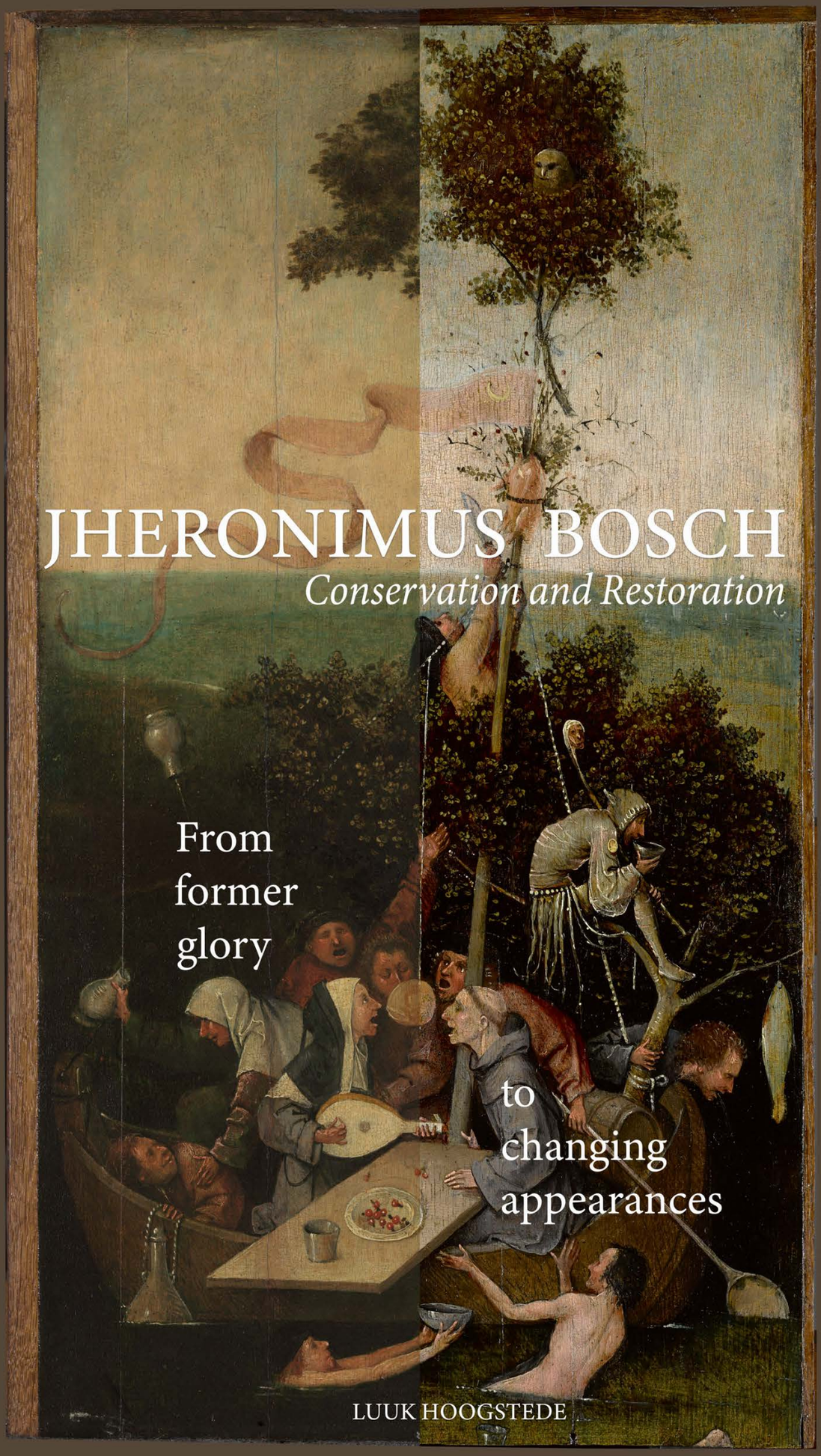
APPENDIX I


JHERONIMUS BOSCH
Conservation and Restoration
From former glory
to changing appearances
LUUK HOOGSTEDE

Errata

Luuk Hoogstede, Ron Spronk, Robert G. Erdmann, Rik Klein Gotink, Matthijs Ilsink, Jos Koldeweij, Hanneke Nap & Daan Veldhuizen, *Hieronymus Bosch, Painter and Draughtsman: Technical Studies*, Brussels, London and New Haven 2016.

PAGE	ORIGINAL TEXT	CORRECTED TEXT
7, 412	*The Temptation of Saint Anthony (fragment)*	*The Temptation of Saint Anthony*
149	layer RR 3	layer no. 3
155	The planks of the wings appear butt-joined and glued.	The planks of the wings are doweled, butt-joined and glued.
246	seven horizontally grained oak reinforcing blocks. (Three others are missing.)	seven horizontally grained reinforcing blocks. (Six in oak, one replacement in softwood, three others are missing.)
250		[note 1 reference: Poch-Kalous 1973 (1967), 25]
250		[note 2 and reference: Marijnissen 1987, 214]
254	The paintings were most likely restored during their stay in Vienna (1838–1919).	The paintings did not go to Vienna, unlike the other two Venetian Bosch paintings.
275	[reference 15:] Koreny 2002–03	Koreny 2004 (2002–03)
276	Thickness c. 0.3–0.4 cm (including the backing, but excluding the cradle).	Thickness c. 0.3 cm (excluding the c. 0.4 cm backing, and excluding the cradle)
394	[3x] Carrying of the Cross	Christ Carrying the Cross
456	*Haywain*, Escorial (PN, 154)	*Haywain*, Escorial (PN, 10014740)
456	*Crowning with Thorns*, Escorial (PN, 100 14473)	Crowning with Thorns, Escorial (PN, 10014743)

Luuk Hoogstede

Summer 2024

HIERONYMUS BOSCH, PAINTER AND DRAUGHTSMAN *Technical Studies*

TECHNICAL STUDIES

HIERONYMUS BOSCH

Painter and Draughtsman

BOSCH RESEARCH AND CONSERVATION PROJECT

Luuk Hoogstede
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MERCATORFONDS

Hieronymus Bosch, Painter and Draughtsman: Technical Studies is the complete edition of the findings of the Bosch Research and Conservation Project (BRCP). It was published in February 2016 together with its companion volume, *Hieronymus Bosch, Painter and Draughtsman: Catalogue Raisonné*, and can also be consulted online at www.boschproject.org.

Bosch online (web application with documentation on all the paintings) and *BoschDoc* (documents on Bosch and his oeuvre to 1800) can be accessed via the website www.boschproject.org.

The Bosch Research and Conservation Project was established and completed as part of the preparations for the exhibition 'Hieronymus Bosch – Visions of Genius' at the Noordbrabants Museum in 's-Hertogenbosch, 13 February to 8 May 2016.
The exhibition and the research project are both part of the 'Jheronimus Bosch 500' event, organized to mark the five-hundredth anniversary of the artist's death.
The Bosch Research and Conservation Project is an initiative of the Noordbrabants Museum, Radboud University Nijmegen and Jheronimus Bosch 500, and has been generously supported by the Gieskes-Strijbis Fund.

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Frontispiece
Visions of the Hereafter, detail from the *Ascent of the Blessed* [CAT. 18, RR 38].
Palazzo Grimani, Venice

Endpapers
Visions of the Hereafter, detail from the reverse of the *Garden of Eden* [CAT. 18, RR 39].
Palazzo Grimani, Venice

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Venice, Gallerie dell'Accademia
Venice, Palazzo Grimani
Vienna, Albertina
Vienna, Kunsthistorisches Museum
Washington, National Gallery of Art

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Foreword and Acknowledgements

Hieronymus Bosch died in 's-Hertogenbosch in 1516 – half a millennium ago. This five-hundredth anniversary in 2016 has prompted a large-scale and critical examination of the painter's complete oeuvre. Some of his works have a pedigree that dates back a very long way indeed, the most complete being that of the *Garden of Earthly Delights*; the triptych is recorded in the palace of the Counts of Nassau in Brussels as early as 1517, and we can track its whereabouts more or less continuously from that moment through to the present. We do not know, however, when or for whom Bosch painted it – a situation that holds true for virtually all the distinctive Brabant master's paintings. All the same, the outlines of an oeuvre have emerged since the late nineteenth century in the shape of a body of works ascribed to Bosch on stylistic grounds. This nucleus crystallized in the course of the twentieth century into a fairly generally accepted corpus of some twenty-five paintings.

The founding principle for our 'Bosch Research and Conservation Project' (BRCP) was to scrutinize Bosch's reconstructed oeuvre as thoroughly and consistently as possible, using modern optical and imaging techniques. Supplementary archive research was also performed, and the style, iconography and meaning of Hieronymus Bosch's paintings and drawings were re-examined. The scholarly goal was to gain a better understanding of questions like: What is a Bosch? Which paintings and drawings are by his hand? What relationships exist within his oeuvre? How reliable are the attributions? What did pupils and assistants contribute?

From our base in 's-Hertogenbosch, the BRCP team set out to study all Bosch's paintings and drawings worldwide. The results of these efforts have now assumed tangible form in the anniversary year of 2016: a new monograph with catalogue raisonné; a supplementary volume with comprehensively detailed research reports of all the examined paintings; and a website with thousands of high-resolution images, innovatively presented and freely accessible to all (www.boschproject.org). Meanwhile, the exhibition being held in parallel at the Noordbrabants Museum in 's-Hertogenbosch, features more works by Hieronymus Bosch than have ever been seen before in the Netherlands.

The collaboration of virtually all the museums that oversee works by Bosch was generous and welcoming: our team was unable to examine and/or document only two of the twenty-five paintings we consider autograph. A panel previously thought to be the work of a follower was recognized as an authentic Bosch, as was a magnificent drawing – one of the now twenty sheets in total that we attribute to the 's-Hertogenbosch master. No fewer than nine panels and triptychs by Bosch were restored by or in close consultation with the BRCP in the period 2013–15, while two more triptychs were restored to their former glory in Spain. As of 2016, therefore, almost half the autograph paintings by Hieronymus Bosch have been given back their original lustre thanks to the efforts and commitment of highly qualified restorers in Italy, Belgium, Spain, France, the Netherlands and the United States.

The Bosch Research and Conservation Project was proposed as a tentative, dream initiative in 2007; less than a decade later, we can present its substantive results. That we are able to do so is due in the first instance to the Mayor of 's-Hertogenbosch, Dr Ton Rombouts, who threw his weight behind the project. It all began with the support of the City of 's-Hertogenbosch and the Province of North Brabant, following which many other funds, foundations, public authorities and sponsors came on board. The Bosch Research and Conservation Project was set up as a collaborative venture between the Jheronimus Bosch 500 Foundation, the Noordbrabants Museum and Radboud University Nijmegen, following which the research itself could get under way. Backed by an academic committee and a foundation board – whose members are listed on page 5 – we established an interdisciplinary team, which began as a five-strong core that was subsequently extended to eight specialists, all of whom contributed their own specific expertise. We feel justifiably proud therefore in presenting ourselves as a team on the title page and of signing off on our work together. We can now look back with satisfaction at several years of intensive and fruitful collaboration.

All that remains is to express our hope that the results achieved so far will allow the remaining works to be examined and documented in exactly the same way: above all the two large triptychs,

the *Last Judgement* in Vienna and the *Garden of Earthly Delights* in Madrid, as well as *The Seven Deadly Sins and the Four Last Things* – the so-called 'tabletop' – also in Madrid. Research is never 'finished'.

The Bosch Research and Conservation Project is a long-term, complex initiative, which has come about with the help of many people. We are grateful to everyone for the assistance we have received in recent years. Our thanks are due in the first place, of course, to those who took the initiative: Mayor Ton Rombouts and Charles de Mooij, Director of the Noordbrabants Museum. They responded to Jos Koldeweij's proposal to thoroughly document, study and, where necessary, restore Hieronymus Bosch's oeuvre from a centre based in the artist's own city. The Jheronimus Bosch 500 Foundation – Ad 's-Gravesande, Paul van der Eerden and Lian Duif – then saw to it that the project could actually be implemented. Jos Koldeweij, Ron Spronk, Matthijs Ilsink and Luuk Hoogstede formulated the research goals and methodology; Robert G. Erdmann, assisted by Travis Sawyer, developed the digital infrastructure to enable all the visual material to be presented online using the latest techniques (www.boschproject.org); Rik Klein Gotink provided the photography; Hanneke Nap and Daan Veldhuizen contributed their specific expertise to the success of this project. None of this would have been possible, however, without the financial foundations laid by various public authorities, institutions, foundations and sponsors, via the aforementioned Jheronimus Bosch 500 Foundation. Special thanks are due to the Gieskes-Strijbis Fund, which supported the research project very generously. The Getty Foundation took part through the 'Panel Paintings Initiative' in the restoration of the Venice triptychs and contributed to the development of the digital infrastructure. Queen's University gave Ron Spronk the scope to participate in the project, and the Stichting Restauratie Atelier Limburg (SRAL) did the same for Luuk Hoogstede.

Equally crucial to the project's success were the collaboration and extraordinary hospitality of all the participating museums. It is impossible to name everyone who helped us devise and perform our research, and to whom we owe our sincere gratitude. We are much indebted to them, especially:

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Note to the Reader

BEFORE/DURING/AFTER TREATMENT

After-treatment photographs, if available, have been added (and identified as such) at the end of the entries for paintings that were restored after the BRCP technical examination (cat. 1, 2, 8 etc.). All other illustrations reflect the pre-treatment condition of the paintings examined, unless otherwise indicated.

DIMENSIONS

The listed dimensions are maximum dimensions, with height preceding width. Additional information, such as aspects of non-original framing and display, can be found on www.boschproject.org.

PAINTING MATERIALS

The paintings were studied and documented using standardized procedures and protocols. Since only non-destructive, visual methods of examination were employed, the identification of painting materials remains tentative, unless otherwise mentioned.

RR (RESEARCH REPORT)

When followed by a single number, this abbreviation is also used to identify the documented surfaces of the paintings. In the case of the *Temptation of Saint Anthony* triptych in Lisbon (cat. 4, RR 11–16), for instance, RR 11 refers to the exterior of the left wing, RR 13 to its inside, and RR 16 to the reverse of the central panel.

OTHER ABBREVIATIONS

IR	infrared
IRP	infrared photography, infrared photograph
IRR	infrared reflectography, infrared reflectogram
MICGBM	micrographs (accessible on www.boschproject.org)
UV	ultraviolet
VIS	(photograph taken in) visible light
XR	X-radiography, X-radiograph

Preface

Technical Studies is the second book of the two-volume monograph, *Hieronymus Bosch, Painter and Draughtsman,* produced by the Bosch Research and Conservation Project (BRCP). The first volume of this set, the *Catalogue Raisonné*, also holds ample technical information, in both text and illustration. Two of its four essays focus on the materials and techniques of the paintings and on the effects of material condition and conservation history on their appearance, while an abundance of technical data is also integrated into the art-historical discussions in the entries on the individual works. The book in your hands, then, differs from its companion volume in that it includes the BRCP's full, systematically compiled research reports as well as additional visual documentation of all examined paintings. The procedures used by the BRCP for photography and image processing are also described here, in two separate essays.

The *Catalogue Raisonné* and *Technical Studies* volumes thus complement each other and are fully intended to be used in tandem. The project's complete visual documentation can be studied online using innovative, custom-designed viewers, at www.boschproject.org. There, anyone can now study Bosch's works in astonishing detail and in different modalities – visible light (VIS), infrared photography (IRP), infrared reflectography (IRR) and X-radiography (XR). Hundreds of micrographs are accessible there as well. The texts of our research reports, which were sensitively and patiently edited by Dawn Carelli, are available at that website, too, where they are more easily searchable than is possible in print.

The Bosch Research and Conservation Project has generated an enormous amount of new data. In order to organize this information and facilitate its use, the same numbering system is applied in both volumes of the monograph and in the Web application. All the paintings discussed in this volume have a catalogue number (1–34) as well as a (range of) BRCP research report number(s): RR 1–158. Unlike the catalogue numbers, which were organized thematically, the research report numbers were assigned sequentially, thus providing a chronological record of our six-year project. All documented surfaces of all examined paintings were given a unique RR number. A single catalogue number will therefore have multiple RR numbers related to it; single panels of which the reverse was also documented will typically have two RR numbers, while larger ensembles can have six to eight such numbers. These RR numbers are critical in the organization of the immense archive of digital images. Three of the paintings discussed in the *Technical Studies* volume do not have entries in the *Catalogue Raisonné*; these were given the catalogue numbers S1 to S3.

