The restoration of *Woman in Blue Reading a Letter* by Johannes Vermeer*

• IGE VERSLYPE •

It has been a long-standing wish to have Vermeer's *Woman in Blue Reading a Letter* restored. The highly oxidized, irregular and yellowed varnish, old discoloured retouching, overpaint and overfill along the bottom edge, as well as the numerous tiny paint losses, especially visible in the light coloured wall on the left and in the figure's blue jacket, interfered with the original cool blue hues, delicate details and overall legibility of the picture (fig. 1). In order to facilitate the restoration, an advisory committee was set up to provide insights into Vermeer's technique, conservation problems and art historical information. Norbert Middelkoop (Curator of Paintings, Prints and Drawings at the Amsterdam Museum), Elke Oberthaler (Head of Painting Conservation at the Kunsthistorisches Museum, Vienna) and Arthur Wheelock (Curator of Northern Baroque Painting at the National Gallery of Art, Washington) shared their expertise with members of the Rijksmuseum's staff – Taco Dibbits (Director of Collections), Pieter Roelofs (Curator of Seventeenth-Century Dutch Painting), Gregor Weber (Head of the Department of Fine Arts) and Manja Zeldenrust (Head of Painting Conservation).[1]

Detail of fig. 13

Conservation History

Until 1962, conservation treatments of *Woman in Blue Reading a Letter* went virtually undocumented. The earliest record of an intervention dates from 1888 and merely states that the varnish was repaired. In 1892, conservator W.A. Hopman regenerated the picture's varnish and applied copaiba balsam. This method of regaining the coherence and transparency of a varnish with solvent vapours was introduced by Max von Pettenkofer in 1863, published in 1870 and translated into Dutch by Hopman in 1871.[2] Copaiba balsam was added to regenerate dull varnish layers that withstood solvent vapours alone. Research has shown that numerous pictures in Kassel and Munich treated with the Pettenkofer method of alcohol vapours in combination with copaiba balsam show severe dislocation of paint particles.[3] However, these paint defects were not noted in *Woman in Blue*. In 1928, the painting was wax resin lined by P.N. Bakker and W.F.C. Greebe. A year later Greebe would proudly state in an article in the *Algemeen Handelsblad* (celebrating his forty years of service with the Rijksmuseum) that it was he who had lined Vermeer's work. According to Greebe, this intervention was something his predecessor had never been willing to embark on. When asked, he would always stammer,

'I w-w-wouldn't d-d-dare!'[4] Lining a work involves gluing an extra canvas to the back of the original to reinforce the original, weakened support. The heat and pressure necessary to effect a bond between the original and the extra canvas mean that traditional wax resin lining procedures leave the surface of the painting vulnerable to deformation. Too much heat and/or pressure can result in flattening and even burning of the paint layers. The picture was

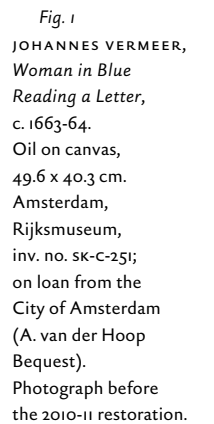

Fig. 1
JOHANNES VERMEER, *Woman in Blue Reading a Letter*, c. 1663-64. Oil on canvas, 49.6 x 40.3 cm. Amsterdam, Rijksmuseum, inv. no. SK-C-251; on loan from the City of Amsterdam (A. van der Hoop Bequest). Photograph before the 2010-11 restoration.

cleaned in 1949 by conservator H.H. Mertens, who was to treat it more extensively thirteen years later. Documenting his work with photographs and written records, during the 1962 treatment Mertens removed overpaint which covered the left wall. The old yellowed varnish was also removed, though only partially along the bottom edge, leaving a large old repair untouched. Discoloured areas on top of this old restoration were retouched. Losses in the paint were filled and retouched and all the edges of the painting were retouched, extending the picture on all sides, especially at the top. Finally, the picture was revarnished with a natural resin varnish.[5]

