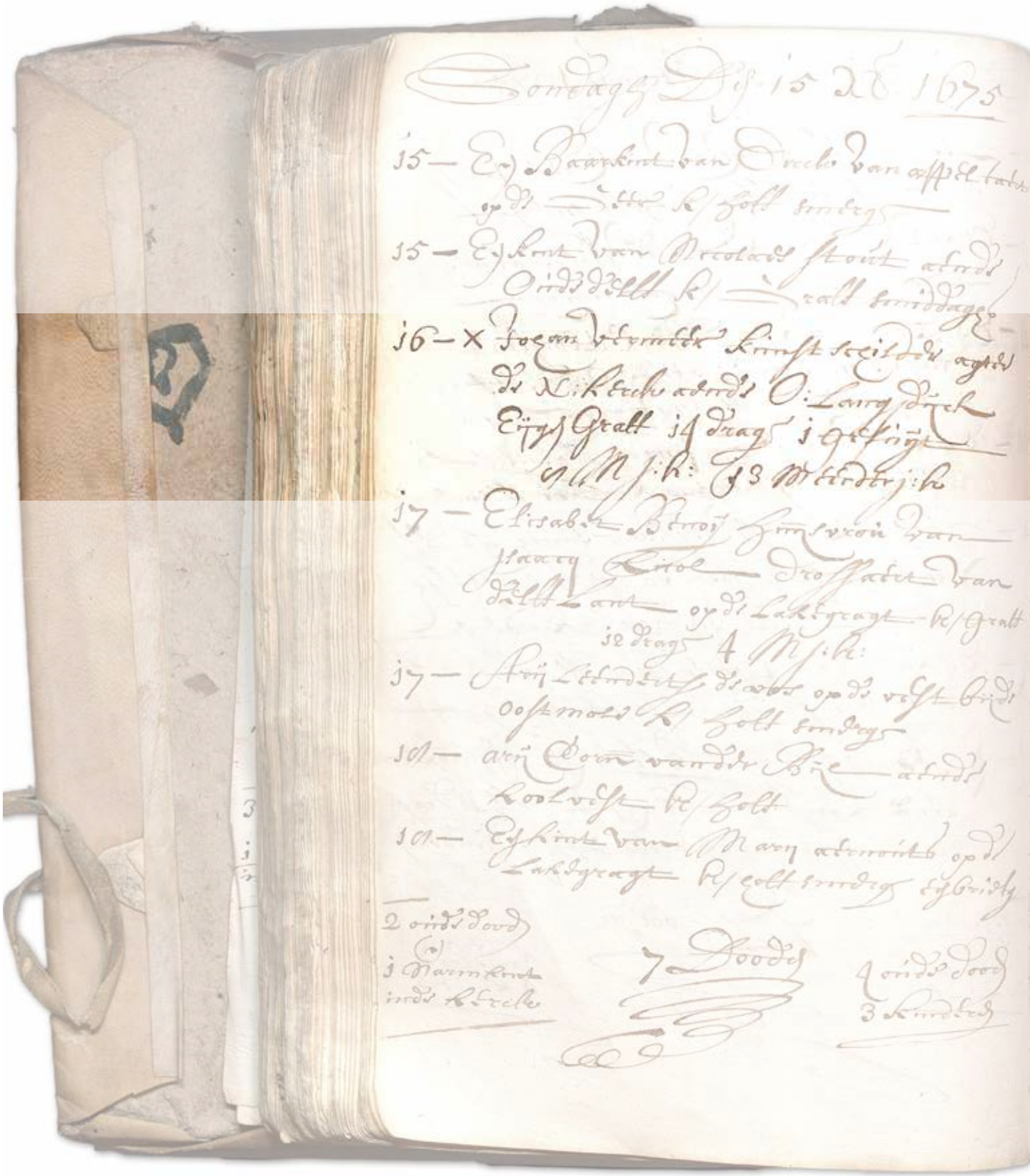


FIG. 1 Burial registration for Johannes Vermeer, featuring details of his funeral on 16 December 1675. Delft, Stadsarchief, archive 445 Hervormde Gemeente (Reformed Congregation) Delft

ACKNOWLEDGEMENTS

We would like to thank all the authors for their inspiring and wide-ranging contributions to this book. We are grateful to the peer reviewers, for their meticulous reading of and comments on the texts. Our thanks also go to Frans R.E. Blom, Maartje Brattinga, Jan van Campen, Femke Diercks, Sara van Dijk, Menno Fitski, Michiel Franken, Victor Gonzalez, Peter Gorgels, Marissa Griffioen, David de Haan, Kees Kaldenbach, Suzanne van Leeuwen, Petria Noble, Monique Rakhorst, Xavier F. Salomon, Hans Slager, Marijn Stolk and Thijs Weststeijn.

The symposium was organized by the Rijksmuseum together with the Mauritshuis. We thank Gregor J.M. Weber, Annelies van Loon, Bente Frissen, Ariane van Suchtelen, Karin Lieftink, Sophie Visser and Sandra Pastoor for their efforts in making this event such a success.

A special word of thanks to our colleagues at the Mauritshuis, and to the other generous lenders who kindly allowed us to examine their paintings: The National Galleries of Scotland, Edinburgh; the Städel Museum, Frankfurt am Main; The Frick Collection, New York; The Leiden Collection, New York; Kufu Company Inc. and the National Museum of Western Art, Tokyo. A considerable portion of the results of the research into these paintings is shared in this book; supplementary results will follow upon completion of the ongoing research in future publications.

We are grateful to Irma Boom and Frederik Pesch for the design of this book, realized with Sarah Schrauwen and Mathieu Vancamp of doublebill.design. *Closer to Vermeer* was conceived by Irma Boom, like the catalogue of the *Vermeer* exhibition, using the format of Vermeer's *The Lacemaker* as its starting point. Kate Bell took charge of the English copy-editing, Pierre Bouvier was responsible for the translation of several Dutch texts, Ellen Slob and Séverine Lacante provided the image editing and Miekie Donner compiled the index; we are grateful to all of them for their work. We thank Hannibal Books, Gautier Platteau and Stephanie Van den bosch for our fruitful collaboration in disseminating so much information on Johannes Vermeer and his painting. This book would never have come to be without the immense and inspirational dedication of Barbera van Kooij. We realize that such extraordinary commitment and effort are not to be taken for granted. For this, therefore, we are particularly grateful to her.

1 'S'il était possible de réunir dans une exposition publique tous ses tableaux, van der Meer de Delft monterait vite au premier rang de l'école hollandaise', Thoré-Bürger 1866, p. 458.

2 Thoré was involved in the *Exposition retrospective. Tableaux anciens empruntés aux galeries particulières* organized from May to July 1866 at the Palais des Champs-Elysées in Paris, which featured eleven paintings he attributed to Vermeer. Of these eleven, four are still accepted today as works by Vermeer himself. On this, see Jowell 1998, pp. 35–39; Jowell 2024, p. 291.

3 On this, see Roelofs 2023a, pp. 36–37. Jowell 2024, pp. 284–285, rightly points out that conspicuous by its absence in exh. cat. Amsterdam 2023 is any acknowledgement of the crucial art-historical intervention by Thoré in the rediscovery of Vermeer. Her impassioned argument in *Simiolus* makes clear that Thoré's role has been unjustly trivialized, inaccurately represented or even ignored in recent exhibition catalogues. We thank her for her invaluable additions and corrections in relation to the provenance of and literature on Vermeer's paintings. The appendix to her text should be considered an important addendum to exh. cat. Amsterdam 2023, pp. 274–291, with respect to cats. 4, 6, 10, 16, 17, 19, 22, 27, 28, 30, 33, 34, 35.

4 Delft, Stadsarchief, archive 445 Hervormde Gemeente (Reformed Congregation) Delft, (1529) 1566–2014, inv. no. 1911, 1675 (dated 16 December 1675), no folio number; Van Eijk 2023, p. 109, document 7; De Haan 2023, p. 86, fig. 105, p. 87. On his untimely death, funeral and the settlement of his debts, see Van Eijk 2023, pp. 109–112; Roelofs 2023a, p. 36; Roelofs 2023b, p. 42.

GLOSSARY
SCIENTIFIC RESEARCH METHODS

To examine a painting up close, a researcher can use various magnifying tools. These range from a head loupe (up to 10×) or a monocular (up to 20×), which are easy to bring to the object, to more advanced systems that allow for higher magnifications, such as a stereomicroscope (up to 50×) equipped with a digital camera to capture micrographs, or a high-resolution 3D digital microscope (up to 140× or higher).

A visible light source can be used to illuminate the painting's surface directly from the front for visual inspection. However, light can also be positioned almost parallel to the painting from one side to observe it in raking light, highlighting the surface topography. If the painting is on canvas, light can also be shone from behind to create a transmitted light image, making variations in thickness of paint application visible.

In addition to visible light, researchers use other types of light and radiation outside the visible spectrum [FIG. 1]. Ultraviolet (UV) light, for example, can help distinguish superficial retouching or overpaint. Some pigments exhibit

FIG. 1 Electromagnetic spectrum illustrating the range of radiation types applied in the examination of paintings

characteristic ultraviolet-induced luminescence, such as red organic lakes, which appear light pink or orange under UV light. Infrared light and X-rays penetrate deeper into the paint layers, revealing features that would otherwise remain hidden. Infrared photography and reflectography are particularly useful for detecting underdrawings or sketch layers containing carbon black, as these absorb all infrared light. They also help identify compositional changes made by the artist or later alterations. X-radiography, in contrast, can 'see' through the entire painting and provides additional insight into the paint layers and construction of the canvas or panel support. Heavy elements such as lead, present in pigments like lead white, absorb X-rays, while lighter elements allow X-rays to pass through, creating the black-and-white contrast images familiar from medical radiography.

In recent years, novel non-invasive imaging techniques have emerged. High-resolution technical photography, along with chemical imaging techniques such as macroscopic X-ray fluorescence imaging spectroscopy (MA-XRF), reflectance imaging spectroscopy (RIS), and macroscopic X-ray powder diffraction imaging (MA-XRPD), have become indispensable tools for researchers. These techniques, along with paint cross-section analysis, have been applied in the latest research on Vermeer's paintings, with the results discussed in the technical essays of this publication.

The different research techniques are complementary. Each technique provides a piece of the puzzle. Together, they offer a unique glimpse into the materials, creation and condition of Vermeer's paintings.

HIGH-RESOLUTION TECHNICAL PHOTOGRAPHY

High-resolution technical photography enables the viewer to zoom in to the smallest details of Vermeer's paintings, far beyond what one can see with the naked eye. In the obtained high-resolution images, 1 pixel represents about 5 micrometres on the painting (approximately 5000 ppi). One micrometre (µm) is equal to one thousandth of a millimetre (0.001 mm). For comparison, a human hair is about 70 µm thick. To achieve such a high-resolution image, numerous separate close-up shots are taken and digitally assembled [FIG. 2]. For a relatively small painting such as *The Milkmaid* (45.5 × 41 cm) (**CAT. 8**), 117 separate close-up images were necessary, and for the large *Christ in the House of Mary and Martha* (158.5 × 141.5 cm) (**CAT. 1**) the total was 1776.

High standards for colour management are maintained to ensure that the colours in the final photos correspond to those of the painting itself. High-resolution images serve as an excellent foundation for correlating with all other chemical imaging techniques.

MACROSCOPIC X-RAY FLUORESCENCE IMAGING SPECTROSCOPY (MA-XRF)

Macroscopic X-ray fluorescence imaging spectroscopy (MA-XRF) reveals the distribution of individual chemical elements across the painting and thus surpasses traditional X-radiography, which only provides a contrast image distinguishing between light and heavy elements. After scanning, the data are processed and different elemental maps are generated. These elemental maps help identify the specific pigments used and their locations within the artwork. MA-XRF can also reveal hidden paint layers, uncovering changes made by the artist or later overpainting. Through the development of mobile MA-XRF scanners it is possible to chemically image an entire painting directly in situ, whether in a museum's gallery or a conservation studio.

Like X-radiography, MA-XRF uses an X-ray source that penetrates all paint layers, expelling electrons from the inner shells of atoms. As outer-shell electrons fill these vacancies, they emit fluorescent X-ray photons with element-specific energies [FIG. 3]. Detecting these photons allows for elemental identification. However, MA-XRF is generally limited

FIG. 2 *The Milkmaid* (cat. 8), detail of the high-resolution photograph (5167 ppi) showing one of the knops of the Westerwald stoneware jug

organic colourants, such as indigo, or red and yellow lake pigments, for the latter, their crystalline substrate, such as calcite or gypsum, can be identified. MA-XRPD is a very time-consuming technique and is therefore not used to scan entire paintings. Also, the images produced show less detail due to the lower resolution (around 1–2 mm), as the technique inherently lacks sensitivity. Additionally, the technique mainly looks at the top paint layer as the diffracted X-rays from deeper layers are easily absorbed.

REFLECTANCE IMAGING SPECTROSCOPY (RIS)

Reflectance imaging spectroscopy (RIS) typically operates within a spectral range of 400 to 2500 nanometres (nm), encompassing the visible spectrum – to which the human eye is sensitive – and the infrared region, making it possible to look beneath the surface. To collect data, a light source is directed at the artwork's surface, and the reflected light is captured by an imaging spectrometer. Since materials interact with light in unique ways depending on their chemical composition, these interactions enable material identification. In the Vermeer research, this technique has proven highly effective in identifying pigments such as ultramarine – an essential pigment in the artist's palette – red lakes, various iron- and copper-containing pigments, and in revealing underdrawings, sketches and compositional changes.

While traditional colour photography and infrared reflectography (IRR) produce a single image covering an entire spectral range, RIS captures hundreds of images across a broad spectral range. At the end of a RIS acquisition, the output is a 3D data cube, with the x and y coordinates corresponding to the object's spatial dimensions, and the third dimension representing the wavelengths [FIG. 6A]. A spectrum containing signatures that allow different materials to be identified can be retrieved for each measured spot on the artwork. Using statistical algorithms, spectra associated with a pigment, or a mixture of pigments can be visualized across the painting's surface, producing a 2D greyscale map that shows the distribution of those specific materials. Additionally, an image for each wavelength can be retrieved from the 3D data cube [FIG. 6A]. By selecting any three of these images and assigning them to the red, green and blue (RGB) channels of a standard visible image, a so-called false-colour image can be generated [FIG. 6B]. Depending on the investigated spectral range – visible to near infrared (VNIR, typically 400–1000 nm) or short wavelength infrared (SWIR, typically 900–2500 nm) – RIS can provide various types of chemical data.