We are excited and proud to share our findings and our standardized documentation, the latter in unprecedented volume and state-of-the-art quality, but our views and opinions on Hieronymus Bosch will by no means be the last word on this uniquely creative painter. We used non-invasive methods of examination only, which implies that any identification of painting materials remains tentative. Future analyses, using information from still-developing research methods such as macro X-ray fluorescence (MA-XRF) scanning, will certainly augment and correct some of the observations presented here, just as we have been able to correct many findings dating from before our research project. Moreover, several paintings were restored for this project, but only *after* we examined them, so the multiple layers of degraded varnish, now removed, will have doubtlessly obscured some of our observations. Nonetheless, our research has resulted in an unsurpassed level of access into a painter's oeuvre: in breadth, depth, image quality and – thanks to standardization – comparability. Like its fraternal twin, the *Catalogue Raisonné*, the BRCP's *Technical Studies* is brimming with new information on Hieronymus Bosch. We trust that the full accessibility of our data, methodologies and procedures will serve the scholarly community for many years to come, and it is our hope that our procedures and working methods will inspire other research groups to apply similar or improved approaches.

Describing and comparing works of art are central to the work of art historians.—Jaś Elsner[1]

CHAPTER I

Photography for the Bosch Research and Conservation Project

Aims

In order to achieve the most objective possible comparison of works of art, good reference material is of the greatest importance. Existing photography (and other visual documentation) can vary greatly in resolution, colour, contrast and so on. Among other things, the Bosch Research and Conservation Project (BRCP) has set itself the goal of documenting the paintings and drawings of Hieronymus Bosch with the greatest possible uniformity so as to achieve a standardized collection of data enabling us to compare the most accurate visual records of these works, which are themselves spread throughout the world. It was therefore decided to invest in new, high-quality standardized photography. This was based on the conviction that 'basic documentation' of excellent and uniform calibre, covering as much as possible of Bosch's oeuvre, would be of enormous value and would provide a good starting point for art-historical and technical research. The aim of this essay is to describe what the BRCP has achieved in photographic documentation and how it went about this task.

The mission of the BRCP, as far as photography is concerned, includes the compilation of photographic documentation of paintings and drawings by Bosch, using the following methods:

- Visible spectrum light (VIS) photography with extremely high resolution (1200 ppi, or pixels per inch).
- VIS images made according to Metamorfoze guidelines.[2]
- Infrared photography (IRP) also using extremely high resolution (1200 ppi).
- Infrared reflectography (IRR) images using an Osiris camera (260 ppi).
- Occasional photographic documentation in raking light and ultraviolet (UV) light.
- Digitization of existing X-ray films.
- Collection of all photographic documentation within a digital infrastructure so that ideally, all images in every possible combination could be placed next to each other and compared.

Equipment

A Hasselblad 60 megapixel camera, modified by the Hasselblad Company to enable infrared imaging, was used in this project. This modification meant that the filter usually found immediately in front of the sensor was replaced by clear glass. All cameras have a natural sensitivity to infrared emissions that interfere with the image in the visible area, and to remove this interference, a special filter is built into the camera. This blocks IR completely and also a small amount of red. Without this filter, the camera can be used for both VIS and IRP imaging. FIG 2

When VIS images were made with the modified camera, an IR-blocking filter was fitted in front of the lens. When IRP images were made, a black filter was used that allowed IR light ranging from about 930 to 1100 nanometres (nm) to pass through.

The Osiris camera of Queen's University in Kingston, Ontario, Canada, was available for IRR.[3] The sensitivity of an Osiris camera ranges from 900 to 1700 nm. The sensor is an indium gallium arsenide (InGaAs) semiconductor. This is a scanning camera with a line FIG 3

FIG 1 Extreme macro VIS of the *Haywain* (Madrid), central panel [100PCPVIX]

FIG 2 Hasselblad 60 megapixel camera

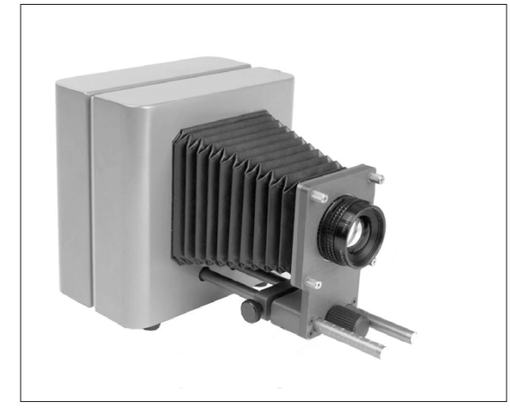


FIG 3 Osiris camera

FIGS 4–5 Camera support frames

sensor of 512 pixels that makes a scanning movement of 512 lines. It can be set to a maximum of eight by eight sequential positions so that a total field of 4096 × 4096 pixels can be imaged. Such a capture takes about 10 minutes.

For lighting, two Broncolor® studio flash light units with softboxes to soften the light were used. Flash was employed for the Hasselblad images, in both VIS and IRP. Continuous light with sufficient IR is necessary for the Osiris; this was provided by the 650 W halogen modelling lamps of the flash lights. In addition, a Bosch-brand laser measurer was an essential aid for the rapid and accurate positioning of cameras and lamps in relation to the works.[4]

Camera support frame

To achieve the necessary resolution, the works had to be photographed in numerous partial images, so a camera support frame was developed for that purpose.[5] This frame had to satisfy a number of conditions, including sufficient accuracy, speed and size of format, while it also had to be compact, easy to install and disassemble, and light enough to be transported by plane, train and taxi. All these conditions were met by the Maytec aluminium profile system, which allowed the camera to be mounted on a cradle sliding between two vertical rails. In principle, the image is made from above to below. The cradle can be fixed at any height and there is a system with a guide and an adjustable spacer cord to lower the camera quickly and efficiently to a previously set and repeatable distance. Once a column is completed, the set of vertical rails is moved sideways to make the images of the next column. FIGS 4–5

The vertical rails slide between a set of horizontal rails, and a synchronized adjustable spacer follows the camera's movement. The vertical angle of the support frame can be adjusted by making this spacer longer or shorter, so that the vertical rails can be accurately moved parallel to the painting. The frame is set to an equal distance horizontally as well. In this way the camera can move at a fixed distance over the whole painting if the support is sufficiently flat. Because imaging must take place with a previously determined resolution, there is an extra horizontal adjusting cradle under the camera, enabling the operator to alter the camera-to-surface distance from the artwork within a margin of ten centimetres. In the case of curved surfaces – for example, panels that have warped with age or those with high-relief painted frames – the settings must be adjusted at intervals, which is usually possible with the help of this cradle.

The support frame in figure 4 is the version that was used for most of the photography for the BRCP.[6] The standard size is 2 × 2 metres, which can easily be extended to 2 × 2.5 or 2.5 × 2 m. All these configurations were used for this project. For transport, the length of all aluminium profiles was reduced to 1 metre. The weight, including the case, was just over 23 kg per item.

Settings and standardization

An undertaking such as this one can only be of value insofar as all the works to be documented are dealt with under the same reproducible conditions and with standardized procedures. Although growing knowledge is an inevitable factor in such a long-term project,[7] its effects were consciously kept to a minimum in order to preserve the comparability of the results. This is dealt with in a separate section below. What follows is a bulleted description of the photographic set-ups used for the BRCP.

VISIBLE LIGHT (VIS)

- A modified Hasselblad H60 camera with a BG39 filter, and later a Makario (MAK) filter that had the same function but was thinner.
- A direct, tethered connection of the camera by a FireWire cable to an Apple MacBook Pro laptop computer running the Hasselblad Phocus software.
- Camera profile, made with the BasICColor program, employed to create a calibrated

system delivering standard reproduction across the whole set-up. This profile was created by making a correctly lit exposure of a standard colour chart, the ColorChecker® Digital SG. A white square and a mid-grey square were determined to have correct RGB values for the specific lighting. These values were measured using Phocus, after which the image format was developed into a TIFF image, and opened in BasICColor, which calculated a camera profile. This profile was then entered in the Phocus program so that all images became device-independent, and thus were calibrated to a single standard. Later in the project, it also became possible to evaluate the image of the colour chart on the website http://delt.ae/.

FIG 6

- Hasselblad lens HC MACRO f/4 120 mm.
- Aperture f/13 (a compromise between optimum sharpness, around f/11, and a slightly greater depth of field that captures very small discrepancies in focus, and more importantly, irregularities in the works themselves).
- ISO value 50: the lowest possible sensitivity setting with this camera, producing the least possible optical noise.
- Image area gross (including a 25% overlap): 13 × 18 cm.
- Image area net: 10 × 15 cm (effective area after removal of a 25% overlap).
- Distance between front of lens and artwork: 435 mm.
- Broncolor studio flash with softboxes. Standard set-up comprises one flash unit on each side of the artwork.
- Flash lamps were adjusted to correct lighting on the colour chart, as measured in Phocus, and to produce an even lighting across the work, as measured with a light meter.
- Raw files were converted to TIFFs with a 16bit/channel eciRGB_v2 colour space. eciRGB_v2 is a colour space (a mathematical model or description of colour) developed by the European Colour Initiative (ECI), in collaboration with the printing industry. This large colour space can include even very saturated colours, but it is also linear, which means that it is simpler to convert the image to another colour space. This is essential for the conversion needed for printing (CMYK) or web (sRGB) applications. The bit depth of 16 bits/channel delivers greater accuracy than the 8 bits/channel often used.

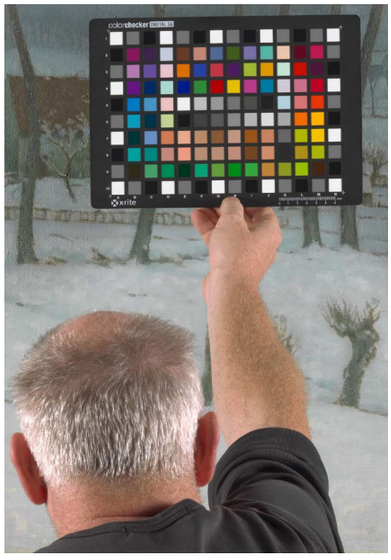


FIG 6 ColorChecker® Digital SG standard colour chart

INFRARED PHOTOGRAPHY (IRP) WITH THE HASSELBLAD CAMERA

- Modified Hasselblad with IR filter: B+W 093 IR. Infrared sensitivity range was between 930 and c. 1100 nm.
- Direct, tethered connection by a FireWire cable to an Apple MacBook Pro running Hasselblad's Phocus software.
- Focusing in IRP is not the same as in VIS and must be done via the 'Live view' software function in Phocus, which produces a live video image on the screen.
- Hasselblad lens HC MACRO f/4 120 mm. The lens function proved to have certain flaws under IRP conditions. Sharpness was good, but reflections between the various internal lenses caused problems.[8] Reflection created a 'hot spot', a lighter area, in the middle of the image. There was a direct relation with the aperture used: the greater the aperture, the larger and hazier the hot spot; the smaller the aperture, the smaller and brighter the hot spot. An aperture of f/9.5 was found to be least problematic. The light spot resulting from this was standardized and corrected in Photoshop by increasing the contrast of the image and decreasing it towards the edges. Digitally stitching the partial images to a single whole caused the hot spot to disappear.
- Aperture f/9.5 (as mentioned above, a compromise). Depth of field was a little less than in VIS, but overall sharpness of IRP images is less than in VIS at any rate. The hot spot was a greater issue than the depth of field, so this aperture was chosen over the f/13, which could not adequately eliminate the spot.
- ISO value 50: lowest possible sensitivity setting with this camera, producing the least possible optical noise.

- Image area gross (including a 25% overlap): 13 × 18 cm.
- Image area net: 10 × 15 cm (effective area after removing a 25% overlap).
- Distance between front of the objective lens and the artwork: 435 mm.
- Lighting as in VIS, but with aperture of f/9.5. Infrared images were also made using Broncolor studio flashes with softboxes, and IR content proved to be sufficient.
- Conversion to grey values in Phocus. The three RGB channels have very comparable responses to IR, and thus the colour differences were negligible. Conversion to TIFF, 16 bits/channel; colour space Generic Gray Gamma 2.2 Profile, thus with only a grey channel.
- Batch correction of the hot spot in Photoshop.

INFRARED REFLECTOGRAPHY (IRR) WITH THE OSIRIS CAMERA

- A choice was made based on a compromise between time available and desired minimum resolution: areas of 40 × 40 cm per image at a resolution of 4096 × 4096 pixels, or 266 ppi. The capture of each section took 10 minutes on average. A linear doubling of resolution to get only half that of the Hasselblad images would have already meant a quadrupling of the imaging time needed, which would have resulted in areas of 20 × 20 cm. This also would have required extra time for adjustments of the set-up, even if these were very small, thanks to the support frame. This choice led to the resolution of the IRRs being at least four times lower than that of the Hasselblad images.
- Lighting from the halogen lamps built into the Broncolor studio flashes: 650 W per flash unit. Here also, two lights were used as standard.
- Aperture between f/8 and f/11.
- Lighting levels were established by including in the image a piece of white paper, which was given a brightness level of 93–97 per cent, as determined by the proprietary software of the Osiris camera.
- Imaging distance: front of camera body to artwork,90 cm; image area, 40 × 40 cm.
- Lens: Rodenstock 150 mm f/5.6 Rodagon enlarging lens. Because the effective imaging area is quite large (approx. 65 × 65 mm) due to the scanning motion of the sensor, it was difficult to find a sufficiently large objective lens for this camera. Most lenses are made for a very small sensor. This lens was designed for visible light, to print from negatives. The adaptation for IRP consists of optimizing the anti-reflection coating designed for IR, so the problem we encountered with the Hasselblad lenses did not arise here. However, there were other issues. The objective lens could not record with the expected sharpness in IR. Whatever setting was used, the image was never completely sharp. As a result, the effective resolution was closer to 200 ppi than the 266 ppi mentioned above.
- For details, as macro lens: Rodenstock 50 mm f/2.8 Rogonar enlarging lens. In contrast with the 150 mm lens, this lens gave sharp images but was suitable only for macro imaging. We used it for details of 35 × 35 mm. It was not suitable for use as a standard lens, since at greater distances the whole effective image area would have been much too small.
- The Osiris camera is connected via USB to a laptop loaded with the proprietary Osiris software (compatible only with Microsoft Windows) that directs the camera and records its images. The only file format in which images can be saved is RGB bitmap (BMP). The image is in grey values because there is only one type of pixel in the sensor and there are no band filters. Nevertheless, it is saved by the software in RGB format, with three times the amount of data in colour channel content.
- The camera needs to be calibrated before each imaging session because there can be irregularities in the image. These may have two causes: dust motes on the glass in front of the sensor and irregular lighting of the painting. We did not correct the camera in the latter case, but in the former it was necessary. Dust particles can land on the glass in front of the sensor during transport, and these can cause elongated shadows, resulting in dark linear smudges on the image. Because of the repetitive motion of the scanner in the camera, this may occur 64 times per image. The calibration process is essentially photographing an evenly lit white area, following which the software corrects all areas of

the white 'image' to uniform brightness. This counteracts any effect of dark smudges that might result from dust on the equipment. Conversely, if dust vanishes during an imaging session, it results in light-hued linear smudges. In that case, too, the camera has to be recalibrated.[9]

DIGITIZING X-RADIOGRAPHS

- Where possible, X-ray images were photographed at 1200 ppi with the Hasselblad, on a light box or an improvised apparatus with a studio flash unit. Occasionally, for practical reasons such as location or pressure of time, images of lower resolution were made.

OTHER IMAGES

- Ultraviolet (UV) fluorescence was done on occasion, depending on the availability of UV lamps, a room that could be darkened and the time available.
- Raking light images (using a single studio flash unit) were sometimes made when there were material reasons to do so.
- Hundreds of micrographs, made with a special camera and an optical stereo microscope, were also produced. All these images, a small selection of which is reproduced in the *Catalogue Raisonné* and in the present volume, can be consulted on www.boschproject.org.[10]

FILENAMES AND STANDARDIZED ARCHIVING

All images were archived as raw files, 16 bit/channel TIFF files and 8 bit/channel JPG files. Raw format is indicated by the filename suffix *.fff* for the Hasselblad and *.bmp* for the Osiris.