Preliminary Research and Condition before the 2010-11 Restoration

Several techniques were used to establish the condition of the painting and determine the appropriate treatment plan for the 2010-11 restoration. The painting was examined in visible light, raking light and UV light, and studied under magnification.[6] Infrared reflectography was carried out and existing infrared reflectograms were studied.[7]

X-radiographs of the painting made at the Rijksmuseum in 1948 and in 2007 were researched.[8] To understand the build up and composition of the paint layers, existing paint cross-sections were re-examined and new paint cross-sections were taken along the edges of the painting and near existing paint losses. All cross-sections were examined with light microscopy and SEM-EDX with the assistance of Dr Jaap J. Boon.[9] A complete XRF scan showing the distribution of elements was made by M. Alfeld (University of Antwerp) and J. Dik (Delft University of Technology). An automatic thread count report was generated by Richard Johnson Jr (Cornell University) and Don H. Johnson (Rice University).[10]

Support

The tacking edges of the original canvas support have not been preserved and the original canvas now measures approximately 46.6 x 38.7 cm. Cusping is present on all sides and strainer marks are visible all round at about 2.1 cm from the edges of the original canvas. The distance of these strainer marks coincides with the smallest distance of the strainer marks found on *Woman Playing the Guitar*, the only canvas by Vermeer that has not been lined and is still on its original strainer.[11] This comparison indicates that although the tacking edges have been removed, the original sight size of the painting must have remained unchanged. In the 1928 lining, the canvas was attached to an auxiliary canvas support with wax resin and mounted on the current stretcher (49.6 x 40.3 cm). Both the lining and the original canvas are in stable condition.[12]

Paint Layers

In several areas the paint surface was slightly raised, most notably in the figure's hair and the section of the map to the left of the figure, as well as in the dark blue shadow area of the jacket, but stable paint was visible. In several areas, the paint surface has been flattened by the lining. Dots of impasted paint, such as the highlights on the brass nails on the blue chairs, have been pressed into the paint layer, and in several areas pieces of raised paint were pressed down on top of each other.

Various areas of the paint surface, not confined to any particular colour or part of the painting, show tiny circular losses in the paint layer. These small circular losses, filled with dirt and residues of discoloured varnish, were most noticeable in the light wall on the left side, above and on top of the table and in the lighter blue areas of the jacket (fig. 2). Under magnification it was noted that small blisters of paint were present in certain areas next to these losses (fig. 3).

Fig. 2
Photomicrograph from a light blue area of the jacket, showing small circular losses in the paint layer, filled with varnish and dirt (Hirox 3D, 50x magnification).

Fig. 3
Photomicrograph from the blue tablecloth showing small blisters of paint in addition to the small circular losses in the paint layer (Hirox 3D, 40x magnification).

These small blisters of paint, resulting in a raised and bubbled surface of the paint layer, resemble paint surfaces in other paintings that have suffered from overheating.[13] A paint sample taken from a damaged area in the light wall above the table showing numerous small losses was prepared as a paint cross-section. Dr Jaap J. Boon conducted light microscopy, SEM-EDX research and X-ray tomographic microscopy on this sample.

Fig. 4
1894 reproduction of *Woman in Blue Reading a Letter*. Maison Ad. Braun & Cte, Paris and Dornach, Alsace.

This revealed that the paint layers were quite extensively deformed, indicating exposure to a high temperature. It also became obvious that the damage to the paint was not confined to the blisters and holes on the surface but that the paint has an open structure (bubbles) throughout the paint layers, from the ground up to the paint surface.[14] It appears that Vermeer's *Woman in Blue Reading a Letter* was once overheated, most likely during a lining procedure, causing the paint to blister. Some of these small blisters would then have erupted at the surface, leaving small circular losses in the paint surface. It is unclear when this damage occurred, but it must have been at least a century ago and before the 1928 lining, as the small losses in the paint layer are visible on a reproduction of *Woman in Blue* published in 1894 (fig. 4).[15]