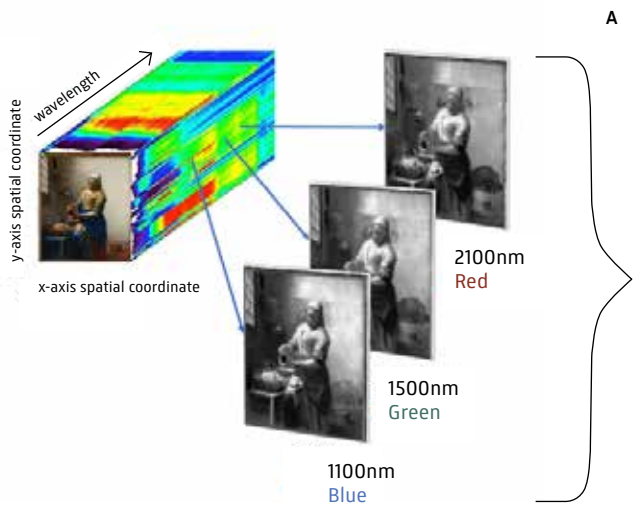


FIG. 6 RIS 3D data cube of *The Milkmaid* (cat. 8) and the extracted images for certain wavelengths from the visible to the short-wave infrared ranges (**A**). The creation of a RIS-SWIR false-colour image by assigning three infrared images to the RGB channels (R: 2100 nm, G: 1500 nm, B: 1100 nm) (**B**)

The RIS-VNIR spectral range typically spans from 400 to 1000 nanometres, where various electronic transitions in molecules take place. These transitions are what give pigments their colour and are unique to each pigment, enabling their identification. As RIS-VNIR primarily detects surface-level features, it serves as an effective tool for analyzing pigments found on the surface. Through RIS-VNIR mapping, for example, it was possible to identify and visualize the different blue pigments used in Vermeer's works. In the foliage of *The Little Street* [FIG. 7A], MA-XRF detected only the presence of copper [FIG. 7B]. However, RIS-VNIR mapping not only confirmed that the copper-based pigment was azurite [FIG. 7C] but also revealed blue highlights created with ultramarine [FIG. 7D], a pigment composed of light elements that are more challenging to detect using MA-XRF.

The RIS-SWIR technique generally examines a spectral range of 900 to 2500 nanometres. Within this range, while certain pigments may still exhibit electronic transitions, the spectra are primarily dominated by the vibrational modes of

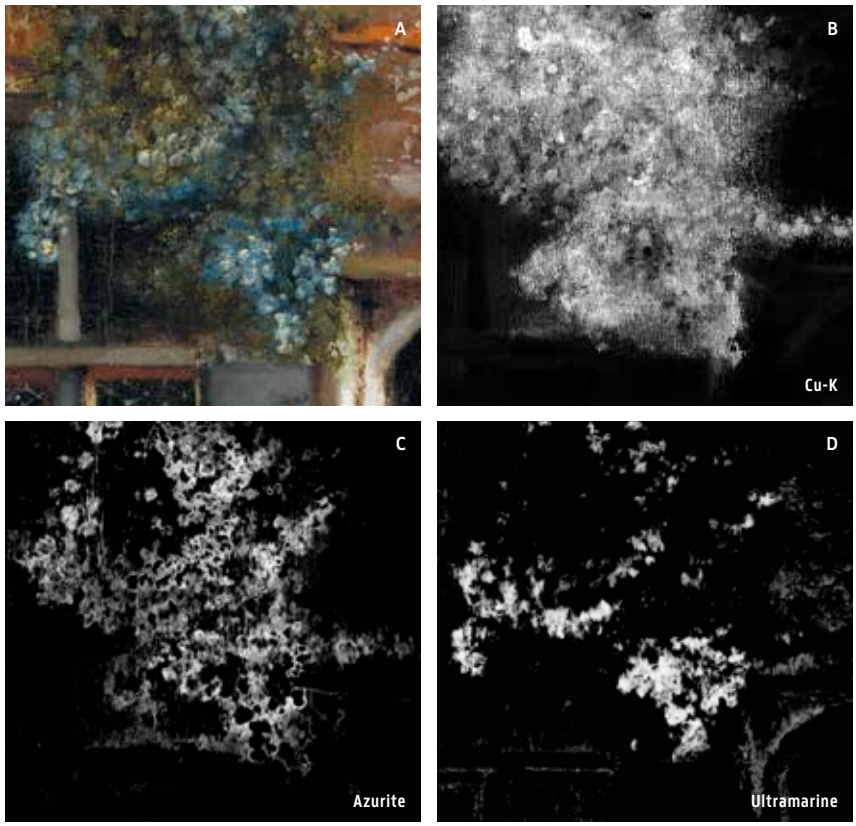
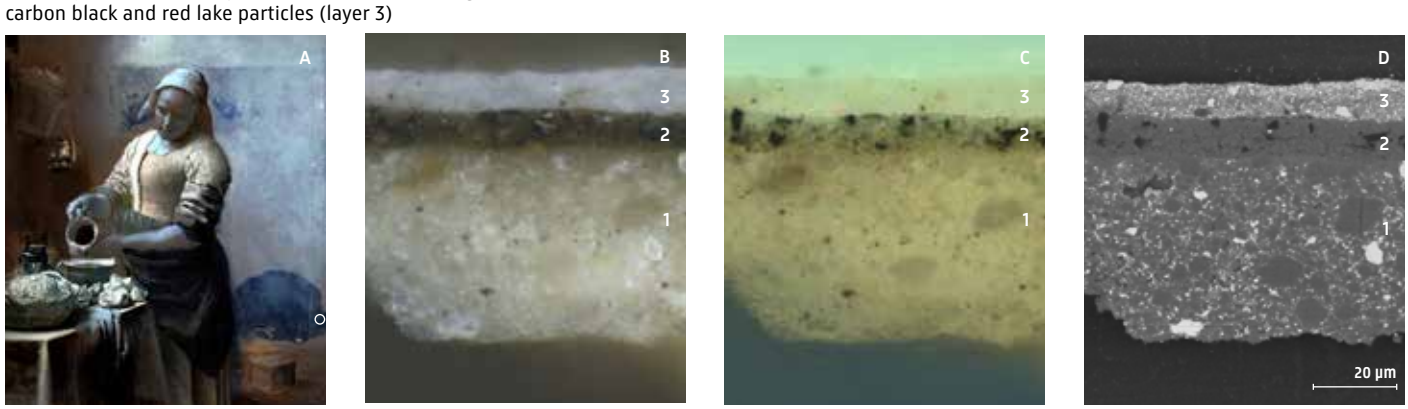
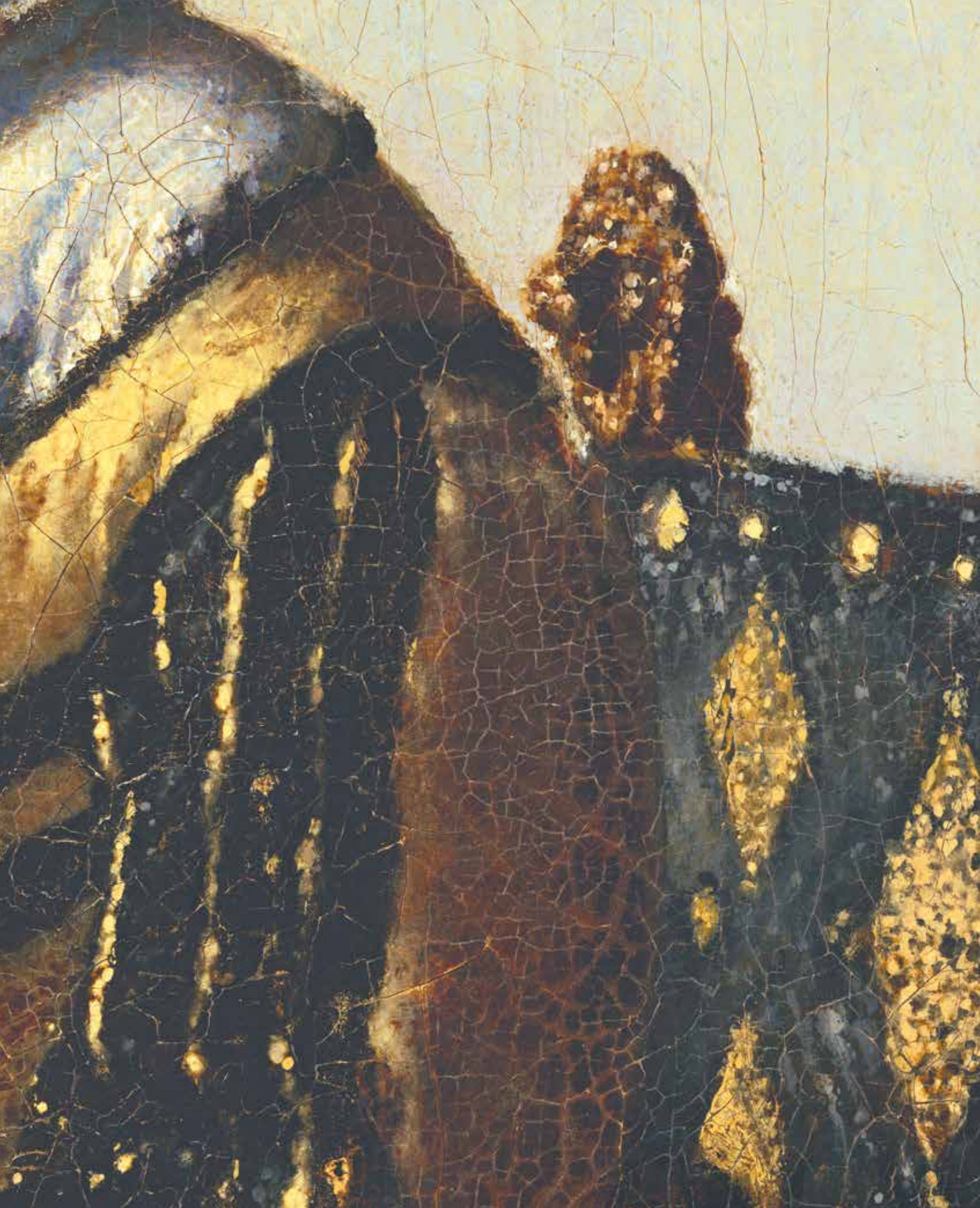


FIG. 7 *The Little Street* (cat. 9), detail of the foliage in visible light (**A**); corresponding MA-XRF map of copper (Cu-K) (**B**) and RIS-VNIR maps of azurite (**C**) and ultramarine (**D**)

FIG. 8 *The Milkmaid* (cat. 8), detail of fig. 6B (**A**); paint cross-section from the lower right edge where Vermeer initially planned a basket, shown in normal light (dark field) (**B**), ultraviolet light (**C**), and as backscattered-electron image (BSE) (**D**). The cross-section reveals a single grey ground, containing lead white, chalk, fine carbon black and earth pigments (layer 1), followed by a thin black underlayer of the basket, containing charcoal black, chalk, gypsum, and a little fine yellow and red earth (layer 2). On top of these layers is the white paint of the wall, containing lead white, and few carbon black and red lake particles (layer 3)





CLOSER TO VERMEER AT THE RIJKSMUSEUM
THE 2023 RETROSPECTIVE EXHIBITION IN AMSTERDAM

PIETER ROELOFS

At 6 p.m. on Sunday 4 June 2023, after 114 days, the Rijksmuseum closed its doors on *Vermeer*, not only the first monographic exhibition on Johannes Vermeer in the more than 200 years of the museum's history, but also his largest retrospective ever.[1] Never before had so many of the seventeenth-century Dutch master's paintings been assembled in one exhibition. The project proved to be a significant catalyst for research, generating new insights into Vermeer's life as well as his work. More than half the artist's surviving pictures have been scientifically investigated in connection with the Vermeer exhibition in the last few years.[2]

The event recorded stunning numbers on a variety of fronts. No fewer than 28 of the 37 paintings currently attributed to Vermeer were generously entrusted to the Rijksmuseum by 13 lenders. The museum hosted more than 650,000 visitors from 113 countries. Over 100,000 copies of the catalogue were sold worldwide. Nearly 900,000 people tuned into the online 'Vermeer experience' via the Rijksmuseum website, and the Omroep MAX broadcaster's six-part programme *De Nieuwe Vermeer* (The New Vermeer) consistently drew 1 to 1.5 million viewers on Dutch television. The exhibition was internationally considered a 'must-see' experience – dubbed 'the exhibition of the century' by *The Times* and lauded in *The Guardian* as 'one of the most thrilling exhibitions ever conceived' – and it was awarded a number of prizes.[3]

The impact of the exhibition on the public at large also demonstrated a clear pattern in terms of the content as well as of the sensations conveyed. With *Vermeer*, the Rijksmuseum strove, as far as possible, to bring people closer to the artist. The numerous comments from the public proved that it had succeeded in this ambition. However, the feedback was not solely positive. A number of the project's practical and substantive aspects were the focus of debate among visitors, with some even questioning whether the museum should have sought to organize a 'blockbuster' such as *Vermeer* in the first place.

INSPIRATION AND ORIGINS

With its own collection as a foundation, the Rijksmuseum considers it one of its fundamental tasks to provide each successive generation the opportunity to get to know the great masters of Dutch art history, including Rembrandt, Frans Hals and Johannes Vermeer. Ever since its re-opening in 2013, the museum has displayed the four Vermeer paintings in its possession – *The Milkmaid* (**CAT. 8**), *The Little Street* (**CAT. 9**), *Woman in Blue Reading a Letter* (**CAT. 15**) and *The Love Letter* (**CAT. 31**) – in its Gallery of Honour. In order that knowledge about these paintings and their maker be augmented and new insights shared with visitors, the aspiration to devote a research project and an exhibition to Vermeer had long been cherished within the museum. Concrete possibilities for this were explored as early as 2014.