All photographed surfaces of paintings and drawings were given unique BRCP Research Report (RR) numbers. A single object will typically have two such RR numbers allocated (one for

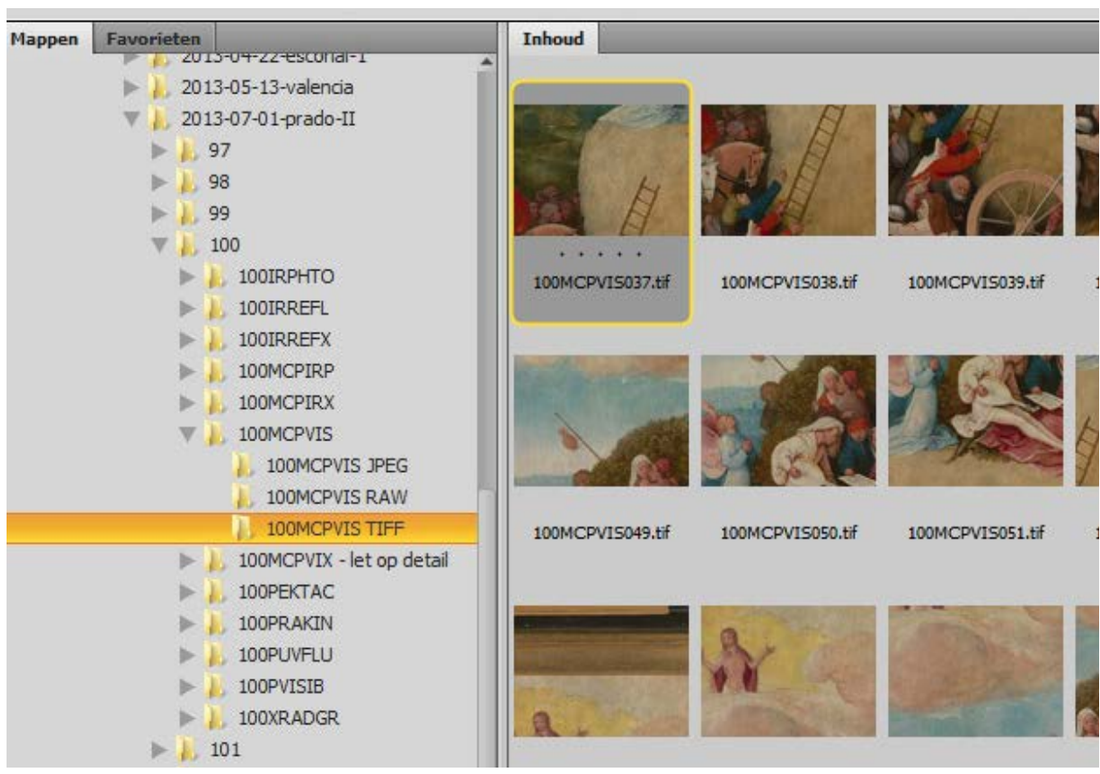


FIG 7 Standardized archiving system

the front, the other for the reverse, when photographed), while a triptych can have six RR numbers (for the exterior left wing, exterior right wing, interior left wing, central panel, interior right wing, and the reverse of the central panel, respectively). Each folder, subfolder and photograph has an index indicating the type of lighting and whether this refers to a macro or an overall image, plus the file type, followed by a sequential serial number. FIG 7
Example:

>97–102 [the Prado *Haywain Triptych* folder, with six subfolders organized by RR]
>100 [one of six subfolders, this being the RR number for the central panel]
>100MCPVIS [indicating type of imaging; see below]
>100MCPVIS TIFF [indicating one file type out of several]
>100MCPVIS001 [name of first of 120 files in folder]

IMAGE TYPES

- IRPHTO overall IRP using Hasselblad
- IRREFL infrared reflectogram using Osiris, 40 × 40 cm standard partial image
- IRREFX infrared reflectogram in extreme macro using Osiris, detail of 35 × 35 mm
- MCPIRP macro IRP using Hasselblad, 10 × 15 cm standard partial image
- MCPIRX extreme macro IRP using Hasselblad
- MCPVIS macro VIS using Hasselblad, 10 × 15 cm standard partial image
- MCPVIX extreme macro VIS using Hasselblad
- MICGBM micrographs
- PUVFLU overall UV fluorescence
- PVISIB overall VIS
- PEKTAC photograph from an Ektachrome slide
- PRAKIN overall raking light using Hasselblad
- XRADGR macro from X-radiograph

All images have been archived according to this structure on both external hard drives and Amazon Glacier. Moreover, all the participating museums have received a full dataset with the images of the work(s) from their own collections. Each individual photograph can also be found on the website www.boschproject.org, under these numbers, headings and file names.

CONTACT SHEETS

For easy reference and for control purposes, contact sheets in PDF format were made for each side of every object studied. Each sheet was marked with the BRCP number assigned to the given object, plus the 'image type' code (see above) for the kind of light in which the images were made.

To illustrate this method and to give an indication of the number of photographs taken for this project, the contact sheets made for the painted side of the central panel of the Prado *Haywain* are reproduced here. In addition to the contact sheets, the overall images FIGS 8–15 and an extreme macro detail taken under visible light are also shown. In this way an overview appears of all the images of this single painted surface. No UV fluorescence images were made for the Prado *Haywain*. The number of images made for this one panel totals 415. For the whole project at least 10,000 images were made, which can all be consulted on www.boschproject.org. Please note that the sizes of the 'thumbnail' images on the contact sheets are unrelated to actual file size and resolution.

FIG 8 Overall VIS [100PVISIB]

FIG 9 Overall IRP [100IRPHTO]

FIG 10 **VIS thumbnails** [100MCPVIS001–100MCPVIS120]

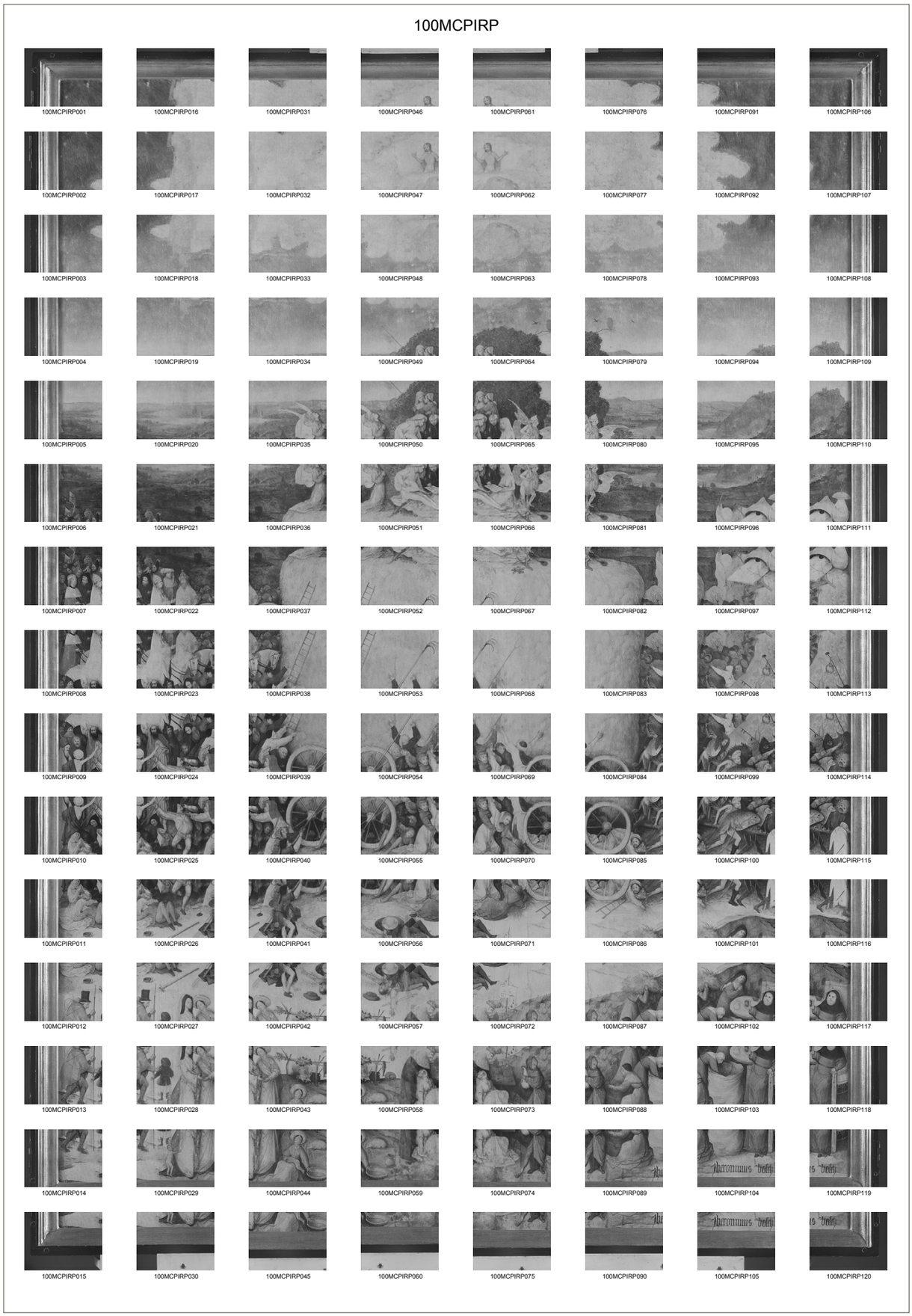


FIG 11 **IRP** thumbnails [100MCPIRP001–100MCPIRP120]

FIG 12 IRR standard partial images [100IRREFL001–100IRREFL020]

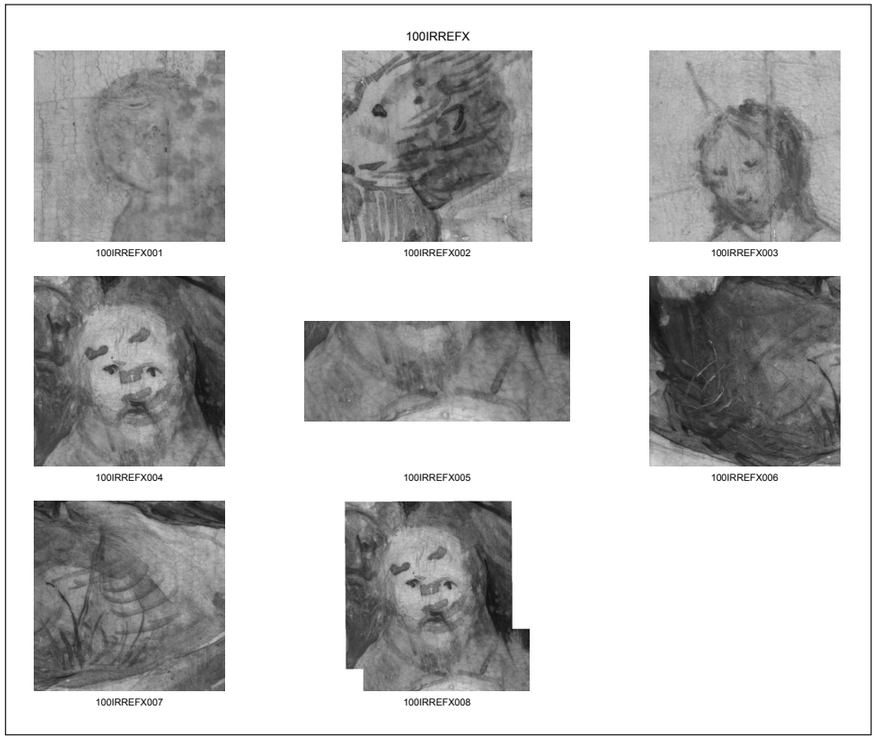
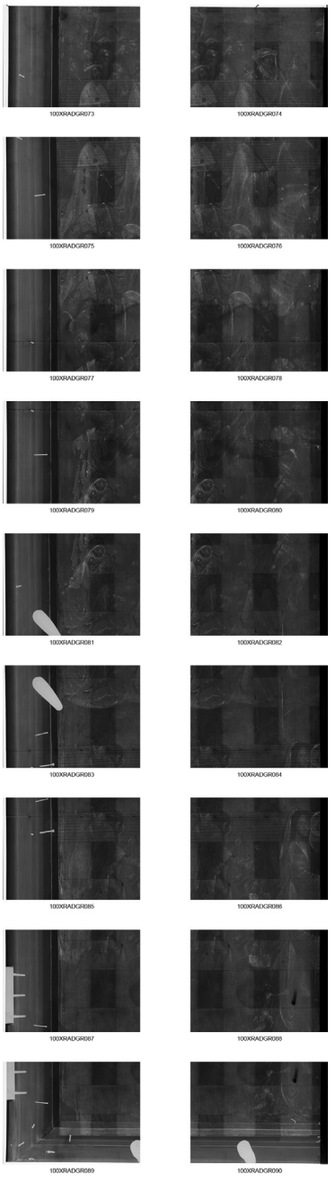


FIG 13 IRR macros [100IRREFX001–100IRREFX008]

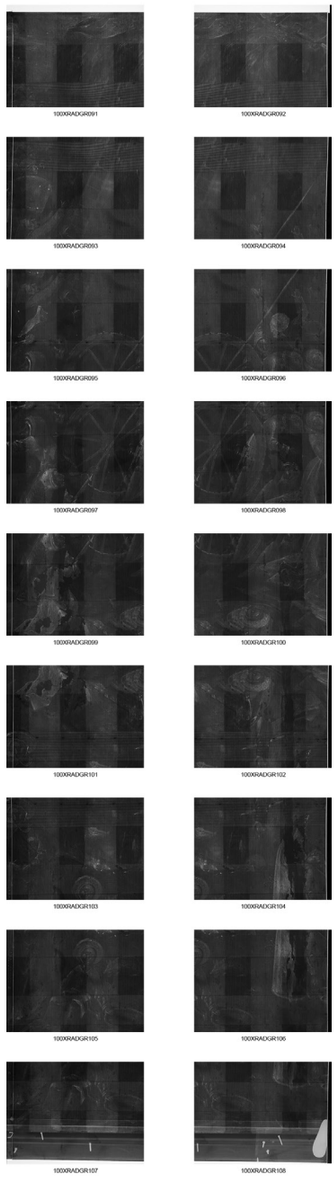
FIG 14 Raking light [100PRAKIN]

FIG 15 XR: for the central panel, eight films were digitized in eighteen images per strip [100XRADGR].

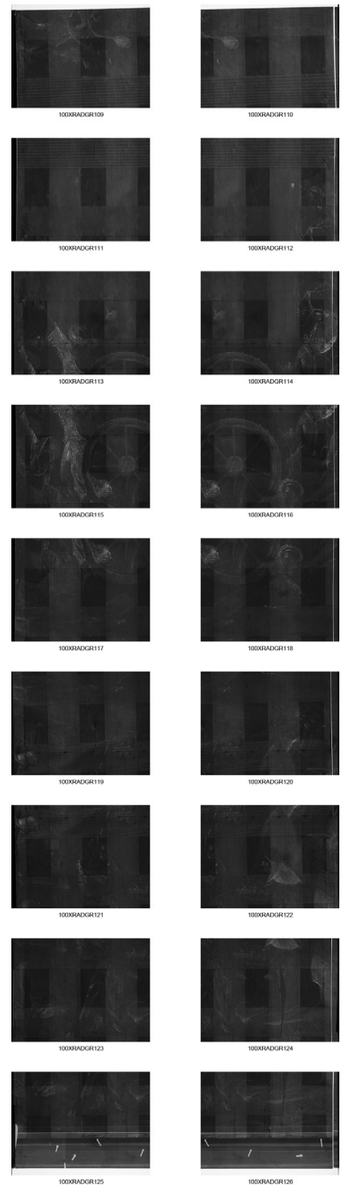
100XRADGR-BOTTOM-1



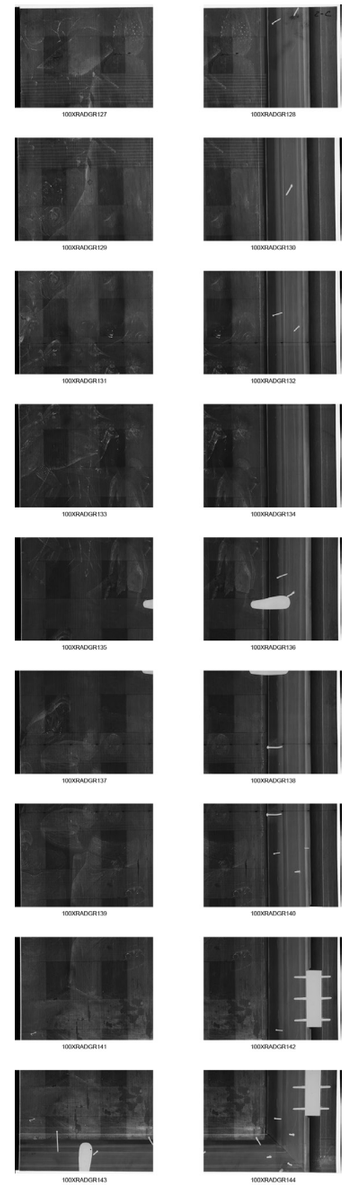
100XRADGR-BOTTOM-2



100XRADGR-BOTTOM-3



100XRADGR-BOTTOM-4



Problems, solutions and evolving expertise

After the modification of the Hasselblad camera for IRP, problems arose with the filter that was meant to ensure that the camera remained functional for visible light. The BG39 filter, obtainable from the Dutch supplier of Hasselblad, turned out to exist in various strengths. This was unexpected and illogical, since for each type of filter, spectral transmission curves are determined that all filters should satisfy, but this was apparently not the case here. In the first instance it proved impossible to set the correct white balance in the software, on account of the dominant blue colour of the filter. At the start of the project, therefore (at the Museum Boijmans Van Beuningen, Rotterdam, and Kunsthistorisches Museum, Vienna), the images in visible light were made with another, unmodified, Hasselblad, and the infrared photographs with the modified camera.