The paint surface is irregular along the bottom edge of the picture, showing large cracks and discoloured retouching and overpainting covering an old horizontal loss in the paint layer. This loss, just above the edge of where the original bottom member of the strainer would have been, is clearly visible in the x-radiograph (fig. 5). This damage may have occurred because the canvas was slightly slack on its strainer, allowing the canvas to move against the strainer bar, as well as enabling dirt, which would attract moisture, to collect between the bottom strainer member and the canvas. The damage is visible in the 1948 x-radiograph, but it had probably already occurred long before then, as reproductions from before 1948 show old restorations along the bottom edge. When the reproductions of *Woman in Blue Reading a Letter* made at different times are compared it is remarkable that in the earliest reproduction, the 1894 photograph (fig. 4), the chair leg next to the woman's skirt is wide, whereas the photographs published after 1928 reveal that the leg of the chair had been reduced in size. The retouches covering this old damage were severely discoloured, disturbing the legibility of the painting. In the IRR image (fig. 6) the retouch paint, which contained carbon, registered darker and was clearly visible, not only where it covered the old loss but also along the edges of the canvas, especially at the top of the painting.[16] A comparison of the x-radiograph (fig. 5), which shows clearly where the original canvas ends, and the image of the painting before restoration (fig. 1) reveals that the original size of the composition was enlarged on all sides at a later date, especially at the top and bottom. This resulted in a rather elongated composition. The composition as Vermeer intended it is squarer, and this makes it a stronger and more intimate image.

Fig. 5
X-radiograph of
Woman in Blue
Reading a Letter.

Fig. 6
IRR image of
Woman in Blue
Reading a Letter.

Fig. 7
UV photograph
of *Woman in Blue*
Reading a Letter.

Varnish

The yellowed oxidized natural resin varnish fluoresced bright green in UV light (fig. 7). The patchy fluorescence indicated that the varnish was uneven in thickness, fluorescing more strongly where there was more oxidized varnish, resulting in uneven yellowing of the varnish layer (fig. 1). The stronger fluorescence in the lower part of the painting, indicating the presence of more varnish in this area, was the result of the 1962 cleaning, which only partially removed the old varnish at the bottom of the painting.

It was decided to remove the old varnish layers so as to restore the intended cool tones of the painting and enhance the visibility of the finely executed paint surface. Old restorations along the bottom edge were to be removed, especially where original paint was covered, to regain as much of the original paint surface as possible. Uncovering all the remnants of original paint would make it possible to create an accurate reconstruction of the chair leg, the shape of which had been changed over time. It was also decided to remove all of the retouches and overpaints along the edges, which would result in a squarer composition as Vermeer intended. After cleaning, a new varnish would be applied to saturate the paint layers. The large area of damage at the bottom, old losses in the paint surface and the numerous tiny holes in the paint surface would be filled and retouched in order to restore the painting's legibility.

The 2010-11 Restoration

After several tests, the varnish was removed with an organic solvent to ensure minimal mechanical contact with the fragile paint surface. The removal of the yellowed varnish revealed the intense blue hues and detailed paint surface (figs. 8, 9). The shift in colour was quite dramatic, particularly in the shadowed area of the figure's blue jacket. While the blue of the chairs