Although the Rijksmuseum had been lent various individual works by Vermeer over the years, it had never before devoted an entire retrospective to the Delft master.[4] The idea that more than a quarter century after the only solo exhibition on Vermeer to date – at the Mauritshuis in The Hague and the National Gallery of Art in Washington (1995–1996) – it would be feasible to organize a monographic presentation on Vermeer was long considered dubious by the Rijksmuseum's own directors and curators. His paintings, after all, are indispensable works highly valued by the museums and collections that have them in their possession – public favourites that visitors travel specifically to see. What's more, it was generally known that several crucial works had never been lent out. At the outset, therefore, the Rijksmuseum directed its efforts towards developing a rather broader, thematic exhibition, with Vermeer in the leading role, among the work of other artists.[5]

The origins of the fully monographic exhibition as it would ultimately be held at the Rijksmuseum can be traced back to the The Frick Collection in New York agreeing to lend out its three Vermeer masterpieces on a one-off basis: *Officer and Laughing Girl* (**CAT. 7**), *Girl Interrupted at her Music* (**CAT. 12**) and *Mistress and Maid* (**CAT. 22**). The Vermeer exhibition was the first time the three paintings would be exhibited together outside New York since their acquisition by Henry Clay Frick more than a century ago. The closing of the mansion and museum building on Fifth Avenue due to an extensive renovation and expansion from 2020 to 2024 provided a unique opportunity for a one-off loan, simultaneously determining the time frame within which the exhibition could take place.[6] With the generous gesture of The Frick Collection in mind, the staff of the Rijksmuseum worked tirelessly on the exhibition, including during the COVID-19 pandemic, whereby exhibition curators Gregor J.M. Weber and Pieter Roelofs, in addition to conducting meetings about the loans of the paintings, also explored and elaborated possibilities for research and exchange with partner institutions.[7] An essential idea in this was that, following an extended period when society – and the cultural sector in particular – had been virtually immobilized because of the marauding virus, *Vermeer* might also offer visitors a renewed sense of hope and positivity.

FIG. 1 *Vermeer* banner on the façade of the Rijksmuseum. Design by Irma Boom

VISITOR INFORMATION AND PUBLICATIONS

In order to keep the flow of visitors running smoothly, it was decided to provide neither an audio tour nor guided visits. A single gallery text with a maximum length of 150 words was displayed for each cluster of paintings, supplemented by a few visual details and viewing prompts, so that the visitor was already supplied with a certain amount of information prior to viewing the actual painting. Each of the paintings was given an individual label bearing its title, the year of its creation and its lender. A QR code made all exhibition texts available for reading in seven languages, as well as enabling blind and partially sighted visitors to listen to an audio description tour by Dutch cabaret artist and writer Vincent Bijlo.[29]

FIG. 8 From left to right, Dutch Prime Minister Mark Rutte, French First Lady Brigitte Macron, French President Emmanuel Macron, King Willem-Alexander, Queen Máxima and Rijksmuseum general director Taco Dibbits in front of *The Milkmaid* (cat. 8)

A number of educational products were developed for the exhibition, which contributed to imparting knowledge about Vermeer and his work, including two podcasts by the exhibition curators, an online course, various lectures, a memory game with viewing challenges for families with young children, and a creative programme and workshops in painting and photography with Vermeer as inspiration.[30] A two-day scientific symposium was organized in collaboration with the Mauritshuis on 28 and 29 March, at which specialists from the Netherlands and beyond presented recent technical and art-historical research. The motto 'Closer to Vermeer' was the overall guiding principle for all these elements. The online experience *Closer to Vermeer* drew attention to various stories and new insights into the painter's life and work with evocative details from the paintings. The Dutch-language version was narrated by actor and writer Joy Delima and the English-language version by actor, comedian and writer Stephen Fry.[31]

Three publications were produced to accompany the exhibition. In collaboration with Hannibal Books, Thames & Hudson and Belser Verlag, the catalogue *Vermeer*, edited by Gregor J.M. Weber and Pieter Roelofs, was issued in four separate language editions. This book, in which the curators of the exhibition and various specialist curators from museums in Europe and the United States with Vermeer paintings in their collections discuss Johannes Vermeer and his painting based on new collaborative research, became the Rijksmuseum's best-selling catalogue ever, at more than 100,000 copies.[32] In addition, Gregor J.M. Weber wrote the book *Johannes Vermeer. Faith, Light and Reflection*, published in two language editions, documenting the influence of Catholicism on Vermeer and his art and pointing out the great

FIG. 9 Rijksmuseum paintings research scientist Annelies van Loon placing *The Milkmaid* (cat. 8) under the MA-XRF scanner

interest in optics and light reflected in the devotional literature of the Jesuit order, a station of which stood next to Vermeer's home in Delft.[33] For the youngest members of the public, the Rijksmuseum collaborated with Mercis publishing house to produce the book *miffy x vermeer*, in which children as well as adults are invited to look at similarities and differences in the art of Vermeer and Dick Bruna, miffy's creator, in both Dutch and English. After all, just like his seventeenth-century forerunner, twentieth-century artist and writer Bruna was fascinated by intimate domestic scenes, and simplicity plays an equally important role in his work.

SCHOLARLY AND SCIENTIFIC RESEARCH

All of the museum's communications and publications concerning Vermeer were based on extensive scholarly and scientific research conducted in preparation for the exhibition, which produced new insights into such subjects as the unique nature of his art practice, his artistic choices and the

COMPOSITIONS IN THE MAKING
VERMEER'S CHANGES

ANNA KREKELER, FRANCESCA GABRIELI,
ANNELIES VAN LOON AND IGE VERSLYPE

When viewing Johannes Vermeer's paintings, we see perfect and seemingly effortless end results. However, appearances can be deceptive, and the genesis of these works was often more complex than it seems. For instance, who would have thought that the empty, serene, whitewashed wall behind Vermeer's *The Milkmaid* (**CAT. 8**) was initially planned to be filled with jugs hanging from a shelf, or that there were no children playing in *The Little Street* (**CAT. 9**)?

Constantly in search for the masterly composition, artists in the seventeenth century developed their creations in various ways. Before starting a painting, most made preliminary drawings and created monochrome or colourful sketches. Others preferred to develop their compositions while painting, experimenting with their ideas directly on the support, which often implies that there is more to the composition of a painting than meets the eye. Hidden beneath the surface, traces of its genesis – compositional changes or pentimenti – can offer fascinating glimpses into the artist's creative process.

Vermeer is known to have made many compositional changes while painting. In the past, these could sometimes be visualized through traditional imaging techniques such as X-radiography (X-ray) and infrared reflectography (IRR), as well as, more uncommonly, neutron-activated autoradiography (NAR). Since 2020, the Rijksmuseum in Amsterdam, in collaboration with the Mauritshuis in The Hague and the University of Antwerp, has carried out extensive technical research on twelve paintings by the Delft master, using new advanced, non-invasive chemical imaging techniques, including macroscopic X-ray fluorescence imaging spectroscopy (MA-XRF) and reflectance imaging spectroscopy (RIS, in particular using short wavelength infrared: RIS-SWIR).[1] These techniques provide, respectively, distribution maps of chemical elements, which are indicative of the use of certain pigments, and false-colour infrared images, which represent an enhanced infrared reflectography and visualize underlying hidden paint layers.[2]

In several instances, this recent research unveiled previously unknown compositional changes that have been hidden from viewers since the day Vermeer decided to rework his composition. In other cases, it provided a more refined visualization of changes that have already been identified in the past. Tracing these changes provides insight into Vermeer's thought process, helping to identify and reinforce connections within and beyond his body of work, thereby enhancing our comprehension of his artistic intent. Visualizing these numerous changes is the closest we can get to looking over Vermeer's shoulders while he painted.

FIG. 1 *Christ in the House of Mary and Martha*, c. 1654–1655 (cat. 1), indication of details

CHRIST IN THE HOUSE OF MARY AND MARTHA (C. 1654–1655)

It is fascinating to observe how Vermeer made adjustments to his compositions during the painting process to enhance the narrative and emotional interactions between his figures. This is particularly evident in his early painting *Christ in the House of Mary and Martha* [FIG. 1], where MA-XRF and RIS-SWIR revealed several alterations made by Vermeer to the head of Christ. The artist adjusted the orientation and contour of the head, particularly along the left and top sides. An initial eyebrow and ear – a lay-in for an initial eye is harder to see – suggest that the head was tilted further forward, and sideways towards the rear wall [FIG. 2]. The first position of the pupil of the eye indicates that Christ was initially looking more straight ahead rather than up towards Martha [FIG. 2E]. In the final composition Vermeer emphasizes the dialogue between Christ and Martha. This dialogue is the key to the scene, in which Christ stresses the importance of spiritual nourishment by spending time with him,

DETAIL *The Little Street* (cat. 9), the tile floor shows through slightly – for example, through the boy's leg and the girl's skirt

FIG. 2 *Christ in the House of Mary and Martha* (cat. 1), detail of Christ's head. The visible light image (**A**) is compared to the RIS-SWIR false-colour image (R: 1680 nm, G: 1300 nm, B: 1030 nm) (**B**) and the MA-XRF maps of lead (Pb-L, histogram adjusted) (**C**), mercury (Hg-L, histogram adjusted) (**D**), cobalt (Co-K, histogram adjusted) (**E**) and iron (Fe-K, histogram adjusted) (**F**), showing the revisions in the orientation and contour of the head, which was tilted further forward, and sideways towards the rear wall

represented by Mary's choice to listen to his teachings rather than focusing on worldly tasks, as Martha is doing.[3]

Christ's left hand, dangling from the armrest, was adjusted to display more of the wrist and shows a change in the position of the index finger. Initially, Vermeer positioned the latter more to the right and connected to the other fingers [FIG. 3]. The current position with the wrist visible and the separated index finger gives the hand a more natural and loosened appearance. In Mary's left hand, resting on her knee, the thumb and index finger were planned to be visible from the outset, yet one can see even with the naked eye that her middle and ring fingers were added at a later stage during painting, on top of Christ's blue robe, to allow the viewer to see more of Mary's hand. Additionally, the bread and basket held by Martha underwent alterations during the painting process. In its initial design, the basket had a square shape and the lower rear edge revealed more of Martha's sleeve. Also, the bread was smaller on the left and at the top [FIG. 4]. The low wooden footstool Mary is sitting on rests on curved and elaborately carved lions' paws; however, Vermeer's initial design of the stool was rather simple and box-like [FIG. 5]. All of these smaller changes seem to be expressions of the young artist's quest to enhance the visual experience of the composition.[4]

A

B – STAGE 1

C – STAGE 2

D – STAGE 3

E – STAGE 4

F – STAGE 4 (FRAMED)

FIG. 11 *Girl Reading a Letter at an Open Window*, c. 1657–1658 (cat. 6). The visible light image (**A**) shows the appearance of the painting since 2021, after the treatment that revealed Cupid's figure. (**B–F**) show the 4 stages in the development of the composition in the correct sequence

VERMEER'S CANVASES
WEAVE MAPS AND MATCHES IN A WIDER PERSPECTIVE

IGE VERSLYPE

In the seventeenth century, paintings were typically created on either canvas or wood, but nearly all of Johannes Vermeer's surviving works are on canvas. These canvases not only function as the support for his iconic paintings, but also serve as valuable research tools. They can reveal unexpected relationships between works, assist in questions of authenticity and provide surprising insights into dating. The potential of canvas research was demonstrated by Ernst van de Wetering's pioneering study for the *Rembrandt Research Project* (RRP), published in 1986.[1] Van de Wetering and his colleagues counted the threads of hundreds of canvases attributed to Rembrandt. Since the original canvases of seventeenth-century paintings are usually obscured by a lining canvas – an extra canvas applied to the reverse during restoration to reinforce the original – the measurements were made from X-radiographs, which reveal an imprint of the original canvas in the ground layer that absorbs X-rays. Depending on the painting's size and the available X-radiographs, thread densities were counted in up to twenty areas using a simple magnifying glass and ruler. This generated an average thread density for each canvas. The researchers also noted the minimum and maximum number of horizontal and vertical threads in the various counts, to assess the degree of irregularity in the thread density. If the average thread density and the spreads of the densities between two canvases matched, they were considered a 'canvas match' and very likely cut from the same bolt of cloth.[2]

Nowadays, this labour-intensive task of manually counting threads can be automated via computer-assisted analyses. This development started in 2007 when Richard Johnson (Cornell University) founded the Thread Count Automation Project (TCAP).[3] In addition to the examination of many canvases by Vincent van Gogh and other painters, at Johnson's initiative, 34 of Vermeer's known works on canvas were examined between 2008 and 2017 using computer-assisted analysis.[4] The research uncovered a total of eight canvas matches in Vermeer's oeuvre and proved a valuable tool in assessing questions regarding dating, pendant relationship and authenticity [FIG. 1].[5]

Johnson's complete study of Vermeer's canvases was made public online in 2017 in the RKD Studies series: *Counting Vermeer. Using Weave Maps to Study Vermeer's Canvases*.[6] The publication explored the history of canvas research, the transition from manual thread counting to the study of canvases via computer-generated weave maps, and the potential application of these maps. It also included the full weave map dataset of Vermeer's canvases, which is unprecedented for Dutch seventeenth-century artists.

The current contribution places the weave maps and matches of Vermeer's canvas supports in a wider perspective through the integration of the weave map dataset with other technical, art-historical and archival information. This leads to further insights into the choices Vermeer made when selecting his canvases and offers significant information about seventeenth-century practice in the preparation of canvas supports. Additionally, these findings refine or challenge some of the conclusions drawn from weave matches in the past.