Following this, the BRCP camera with the filter was sent back to the factory, where it was adjusted to achieve the middle of the white balance scale. Then the camera was calibrated and we began to work with this altered camera profile. A way to determine whether the profile was indeed correct was not available. Hasselblad did not offer any advice. The following sessions with this filter and the adjusted Hasselblad were: Lisbon (*Temptation of Saint Anthony*, cat. 4, RR 11–16), Paris (*Ship of Fools*, cat. 19B, RR 17–18), Brussels (*Calvary with Donor*, cat. 15, RR 19–20), Venice (*Visions of the Hereafter*, cat. 18, RR 32–39; *Hermit Saints Triptych*, cat. 2, RR 27–31, 40; *Saint Wilgefortis Triptych*, cat. 8, RR 21–26) and the Cranach copy in Berlin of the Vienna *Last Judgement*. At this point a suspicion arose that something was wrong, particularly in the darker red tints. The search for a more suitable filter led to the German firm Optic Makario, which also modifies cameras – though not Hasselblads – and supplies special filters for this. In tests with the Makario filter, however, it turned out that Phocus (the Hasselblad operating system) could not get the white balance right, presumably because of an earlier adaptation. Yet when the Hasselblad raw files were developed in the Adobe Photoshop RawConverter (Camera Raw) as a workaround, nothing could be seen of the changes in the Hasselblad. Hasselblad had made a change in the camera, the effect of which was revealed in Phocus but not in Adobe's Camera Raw. This peculiarity enabled us to compare results. Ultimately, preference was given to working with Phocus after all, since adapting the camera profile was easier with that software. Another asset was that it had always been our intention to work with the same set-up, even if for that purpose the camera had to be sent once again to the Hasselblad factory to make it possible to use Phocus again.

Good results were obtained with the new filter from Optic Makario and the following sessions were shot in parallel with both filters: Madrid, Museo Lázaro Galdiano (*Saint John the Baptist*, cat. 5, RR 47–48), Frankfurt (*Ecce Homo*, cat. 11, RR 49–50), Berlin (*Saint John*

FIG 16 Members of the BRCP team at work in the Escorial. From left to right: Ron Spronk, Jos Koldeweij, Matthijs Ilsink, Rik Klein Gotink (in front of the central panel of the Escorial *Haywain*, cat. S1, RR 103–108)

on Patmos, cat. 6, RR 51–52), Washington, DC (*Death and the Miser*, cat. 19C, RR 53–54), New York (*Adoration of the Magi*, cat. 10, RR 55–56) and Philadelphia (*Adoration of the Magi*, cat. 25, RR 57–58; *Two Shepherds* and *Retinue of the Magi*, cat. 26, RR 59–92). After the trip to the United States, the camera was once again sent to the Hasselblad factory to remove the modification. The new filter was used from Bruges (*Last Judgement*, cat. 16, RR 69–74) onwards and the files were once again developed in Phocus.

Summarizing, there were four periods of documentation in VIS, corresponding with the following BRCP RR numbers:

- 3–10: Rotterdam and Vienna, KHM: taken with an unmodified camera and processed in Phocus.
- 11–46: Lisbon to Berlin (Cranach): taken with a filter that turned out to be too strong and with a modified camera; problems with dark red; processed in Phocus.
- 47–62: Madrid (*John the Baptist*) to Philadelphia: taken with a good filter and processed in Adobe Photoshop. This meant that the camera modification had no influence on the results.
- 63 (Bruges) and thereafter: taken with the good filter and the camera restored to its original state; processed in Phocus.

Thus images 11–46 fall outside the optimum colour management, with problems occurring particularly in the darker red areas, which appear darker than they should. Although the exact information for these images cannot be retrieved from the raw images, the fact that colour management has been applied means that these differences in equipment could generally be corrected. Good colour management makes image information mostly independent of equipment.

The starting point of the BRCP photography project was to produce standardized documentation of the whole oeuvre of Hieronymus Bosch in VIS, IRP and IRR, supplemented by photographic digitization of X-ray films, using one set of cameras and a fixed procedure for lighting, resolution and method. This aim has been realized for the most part, but the technical problems explained above, and organizational obstacles (for example certain institutions/collectors refusing to cooperate), have led to a few inconsistencies and a lack of completeness. Nevertheless, documentation has been built up on a scale hitherto unknown, which will enable a thorough study of the painted oeuvre of Hieronymus Bosch and in which the differences in photographic documentation have been reduced to a minimum.

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1 Jaś Elsner, 'Art History as Ekphrasis', *Art History* 33, no. 1 (2010), 10–27.

2 See http://www.metamorfoze.nl/digitalisering (Dutch) or http://www.metamorfoze.nl/english/digitization (English).

3 Queen's University's Osiris infrared camera was acquired through the generous support of Dr Alfred Bader. In making the IRRs of Cranach's copy after Bosch's *Last Judgement* in the Gemäldegalerie in Berlin, one of the Osiris cameras of the Rijksmuseum, Amsterdam, was used. For this we thank Robert van Langh, head of the Department of Conservation and Restoration there.

4 For the exact set-up of the equipment used for documentation of the objects, see Appendix II, pp. 459–60.

5 Idea and implementation of Rik Klein Gotink.

6 A second version of the support frame (fig. 5), developed for Queen's University, is heavier. Indeed, if weight is not a critical factor, it is better to use a somewhat heavier and sturdier version of the support frame, which enables quicker assembly. The whole can then be packed for transport into a flight case slightly longer than 2 metres, with a total weight of about 50 kg.

7 The photography for the BRCP took place between 2010 and 2015.

8 Given that lenses were not developed for IRP, possible malfunctions under those conditions were obviously of no interest to the manufacturer.

9 None of this is to be found in the user's manual for the Osiris, provided by Opus Instruments.

10 With the exception of cat. 32, RR 87 (made by Gwendoline Fife) and cat. 3, RR 155–156 (made by John Twilley, Nelson-Atkins Museum of Art, Kansas City), all micrographs were taken by Luuk Hoogstede with equipment of the Stichting Restauratie Atelier Linmburg (SRAL), Maastricht. For equipment specifications, see Appendix II, pp. 459–60.

CHAPTER II

Image Processing for the Bosch Research and Conservation Project

Background and overview

As described elsewhere in this volume, the Bosch Research and Conservation Project (BRCP) collects terabytes of image data from Bosch paintings and drawings in multiple imaging modalities and resolutions. Medium-resolution whole-painting images are collected in visible light, ultraviolet light, raking light from multiple directions, and infrared. Very high-resolution images requiring many overlapping images to cover a painting are collected in both visible light and infrared, and a special infrared camera (an Osiris camera) is used to collect medium-resolution infrared reflectograms out to wavelengths of around 1700 nm. When radiographs of a painting already exist, images of those are collected via very high-resolution visible photography.

To make the most effective use of these images, they must be processed to achieve two main goals. First, they must be *stitched*: the multiple tiled images covering a painting must be blended smoothly into a single high-resolution image without any visible artefacts arising from the multi-photograph acquisition process and subsequent processing. Second, they must be *registered:* images of the same artwork using different imaging modalities should be precisely aligned with each other so that a feature on one imaging modality can be precisely correlated to the same point in an image from another modality.

Several free and proprietary software packages for image stitching and, indirectly, registration already exist, and as a first step we performed a detailed assessment of these packages to determine their suitability for processing the BRCP images. Although some packages were much better than others, our assessment revealed that none was completely free of critical defects. Among the deficiencies in existing packages are the following:

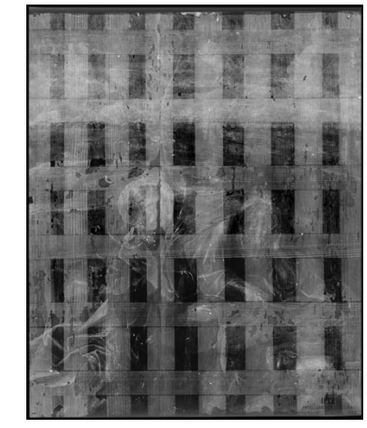
- inability to perform stitching and registration simultaneously, leading to poor alignment between imaging modalities as well as accumulation of error due to slight misalignments across a large painting;
- inability to use a whole-painting overview image as a ground truth for exact shape when stitching high-resolution images, leading to the accumulation of placement error across the extent of a large painting;
- inability to automatically filter feature points to remove feature-point matches in painting frames and background regions, leading to misalignment due to parallax effects;
- inability to perform robust filtering of false-positive feature-point matches arising from recurrent features such as crack patterns, leading to gross errors in image placement;
- inability to refine feature-point placement and pairwise matching after a first pass, leading to imperfect alignment between overlapping images as well as missed feature alignment on nondescript portions of overlapping images;
- inability to consider perspective transformations (homographies) when determining optimal image placement, leading to poor alignment;
- inability to find matches across imaging modalities, leading to the need to perform completely manual registration;
- inability to process many-gigapixel images due to a requirement that all processing

FIG 1 *Saint John the Baptist* [CAT 5, RR 47–48] seen through the 'curtain viewer'; clockwise, from top left: VIS, IRR, XR and IRP

Low-resolution VIS (PVISIB)

High-resolution VIS (MCPVIS)

Raking-light VIS (PRAKIN)



XR (XRADGR)

FIG 2 *Saint John the Baptist* [CAT 5, RR 47–48]: overview of images

be performed in-memory, leading to a dramatic limitation in the resolution of the images which could be processed;

- inability to process images in 16-bit precision, leading to banding artefacts and loss of colour information;
- inability to resample images by performing interpolation in a perceptually uniform colour space, leading to unnatural colour artefacts;
- inability to resample images by applying high-order interpolation to avoid decimation of high-spatial frequency image components, leading to a loss of image quality;
- inability to blend images using an optimized blending mask, leading to 'ghosting' or visibly truncated features;
- inability to blend images using a multiscale blending technique, leading to visible seams in cases of non-uniform illumination or the presence of specular highlights;
- inability to smoothly deform images during registration, leading to persistent misalignment across imaging modalities.

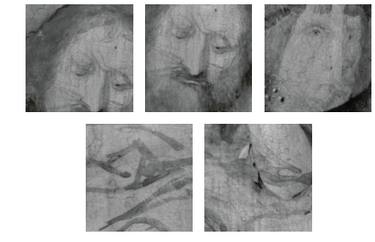
Given that these are typically the highest-resolution and highest-quality images that have ever been collected of these paintings and drawings, and given the substantial time, effort and expense needed to collect them, it is important that the best practices for preserving the colour and resolution of the images be adopted and that our image-processing algorithms minimize any processing artefacts, even when doing so would greatly complicate the stitching and registration procedures or increase the required processing time. Consequently, we consider all of the above deficiencies to be unacceptable, thereby ruling out the use of all software packages for stitching and registering that we tested. We therefore opted to design a comprehensive image-processing pipeline to overcome these inadequacies, so that we could present the images in the best possible quality.

The goal of this article is to present our image-processing pipeline by explaining in detail each of the processing steps. The exposition is intended to contain sufficient detail for a dedicated image-processing practitioner to be able to duplicate or improve upon our efforts while avoiding the many pitfalls we have encountered. Meanwhile, the framing is sufficiently non-technical for other readers to understand and appreciate the many specific problems to be overcome while performing stitching and registration, and should enable them to judge for themselves whether we have taken sufficient care in our handling of the Bosch images. It is further hoped that the carefully designed processing sequence described here will serve as a best-practice guide for processing conservation-grade cultural heritage images so that conservators and art historians will be better equipped to understand the many trade-offs in quality prevalent in other generic commercial and open-source image-processing packages used for stitching and registration.

Low-resolution IRP (IRPHTO)

High-resolution IRP (MCPIRP)

Normal-resolution IRR (IRREFL)



Extreme-resolution IRR (IRREFX)

The remainder of this essay is structured as follows. First, we give a high-level overview of the steps involved in the image-processing pipeline. Subsequently, for each of these steps we provide a more detailed explanation of the operations while also providing the technical motivation for each design choice. For each stage of the process we also provide detailed illustrations using images from Bosch's small (48.5 × 40.5 cm) *Saint John the Baptist* in the collection of the Museo Lázaro Galdiano in Madrid.

OVERVIEW OF STITCHING AND REGISTRATION PIPELINE

The following is a high-level overview of the sequence of steps involved in stitching and registering a set of multimodal images collected for a single painting.

FIG 2

- ***Processing of the overview image*** The low-resolution whole-painting overview visible photograph is manually processed to mask out any non-painted features including the easel, the frame, and the background, after which the image is rectified to fit in a minimal axis-aligned bounding box. This image serves as the ground truth for the shape of the painting and the exact placement of each of its features.
- ***First-pass pairwise image feature matching***
  – Feature points are automatically extracted from the whole-painting overview image and each of the high-resolution visible images, and a mathematical descriptor is calculated for each of these feature points, which records the appearance of the neighbourhood of the feature in a way that is approximately independent of contrast, brightness, rotation, scale and perspective effects.
  – All pairs of these images are searched to find geometrically plausible matching feature points arising from overlaps between imaged areas of the painting.
- ***First-pass global image placement optimization*** A global optimization is performed to find the ideal placement of each of the images with respect to the images with which it shares features. The inclusion of the whole-painting overview image in this process ensures that the high-resolution images do not exhibit large errors from one side of the painting to the other resulting from the accumulation of slight errors in misalignment between sequences of mutually overlapping image pairs.
- ***Feature-point filtering*** The resulting geometric description of the positions of the images is used to remove any feature points falling outside of the painted area of the whole-painting overview image, after which a second optimization is performed with this reduced set.
- ***Second-pass targeted feature-point extraction*** The known and inferred overlaps between images are used to perform a second targeted pass to find matching features between

overlapping images. On this second pass, feature-point descriptors are extracted from geometrically transformed images rather than the original images in order to increase the relative similarity of matching features between overlapping images.