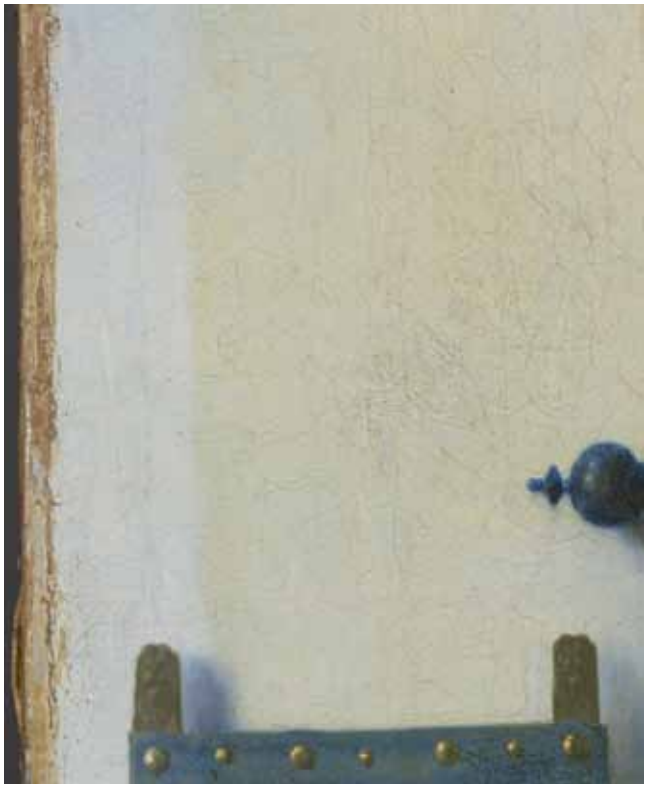

Fig. 8
Detail of the wall to the left of the woman during cleaning. On the left side the old yellowed varnish has been removed, revealing a cool blue tone.

Fig. 9
Detail of the blue jacket during cleaning. The upper right corner has been cleaned, showing the dramatic shift in colour.

Fig. 10
Lower right corner during cleaning. Discoloured varnish, overpaint and fill material are still present on the left. On the right they have been partially removed, revealing the small painted brass nails and the original purplish blue colour underneath the chair.

appeared to be the same as the blue of the jacket before the old varnish was removed, after its removal it became quite apparent that Vermeer had used two different shades (fig. 12).

Once the varnish had been removed, it was also possible to remove the retouches and overpaints along the edges of the picture – exposing the bright orange filler material from a previous restoration – and some of the overpaints covering the damage at the bottom. Overpaint and overfill covering original paint along the large loss at the bottom, which could not be removed with solvents, were removed mechanically with a scalpel under the microscope. At least six different filler materials could be discerned in and around the large damage, evidence of several previous restorations. Where it was not covering original paint, old inert filler was left and used as a base for retouching. With the removal of the old restorations in the lower right corner came a surprising discovery: small painted brass nails in the chair – delicate details painted by Vermeer that had been covered for decades – were revealed (fig. 10).[17] It also became apparent that the area of the wall below the chair was originally a vibrant purplish blue, and that it had been painted over in the greenish-grey colour of the wall above the chair at a later date.[18] The removal of a thin brown overpaint covering the brown cloth laid over the table revealed the original rounded folds with slightly different hues. The four yellow dots of paint on top of the table and the small stroke of yellow paint above the letter extended over cracks in the paint layer, indicating that they were not original. They were easily removed with solvent and it became apparent that, with the exception of the third dot of yellow, which had been applied directly on top of the light blue tabletop, they had been covering dots of original white paint. The dots of yellow paint must have been added at some time to transform the small dots of original white paint into a string of pearls (fig. 11).

Fig. 11a, b
Tabletop before (a) and after (b) cleaning.

Once the painting was cleaned (fig. 12), the old loss at the bottom was clearly visible, and it also became obvious to what extent the numerous tiny holes interfered with the legibility of the painting. These small holes needed to be concealed, and it was decided to do so with a gouache paint, as this material has a certain 'body' that also acts as a filler. Because the holes were so small, this part of the inpainting was done under the microscope. The large loss at the bottom was filled and subsequently covered with gouache paint. To imitate the structure of the original paint surface on top of the filler material, a silicone mould was made of the original paint surface elsewhere in the painting and pressed into an acrylic binder applied on top of the gouache base. Several seventeenth-century Spanish chairs were studied, as was Vermeer's depiction of them in other paintings, in order to understand their construction. With this knowledge, and the fragments of original paint that were previously covered with overpaint, the chair leg in *Woman in Blue Reading a Letter* was reconstructed as Vermeer intended it – wide at the bottom and narrower at the top.[19]

Before the final inpainting was carried out, a stable synthetic varnish was brush applied to saturate the colours. The application of this varnish served to level out the uneven surface of the painting caused by the tiny holes and blisters to some extent. The final inpainting was done with a stable synthetic resin and loose pigments in order to achieve optimal concealment of the damage and restore the legibility of the image (fig. 13). A final natural varnish layer was then brushed on to the surface to fully saturate the colours, to seal off all retouches and to even out any differences in gloss.[20]

Frame

The removal of the discoloured retouches and overpaints along the edges revealed the squarer composition that Vermeer intended. This

Fig. 12
Woman in Blue Reading a Letter
after cleaning, before filling and inpainting.