WEAVE MAPS

Before delving into the specifics of Vermeer's canvas supports, it is important first to provide some background on computer-assisted canvas analysis and its various applications. For the computer-assisted analyses of canvases, digitized X-radiographs can be used to measure thread density across the entire painting, contrary to the traditional manual technique, which only allowed for measurements in a few locations. Additionally, the variation in thread density can be visualized in 'thread density weave maps' through colour-coding of the thread counts. These maps can be generated for both the vertical and horizontal threads in a canvas and correspond with either the warp or the weft threads of the woven textile. The warp threads are the vertical threads on a loom and run through the entire length of a bolt of canvas. The weft threads are woven horizontally over and under the warp threads and correspond with the width of a bolt of canvas. The loops on either side, where the weft threads turn back at the edges, form a finished edge or selvedge [FIGS. 2A, B]. Due to the weaving process the thread density varies throughout the canvas creating a distinct pattern of stripes in the weave maps. When patterns of thread density maps can be matched, it not only indicates that the canvases were cut from the same bolt of fabric, but also reveals how the canvases were positioned in relation to each other [FIG. 5].

Apart from thread density weave maps, computer-assisted canvas analysis can also generate 'thread angle weave maps'. The latter show deviations in thread angles and are particularly useful for visualizing cusping – semi-circular or wave-shaped distortions that result from stretching the canvas. To prepare the canvas as a painting support it was stretched on a strainer (a wooden framework with fixed corners), either by lacing it onto a temporary strainer with cords [FIG. 3] or by attaching it to the final strainer, using nails or wooden pegs.[7] The tension from this stretching

DETAIL *The Little Street* (cat. 9), high-resolution photograph showing the bricks above the upper-right window. The canvas weave is visible in the paint surface

process creates a regular pattern of 'cusps' along the edges of the canvas, which become fixed by the application of glue sizing and priming layers. The pattern from the first stretching of the canvas is called primary cusping. Canvases could also be primed in larger formats and then cut to the required size. The cut piece of primed canvas would then be re-stretched on a strainer to be painted. If the glue and paint were not completely hardened during the re-stretching, new distortions in the fabric could occur. Since the canvas was already fixed by the glue sizing and priming layers, this second stretching would produce only slight additional distortions, which penetrate less deeply into the fabric and are spaced more closely together. These distortions are called secondary cusping [FIG. 4].

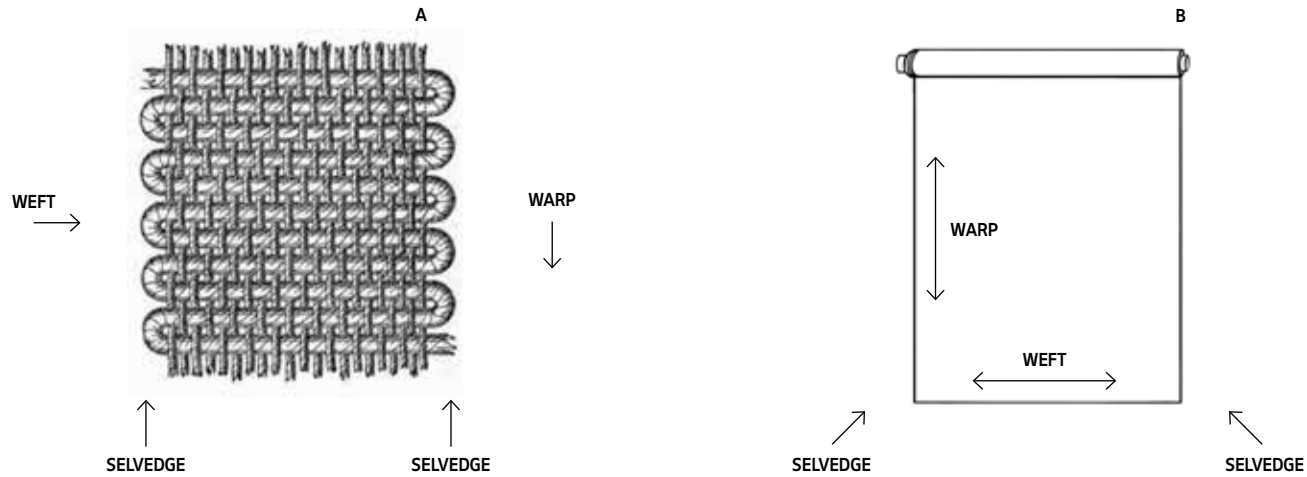


FIG. 2 Warp and weft threads in a woven fabric. The loops at either side of the canvas form a selvedge. Adapted from A. Barlow, *The History and Principles of Weaving by Hand and by Power*, London 1878, p. 67, fig. 8 (**A**); the warp threads run through the entire length of a bolt of canvas. The weft threads correspond with the width of the canvas (**B**)

The study of cusping can provide valuable insights into questions related to the original format. The absence of cusping on one or more sides of the canvas may indicate that the support was cut down from its original size. This is the case for Vermeer's *Diana and her Nymphs* (**CAT. 3**) where cusping is completely absent on the right edge of the picture. During the 1999–2000 restoration, when the lining canvas was removed, an imprint of the original strainer with diagonal corner braces was found on the reverse of the canvas. Comparison of the imprint on the right with that on the left side, indicated a reduction of the painting of approximately 12 centimetres on the right.[8]

Differentiating between primary and secondary cusping can help evaluate whether a canvas support was either individually stretched and primed or cut from a larger pre-primed canvas. This is of interest as canvases cut from larger pre-primed pieces usually indicate the use of commercially prepared canvases and can thus give information about whether an artist bought canvas supports from a specialist art supplier or professional primer, instead of preparing the canvas himself.

In the past, cusping was studied by the close examination of X-radiographs – as was also done by Van de Wetering in his canvas research. This could be challenging, especially in determining secondary cusping. In computer-generated thread angle maps, however, both primary and secondary cusping can easily be distinguished. This can be illustrated by comparing the X-radiographs and weave angle maps of the canvases of Vermeer's *The Geographer* (**CAT. 30**) and *Young Woman Seated at a Virginal* (**CAT. 34**). Fortunately, both canvases have kept their original tacking edges. These outer edges of a canvas that would have been folded around and tacked to the edges of the strainer provide information about how a canvas was stretched before painting. In *The Geographer* the ground does not extend over the tacking edges. Instead, the bare canvas is exposed, indicating that the canvas was individually stretched and primed in this format and should therefore have primary cusping on all sides. Indeed, the thread angle map of the painting reveals a clear pattern of cusps that continue over 5 centimetres into the canvas support and is also visible in the X-radiograph [FIGS. 6A, B]. The tacking edges of *Young Woman Seated at a Virginal*, on the other hand, are unpainted but completely covered with ground. This indicates that the canvas must have been cut from a larger pre-primed canvas before it was stretched onto the strainer it was painted on and should therefore show secondary cusping. In this case secondary cusping is apparent on all four sides as the thread angle map shows closely spaced cusps that extend only slightly, less than 5 centimetres, into the canvas support. Since this cusping can hardly be

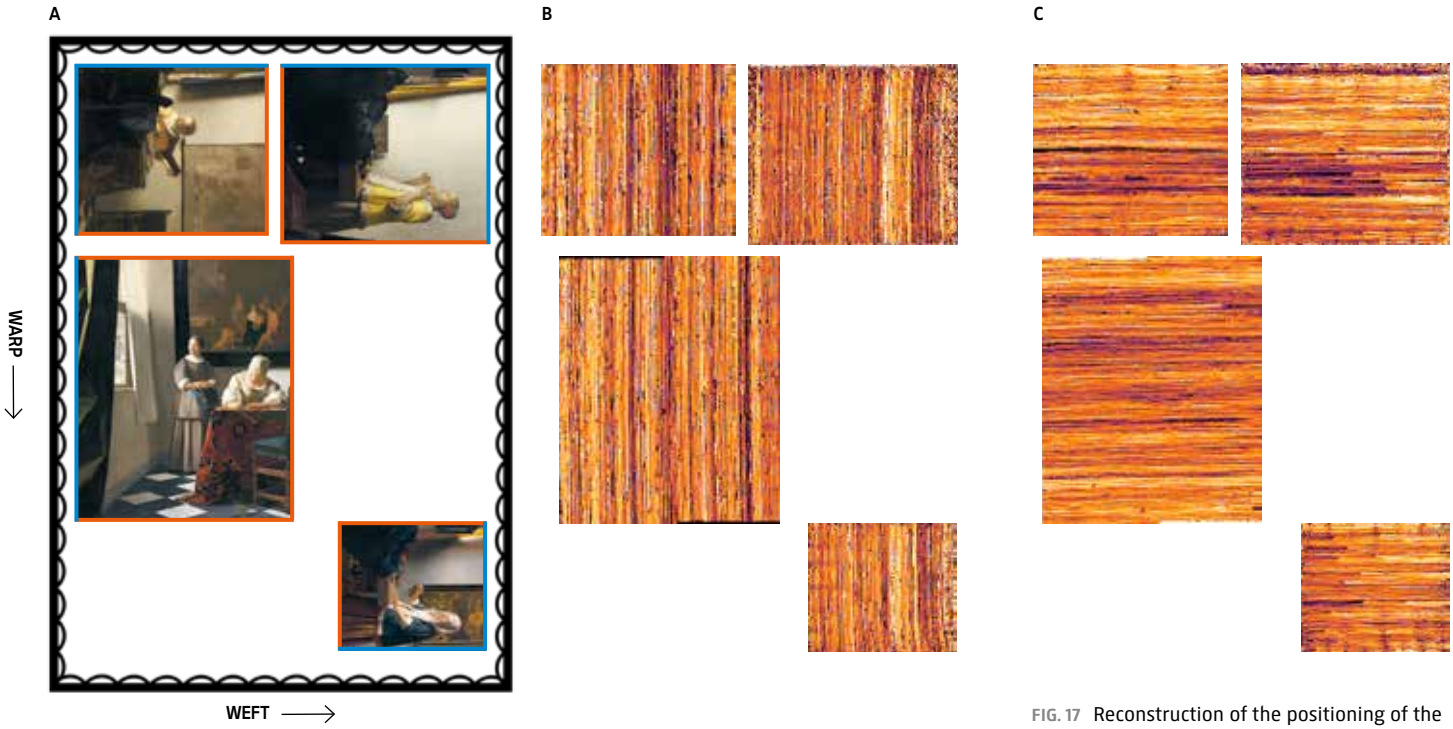
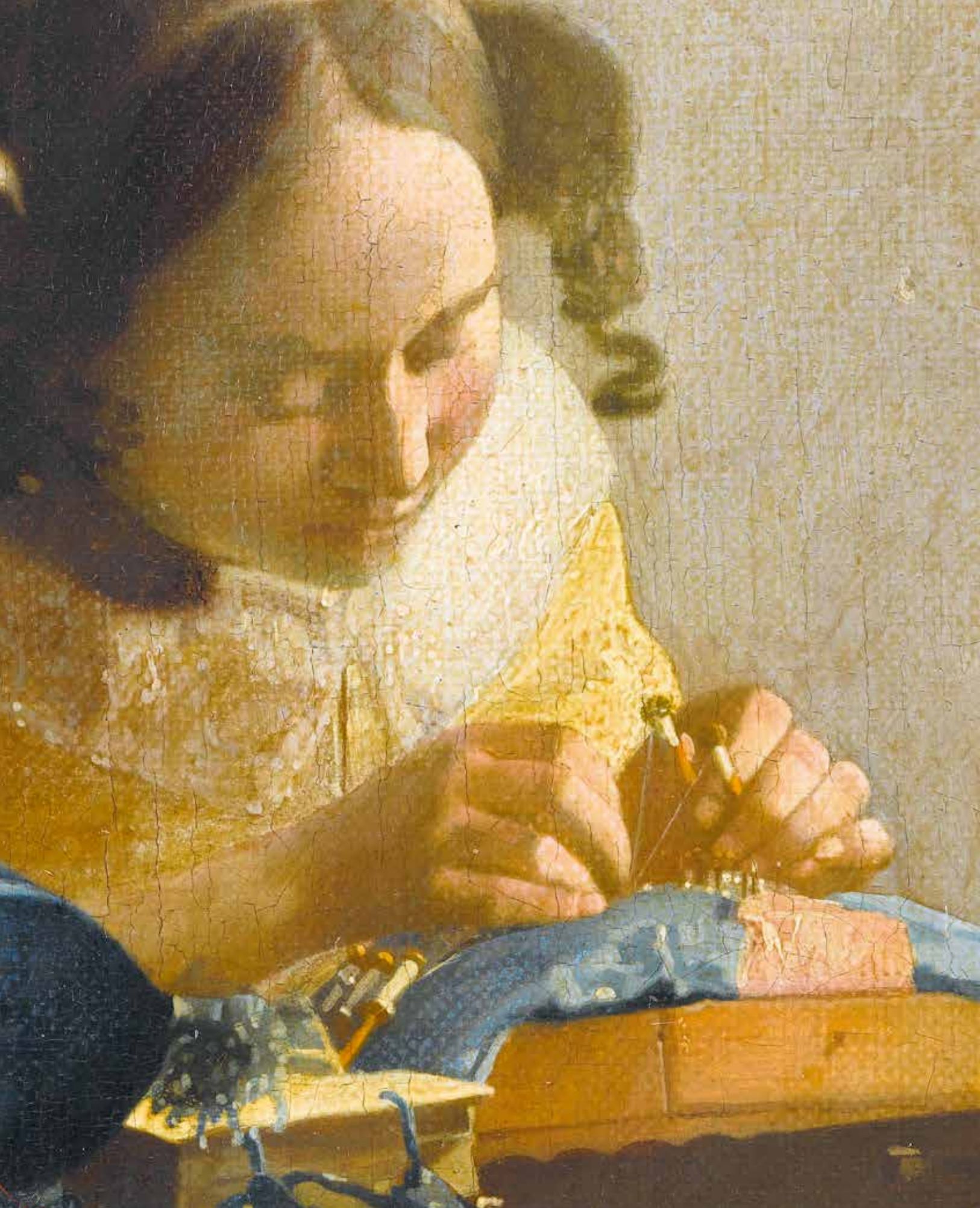


FIG. 17 Reconstruction of the positioning of the weave-matched canvases in their large pre-primed support. The reconstruction shows there is space for more canvases above and to the left of *Woman Holding a Balance* (cat. 20) positioned at the bottom right (**A**); vertical thread density maps corresponding with warp threads (**B**); horizontal thread density maps corresponding with the weft threads (**C**). Additional canvases could have been positioned in between the matches in the warp direction



WOMEN'S VERMEERS
MARIA DE KNUIJT AND NEW ARCHIVAL DOCUMENTATION ON VERMEER'S PRIMARY PATRON

PIET BAKKER AND JUDITH NOORMAN

On 9 June 1664, Maria de Knuijt, the daughter of a Delft cloth merchant, had a notarial document drawn up to record her wishes regarding her belongings should she outlive both her husband, Pieter van Ruijven, the son of a brewer, and their only surviving child, Magdalena.[1] It was not the first time: on 3 July 1662, De Knuijt had previously expressed such wishes, and even earlier, on 13 October 1661, she had done so in a private will kept in her own possession [FIG. 1].[2] The events themselves are unremarkable: in the Dutch Republic, married women had the legal right, rare in Europe at the time, to independently register a last will.[3] In particular, affluent women such as De Knuijt, who had probably brought more wealth to her marriage than her husband, would typically protect their possessions by having their particular wishes in this respect drawn up by a notary.[4] What *is* remarkable, however, are two passages in De Knuijt's notarial document of 1664, both made out to non-relatives: a monetary bequest to the painter Johannes Vermeer and, to Nicolaes van Assendelft, a painting of his choosing.[5] Why did De Knuijt bequeath money to Vermeer? And why did she stipulate that Van Assendelft could choose a painting himself? The passages and questions suggest that De Knuijt was a uniquely well-documented art lover, even though it is her husband, Pieter van Ruijven, who has until recently been considered Vermeer's main patron.