- ***Second-pass global image placement optimization*** The resulting set of matching feature points is more complete and accurate than the first pass, so these are used to perform a second geometric optimization of the global placement of each image.
- ***Image resampling into global coordinate system*** Each of the images is converted to a perceptually uniform colour space and resampled into its final position using high-order interpolation. This ensures that perceptually inappropriate colour artefacts are not introduced during the resampling process and that high-frequency image components are retained.
- ***Image blending***
  – The set of images is organized into rows of images, where each row is organized in a sequence from left to right.
  – For each pair of images in a row, an optimum blending seam between the images is found such that the seam stays away from image edges and places the boundary between overlapping images in a way that reduces visible discontinuities across the seam.
  – A multiscale blending algorithm is used to merge the two images into each other, resulting in a fused image without visible seams or ghosting artefacts.
  – This procedure is repeated to assemble each row from left to right and then to merge complete rows together from top to bottom, resulting in a high-resolution whole-painting image.
- ***Mask application*** The painted surface mask from the processing of the whole-painting overview image is resampled and transferred to the high-resolution stitch, thereby blacking out non-painted portions of the image.
- ***Chained stitching, registration, blending and mask application for other imaging modalities*** This high-resolution visible-light whole-painting stitched image is then used as the anchor for repeating steps 2 to 9 with the other image modalities.
  – High-resolution infrared photographs are placed by finding intra-modality feature points as well as by finding feature points matching between these photographs and the high-resolution visible-light assembly. The resulting infrared photograph assembly is thus both internally consistent as well as being coarsely registered with the high-resolution visible image.
  – Infrared reflectogram (Osiris) images are stitched and simultaneously coarsely registered with the infrared photograph assembly.
  – Ultraviolet and raking-light overview photos are coarsely registered with the whole-painting visible assembly or the whole-painting overview visible photograph.
  – X-radiographs are stitched and coarsely registered with any image modality containing feature matches. In cases where no match can be found due to the extreme dissimilarity between radiograph images and other images, proxy images of crack patterns are used for automatic extraction or, when necessary, a manual tool can be used to mark matching features.
- ***Bayesian cross-modality registration refinement***
  – The coarse registration achieved in the previous steps is refined using a Bayesian formulation for computing a small-magnitude smooth deformation field needed to bring the image from one imaging modality into precise registration with those from another. In all cases, the high-resolution visible image is used as the rigid image, while other imaging modalities are deformed to match it.
  – Using this small deformation field for each imaging mode, the images are resampled from their original mosaic images and restitched, resulting in precisely-registered whole-painting images across all imaging modes.

Detailed explanation of image-processing pipeline

The following subsections elaborate on the image-processing steps and provide additional motivation for each of the specific algorithms we adopt when processing the BRCP images.

PREPARATION OF OVERVIEW IMAGE

A basic problem in assembling the various images together is that the camera moves from one image to another and that the images themselves have different resolutions. Tiny variations in the tilt of the camera about its in-plane *x*- and *y*-axes cause perspective effects that can alter the apparent shapes of elements in the painting, and even the lateral translation of the camera can change the apparent shape of the painting if the surface is not perfectly flat. In order to assemble them into a single self-consistent data set from the component images, it is therefore necessary to establish a kind of ground-truth shape for the entirety of the painted surface. As described in the essay detailing our photography procedure in this volume (p. 15), this is done by capturing a single whole-painting overview photo in normal visible light with the camera carefully positioned to be equidistant from the corners of the painting and aimed so that the camera's optical axis is normal to the painting.

FIG 3 The first step in processing the images for a painting is to prepare this overview photo. The high-resolution images will be positioned relative to this higher-resolution image via feature-point matching, so the first step is to mask out the non-painted portions of the overview image since those portions include the distant background and the raised frame, both of which shift relative to the painted surface when the camera moves due to parallax effects. If the full-resolution images were aligned to those features, they would be inconsistently matched on the painted surface itself. This masking is performed manually in an image-editing program such as the GNU Image Manipulation Program by tracing the exact boundary of the painted surface with the assistance of an edge-following selection tool. A Gaussian blur with a 5-pixel standard deviation and thresholded at 50% in order to smooth the boundary of the mask is then applied to the resulting selection mask. All pixels outside the mask are overwritten with black, and an alpha channel is added to the image to store the mask.

The resulting overview image is taken as having the correct shape, but the exact orientation is still not determined. To find this orientation and a minimal bounding box, the contour between black and white areas of the image mask is extracted as a sequence of image coordinates, from which the minimum-area bounding rectangle [1, 2] containing these coordinates is extracted. The smallest rotation needed to bring this rectangle to an axis-aligned orientation is applied to the original image by 7-weight two-dimensional Lanczos interpolation,[14] and the image is then cropped to the axis-aligned mask bounding rectangle, resulting in a straightened overview image containing only painted surface. This image will serve several purposes in the remaining steps, including defining the canonical shape of the painting, defining the extent of the painted regions and the final black mask on the image, and defining the canonical bounding box for clipping all of the additional layers once they are stitched and registered.

VISIBLE IMAGE STITCHING AND REGISTRATION

In the following sections we describe the general procedure for stitching and first-stage registration. This procedure is identical for all image modalities, but in the examples that follow we consider only the visible-light images.

FIG 3 Masking and rectification of overview photograph:

a *whole-painting overview*
b *painting mask with minimum-area bounding rectangle*
c *masked, cropped and rectified*

FIG 4 Feature-point matches

First-stage image alignment

For the first stage of both stitching and registration, the task is to determine the approximate geometric transformation that would bring overlapping images into correspondence with each other. The approach we take here is typical of the state-of-the-art approach for solving similar problems encountered in computer vision, such as reconstructing image panoramas or finding points of correspondence in stereo images. Broadly, the approach is to consider each image in turn to find locations around which the image has a distinctive

appearance. At each of these so-called *feature points*, the many details of the local appearance of the image in the neighbourhood of the feature point are quantified into a vector descriptor, where the descriptor is designed so that descriptors for feature points with similar appearance will be mathematically similar. The descriptors are further designed so that image translations, rotations, small perspective tilts, changes in image scale, and changes in brightness and contrast have a relatively small impact on the descriptors.

Once the set of feature points and associated descriptors is extracted from each constituent image, the next phase is to perform pairwise comparisons between each pair of images to detect overlapping features by finding similar feature-point descriptors between the images. When a match between a pair of images is found, the set of cross-image matching feature points is recorded for subsequent use. As the final step of first-stage alignment, the geometric transformation needed to place each image relative to its overlapping matches is determined by a global optimization process to minimize the mismatch between all matching feature points. Each of these steps is described in more detail in the remainder of this section.

Feature-point detection and descriptor extraction

The first step of stage-one alignment is the location of feature points and the extraction of their corresponding descriptors. For overlapping images within the same imaging modality, the ultimate use of the feature points will be to provide the image transformation needed to bring the feature points in one image into alignment with the matching points of an overlapping image, so it is important that a large number of widely spaced points be found to ensure that the error in the transformation arising from local errors in the feature-point locations is minimized.

To ensure that the component images are covered with a sufficient number of features even in low-detail areas, the process of feature-point location is performed in a tile-wise fashion, where each constituent image is deconstructed into non-overlapping tiles with dimensions of 1024 × 1024 pixels. This tile-wise approach also allows the extraction of feature-point locations and associated descriptors to be performed in parallel to increase speed. We make use of the OpenCV open-source computer vision library,[2] which offers a variety of algorithms for both feature-point detection and descriptor extraction at each feature point. In practice, we have found that both SIFT[3] and SURF[4] perform well for both the feature-point location and as descriptors for our images, which generally have minimal rotation with respect to each other. For a typical visible colour image, each 1024 × 1024 tile yields approximately 900 feature points.

Pairwise matching

Once the descriptors have been extracted for each image, the next step is the exhaustive comparison between all pairs of images for which matches are sought. The search for a match between a pair of images involves finding descriptors that are near each other in the high-dimensional (e.g. 128 dimensions for SIFT descriptors) descriptor space. Exhaustive comparison of all possible pairs of descriptors would be computationally prohibitive since the BRCP images typically contain tens of thousands of descriptors, necessitating hundreds of millions of high-dimensional distance calculations for each pair of images, so we use a *k*-d tree structure or, more recently, an adaptive algorithm as implemented in the Fast Library for Approximate Nearest Neighbors (FLANN)[5] to speed the search for pairs of similar descriptors. In these approaches, a *k*-d tree or similar data structure is populated with all of the descriptors from the first image. Next, the tree is queried with the descriptors from the second image to find the two nearest-neighbour descriptors in the original set. To identify distinctively matched descriptors, we only retain descriptors for which the ratio of first-nearest-neighbour to second-nearest-neighbour distance is less than 0.7.

FIG 4

The set of similar descriptors emerging from the previous step typically contains a number of false-positive matches arising from repetitive features such as paint cracks. To further refine the matched features between a pair of images, the homography mapping the

feature points from the first image onto the feature points of the second image is estimated using the Random Sample Consensus (RANSAC) algorithm,[6] which performs robust estimation to separate geometrically plausible inlier points from geometrically implausible outlier matches. The homography estimation is configured to require at least 7 matching feature points, where in order to match they must be within 5 pixels of each other after the application of the homography. In practice, for a pair of overlapping images photographed according to BRCP standards, the match distinctiveness filter typically leaves 1000 to 2000 descriptors, and the RANSAC-based geometric filter typically retains around 60% of those.

Global image placement optimization

Following the determination of the pairwise matches among the images, the next step in the first phase of image alignment is the determination of the optimal geometric transformation of each image to put it into ideal alignment with the other images with which it overlaps. The lenses used by the BRCP are of scientific grade, so correcting for lens distortion is not necessary. Movement of the camera with respect to the idealized plane of the picture induces distortions of the picture in the photograph such that lines in the idealized plane of the picture map to lines in the photograph. Projective transformations possessing the property that lines are mapped to lines are known as homographies. Figure 5 shows the deformations possible with this class of transformation.

FIG 5

Global optimization of homographies for all images

In our formulation, an untransformed image has its upper left corner at the origin and has unity as the value for the scale and aspect ratio parameters and zero for all others. To place each image with respect to its overlapping matches, the goal of the next step is to find the geometric parameters which minimize the mismatch between the feature points that are known to match.

This mismatch is described using an error metric to be minimized. In early stages of the BRCP, the error metric was defined to be the sum of squared distances between matching pairs in the global (post-homography) coordinate space. However, this seemingly sensible choice yields non-optimal results because even when one image is 'pinned' to have a constant scale, a reduction of the mismatch in the global coordinate space between a pair of feature points can be achieved by means of foreshortening perspective transformations, gradual reductions in the scale parameter over a sequence of images, skewing transformations, or other kinds of homographies in which the ratio of pairwise distances is altered by the transformation. The result of global optimization was typically a small overall error metric, but the results had the tendency to display solutions with abnormal geometric parameters in order to further minimize the error.

A modified error metric was found to completely eliminate this problem. Rather than computing feature-point mismatch in the global coordinate system, we compute feature-point mismatch in the local coordinate system of the larger of the two images in any given pairwise match. Given a homography for transforming local image coordinates into global coordinates for each of a pair of matching images, the feature points from the smaller of the two images can first be transformed into the global coordinate system by applying the homography of the smaller image, and those global feature-point coordinates can then be transformed into the local coordinate system of the larger image by applying the inverse of the local-to-world homography associated with the larger image. The sum of squared pairwise distances between the feature points of the smaller image and the feature points of the larger one can then be computed there, with a resulting global error metric computed as the sum of these sums across all matching image pairs. With this strategy, it is seen that any uniform application of a homography to all images in the collection will have no effect on the overall mismatch since the forward transform of that homography to place feature points into the global coordinate system will immediately be followed by its inverse transform to place those global points into the local coordinate system of the other image.

With the global error metric defined as the sum of squared pairwise feature-point mismatches (in local image coordinates), the unique solution of the system further requires 'pinning' the overall scale, orientation, translation and other geometric parameters of the image collection since, as mentioned above, the global error metric is invariant with respect to the application of any homography across the whole collection of images simultaneously. Our approach is to select one image as having the correct geometric parameters (the so-called 'anchor image') and then to perform a global optimization of all per-image homographies except for the ones corresponding to that image. Provided that the graph of pairwise image matches contains only a single connected component, the problem will be well posed. In cases where the image graph contains more than a single connected component, linking these components by manual addition of matching feature points across images from different components is necessary since only a single image is designated as having known geometric parameters.

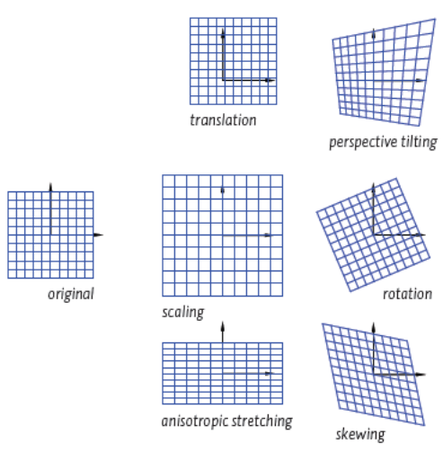
The simultaneous optimization of all image homographies is carried out using the Levenberg–Marquardt algorithm for non-linear least-squares problems[7] with an added RANSAC step which only retains feature points with mismatches of less than 5 pixels in the image-local coordinate system.

Following completion of the process, the results are visualized to ensure that they are sensible. Failure modes include severe warping due to specious matches between images, fracture of a single connected component into multiple components during optimization as feature-point matches are removed during RANSAC filtering, or poor overall geometric alignment due to cases in which only a small number of useful feature points are found on a given image. The latter case can occur when an image is relatively nondescript, such as a large area of background with little texture or cracks, or when only a small portion of an image contains painted surface, as can occur due to poor relative alignment of the uniformly spaced photographic tile grid with the boundary of the painting.

Manual matching or repair

In cases where the original set of optimized images is not fully connected or if the results from the first-stage optimization step are not satisfactory, a manual matching or repair step is needed. For this we developed a web-based tool which enables the user to precisely manually mark matching points between any pair of images using a pair of smooth zooming image viewers. Additionally, the software can display a match matrix showing the

FIG 5 Deformations expressible with homography



ASIDE: HOMOGRAPHIES

For projection from points in the plane to points in the plane, homographies are conveniently written as 3 × 3 matrices with 8 degrees of freedom (the lower right entry is maintained as unity). While convenient for applying the transformation, this representation is unintuitive and difficult to constrain to enable only a subset of geometric transformations, so we maintain an alternate representation of homographies in terms of a sequence of geometric transformations. An arbitrary homography can be decomposed into a sequence of 5 simple geometric transforms involving 8 parameters as follows:

– a perspective tilt around the *x*- and *y*-axes by angles ϕ_x and ϕ_y, respectively;
– an area-preserving stretch of the *x*- and *y*-axes by $1/\sqrt{\rho}$ and $\sqrt{\rho}$, respectively, where ρ encodes an aspect ratio;
– rotations of the *x*- and *y*-axes by amounts $\vartheta - \Delta\vartheta/2$ and $\vartheta + \Delta\vartheta/2$, respectively, where ϑ is an overall rotation parameter and $\Delta\vartheta$ is a shearing parameter;
– an isotropic homogeneous scaling by a factor *s*;
– a translation by amounts *x* and *y*.

number of pairwise matches between all image pairs, from which specious computer-generated feature-point matches between non-matching images can be detected or missing matches between images can be added. When this manual step is undertaken, the first-stage alignment procedure and manual editing are repeated as needed.

On-painting feature-point filtering

In cases where the painting is framed or is supported by an easel during photography, or when portions of the photography studio are inadvertently photographed, the automatic extraction of feature points between all pairs of images will typically include some feature points outside of the painted surface. As described above, these features are unwanted, but the information about which pixels are in the painted surface is only contained in the mask channel of the overview image created in the first step. Thus, not until the visible images are approximately aligned with the overview image is it possible to detect which feature points are contained in the painted surface by transforming them from the global coordinate system to the local coordinate system of the whole-painting overview image. These non-painting feature points are unwanted because they tend to lead to misalignments due to the parallax motion of three-dimensional features when observed from a translating camera, so this implies that first-stage alignment will contain some errors in image placement and that the filtering to retain on-painting feature points will then be only approximate. To combat this problem, we apply 30 iterations of morphological erosion[15] to the frame mask on the whole-painting overview image when performing the above filtration, so that a further 30-pixel buffer of near-frame feature points is also removed. The resulting reduced set of feature points should then contain only features on the painted surface, so the global placement optimization of the first stage is iterated along with this filtration step until no feature points are found to be on the frame.

Second-stage image alignment refinement

The result of the first-stage alignment is a set of trial geometric transformations to be applied to each image, in order to place it into its final 'global' position to match each of the other images with which it is known to share image features. In the case of the visible overview image and the high-resolution tiled visible images, the overview image serves as the anchor for all parameters except scale, for which the scale of the first high-resolution mosaic image is used.