Fig. 13
Woman in Blue Reading a Letter after the 2010-11 restoration.

Fig. 14a, b
Upper right corner of the French Régence frame before (a) and after (b) restoration.

change in format dictated an adjustment of the framing of the painting. *Woman in Blue Reading a Letter* has been mounted in several different frames in the past, as Merel van Erp and Maarten van 't Klooster discovered during their internship project recording the frames in Rijksmuseum storage. Apart from the current French Régence frame,[21] they found no fewer than three other frames that had once adorned Vermeer's *Woman in Blue* in the Rijksmuseum's collection.[22] None of these frames, though, fitted the original sight size of the picture. When the work was framed after cleaning, each frame showed a gap between the edges of the picture plane and the edges of the sight opening of the frame, especially at the top and bottom. Even the oldest known frame – a Neo-Rococo example – did not fit the original sight size of the picture. According to a label on the back, this frame was supplied by John Mountjoy Smith and Samuel Mountjoy Smith, sons of John Smith, the London art dealer who sold the picture to the Amsterdam banker Adriaan van der Hoop in 1839.[23] As there are no indications that the sight size of the Neo-Rococo frame was ever altered, the non-original extensions to the composition must already have existed by then. An extensive search for a suitable contemporary frame was subsequently coordinated by Hubert Baija, senior conservator of frames and gilding. In the end it was decided to try to adjust the sight size of the Régence frame. Since the sight size needed to be adjusted more at the top and bottom than at the left and right, there were initial doubts as to whether an asymmetrical inlay might be disturbing to the eye. Baija created a fine inlay, gilded and finished with a patina, which blends beautifully with the surrounding frame without attracting attention to it (fig. 14).[24]

The investigation and restoration of *Woman in Blue Reading a Letter* revealed that the painting had suffered severely since its conception by Vermeer and had undergone numerous restorations. It is hoped that the latest treatment has succeeded as far as possible in restoring the delicate details and nuanced palette Vermeer intended, and that the work can once again be enjoyed in all its refinement and subtlety.

NOTES

* An abridged version of this article was translated into Japanese and published in *Communication. Visualizing the Human Connection in the Age of Vermeer*, exh. cat. Kyoto (Kyoto Municipal Museum of Art)/Sendai (Miyagi Museum of Art)/Tokyo (Bunkamura Museum of Art) 2011-12, pp. 185-89. I am grateful to Jonathan Bikker, who edited this version of the article.

1 Besides the members of the advisory committee, I would also like to thank my colleagues in the conservation studio whose helpful discussions and valuable insights played an important role in the restoration: Hubert Baija, Anna Krekeler, Michel van de Laar, Camille Marchand, Willem de Ridder, Erika Smeenk, Laurent Sozzani, Gwen Tauber, Lisette Vos and Jessica Korschanowski (intern at the department of paintings).

2 M. von Pettenkofer, *Over olieverwen en het conserveeren van schilderijen door de regeneratiebehandeling*, translated by W.A. Hopman, 1871.

3 S. Schmitt, 'Examination of paintings treated by Pettenkofer's process', *Cleaning, Retouching and Coatings* 1990 (IIC preprints), pp. 81-84.
H. Brammer, 'Firnisschichtungen. Beobachtungen an Farbfirnisquerschnitten von vier Gemälden der Kasseler Gemäldegalerie Alte Meister', *Firnis. Material, Ästhetik, Geschichte*, Internationales Kolloquium, Braunschweig, 15-17 June 1998, pp. 174-81.