In March 2023, the archival document from 1664, which includes the two important passages as we shall see, was presented for the first time by Judith Noorman at the symposium devoted to Vermeer at the Rijksmuseum. Although it had been digitized and made available in the online catalogue of Heritage Leiden, its discovery and reinterpretation are results of the research project 'The Female Impact', which studies the significance of women on the Dutch art market in the period between 1580 and 1720.[6] Established in September 2021, this project examines the art market as an aspect of household consumption in the seventeenth century, often largely a woman's domain. Our integral and interdisciplinary approach has fostered new insights into women's roles in the production and consumption of seventeenth-century Dutch paintings. Previously, the art market had often been studied and presented as primarily a man's world, leaving little or no room to understand the presence and involvement of women. This is not to say that women have been malevolently written out of history or that art historians have asserted outright that they played no role in the art market. But, unlike men, women are rarely mentioned by name. In the case of Maria de Knuijt, archival documents about her belongings and her relationship to Vermeer have not been used to her 'advantage' but mainly to substantiate Van Ruijven's rapport with Vermeer, as will be detailed below.

Drawing on a rereading of previously known documents, along with an analysis of newly published ones, this essay – the first to focus on Maria de Knuijt – outlines the most likely scenario that De Knuijt was Vermeer's primary patron. It demonstrates that she, rather than her husband, was deeply invested in Vermeer's artistic output, even after her death. Through her wills, she sought to continue improving his financial situation. Introducing two new documents into the discussion sheds new light on the early collection, documentation and management of Vermeer's paintings. What emerges from this discussion is a picture of a well-documented woman patron, collector and protector who bought Vermeer the time and freedom to pursue his artistic ambitions, thus changing the course of art history. To arrive at this new insight requires a close reading of the complex set of surviving archival documents, as well as the circumstances in which they were drawn up and the motivations behind them. Ultimately, the new findings reprompt questions about the elusive meaning and interpretation of Vermeer's paintings.

STATE OF SCHOLARSHIP. MONTIAS'S LONG REACH

Maria de Knuijt and Pieter van Ruijven were first mentioned in 1987 in an essay by John Michael Montias published in *The Art Bulletin*, and two years later in his groundbreaking book *Vermeer and his Milieu*.[7] Montias brilliantly laid out the connection between archival documents about Pieter van Ruijven and Maria de Knuijt on the one hand, and the estate of their daughter, Magdalena van Ruijven, and son-in-law, Jacob Dissius, on the other.[8] As we know from Magdalena's inventory, she and her husband owned 20 or 21 paintings by Vermeer, which were sold after Dissius's death at auction in Amsterdam in May 1696 [FIGS. 2, 3].[9] The sale, long known before Montias's publications, included, among many others, works such as *View of Delft* (**CAT. 10**), *Woman Holding a Balance* (**CAT. 20**) and *The Lacemaker* (**CAT. 27**). Montias argued that Jacob Dissius inherited the paintings from his father Abraham and his wife Magdalena van Ruijven, who had in turn inherited them from her mother, who had outlived Pieter van Ruijven.[10]

Montias's most important argument was based on the 200-guilder loan that Vermeer and his wife, Catharina

DETAIL *Woman Holding a Balance* (cat. 20)

CATALOGUS
VAN
SCHILDERYEN,

Verkogt den 16. May 1696. in Amſterdam.

1 EEn Juffrouw die goud weegt, in een kasje van J. vander Meer van Delft, extraordinaer konſtig en kragtig geſchildert. 155 - 0
2 Een Meyd die Melk uytgiet, uytnemende goet van dito. 175 - 0
3 't Portrait van Vermeer in een Kamer met verſcheyde bywerk ongemeen fraai van hem geſchildert. 45 - 0
4 Een ſpeelende Juffrouw op een Guiteer, heel goet van den zelve. 70 - 0
5 Daer een Seigneur zyn handen waſt, in een doorſiende Kamer, met beelden, konſtig en raer van dito. 95 - 0
6 Een ſpeelende Juffrouw op de Clavecimbael in een Kamer, met een toeluiſterend Monſieur door den zelven. 80 - 0
7 Een Juffrouw die door een Meyd een brief gebragt word, van dito. 70 - 0
8 Een dronke ſlapende Meyd aen een Tafel, van den zelven. 62 - 0
9 Een vrolyk geſelſchap in een Kamer, kragtig en goet van dito. 73 - 0
10 Een Muſicerende Monſr. en Juffr. in een Kamer, van den zelven. 81 - 0
11 Een Soldaet met een laggent Meysje, zeer fraei van dito. 44 - 10

12 Een Juffertje dat ſpeldewerkt, van den zelven. 28 0
13 De Oude Kerk 't Amſterdam, konſtig van Emanuel de Wit. 74 - 0
14 't Graf van de oude Prins tot Delft, van den zelven. 52 - 0
15 Nog een Kerk van dito. 34 - 0
16 Een Juffertje van Netſcher, zyn beſte trant. 164 - 0
17 Een Vrouwtje dat naait van Gerard ter Burgh. 56 - 0
18 Lucretia van de oude Palma. 30 - 10
19 Een Geſeldſchap van Gerards, heel uytvoerig. 96 - 0
20 Een Zeehaven van Adam Pynakker. 42 - 0
21 Beelden van Andries Both. 24 - 0
22 Een Triumf wagen van de vier getyden van 't Jaar in een Landſchap, den aart van Pouſin. 82 - 0
23 Een geſelſchap van drie Perſoonen van Gerard Terburgh. 80 - 0
24 Batzeba van Jacob de Loo. 104 - 0
25 Chriſtoffel van Spanjolet. 13 - 0
26 Een Grot met Beelden en Beeſten van P. de Laar (anders) Bamboots. 104 - 0
27 Daerze na de Jacht gaen door denzelven. 29 - 0
28 Pomona en Virtumus van Argous tot Romen geſchildert. 17 - 10
29 Venus met Kindertjes van dito. 21 - 0
30 Een Italiaens Barbiertje van denzelven. 42 - 0
31 De Stad Delft in perſpectief, te ſien van de Zuyd-zy, door J. vander Meer van Delft. 200 - 0
32 Een Geſicht van een Huys ſtaende in Delft, door denzelven. 72 - 10
33 Een Geſicht van eenige Huyſen van dito. 48 - 0

FIG. 2 Pages of the auction catalogue of the Dissius sale, Amsterdam, 16 May 1696

The second relevant passage in the 1664 document concerns Nicolaes van Assendelft, a son of Willem van Assendelft, the Delft 'house notary' of Van Ruijven and De Knuijt as husband and wife [FIG. 4]. After studying law in Leiden, Nicolaes worked as a lawyer in The Hague. In 1657, he returned to Delft to marry Agnetha van den Mierop, daughter of a cloth merchant. Back in Delft, he had served several terms as Charity Master starting in 1662, indicating regular contact between 1668 and 1672 with Pieter van Ruijven, who held the same position during those years.[31] By 1667, Van Assendelft had already married again, this time to Maria Magdalena van der Hoeff, daughter of the bailiff and *dijkgraaf* (dike warden) of Delfland. Alongside her brother, the future mayor Adriaen van der Hoeff, Van Assendelft acted as the official mediator in the settlement of Vermeer's estate in 1677.[32] De Knuijt would leave Van Assendelft a painting of his own choosing: ('*een van de schilderijen naar zijn keuze*').

Bequeathing a painting was not unusual. Paintings to be handed down were frequently family portraits, but if the work belonged to a genre other than portraiture it would usually have had monetary or personal value for the owner. The clause in the 1664 codicil granted Van Assendelft permission to select a painting of his choice after De Knuijt's death. Like her, he was probably an art collector: the death inventory of his widow and second wife, compiled twenty years after his own death, lists about 20 family portraits and 87 other paintings, including 'A lady playing the virginal' by Vermeer, which might refer to one of the two Vermeers now at the National Gallery in London (**CATS. 33, 34**).[33] The paintings in the estate were valued at 1,500 guilders in total. All movable goods in the house were estimated to be worth around 4,500 guilders in total, making the paintings a significant portion of the overall value of the house's interior items. However, the inventory drawn up immediately after Van Assendelft's death in 1692, which has previously been overlooked, provides an even clearer indication of his passion for art. This document lists no fewer than 140 paintings, categorized into four groups, distinguished from other furnishings, and described in a dedicated document titled 'Paintings'.[34] The nature of De Knuijt's bequest – a painting of his choice – suggests that she believed he would have been touched by the gesture and indicates a discerning taste and a desire to collect according to his personal preferences. A shared love of painting is thus implied in the previously unknown passage in De Knuijt's last will. To the best of our knowledge, it is the only known bequest from one art lover to another in seventeenth-century Dutch archival sources.

Previously published documents indicate that De Knuijt was a collector and protector of Vermeer, but this new information demonstrates that her protection of Vermeer was an expression of her longstanding intentions and that she was a discerning art lover, and a well-documented one at that. This latter revelation is important because art historians liberally – and, it must be said, sometimes mindlessly – apply the term 'art lover' and 'collector' to men but rarely to women. Even the well-known Petronella de la Court, described in her own time as a *liefhebber* (art lover), is more often remembered for her doll's house than for her extensive collection of paintings.[35] While the doll's house is undoubtedly a remarkable masterpiece, it should not lead to De la Court's dismissal as an art lover and collector of paintings in discussions on the subject.

Also illustrative here is the incorrect assumption that Nicolaes van Assendelft owned the Vermeer painting mentioned in his second wife's inventory of 1711.[36] Not so: in his 1692 inventory, compiled the year Van Assendelft died, all 140 paintings are described by subject, and none of these works corresponds to 'A lady playing the virginal'.[37] Van Assendelft never had the opportunity to choose a painting from De Knuijt's collection because her daughter Magdalena outlived both her and her father, and the will mentioning this bequest never took effect. It was only after Van Assendelft's death that his second wife acquired a painting by Vermeer. After her death in 1711, the document listing the Vermeer painting was drawn up.[38] When the estate was divided among the heirs, the painting was allocated to her family rather than to Nicolaes's son. Consequently, the artwork came into the household only after Nicolaes's demise. The exact means of acquisition remain unknown; the widow may have purchased it herself or inherited it from her aforementioned brother, Adriaen van der Hoeff who, intriguingly, worked alongside Nicolaes van Assendelft as commissioners overseeing the proper settlement of Vermeer's estate in 1677.[39] Clearly, art historians have too quickly presumed that paintings mentioned in archival sources that document jointly owned possessions were acquired only by men, and not just in the cases of Van Ruijven-De Knuijt and Van Assendelft-Van der Hoeff. Instead, the paintings mentioned may have been purchased by women and, equally importantly, either spouse could have been the inheritor of the work of art or its recipient as a gift.

HER, HIM, OR BOTH?