Although the descriptors computed from each feature point are designed to be relatively robust to geometric transformations, in our experience even slight relative transformations such as a scale change of a few per cent or a very slight perspective tilt can cause significant degradation of the similarity of known matching features across different photographs. The consequence is that the initial first-stage search for matching features can often miss a large fraction of matching features and, in cases where a pair of overlapping images are relatively nondescript in their overlapping regions, can completely miss any match between the images. The global placement optimization of the first-stage matching procedure can often infer the relative placement of overlapping images, even if there is no direct feature-point match between them. However, in such cases the relative alignment tends not to be ideal since it is only through a chain of matches with other images that the relative positioning is determined.

To improve the thoroughness of feature-point matching between images which are known to overlap, we perform a second stage of feature-point matching and placement optimization. In this stage, each image is transformed by applying the homography transformation determined from the first-stage optimization procedure. With these resampled images, feature points are located and descriptors extracted across all of the images. For each image, the polygon of the boundary of the image is computed, after which the polygonal intersection between each image and its overlapping neighbours is computed. The result of this step is the set of polygons covering each of the pairwise intersections of the images in their stage-one positions. For each of these intersection polygons, the feature points are extracted from the parent images and filtered to retain only those points falling in the intersection polygon. A search for matching feature points within this reduced set is then performed, again using the RANSAC algorithm

to ensure that only those feature points which are geometrically plausible are retained. When matching feature points are found, their positions are then transformed back into non-transformed local image coordinates for each of the parent images.

This second stage of feature-point matching has three beneficial effects. First, the number of detected feature-point matches between any given pair of images is typically much higher than the original number of matching features between the same pair from the first stage. Second, the accuracy of the locations of the points improves substantially, as judged by the eye when comparing matching features and also as measured by the root mean square error between matching feature positions after optimization. Third, images which were inferred to overlap but between which no matching feature points were found in stage-one alignment are usually directly matched, including images with minimal overlap and images with relatively nondescript overlapping regions.

Given the enhanced precision of the feature points found through this second-stage procedure, the feature points from the first step are completely discarded in favour of the newly located points. The first-stage optimization procedure is then followed using the new set of improved-accuracy feature points: points falling outside of the painted surface, as determined by referencing their positions to the painted-surface mask of the overview image, are discarded, and the homography needed to minimize the sum of squared distances between feature points and their matches is determined for each image simultaneously using the RANSAC algorithm to retain only those feature points which have total mismatch distances of less than 5 pixels. At the completion of the optimization procedure, the root mean square mismatch with our images is typically of the order of 1.2 pixels.

FIG 6 Visible image placement after optimization

Resampling into the global coordinate space

As with the first stage, the result of second-stage placement optimization is a set of homographies needed to transform each image from its as-captured pose into the optimum position to overlap ideally with the other images in the assembly. The next step of the process is to apply these homographies by resampling each of the images into its final position.

The resampling procedure for an image is as follows. First, the axis-aligned global bounding rectangle of the image is determined by applying that image's global homography to its four corners. This bounding box is then intersected with the bounding box of the whole-painting overview image to obtain the global bounding coordinates of the relevant parts of the high-resolution image. For every global pixel coordinate within this rectangle, the inverse of the image homography is applied to determine the equivalent local image coordinate. An image mask is computed from these transformed coordinates by finding those coordinates which fall outside of the local image bounds; the mask is incorporated into the alpha channel of the resulting image, and is used during the blending step. For each of the transformed pixel coordinates falling within the image, the colour of the pixel is determined via 7-point Lanczos interpolation into the original image. As described below, we use a perceptually uniform colour space to perform interpolation and blending to ensure a minimum of artefacts arising from image processing. All image channels are interpolated, including any alpha channel from the original image if one is present. Though not used in processing the BRCP images, this feature enables one to mask out manually unwanted portions of an image, such as may be contained in the background or the frame, to ensure that they are not used in the blending step.

Each of the images from this resampling step is output in 2- or 4-channel TIFF format, with the last channel corresponding to the merge of the computed image mask and the resampled version of any original masks, if present. Additionally, the global pixel coordinate of the upper left corner of the resampled image is stored in a metadata tag for subsequent use during the blending step.

Perceptual uniformity and CIECAM02

The geometric transformation from global pixel coordinates back into local pixel coordinates by applying the inverse of the global homography for an image results in local pixel coordinates that do not fall directly on pixel centres. Thus, to determine the colour at such intermediate points, interpolation is needed. A straightforward interpolation of the raw R, G and B values stored in the image would not be appropriate, however, since the mathematical average between the RGB values of two colours does not, in general, result in a colour perceived by humans to be intermediate between those colours. To solve this problem, we first convert all pixels into a colour space described by the CIECAM02 colour appearance model,[8] which was designed to be perceptually uniform to a good approximation. In the CIECAM02 model, one must specify several aspects of the viewing conditions; the values we use are those recommended in [9], specifically: (1) the luminance of the adapting field (L_a) is 31.83 cd/m^2 (corresponding to viewing under 500 lux); (2) for a D50 illuminant, the relative chromaticities for the adopted white point are $X_W = 96.42$, $Y_W = 100$, and $Z_W = 82.49$; (3) a luminance for the background $Y_b = Y_W / 5 = 20$; (4) 'average' surroundings; and (5) complete adaptation ($D = 1$). Using the colour profile of the images, we convert into the CIECAM02 colour space, perform interpolations and blending there, and finally convert back at the final step.

Blending

The goal of the third phase of image processing is to blend together all of the resampled images within any given imaging modality (visible photography, infrared photography, infrared reflectography, etc.) into a whole-painting stitched image. As described in a previous chapter, great care is taken during photography to ensure spatially uniform lighting, and, as described above, great care is also taken to ensure that matching features from overlapping images are in

precise alignment. Despite these efforts, small differences in the exact colour or brightness of a given shared feature from one image to another can be observed, and there are some three-dimensional painting features, such as impastoed areas, which shift their relative positions due to parallax as the camera moves.

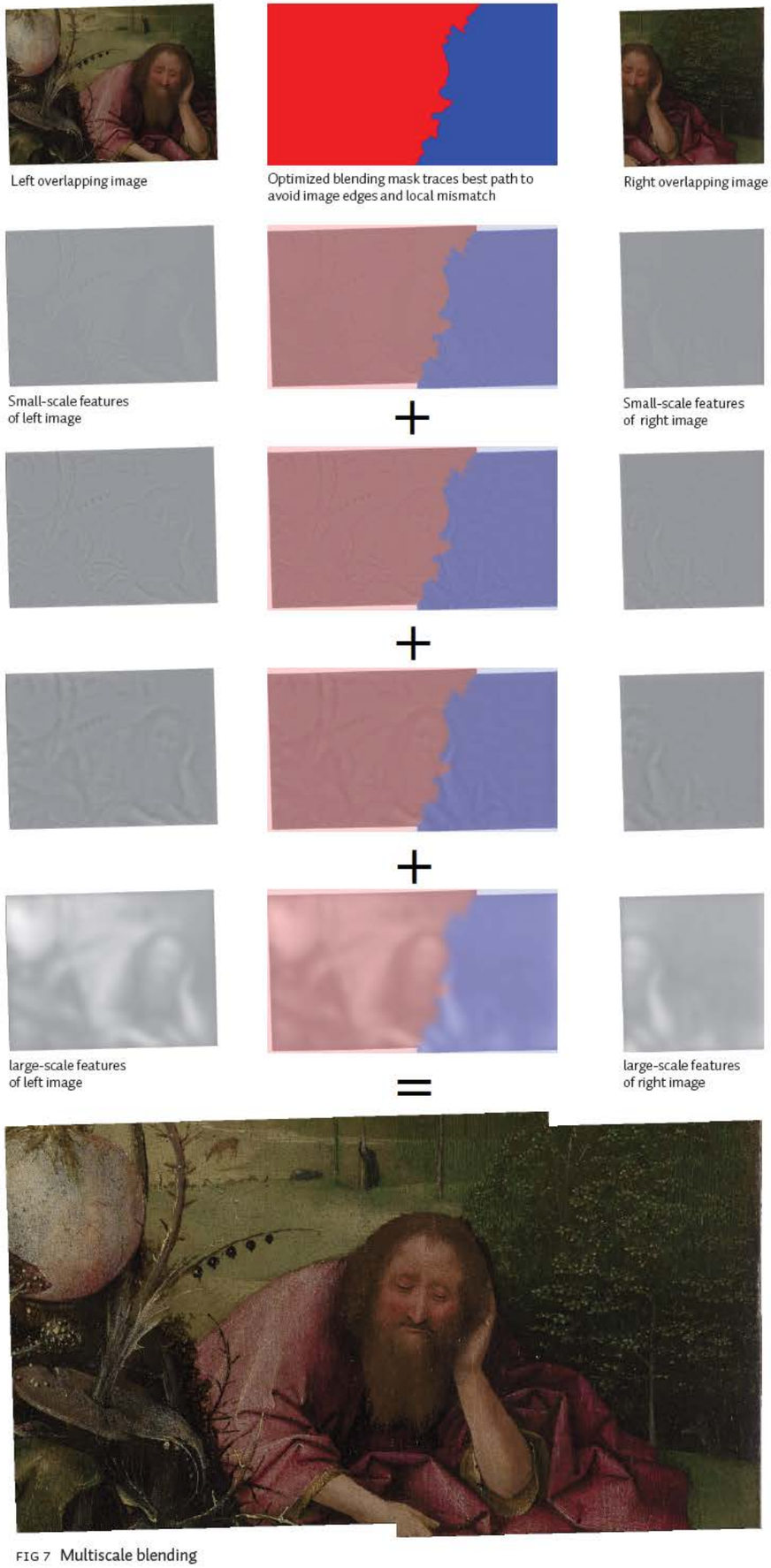
The consequence is that simple blending between two images would result in one of two types of competing artefact depending on the strategy adopted. The basic problem is that when a pair of images A and B overlap, they will typically disagree about the exact colour of any given pixel in their overlapping regions. Consider first an algorithm in which pixels from image A are used on one side of a dividing boundary curve running through the overlapping region, and pixels from image B are used on the other side of the curve. In this approach, no compromise is made between the two versions of an overlapping pixel; a given pixel in the final image is owned either by image A or by image B. If the two images differ about the pixels along the dividing boundary, such as might be the case with slightly different illumination conditions across each image, the result will be an unacceptable jarring discontinuity across the dividing curve. This problem might then lead one to consider an alternative simple algorithm in which, rather than simply choosing from the pixels of image A or image B on either side of the dividing curve, one smoothly fades from the pixels of image A to those of image B, with the relative weights of the two images varying continuously across the dividing curve. Such a strategy would smooth the discontinuity, but would tend to introduce unacceptable 'ghosting' artefacts due to slight feature misalignment of the images in which misaligned features from one image would appear to fade out to nothing across the blending line, and misaligned features from the other image would appear to fade in from nothing.

From the foregoing, it is clear that neither strategy is acceptable on its own. An ideal algorithm would be designed so that slight differences in lighting from one image to its neighbour are smoothed out to remove any visible discontinuity across the boundary between the two, while detailed features are transitioned abruptly to avoid ghosting artefacts. In other words, large-scale image features such as gradual lighting trends should be blended into each other gradually over a large distance across the blend line, medium-scale features should be blended together over a medium distance, and small-scale features should be blended together over a small distance. Furthermore, in an ideal algorithm the blend line should be chosen to minimize the difference between the pixels of the two images so that small-scale features are not cut mid-feature.

To blend together a large collection of images, the images are first clustered into rows according to their global *y*-coordinates. For each row, blending proceeds sequentially from left to right, so that each row is assembled by accrual of successive images onto the growing row. After each row has been stitched, the individual rows are stitched together starting with the top row and adding sequential rows moving downward until finally a whole-painting stitch is obtained. Thus, at any given time the blending operates between a pair of images. This two-step pairwise blending operation embodies both of the advantageous properties described above. The first step involves finding the optimal blending line between the images. The pairwise blending algorithm we apply to blend same-mode images together into a seamless whole-painting image proceeds in two main phases. First, an optimum blending line is found between any given pair of overlapping images, after which a multiscale procedure is used to blend the images together.

Finding the blending mask

When a pair of images is blended together into a single image, the colour of the final pixel can be expressed as a linear combination of the colours of the source images. Considering a single channel of a single overlapping pixel of a pair of images A and B, we denote the respective intensities of the two images as I_A and I_B, and the final combined channel intensity as I_C. We further denote the fractional contribution of image A to the combined pixel intensity as f_A, so that we can simply write $I_C = f_A I_A + (1 - f_A) I_B$. Taking all the pixels in the overlapping region together, it is seen that the contribution of image A to the blend can be represented as a greyscale blending



Each image is decomposed into a sum of images with features of different sizes.

Small-scale features blended with a mask that transitions over a short distance.

Large-scale features blended with a mask that transitions gradually over a long distance.

Final seamless blend avoids ghosting artefacts or seams due to lighting-angle differences.

FIG 7 Multiscale blending

mask containing f_A values: pure black and pure white areas represent areas where only images B and A contribute, respectively, while grey areas represent pixels where the final pixel intensity is a weighted average of the two.

The baseline blending mask between a pair of images is created using the so-called 'nearest feature transform' (NFT). First the exact geometry of the overlap region is determined from the overlap of the image masks of the two input images. For each of the pixels in the overlap region, there is a distance to the nearest non-overlap pixel of image A and a distance to the nearest non-overlap pixel of image B. Pixels that are nearer to image A are 'owned' by image A and are made white in the mask image, while pixels nearer to image B are owned by image B and are black in the mask image. The effect is that the boundary between the white and black regions stays as far away from the edges of each image as possible. This is preferable because perspective distortions and edge artefacts from resampling are greatest at the edges of an image, and with this algorithm, all other things being equal, when a contested pixel is close to the original edge of one image but far from the original edge of the other image, the pixel from the second image will be used.

The baseline mask is constructed without regard to the discontinuity that may exist across the blending line, so an additional optimization step is performed on this mask. First, the mask is converted to a polygonal path by extracting the contour of the black–white boundary as a sequence of lines between points on the boundary. A 'local cost image' is computed within the overlap area as the colour difference between the pixels of the two overlapping images plus a scalar times the absolute difference between the distances to the nearest non-overlap A-image pixel and the nearest non-overlap B-image pixel, the latter representing a cost for deviating from the original image-edge avoiding path. The value of this scalar can be increased to give greater importance to the goal of avoiding pixels near the image edge. A simulated annealing optimization[10] is then performed by successively perturbing the curve locally normal to its path and integrating the local cost along the entire path. In the typical case in which the contour is an open curve, the positions of the endpoints are fixed during the optimization, while for closed curves all path points are mobile. At the conclusion of this simulated annealing step, Dijkstra's algorithm[11] is used to find the optimal pixel-scale path between successive points on the path using the same cost image as with the simulated annealing step. As shown at the top centre of figure 7, using red en blue to denote the resulting regions, the output of this step is a full-scale binary image of the final blending mask.

Multiscale blending

The blending-line optimization of the previous step ensures that there is a minimum of mismatch across the blending line, but in the case in which large-scale lighting trends differ between the two images, even this path would still display a considerable discontinuity across the blending line. As mentioned above, large-scale features of the two images should be blended into each other over a large distance, while small-scale features should be blended over a small distance.

To effect such a result, we use a multiresolution spline technique to perform image blending, the main concept of which was first detailed by Burt and Adelson.[12] Each of the input images can be imagined as comprising a sum of different images each containing features at a particular range of scales. The basic idea of the blending algorithm is first to decompose the two input images into a stack of images with features at different scales. This scale decomposition takes a single image and expresses it as a sum of several images, each of which contains features of only a certain scale. A simple pixel-wise addition of these images then reconstructs the original image, so this decomposition is completely reversible. To blend the images, this decomposition is performed on both input images. Next, the blending mask image is expanded into a stack of blending images with increasingly gradual transitions between the black and white regions. At each scale, the corresponding images from image A and image B are blended together with the corresponding mask in order to arrive at a hybrid of the two images at that scale. The resulting stack of hybrid images at different scales is then added together pixel-wise to arrive at a final blended image with no visible seams. FIG 7

Whole-painting mask application

The result of the whole-painting blending procedure is a high-resolution image spanning the whole painting, but some regions are still undesirable since they may capture the painting frame or details of the easel or background. To remove these regions, we also resample the whole-painting overview image's mask channel by applying its global homography (as determined during the global optimization step; recall that although most of the geometric parameters of this image were anchored during optimization, the scale was a free parameter in order to enable the scale of the high-resolution tile images to dictate the final scale). The resulting full-scale painted surface mask is then rescaled to occupy a gamut of 0 to 1, and is used to multiply the blended image pixel- and channel-wise. The result is that areas outside of the painted region are blackened, and the result of interpolating into the mask from the lower-resolution overview image is that the full-scale mask has a gradual transition from black to white at the boundary of the painted surface, resulting in an aesthetically pleasing border.