4 'ddat…ddurf…ik nie-niet te-te-te… d-doen!' See 'Veertig jaar "Kunstbeschermer". Achter de schermen van het Rijksmuseum', *Algemeen Handelsblad*, 31 August 1929, p. 3.

5 Apart from these interventions, a small conservation treatment was carried out in 1992, when Rijksmuseum conservator H. Kat consolidated a small section of slightly raised paint in the hair band and retouched an old small loss in the hair.

6 A HIROX 3D digital microscope was used for high magnification digital microscopy. Photomicrographs were made by Emilien Leonhardt, European Manager at Hirox Europe, and by Arie Wallert and Jolanda van Iperen of the Rijksmuseum.

7 Infrared reflectography was carried out with an Osiris scanning InGaAs camera equipped with a 16 x 16 tile system of 512 x 512 focal plane array to just beyond 1700 nm. Visible light was filtered through an 875 nm infrared filter. Infrared reflectograms of the back of the blue jacket were published in A. Wheelock, *Vermeer and the Art of Painting*, New Haven/London 1995, p. 10.

8 X-radiography, nos. 90-93, 22 June 1948; x-radiography: Rene Gerritsen, nos. 1819 (1-4), 11 October 2007.

9 Kühn took five paint samples of *Woman in Blue Reading a Letter* in 1966. The results were published in H. Kühn, 'A study of the Pigments and the Grounds Used by Jan Vermeer', *Report and Studies in the History of Art, Washington (National Gallery of Art)* 1968, pp. 155-202.
The 1966 cross-sections were re-examined and photographed by Dr Jaap J. Boon.
The new cross-sections were embedded in Technovit 2000 LC, cut and dry polished with micromesh.

10 This report (May 2010) shows that the average thread density of the original canvas is 14.6 horizontal threads/cm and 14.7 vertical threads/cm. Angle maps produced a clear visual map of the original cusping of the canvas, apparent on all sides.

11 *Woman Playing the Guitar*, oil on canvas, 51.4 x 45 cm; London, Kenwood House, The Iveagh Bequest, inv. no. 88028841.
See for a technical description and illustration of the original strainer N. Costaras, 'A study of the Materials and Techniques of Johannes Vermeer', in I. Gaskell and M. Jonker (eds.), *Vermeer Studies* (*Studies in the History of Art* 55), New Haven/London 1998, pp. 145-67.

12 The 1928 lining was most likely not the first lining of the picture. The reverse of the stretcher shows traces of a glue paste with a weave imprint differing from the weave pattern of the current lining canvas. The x-radiograph furthermore revealed nails of an earlier tensioning at the sides of the stretcher which are covered with the current lining canvas. This indicates (assuming the same stretcher was used) that before the 1928 wax resin lining the original canvas was initially lined with a glue paste.

13 Initially it was suspected that the small round holes in the paint layer and the blister-like surface could derive from lead soap formation. This degradation phenomenon was also found in the red rooftops of Vermeer's *View of Delft*, oil on canvas, 96.5 x 115.7 cm; The Hague, Royal Cabinet of Paintings Mauritshuis, inv. no. 92. Speculation in the past suggested that the lead soap aggregates

in the red rooftops of this painting were lead white particles, or even sand particles, that were added on purpose by Vermeer to create texture in the paint. See P. Noble et al., *Bewaard voor de eeuwigheid. Conservering, restauratie en materiaaltechnisch onderzoek in het Mauritshuis*, Zwolle 2008, pp. 176-77. In *Woman in Blue Reading a Letter* the circular holes and blister-like paint were not confined – as is usually the case with lead soap aggregates – to a certain colour, area of paint, or evenly distributed throughout the painting, but could for instance be found at the top of one brushstroke and absent at the bottom. This strongly suggested that a local external factor created the deterioration. Furthermore no glassy semi-opaque particles, indicators of lead soaps, could be found at the paint surface and no lead soap aggregates were detected in paint cross-sections of *Woman in Blue Reading a Letter*.