The new documents prove that De Knuijt was an art lover and that she was connected to at least one other art lover. Furthermore, her special relationship with Vermeer is evident from not one but two of her wills. As was already known, she probably brought money to her marriage with Van Ruijven, and she and Vermeer lived in the same neighbourhood in their youth. One important reason to consider Van Ruijven's role in collecting the 20 or 21 Vermeer paintings has been a passage about '*beste Schilder konst*' (the finest paintings) in the joint will of 1665. This clause in the joint will, however, is the answer to a problem De Knuijt encountered while trying to articulate her independent wishes. What is more, it refers to a notebook documenting

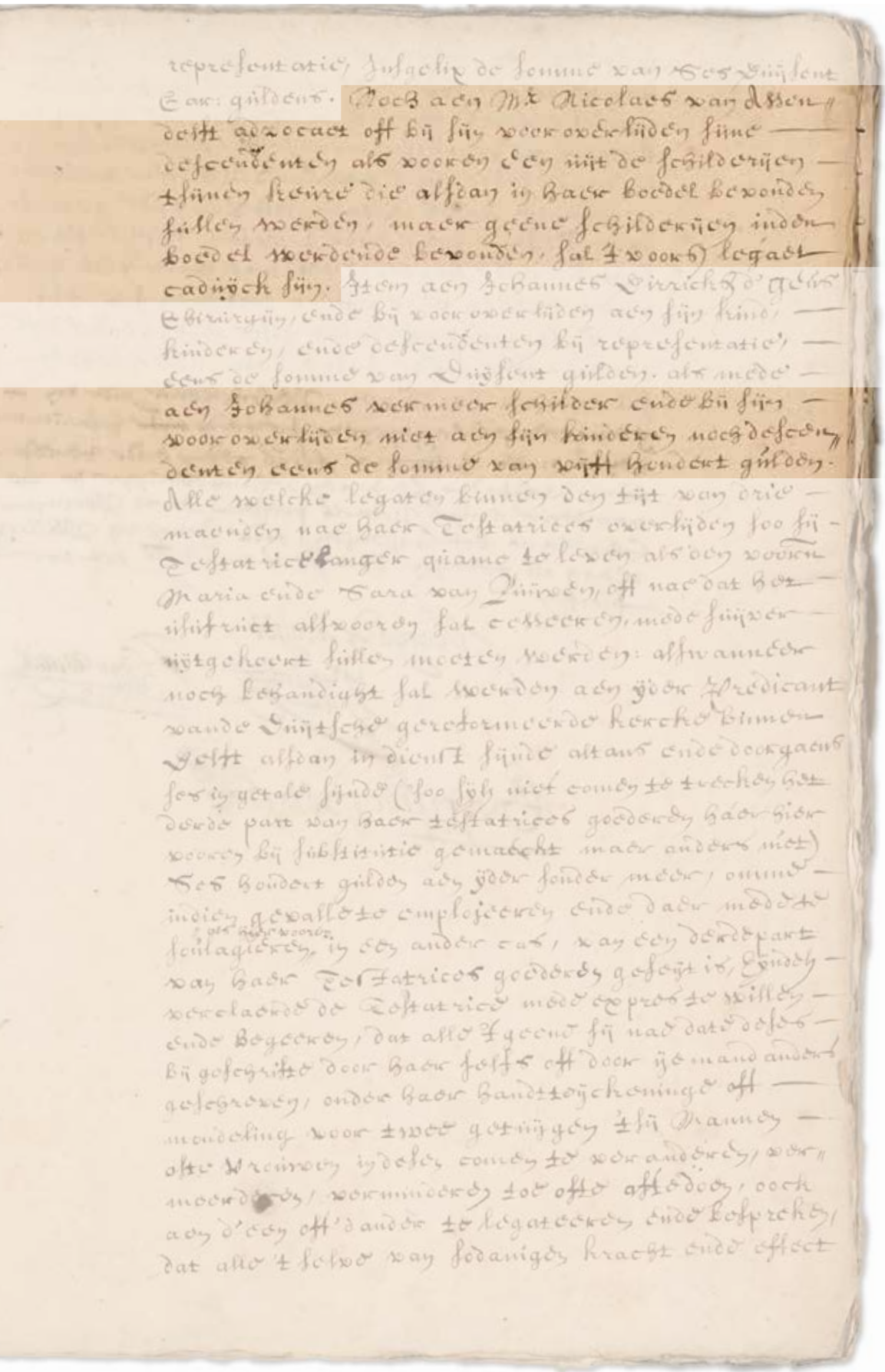


FIG. 4 Extract from Maria de Knuijt's last will, 9 June 1664: 'Noch aen Mr Nicolaes van Assendelft advocaet off bij sijn vooroverlijden sijne descendenten als vooren een uijt de schilderijen tsijnen keure die alsdan in haer boedel bevonden sullen werden, maar geene schilderijen inden boedel werdende bevonden, sal 't voors[chreven] legaet caduijck sijn … aen Johannes Vermeer schilder ende bij sijn vooroverlijden niet sijn kinderen noch descendenten eens de somme van vijfhondert gulden.'
(Also to Mr Nicolaes van Assendelft, lawyer, or upon his predecease his descendants as mentioned above, one of the paintings of his choice that will then be present in their estate, but if no paintings are found in the estate, the aforementioned legacy will be forfeited … to Johannes Vermeer, painter, and upon his predecease not his children or descendants, the sum of five hundred guilders.)
Leiden, Erfgoed Leiden en Omstreken, Notarieel Archief, notary Claes Dircksz Verruyt, inventory 722, deed 64, 9 June 1664

LEAD ISOTOPE STUDIES OF VERMEER'S PAINTINGS
MYTHS AND REALITIES

PAOLO D'IMPORZANO AND GARETH R. DAVIES

Lead white, a versatile pigment with a rich history, has been widely used across centuries in various fields, including cosmetics, medicine and the arts. Until the twentieth century it was the primary and most important white pigment in oil paintings. Lead isotope analysis provides valuable information about the provenance of the lead used to make the pigment and may indirectly offer insights into the object's origin. It also sheds light on the trade of lead and lead white and, in some cases, can assist in authenticating artworks.[1] This essay investigates the isotopes in lead white used in the paintings of Johannes Vermeer to explain the provenance of the pigment and how to use this information to study paintings created by the Dutch master. Specifically, the lead isotope data available for seventeenth-century European paintings are reviewed. Advice is provided on how these data can or should be used to disprove or support whether a painting is of Dutch origin.

A BRIEF HISTORY OF LEAD ISOTOPES IN NATURE

Lead isotope analysis is based on the study of lead (Pb), an element with four stable isotopes: ^{204}Pb, ^{206}Pb, ^{207}Pb and ^{208}Pb. Lead isotopes are versions of the element lead that have the same number of protons but a different number of neutrons, giving them different atomic masses. Three of these isotopes – ^{206}Pb, ^{207}Pb and ^{208}Pb – are continuously generated by the radioactive decay of the heavier elements uranium and thorium. The fourth stable isotope, ^{204}Pb, is not a product of radioactive decay but has been present in the Earth's crust since the planet's formation. Measuring the ratio of the different isotopes of lead can, among other purposes, trace the source of the lead. The principal lead-containing mineral extracted from ore deposits to produce metallic lead in Europe from which lead white is prepared, is galena (lead sulphide, PbS). Other minerals used as sources of lead include naturally occurring cerussite (lead carbonate, $PbCO_3$) and anglesite (lead sulphate, $PbSO_4$).[2] However, cerussite and anglesite are relatively rare in nature, usually associated with galena and have similar isotopic compositions. All these minerals have extremely low uranium/lead and thorium/lead ratios, meaning that the isotopic composition does not change significantly over time once they are formed. Due to these characteristics, different ore deposits worldwide, formed at different times and under different geological conditions, have different lead isotope ratios. However, deposits formed under similar conditions and at geologically similar times may be isotopically comparable, making it difficult to distinguish them using only lead isotope analysis.[3]

HOW LEAD WHITE IS MADE

Lead white exists as both a natural and synthetic pigment. Evidence indicates that natural lead white was used around 4000 BC, while the earliest synthetic example dates to the seventh century BC in Northeastern China. Its production and use were also described by Theophrastus (fourth century BC), Vitruvius (first century BC) and Pliny the Elder (first century AD). Until the implementation of new chemical procedures in the 1800s, its method of synthesis was always the same: metallic lead was exposed for weeks to gases of acetic acid (vinegar) and a source of CO_2 (usually animal manure). This process[4] causes the metallic lead to undergo a chemical transformation, producing a lead carbonate ((hydro-)cerussite) known as lead white [FIG. 1].[5]

When studying the provenance of lead white through lead isotope analysis, the production of the pigment can be traced back to the mining stage, where lead is extracted and smelted from the mineral galena. The obtained metallic lead is then traded, locally or abroad, and processed to become products such as lead white. The production and trading process links lead white in a painting to the galena source from which the lead was extracted, as the isotopic composition of the lead remains unchanged unless different lead supplies are mixed.

In the seventeenth century, the Dutch Republic was the largest manufacturer and trader of lead white in the world, with many thousands of mills producing thousands of tons per year in total. Dutch lead white has been found in paintings made in Denmark, France, Italy, England and Germany.[6] The Dutch pre-eminence in the field resulted from the implementation of a new production method known as the Dutch stack process. In this method, numerous ceramic jars containing vinegar with suspended coils of metallic lead are stacked together in a closed hut, interlayered with manure [FIG. 1B]. Venice was another major producer of lead white, but it is believed that in the seventeenth century the city primarily sold its lead white locally.[7]

EUROPEAN LEAD ISOTOPIC LANDSCAPE AND CHALLENGES FOR PROVENANCE STUDIES

A key challenge in identifying lead sources is distinguishing between lead ore deposits from different regions that have overlapping isotopic values. This is especially important when these regions were producing lead during the same period, as is the case in the lead production in sixteenth- and seventeenth-century Europe, where Germany, Poland

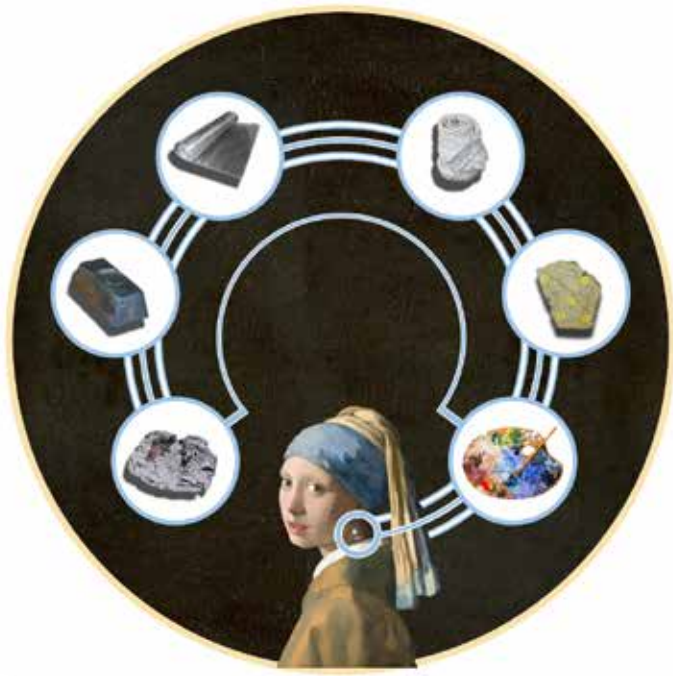
LIFE CYCLE OF 17TH-CENTURY DUTCH LEAD WHITE: FROM DEPOSIT TO CANVAS

A

3
Dutch pigment-makers acquire metallic lead to produce lead white (Dutch stack process)

2
Galena is smelted to metallic lead and traded

1
The mineral galena (PbS) is extracted from English deposits

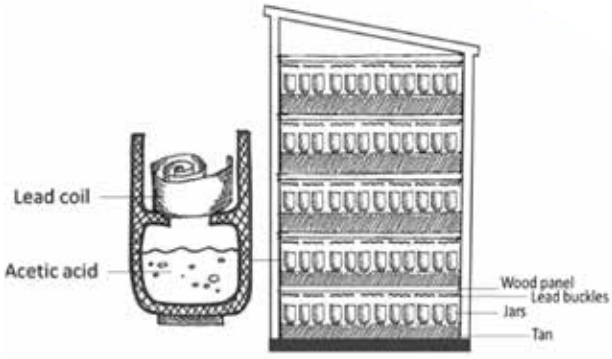


4
After 4–6 weeks the metallic lead becomes lead white

5
Lead white is washed, dried and treated

6
The artist acquires and uses the lead white for paintings

B



C

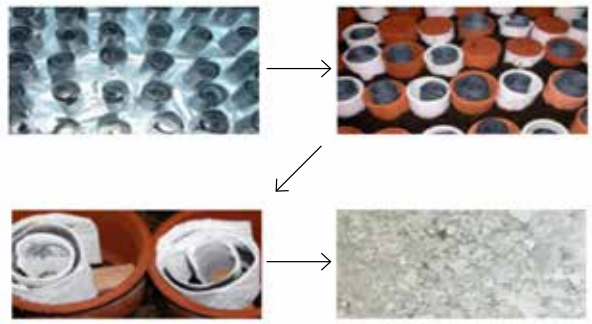


FIG. 1 Schematic representation of the process of lead white production from galena to lead white on paintings (**A**); the process of creating lead white prepared according to the Dutch stack method, using ceramic jars (**B**); the transformation from metallic lead to lead white (**C**)

paintings made between 1670 and 1680. The addition of data from late Vermeer and other late Dutch works would provide a better comparison to the Philadelphia painting.

Provenance of lead in Vermeer's paintings

The samples analyzed in this study support the English provenance of the lead used to make the lead white in all paintings examined, including undisputed Vermeer works and those with disputed attribution [FIG. 5]. The graphs show the lead isotope composition of samples in comparison to English mines in Cornwall, Derbyshire, the North Pennines and the Yorkshire Dales, plotted on a 2D density plot. The isotopic values of the paint samples overlap with those from Derbyshire lead ore deposits. There is also a minor overlap with the

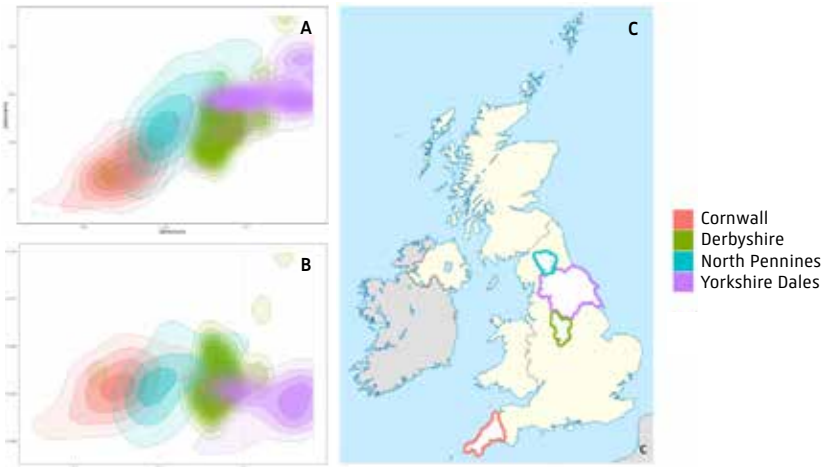


FIG. 5 Comparison of lead isotope values (**A, B**) from different English lead deposits (**C**) exploited in the 17th century and samples from undisputed and disputed Vermeer paintings