Local alignment improvement through modified digital image correlation

The geometric optimization of the placement of individual tile images relative to each other utilizes homographies because they represent the space of all possible transformations of a planar image captured by an arbitrarily positioned camera. For most purposes, this approach is sufficient, but the special system we developed for visualizing images across image modes is especially demanding since even a few pixels of misalignment between images from different imaging modes can be jarring.

Almost all of the assumptions associated with the use of homographies for describing image geometry are violated to some degree by real-world images of paintings. The assumption that the images from different imaging modes are all coplanar is not strictly true, and the failure of this assumption causes slight misalignments between the images. The reduced scattering of light in the near infrared causes a deeper penetration of the light into the paint layers, so the non-zero thickness of the paint implies that visible-light images capture the painting at a greater distance from the support than infrared images; hence, parallax effects can be an issue. Paintings are never perfectly flat, and some panel paintings suffer from severe warping, so that non-linear stretching can occur as the camera moves, with different stretching observed between cameras with different working distances and fields of view. Additionally, we have observed that for scanning cameras such as our InGaAs Osiris infrared reflectography camera, non-uniformity in the scanning speed in the horizontal direction and slight randomness in the vertical displacement between scans even violates the assumption that within one image all pixels are the same shape and size.

Hence, the need for precise pixel-level alignment across imaging modes and the inability of homographies to provide the necessary flexibility led us to develop a final pixel-scale registration refinement algorithm.

The problem of registering images across different imaging modalities is particularly challenging since there is typically little in common between these images, and a feature that is present across two imaging modes may be dark in one image and light in another. The overall approach we take is based on three key observations: first, craquelure patterns are typically dense, distinctive, and are captured across all imaging modalities; second, although non-crack features may have very different appearances across different imaging modes, the geometric pattern of feature *edges* tends to be similar; and third, after application of the homography-based registration procedure described above, the local shift needed to achieve near-perfect registration is both small in magnitude and slowly varying spatially.

Our registration refinement algorithm proceeds in three steps.

In the first step, we extract the edges from each of the input images, resulting in a pair of 'proxy images' from which a registration displacement field will be computed. In our source images, the original images are typically captured at different resolutions, so that once the images have been resampled to the same dimensions, the sharpness of edges in different modalities may be different. For example, the infrared reflectogram images

are captured at lower resolution than the high-resolution visible photographs, so their edges are less sharp. In order to facilitate direct comparison, the proxy images should be as similar as possible, so to extract the edges we utilize scale-space theory[13] to compute the magnitude of the gradient vector at some scale, where the scale over which the gradient is computed is permitted to differ between the two images to compensate for resolution differences. To compute a scale-space gradient at some scale σ, one convolves the image with a Gaussian kernel of standard deviation σ and then computes the gradient vector in the normal way by computing x- and y-derivatives of the blurred image; due to linearity this is equivalent to convolution with the x- and y-derivatives of a Gaussian kernel, so it can be seen that this effectively extracts edges by highlighting areas where the image changes in brightness over a scale σ. FIG 8

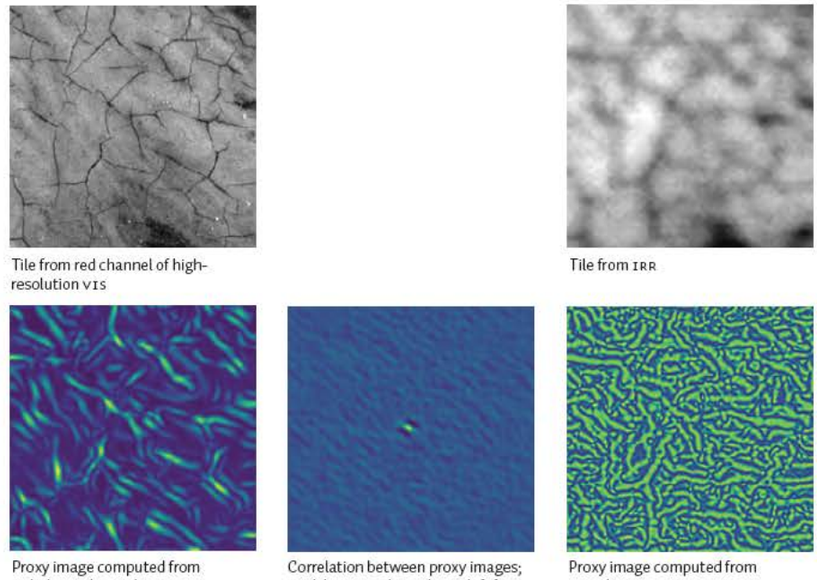
To select the ideal spatial scale for each of the images, the algorithm extracts a patch from each of the images; colour patches are converted to greyscale. A search is then performed over a regular grid of scales for both images to find the blurring scales σ_1 and σ_2 yielding the highest value of the maximum peak correlation between the two scale-space gradient-magnitude images. These values of the scale parameters are then used throughout the registration refinement procedure.

With the optimum blurring scales selected, a proxy image is computed from each source image by computing the magnitude of the gradient vector at their respective scales. The resulting images highlight both craquelure and the edges of features and therefore tend to be quite rich in distinctive detail.

The second step of the algorithm is to make a first pass over a coarse grid of adjacent square image tiles from the proxy images, with typical tile dimensions of 500 px on a side, resulting in a sequence of pairs of tiles from matching grid locations in the two proxy images. This tile dimension is chosen empirically as being large enough to capture sufficient local detail even in relatively nondescript areas of the image while also being small enough to allow for sufficient spatial variation of the relative offset across the entire painting. If the images were perfectly registered, these tiles would closely match since they ostensibly capture the same features in the different imaging modalities. However, slight misregistration between the images implies the need to shift one tile relative to the other to achieve the best match between the two tiles. To find this shift, we first compute the normalized correlation between the images as a function of the relative x- and y-offsets between the images. For any given shift, those pixels not contained in the overlap region are ignored, and the normalized correlation is computed as the inner product between the overlapping portions of the image divided by the products of the Frobenius norms of the overlapping portions of the images. For some given offset, this normalization scheme effectively computes the cosine of the angle between the images in a space with a dimension equal to the number of overlapping pixels; hence, images which are scalar multiples of each other will have a normalized correlation of unity, and the normalization scheme enables a comparison of match quality between different relative shifts, even though they have different numbers of pixels in their overlapping regions.

To incorporate our prior belief that the offset across imaging modes is typically small, we frame the problem of estimating the tile offset in terms of Bayes' Law. The correlation field between the two tiles is treated as an estimate of the relative likelihood of different offsets between the image tiles. Our prior belief is that offsets should be relatively small, and without additional knowledge we have no reason to think that any given direction should be more likely than any other. For simplicity, we assume a two-dimensional symmetric normal distribution with zero mean and a standard deviation of 50 pixels for the prior probability of the offset. According to Bayes' Law, the posterior estimate of the relative probability of different offsets is then computed as the product of the likelihood and the prior. The resulting posterior image assigns increased probability to small offsets since tall peaks in the likelihood are reduced when multiplied by the low values on the tails of the normal distribution in the prior. The offset corresponding to the location of the maximum of the posterior image (the so-called *maximum a posteriori* [MAP] estimate) is then used as

FIG 8 Bayesian registration refinement using proxy images



an estimate of the local offset between the two tiles. The estimation procedure is repeated across the coarse grid for each of the tile pairs, resulting in a painting-wide map of estimated *x*- and *y*-offsets needed to bring the original images into registration.

Despite the use of the prior estimate to give increased weight to small offsets, the results from the first step typically contain many erroneous offsets since the posterior images contain several local maxima and only the global maximum is extracted. When such an error occurs, the nearby points typically contain a better estimate in aggregate because the relative offset between different imaging modalities varies slowly spatially. Thus, at any given point in the coarse grid, the estimated offsets from nearby grid points can be used to form an improved prior belief about the local offset. The next step of the algorithm is to compute this improved prior belief. We first median filter the offset field from the previous step with a 3×3 median filter, and then perform weighted spatial averaging with Gaussian filter with a standard deviation of 1 coarse grid point.

With the improved estimate of the mean of the prior distribution extracted from the spatial averaging of the first pass, we make a second pass over the grid using the same strategy. The normalized correlation between tiles again serves as an estimate of the relative likelihood of different offsets. For the prior distribution, we again use a normal distribution for simplicity, but for this second pass we take the mean of the distribution from the smoothed output of the first pass and reduce the standard deviation to 35 pixels. The product of the likelihood image with the prior image results in a refined posterior distribution for the possible offsets, and the shifted mean of the prior distribution tends to assign increased probability to offsets which are similar to those from nearby grid points. The maximum of this posterior distribution is taken as the final estimate of the local offset for the given pair of tiles. The procedure is again repeated across the entire coarse grid, resulting in a refined whole-painting estimate of the local offset.

The next step of the algorithm takes the offset estimate on the coarse grid and upsamples it using bicubic interpolation to the dimensions of the whole-painting images. This results in a pixel-wise estimate of the offset needed to bring the second image into registration with the first.

To apply this to the second image, the transform is inverted, and each of the mosaic images is again resampled from its original photograph by stepping over a rectangular grid of world-coordinate system pixels, applying the inverse of the small warping transformation and then applying the inverse of the image's homography to that in order to obtain an array of image-local coordinates. As with the first resampling step, high-order

Lanczos interpolation is used, resulting in a high-quality set of transformed mosaic images. The multiscale blending procedure described above is again applied to merge the images into a whole-painting image. Although computationally intensive, this procedure ensures that the final images are formed from the minimum number of resamplings of the source images. In cases where conservation-grade images are not needed, one can also apply the upsampled distortion field directly to the whole-painting image through a second resampling step.

Visualization

The principal motivation for performing the many steps needed to stitch and register the images is to enable art historians, conservators and, ultimately, the public to see the artworks as accurately as possible and in exquisite detail in order to make a wide variety of comparisons. The need for public access and the distributed nature of the Bosch project itself offer a strong incentive to make the images available online with a modern web browser being the only software requirement.

At the beginning of the project, the state of the art in web-based visualization of images was not able to present the images in the most direct or intuitive way, so we designed a new suite of visualization tools for presenting the images, with the main philosophy being to align all aspects of the design to aid in comparisons between images. A typical museum presentation of a work of art lacks many features that we feel are essential for aiding comparisons between images. First, the images are typically presented in a small window and at low resolution and, to make matters worse, the images are usually surrounded or overlaid with distracting menus, logos, advertisements, and other elements which visually interrupt the focus on the artwork by forcing constant context switching. Second, they do not make it easy to place random images side by side or to explore more than one image type together. Third, zooming and panning operations are typically done suddenly, teleporting between zoom levels or positions without showing the image in intermediate states, forcing context switching by breaking the continuity of the presentation and forcing the user to spend a moment understanding the exact relation of the old image to the new one. Fourth, when pre-selected images are placed side by side, one is typically not free to move them independently or to synchronize them, and a side-by-side mode is typically the only option available. Given the short span of our visual memory, even this mode can be problematic when making careful comparisons since changing focus from one image to another takes about as long as we can hold images in our minds.

Our solution to the problem of limited visual memory and forced context switching was to develop a new viewing technology which we called the 'curtain viewer'. The first element of our approach is always to present any images in fullscreen, without any distracting logos, borders, image controls, or other visual elements which might cause context switching. In order to maintain context, zooming and panning movements across the images are always done smoothly in order to maintain a continuous context for the viewer. Image mode changes are done via keypresses or via a normally hidden pull-out menu.

The curtain viewer has several modes to facilitate different kinds of comparison. In the curtain viewer's main 'curtain mode', multiple registered images of the same work of art are overlaid on each other and cropped dynamically according to the current mouse cursor position, enabling the viewer to effectively peel one image away to reveal another while looking at the same position on the screen. This overcomes the problem with limited visual memory and reduces context switching. In another mode, any number of images can be juxtaposed and zoom and pan synchronization between images can be toggled. In yet another mode, any of those images can be shown exclusively, or the viewer can be placed into a fading mode where the images can be mixed together dynamically with a weighted average that depends on the position of the mouse pointer. In the case of raking-light images, one mode allows a dynamic virtual light source to be attached to the mouse cursor, enabling the user to obtain an intuitive sense of the three-dimensionality of the work. In cases such as the comparison between an original painting and a close copy, the viewer allows a 'rolling registration' sub-mode whereby the images are translated to maintain exact alignment under the mouse cursor.

FIG 10

FIGS 1, 9

FIG 9 Curtain viewer: the side-by-side mode shows the same area of the painting in each user-selected imaging modality.

Usability of the online viewers is enhanced by another feature where any change in the mode or placement of the images is reflected immediately in the URL, enabling easy bookmarking or sharing of a particular view. Arbitrary HTML overlays can be added to the views on a per-image basis, for example to enable displays of the scale of the view or of a label of the image type.

Conclusion

We have developed a comprehensive system for making full use of the standardized multimodality imagery collected across the Bosch oeuvre. It enables simultaneous intra-wavelength seamless stitching and inter-wavelength registration with sub-pixel accuracy. This accuracy in turn enables the use of a new 'curtain viewer' visualization technology developed especially for the project, so that the final result is a very high-resolution multimodal tool for making subtle comparisons across all of the works of Hieronymus Bosch.

FIG 10 Curtain viewer: in 'curtain' mode the division between the panes follows the mouse cursor.

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BRCP RESEARCH

REPORTS

1 *Saint Jerome at Prayer*

RESEARCH REPORT 2

Hieronymus Bosch
c. 1485–95

Oil (not analysed) on oak (analysed) panel, 80.0 × 60.7 cm
Museum voor Schone Kunsten, Ghent, 1908-H

The painting was restored in 2015–16, thus after the 2010 BRCP technical examination on which this report is largely based.
BRCP, *Catalogue Raisonné*, cat. 1; www.boschproject.org no.1.

Inscriptions and labels
Reverse: two wax seals, three labels. The wax seals were removed from the original reverse when this was thinned, and adhered to the thinned reverse after the cradling treatment. Some of the original wood is still attached to the back of these seals.[1]
On frame, top centre on built-up reverse: *BOSCH 1908-H*

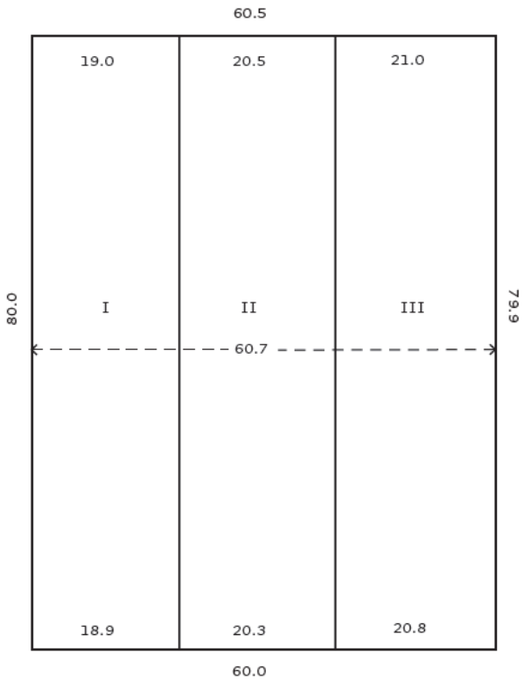
SUMMARY OF CONCLUSIONS

The technical evidence is in full agreement with the attribution of the Saint Jerome *to Hieronymus Bosch. The painting technique, style and material of the underdrawing, and traces of a creative process in all stages of its production place the panel in the core oeuvre, without indications of any workshop involvement.*
The work was originally housed in an engaged frame, now lost. The panel was slightly cropped at the top and bottom. Dendrochronology indicates that it could have been painted from 1476 onwards, although a date after 1478 is statistically more probable. As further explained in BRCP, Catalogue Raisonné, *cat. 1, we date this work to around 1485–95.*

EXAMINATION DATA

22–24 November 2010 (Luuk Hoogstede, Matthijs Ilsink, Jos Koldeweij, Ron Spronk).[2]

The painting was examined out of its frame, both upright on an easel and flat on a table, under strong illumination. Both front and cradled reverse were easily accessible.