14 The results of the ongoing research will be published elsewhere in the near future.

15 It is possible that Bürger's 1860 description of *Woman in Blue Reading a Letter*, in which he stated that the picture was severely abraded (très-frotté), refers to the small holes visible in the paint surface, indicating the damage was already present at that time. W. Bürger, *Musées de la Holland, tome II: Musée van der Hoop, a Amsterdam et Musée de Rotterdam*, Paris 1860, p. 68. The fact that the small holes are visible in reproductions before 1928 indicates that the overheating of the paint surface did not occur during the 1928 lining by Bakker and Greebe.

16 The IRR image also clearly shows the changes Vermeer made to the composition during painting. The woman's jacket was initially planned to be larger and may have had a fur lining. The map was shifted to the left in the final composition, as first noted by Wheelock op. cit. (note 7), pp. 9-11. The IRR image furthermore showed that one of the ribbons at the top of the blue jacket was painted out by the artist with the final paint layers.

17 This was probably done to hide the irregular paint surface, with overlapping raised areas of paint, just beneath these nails. For the present restoration it was decided to accept and show the original though irregular paint surface.

18 The purplish paint was applied directly on top of the beige greyish ground. There is no indication that a layer on top of the purple is missing. The purplish paint contrasts quite strongly with the greyish green paint of the wall above the chair because of a colour shift in the greyish green wall. A paint sample taken from this area shows that the top part of the ultramarine particles mixed in the upper paint layer have a brownish discolouration where they are near the surface of the paint layer. SEM-EDX research carried out by Dr Jaap J. Boon revealed that small 'crusts' containing lead sulphate had formed at the tops of the ultramarine particles. This strongly indicates that a degradation of ultramarine pigment occurred in this area, and that the wall was initially bluer and as such contrasted less with the purplish colour underneath the chair. The ultramarine found in other samples of this painting did not show this discolouration, which could indicate that Vermeer used different qualities or hues of ultramarine. The research into this phenomenon is ongoing.

19 With thanks to Femke Diercks and Suzan Meijer for their valuable insights on the construction of Spanish chairs.

20 A hindered amine light stabilizer was added to stabilize the natural resin varnish.

21 French Régence frame, c. 1710, 70.2 x 63 cm (initial sight size: 46.6 x 39.1 cm, current sight size: 46.0 x 38.7 cm), inv. no. SK-L-1037.

22 A Neo-Rococo frame, c. 1835-40, 71 x 62 cm (sight size: 47 x 38 cm), inv. no. SK-L-374; a carved wooden frame, c. 1700 (?), 73 x 62.5 cm (sight size: 47 x 37 cm), inv. no. SK-L-1814; and an ebony reproduction frame, 1990, 61 x 53.5 cm (sight size: 47.3 x 38.7 cm), inv. no. SK-L-1471. Merel van Erp researched the frame history of *Woman in Blue Reading a Letter* and constructed a timeline for the different frames; *Stageverslag Rijksmuseum Amsterdam. Lijstenregistratie-project 1/02/2010 – 31-05-2010*.

23 The label reads: *[…] M. & S.M. SMITH,/ CARVERS AND GILDERS,/ AND/ [G] eneral Dealers in Works of Art,/ 137, NEW BOND STREET,/(LATE[…] GREAT MARLBOROUGH STREET,)/ [PIC]TURES, LINED, CLEANED AND RESTORED*. In c. 1830, John Mountjoy Smith (c. 1803-1869) and Samuel Mountjoy Smith (c. 1809-1874) took over the business of their father John Smith (1781-1855) as carvers, gilders, picture frame makers and art dealers. They were partners in business until 1852, when John Mountjoy Smith continued the business on his own. Source (15 November 2011): National Portrait Gallery –British picture frame makers, 1630-1950 –S (http://www.npg.org.uk/research/conservation/directory-of-british-framemakers/s.php).

24 See also the article by Gregor Weber in this issue on pp. 20-27.

Detail of fig. 13