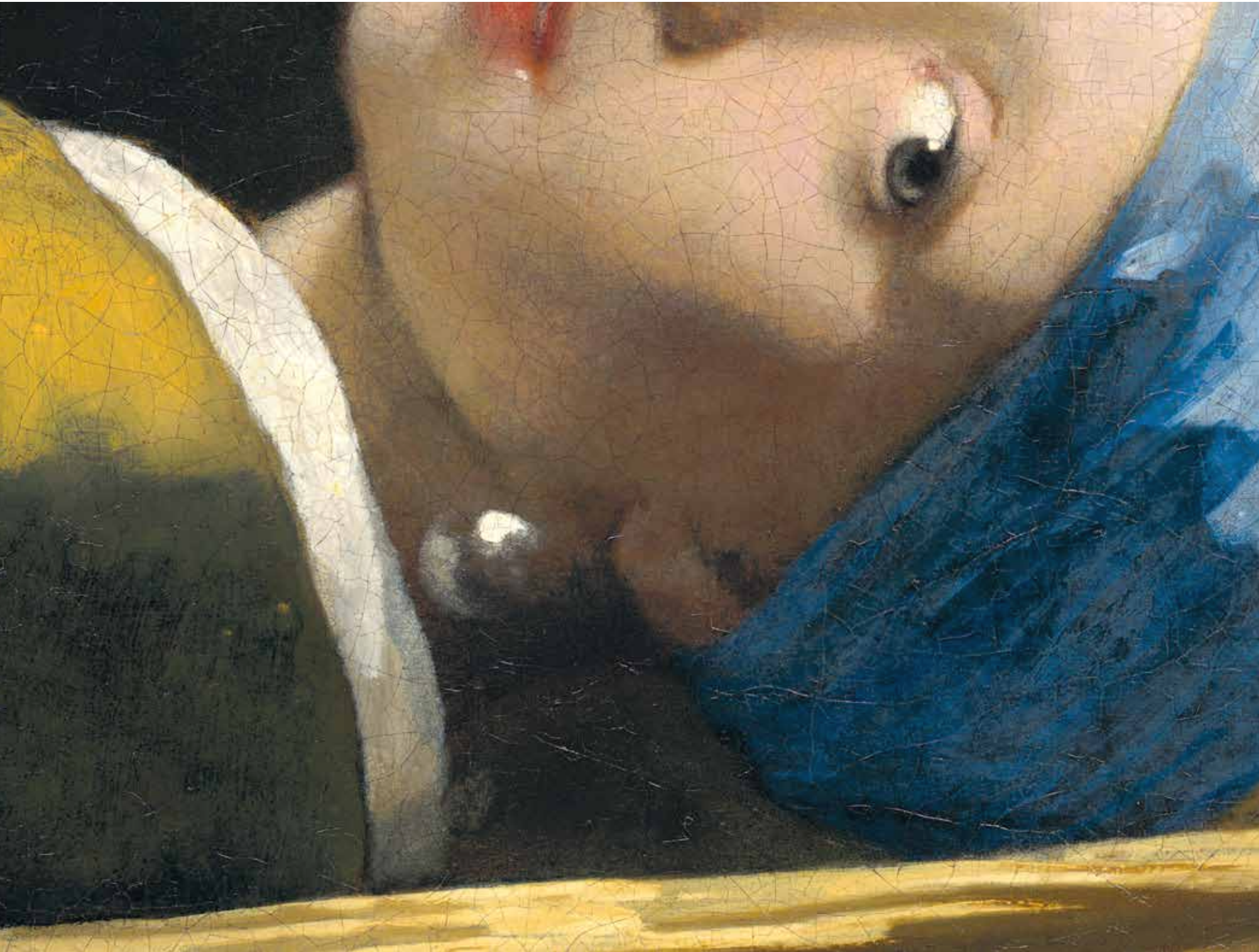
geographically adjacent mines in the Yorkshire Dales, yet based on production and trading records, the Derbyshire deposits are considered to be the source of the lead used to produce Dutch lead white.[12] The results for Vermeer (undisputed and disputed) are in line with what can be expected from lead white used by a painter who lived and worked in the Dutch Republic during the seventeenth century.

Origin of Vermeer's lead whites

The first major study of lead isotopes in cultural heritage and specifically in paintings was conducted in 1976. Samples from eleven paintings by Vermeer were analyzed for lead isotope ratios.[13] Unfortunately, these data cannot be directly compared to modern, twenty-first-century data due to several methodological limitations.[14] The earlier data are affected by analytical errors related to incomplete chemical purification of the lead and the inability to monitor mass-dependent isotopic fractionation due to instrumental limitations.[15] This translates to less precise data with higher isotopic variation. The 1976 data for Vermeer samples alone show a variation in the $^{206}Pb/^{204}Pb$ ratio that is more than five times greater than the entire range observed in seventeenth-century Dutch paintings reported in recent studies.[16]

When discussing the isotopic composition of lead white in Vermeer's paintings, it is therefore best to start with the data produced in 2013–2014.[17] During that period, lead white from two paintings – Vermeer's *Diana and her Nymphs* (**CAT. 3**) and the disputed *Saint Praxedis* – was compared to aid in the authentication of the latter, a repetition or copy of a painting by the seventeenth-century Italian artist Felice Ficherelli, thought by some scholars to be created by the young Vermeer. The results of these data demonstrate that the lead white used in both paintings is consistent with that produced in the Dutch Republic during the seventeenth century. Although the data from the two paintings are identical within analytical error, this only implies that the lead used in both works came from the same English source. However, this match was mentioned in the 2014 auction catalogue as crucial evidence for attributing *Saint Praxedis* to Vermeer. It was stated that the lead isotope ratios of the two paintings '… relate so precisely as to even suggest that the exact same batch of paint could have been used for both pictures'.[18] In this case, this conclusion is, however, incorrect, as lead isotope analysis can only indicate the lead source but not if lead white from the same batch was used. For instance, other paintings, including Rembrandt's *Self-Portrait as the Apostle Paul* (Amsterdam, Rijksmuseum) from 1661 have almost identical isotopic values, as does Gerard van Honthorst's *Portrait of Willem II (1626–1650), Prince of Orange, and his Wife Mary Stuart (1631–1660)* (Amsterdam, Rijksmuseum) from 1647.[19] Furthermore, the 2014 results were presented as 'scientific proof that the picture [*Saint Praxedis*] was not painted

FIG. 2 *Girl with a Pearl Earring* (cat. 25), detail



WHO'S THAT GIRL?
GIRL WITH A PEARL EARRING IN 1665, AND HER CURRENT APPEARANCE IN 3D

ABBIE VANDIVERE

Girl with a Pearl Earring (**CAT. 25**) is undoubtedly Johannes Vermeer's most iconic painting, but it was not always so beloved. In 1881, the artwork was purchased at auction for only two guilders, plus a thirty-cent commission: about 25 euros in today's currency. Now, visitors flock from all over the world to stand in front of the painting. Perhaps the greatest challenge for the Mauritshuis is to present something new about *Girl with a Pearl Earring*. A 2018–2020 examination of the painting using state-of-the-art scientific technologies produced a multitude of data about Vermeer's materials and techniques, where his pigments came from, and how the painting has changed over time.[1] To make these findings more accessible, understandable and relevant to a wider public, a wall display titled *Who's that Girl?* was installed in the foyer of the Mauritshuis. It included a digital reconstruction that approximates the original appearance of the *Girl*, and a four-metre-high 3D print that visitors can touch.

THE GIRL IN THE SPOTLIGHT

Over a two-week period in 2018, *Girl with a Pearl Earring* was examined by an international team of scientists in front of the public at the Mauritshuis. Research questions that guided the examination included the following: 'What did the *Girl* look like around 1665 when painted by Vermeer, and how has the painting changed over time?' A combination of non-invasive imaging methods and analyses of micro-samples was used to identify Vermeer's original materials, and to understand the physical and chemical changes that have taken place throughout the centuries. This essay concentrates on the results obtained using macroscopic X-ray fluorescence imaging spectroscopy (MA-XRF) and 3D digital microscopy.

MA-XRF detected and visualized the elemental distribution of the pigments in the paint, including lead white, earth pigments, lead-tin yellow and vermilion. For other pigments that were more difficult to detect, the results were complemented by evidence from other scientific technologies.[2] MA-XRF revealed hitherto unseen details in the *Girl*. The background of the painting is currently a rather flat, dark grey expanse, but Vermeer's original concept was for a dark green curtain.[3] In the upper-right corner of the painting, several elemental scans – most clearly, lead (Pb-M) – visualized the folds in the fabric [FIGS. 1A, B]. Cross-sections analyzed in the 1990s showed that the upper layer in the background was a green glaze containing weld (yellow) and indigo (blue).[4] These fugitive pigments faded in response to light, resulting in a 'milky' appearance where the glaze now appears greyish on top of a charcoal black underlayer. Other details that were visualized more clearly using MA-XRF include Vermeer's signature in the top-left corner [FIG. 1C]. Until recently, it was assumed that the *Girl* has no eyebrows or eyelashes. Remarkably, MA-XRF detected brown iron-containing eyelashes above the left eye [FIG. 2A]. These had become invisible due to the low visual contrast between the degraded green background and the dark paint, which contains earth pigments [FIG. 2B]. Microscopy showed that Vermeer used tiny brushstrokes to apply eyelashes above her other eye; however, no eyebrows were found.[5]

3D DIGITAL MICROSCOPY

High-resolution digital microscopy was vital for capturing other minute details, from brushstrokes (at 35× magnification) to individual pigment particles (at up to 140× magnification).[6] In 2022, a Hirox HRX-01 microscope with a telecentric lens was used to scan the whole painting at 90× magnification [FIG. 5A]. The microscope was mounted on a motorized T-shaped stand so that it moved incrementally along x- and y-axes to capture the variations in the surface as a pattern of 'tiles'. The microscope employed focus stacking in the z-axis; each tile was built up from around 50 images, which were digitally stacked to create a fully focused image containing the topographic (height/depth) and colour information for each pixel. This automatic process was then repeated 41,106 times to cover the entire painting: 88 hours of non-stop scanning produced a total of 108 billion pixels. Not only did the Hirox digital microscope acquire the largest known 3D map of an artwork, it was also vital for understanding Vermeer's materials and techniques. The colour image shows individual pigment particles, brushstrokes and which colour was layered over another [FIG. 2B]. Using the 3D topographical data, the height differences in the painting could be measured, as well as the thickness of certain paint layers, and the distortions caused by the craquelure pattern that has developed over time [FIG. 2C]. The relative height differences of the cracks are a baseline for the painting's current condition and appearance, and could be compared with a similar scan in the future. The 108 gigapixel scan of the entire painting can be viewed online (scan QR code in FIG. 5B).

DETAIL *Girl with a Pearl Earring* (cat. 25)

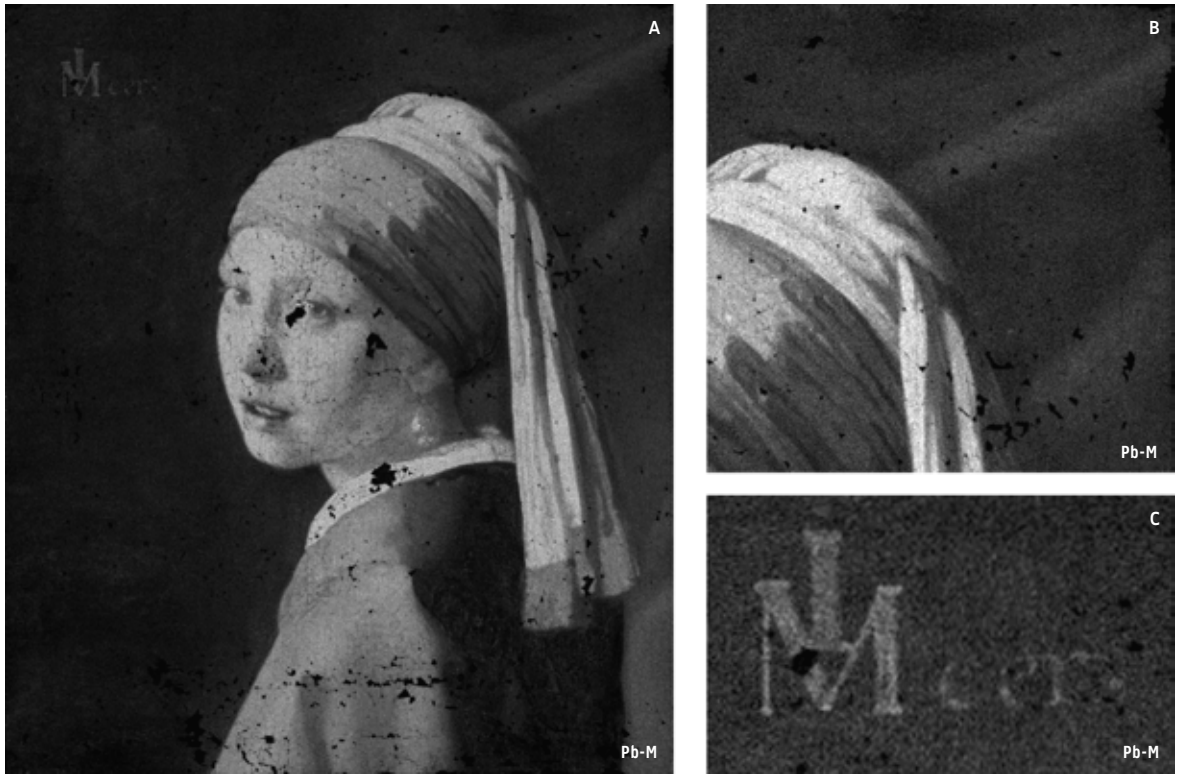


FIG. 1 *Girl with a Pearl Earring*, MA-XRF maps of lead (Pb-M): overall (**A**); detail of top-top-right corner showing folds of a curtain (**B**); detail of top-left corner showing Vermeer's signature (**C**)

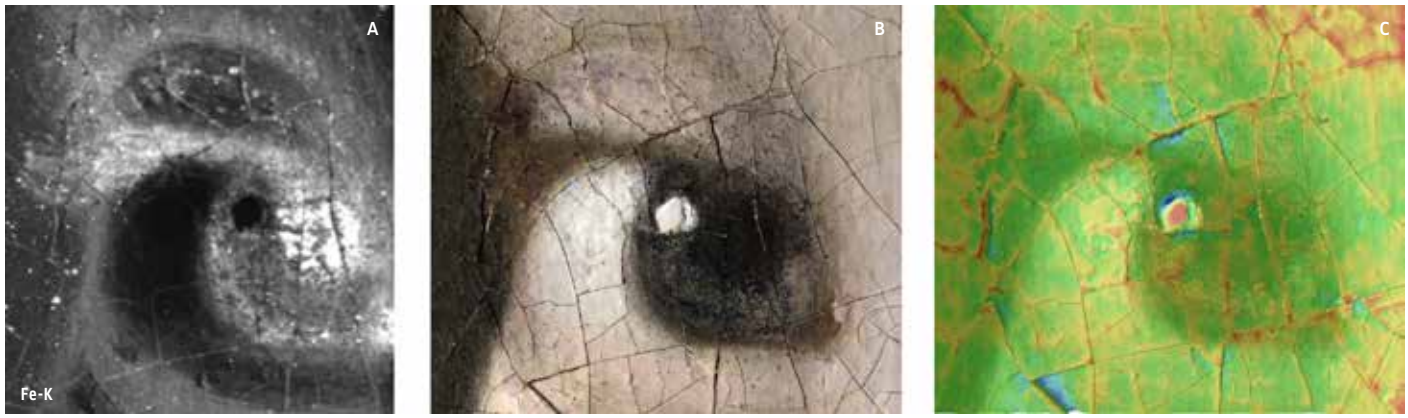


FIG. 2 *Girl with a Pearl Earring* (cat. 25), detail of eye: MA-XRF map of iron (Fe-K), showing eyelashes (**A**). Hirox 3D digital photomicrograph, 140× magnification, 1.1µm/pixel (**B**); Hirox height map of eye (accessible using QR code in fig. 5B) (**C**)

ESSENTIAL VERMEER

JONATHAN JANSON

The story of the website *Essential Vermeer* began in 1968, under the dimmed lights of an introductory art history class at the Rhode Island School of Design in Providence, Rhode Island. My instructor projected slide after slide while adeptly explaining the works of Flemish and Dutch Baroque artists, most of whom I knew absolutely nothing about. With lulling period music in the background, the experience was inebriating, until the instructor wrapped up Rembrandt and projected a work by a painter he particularly admired: Vermeer's *Woman Holding a Balance* (**CAT. 20**). I was shocked. It struck me as something I had never seen before yet, bizarrely, as something I had always known.

Until that moment, my aspiration had been to become an abstract painter. As soon as the lesson was over, I reformulated my goal: to paint like Vermeer... how hard could it be?

To an eighteen-year-old like myself, Vermeer's slow-paced brushwork, relatively simple paint structure and methodical manner of defining form seemed approachable, until I began to discover that making an oil painting look anywhere near lifelike with rebellious paint and brushes was anything but. I hitch-hiked to Boston to see a real Vermeer: *The Concert* (**CAT. 17**). I was bewildered by its cleanliness and superlative technique. For the first time I understood what composition meant – nothing can be added or removed. The abstract patterns of the woman's satin gown made it tangible, more real than any photograph, and the double shadow gently raised the tilted ebony-framed landscape just above the surface of the canvas. Vermeer beats reality, ten to one.

I graduated from college, read everything I could find on Vermeer, and continued to study his technique and compositions, attempting to emulate his manner and create my own 'Vermeers'.

CHALLENGES

Some 30 years after my initial encounter with Vermeer, my first encounter with the internet was to type in the Yahoo! search bar, 'v-e-r-m-e-e-r'. With the exception of Kees Kaldenbach's pioneering initiatives, I was disappointed to see how little came up on the screen, but at the same time piqued. How complicated could it be to construct a simple website? It should at least be easier than painting like Vermeer.

With no idea how to start a website and minimal writing experience since graduating, I embarked on the task armed with a thirst for discovery and a basic website editing programme.

At first, I approached the project as a painter might approach a canvas – with intuitive brushstrokes. I wanted to make Vermeer accessible to people like me: those who were passionate about his work but perhaps did not have access to the depth of resources found in academic libraries. Over time, however, the site became something more significant than I could have anticipated.

After a period of trial and error, sometime in June 2001, I uploaded what would become the cornerstone of essentialvermeer.com: a single-page shortlist of 'essential' Vermeer resources with a dark faux-canvas background.

To build the site's content, I immersed myself in decades of scholarly and scientific research, while also reflecting on my own attempts to replicate Vermeer's techniques. My initial guiding principle – what would Vermeer think of this? – offered little practical guidance for addressing the formidable technical and writing challenges involved in creating a website *ex novo*, especially one dedicated to the most perplexing artistic talent in Western painting. Growth was sporadic and undisciplined, with branches reaching out in all directions but no trunk anchoring them to the ground.

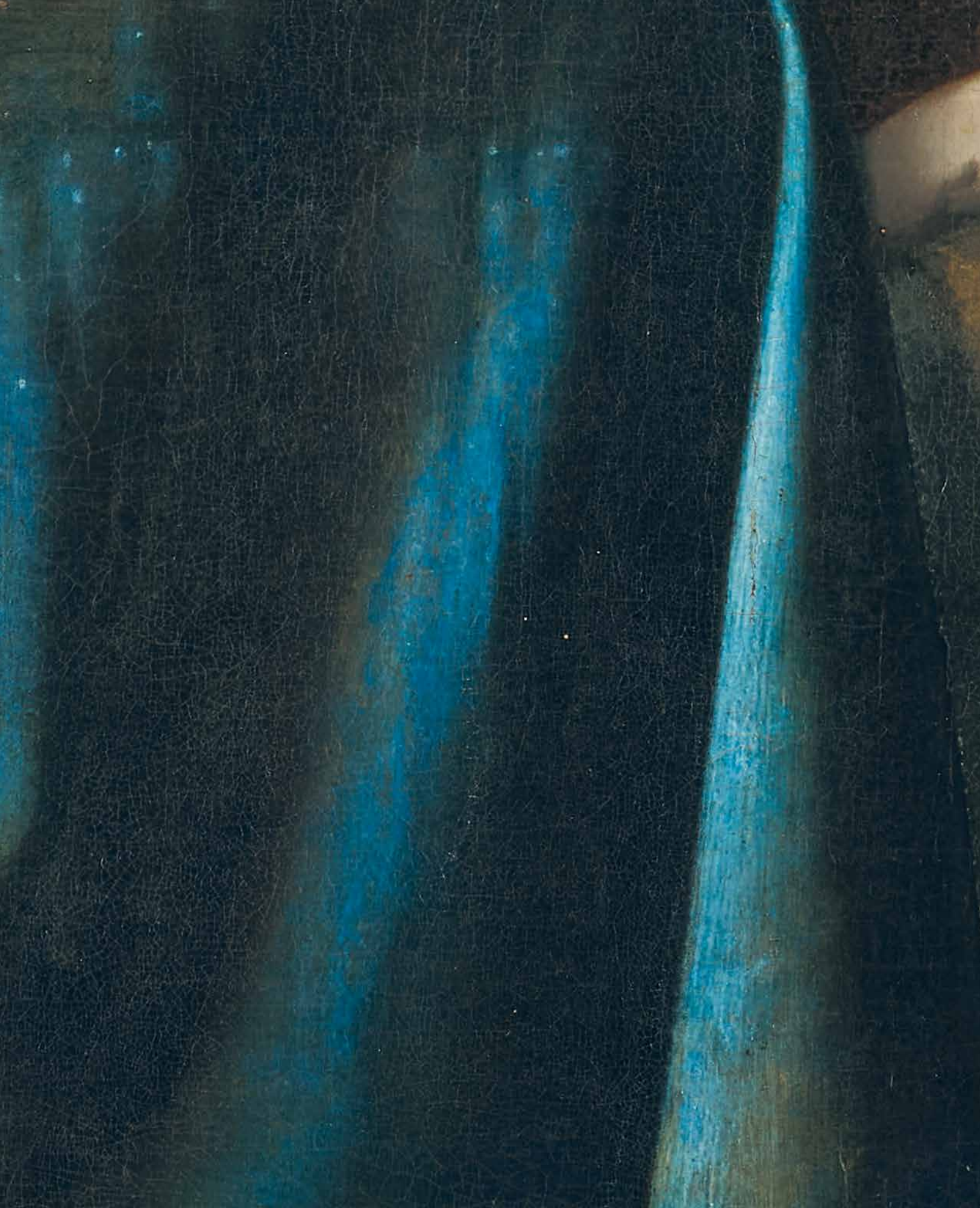
TAKING OFF

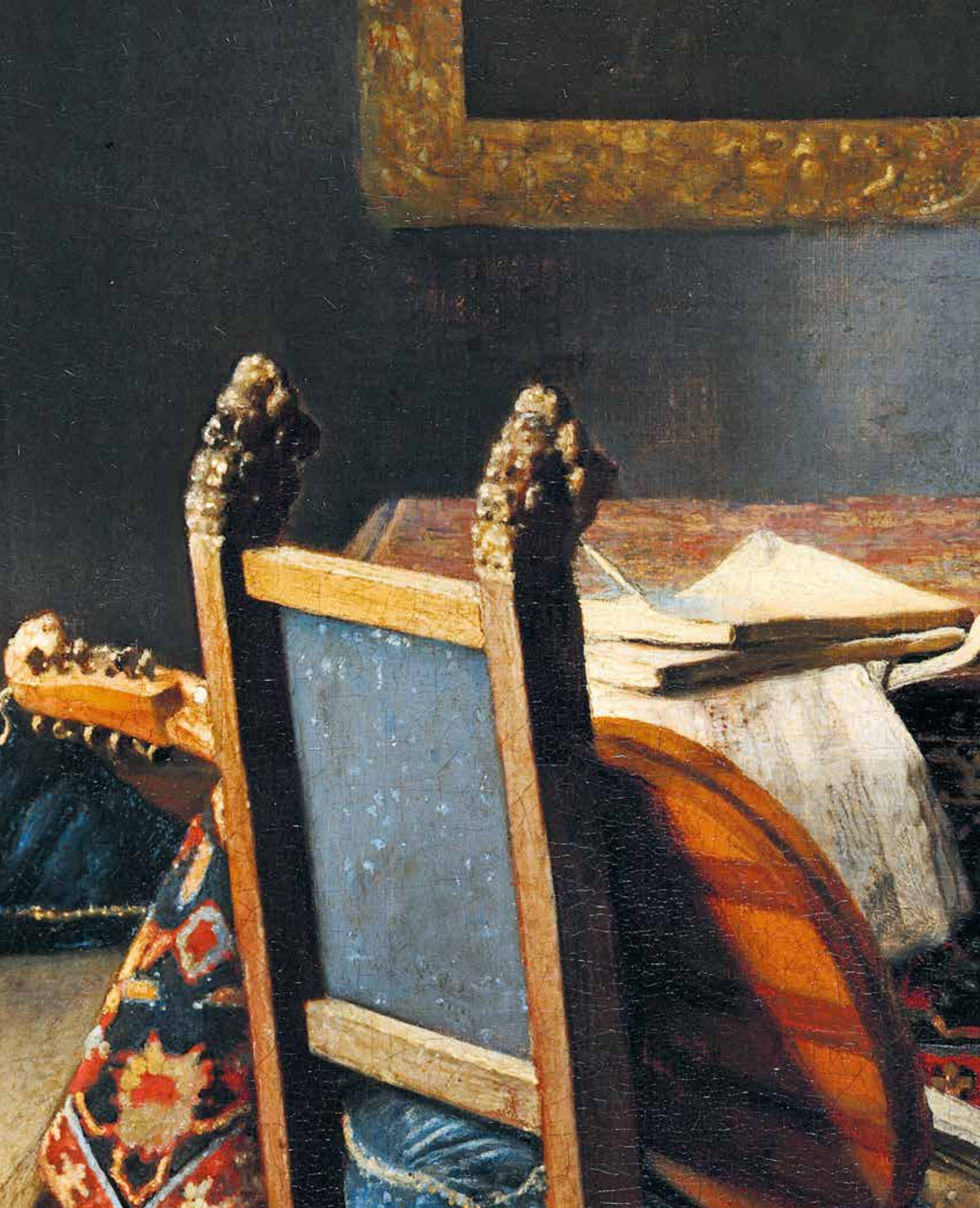
After two years of a titanic adventure, I began to realize that the web offered unparalleled opportunities. While Vermeer studies had been incalculably productive, their reach in the digital age was limited. New ideas typically circulated at a snail's pace within a small group of academics and specialists, who were generally wary of electronic art history.

By 2003, I felt confident enough to address Vermeer scholars, specialists and curators about the many thoughts that I had ruminated on in silence during my years of personal study. Academics responded cautiously at first; nevertheless, I proposed an interview to John Michael Montias, who, although initially curious about who I might be, graciously consented. Other interviews followed, such as with Albert Blankert. Jørgen Wadum and Philip Steadman went above and beyond the call of duty by responding to my questions in unexpected detail. The interview with Jonathan Lopez, author of *The Man Who Made Vermeers*, remains among the most visited pages on *Essential Vermeer*.

I was also surprised by how compartmentalized Vermeer scholarship was, with some academics seemingly unaware of others' research. This led me to create the first of what has now become over 50 'Vermeer Newsletters', compiling all the newsworthy publications, exhibitions, conferences, multimedia events and occasional curiosities related to Vermeer that I could find.

Limited by my fine-art background, the early years of web-mastering presented more than a few hurdles. Most images of Vermeer's paintings available online were scanned from reproductions, and only a few institutions





This book is the result of research in preparation for and following the Vermeer exhibition at the Rijksmuseum, 10 February–4 June 2023, and the two-day symposium focusing on recent technical and art historical research on Vermeer presented at the Rijksmuseum on 28–29 March 2023.

The 2023 *Vermeer* exhibition at the Rijksmuseum was made possible in part by Ammodo, Blockbusterfonds, Rijksmuseum Fonds, Rijksmuseum International Circle, Rijksmuseum Patrons and the Ministry of Education, Culture and Science.

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COVER
The Milkmaid (cat. 8), detail

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