1.1 Construction diagram (seen from the front)

- ***Previous research and additional documentation available*** The Ghent Museum holds several files with information on the painting, including a technical research report from 1950. A cross-section was taken then and XR was done. IRR was conducted by Molly Faries in 1999 and by Arie Wallert in 2009. Photography and IRR (OSIRIS camera) was also done by Ghent University's Interdisciplinary Centre for Art and Science (2010).
- ***Previous treatments*** The painting was acquired in 1908 and might have been treated around that time. From pictures taken during the 1950 examination, it appears that the panel has not been treated between then and the 2015–16 treatment.

SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 1.1). The painting was cropped at the top and bottom. The wood species, Baltic oak, was confirmed by dendrochronological analysis. The panel consists of three quarter-sawn planks, vertical in grain, laid vertically.

  The planks are glued and butt-joined; no dowels are visible on the thinned reverse or in the XR.

  The reverse is not in its original state, having been thinned and cradled. Two small areas of the original panel's reverse, underneath the transferred wax seals, have survived. The seals were affixed to the current thinned reverse.
- ***Dendrochronology*** The youngest growth ring dates from 1465, which, with the minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1474 for the tree that provided the wood for that plank.[3] A felling date after 1476 is statistically more probable, however, since 93 per cent of the possibly missing sapwood rings would be covered by this range. Assuming an additional minimum of two years for drying and transportation, the panel could have been produced from 1476 onwards, although a production date from 1478 onwards is statistically more probable.

GROUND

- ***Visibility*** The off-white coloured ground (not analysed) is present overall and visible in VIS and XR. It is almost completely covered by the paint layers, but shimmers through in specific locations (e.g., in depictions of water [see fig. 1.2], sky and architecture). Partially, this appears to be a deliberate result of the painter's working method. In other areas, however, it seems unintended and caused by the ageing and increased transparency of paint layers. The ground is also visible in cracks and where the paint layers are damaged.
- ***Barb and edges*** Barbs and ungrounded, unpainted edges are present on the left and the right and indicate that the painting originally had an engaged frame. The barb on both sides is slightly damaged and not distinctly raised. The unpainted, ungrounded edge is c. 1.0 cm wide

RR 2 (photo courtesy KIK-IRPA, Brussels)

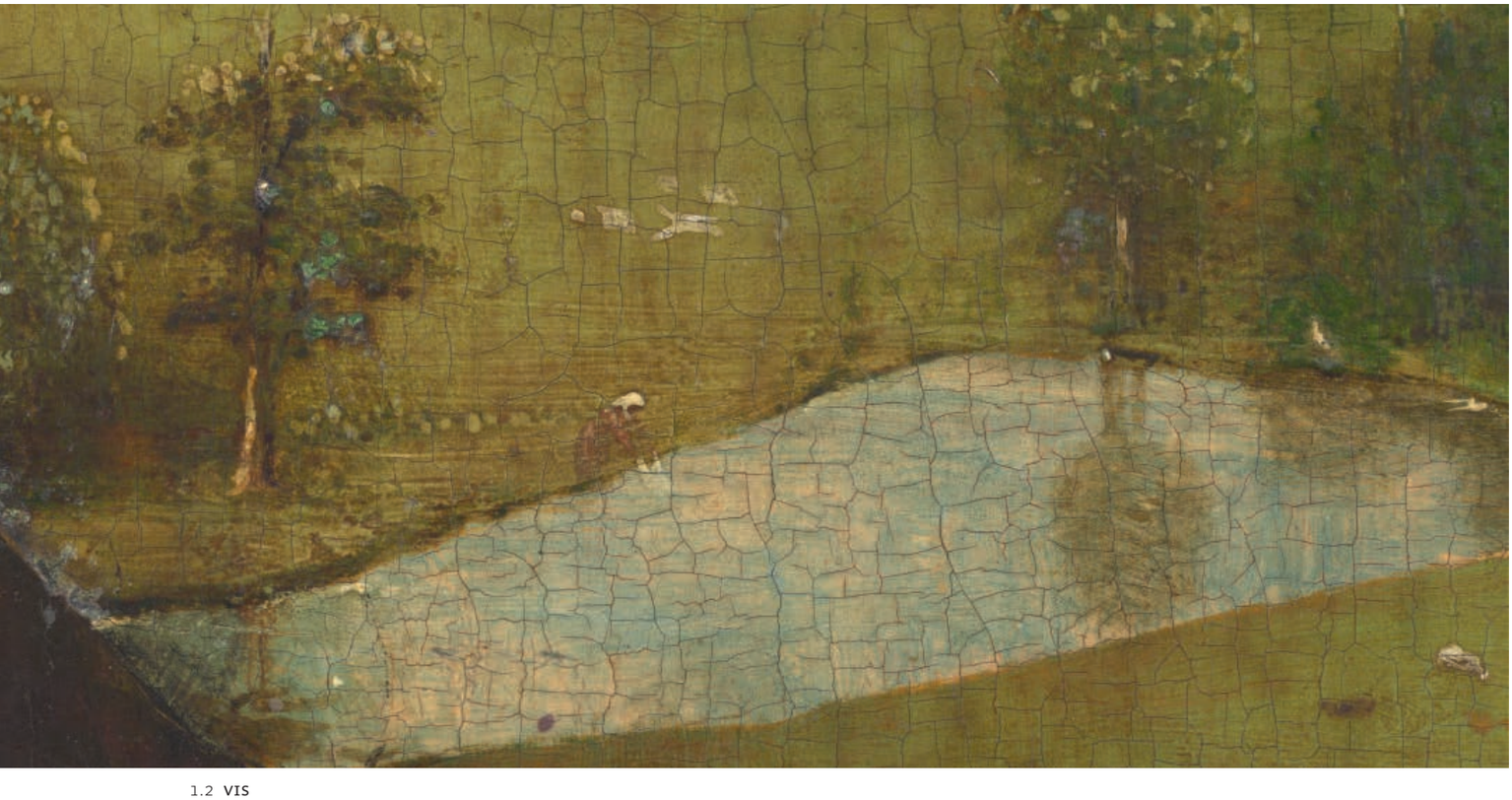
RR 2, **reverse** (photo courtesy KIK-IRPA, Brussels)

on the left and measures 0.8–0.9 cm on the right, from top to bottom. The absence of barbs and unpainted edges at the top and bottom implies that the panel was cropped there (see also *Altered dimensions*).

- ***Application*** The ground is evenly and thinly applied by brush and worked into a smooth finish, with brush marks slightly visible in VIS, IR and XR. The surface texture of the wood support is not apparent.

PREPARATORY LAYERS

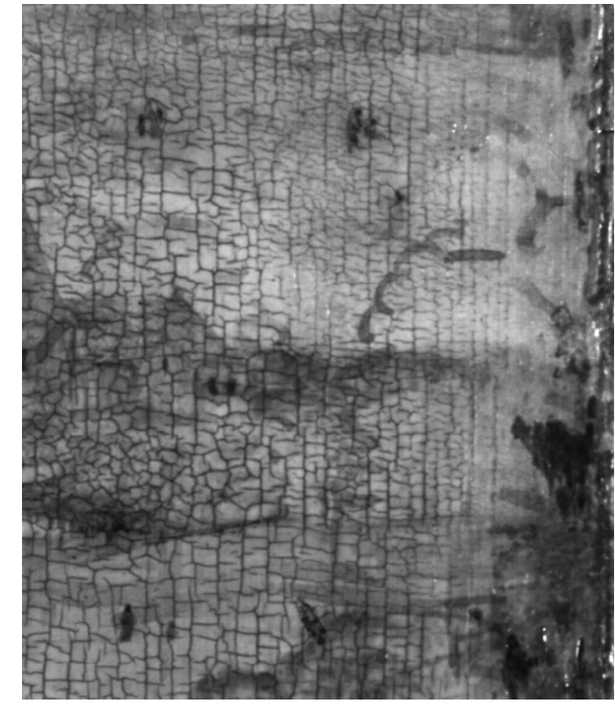
- ***Underdrawing*** Present throughout the composition (fig. 1.3). The underdrawing, most elaborate in the figure of Saint Jerome, is visible in VIS and in IRR/IRP, although it is obscured or partly obscured by dark paint in several larger areas (mainly in the centre left and lower left, but also in some linear elements such as the lower contours of Jerome's left arm, chest, and left leg). Underdrawing was also observed in the background, where it was used to indicate the planes in the landscape as well as several individual trees. The contours of the main compositional elements and some smaller details, such as the cardinal's hat in the lower right, are underdrawn. Some modelling was also prepared in Jerome's garment and his cloak. The function of the parallel diagonal lines on Jerome's lower legs is difficult to establish, since the composition was corrected here and these lines might well relate to an earlier position of the white undergarment (see below, *Revisions …*). Many other elements in the foreground (the crucifix, the owl, the fox and the chicken, the lizards, and the bible) were not prepared in the underdrawing. The underdrawing is visible with the naked eye in places, but it was probably not intended as such, since it often deviates from the painted contours. Therefore, the current visibility of the underdrawing is most likely caused by changes in refractive index due to the ageing of the paint film.
- ***Medium and application*** The detectable underdrawing is applied with a relatively broad brush in an aqueous medium (not analysed), possibly a diluted ink or a finely ground carbon black in a watery



1.2 **VIS**

1.3 IRR

1.4–5 IRP and VIS



1.6 IRP

medium. A first-stage underdrawing in a dry medium has not been observed. It is possible that the brush underdrawing here was applied in multiple stages, with the main contour lines being applied first, followed by some modelling.

- ***Style*** The underdrawing was freely applied in a sketchlike manner, and the liquid medium gives the relatively broad strokes a painterly feel. Longer contours are often drawn in multiple shorter lines that are sometimes broken up, or 'stitched' – for example, in the drawn upper contour of the far peninsula in the lake (figs. 1.4–5). Preparation of shading through hatching is mostly absent, with the exception of areas in the saint's red cloak and on his body, and possibly also in his white undergarment. In one part of the cloak, a small area of shading was prepared with parallel diagonal lines (see fig. 1.7, top left), while in other parts shade is indicated by broad wash-like underdrawing in the watery medium (fig. 1.7, centre right). The underdrawing here is easily confused with black paint mixed in the (now partly faded) red lake in its heavier contours and folds as well as in the darkest areas recognizable by a duller, purple-red colour. Dense parallel hatching was observed extending down from Jerome's waist, but this could also be related to the possible preparation of longer folds extending downward from the waist (fig. 1.8). The underdrawing is generally not worked out to a high degree, but in some areas it is surprisingly detailed, especially in the figure and the garment of Saint Jerome. His tonsure seems to be indicated with some short, thick lines, and the onset of his left arm and the folds of his garment are elaborately prepared.

  The underdrawn line ends are usually blunt or tipped, without hooks or loops. The contour of the foliage of a tree in the right middleground, which was omitted at the painting stage, was indicated with short, curved lines (fig. 1.6). The lines themselves may be curved, depending on the feature drawn (e.g., in foliage and in the scales on the skin of the large red fruit to the left of the saint). Occasionally a 'puddle' of ink is distinguishable at the end of a line.

- ***Revisions in underdrawing and differences from painting stage(s)*** The underdrawing was not followed closely in the paint application phase. Several elements were not underdrawn but only executed in paint, while others were underdrawn but not painted, or painted differently. Examples of elements that were not prepared in the underdrawing are the large tree at the top left (figs. 1.4–5) and the crucifix between Jerome's arms, both of which were added in a later phase of painting. To the right of Jerome's waist, two rounded lines are discernible in the background, probably indicating that the red robe was planned to extend farther to the left. In the underdrawing, the white robe extends quite a bit farther towards the foreground, perhaps also partly covering his left leg, but it was not carried out that way in the paint phase.

  In addition to these larger changes, there were also numerous smaller changes relating to slightly shifted contours and features that were enlarged or made smaller. Jerome's red cardinal's hat was underdrawn slightly smaller. The curious shelter with the elements on top was largely planned, although numerous smaller details were altered, such as the thick, arched stone slab, which was drawn smaller. The rock to the left with the rectangular hole was more detailed in the underdrawing, and had a clearer front. Instead of the rectangular hole, only a round hole was prepared higher and smaller, and without the thorny branch. The scales in the skin of the large red fruit to Jerome's left were scalloped in the underdrawing, but were not painted that way.

  Similar changes can be observed in the middleground and the background landscapes. To the right of the church, which was not underdrawn, several large trees were planned. A road leading up to the church in the same area was perhaps drawn more to the left. Underdrawn lines can be seen to the left of the church, possibly indicating its initial position. Similarly, underdrawn lines can be seen in the water above the farmhouse, perhaps indicating the initial position of that structure, since it was not underdrawn.

1.7 IRP

1.8 IRR macro

PAINT LAYERS

- ***Paint application and painting technique*** The oil paint (not analysed) was applied using a brush and extends onto the edges and on to the barb. It was applied in several stages, mostly wet-on-dry, but sometimes wet-in-wet (e.g., in the thorny 'branches' atop the floating red object at the lower left and in Saint Jerome's toes).

  The wet and glossy paints were applied in both opaque and transparent layers. Glazes were done in red (in the round object floating in the water, the large fruit to the left of the saint, the robe, and the hat), green (in lizards and parts of the landscape – mostly discoloured except for some remains covered by the frame's rabbet), and brownish hues. The artist painted in both a fine and a rougher manner, mostly in a few thin layers, although thicker paints created more impasto. The paint application was hardly sketchlike; almost everything is covered and detailed.

- ***Texture*** Most passages have a relatively smooth finish, but in some areas the modelling and texture created impasto (e.g., in the thicker layers of vegetation and Saint Jerome's hands and ear, fig. 1.10). Brushstrokes are often visible and generally follow the underdrawn contours (e.g., in the lion), even when they are painted in a less linear manner (as on the larger red fruit to the saint's left). In the water of the background, textured vertical brushstrokes of a lead white-containing underlayer are visible in the XR and VIS.[4]

- ***Build-up and palette*** The paint layers were mostly built up from light to dark and painted from back to front. Glazes and highlights were painted last, and finally some contour lines were locally reinforced, sometimes also in black paint, as in Jerome's chest and knee. Ample black paint was used to mix with the colours for the darker, shadowed zones, such as the cave opening and the water below it; the hollow tree trunk; and the small, arched opening to the right of the thick, arched stone slab. With the exception of a narrow, darker zone in the mound behind the shelter, very little black paint was used in the landscape.

  A thin underpainting in a few basic tones seems to have been used to prepare the composition. Under the landscape, an ochre-coloured layer is distinguishable (fig. 1.16). The red hat and robe, for example, were apparently left in reserve during the application of this layer. That also appears to be the case with the lake depicted in the background. A thin, bluish underpaint was used to indicate the shrubbery in the left background and at the horizon (fig. 1.5). The underpaint shimmers through by design, but is also visible where the paint surface is abraded. Furthermore, the blue is noticeable through the later-painted tree at top left.

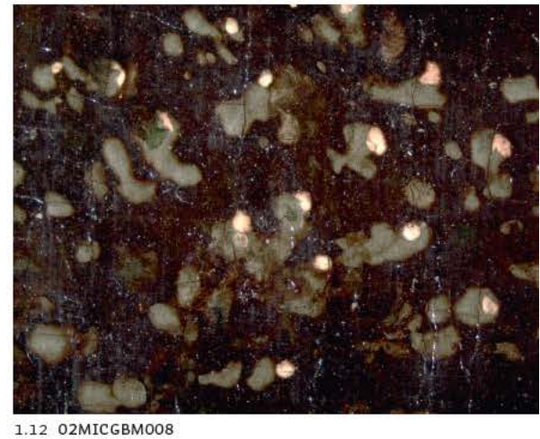
  The figure of Saint Jerome was possibly underpainted in an ochre colour before the basic fleshtones were applied. Then the white robe was painted followed by a thin semi-transparent light brown paint. In the final phase flesh-coloured paint mixed with red lake was used for important facial features (fig. 1.17). This mixture was also used very thinly in certain areas of the white robe to give the impression of fleshtones shimmering through. Finally, brown-black contour lines were added, which were also used to sketch physiognomic details. In the lighter areas of the red robe, the first modelling seems to have been done in a lead-white-based paint with medium impasto, the strokes of the stiff brush being clearly visible. It appears that the underdrawing also functioned to indicate where this lead-white underpainting was not to be applied. This was followed by a thin layer of red lake and subsequently a thicker red lake, mixed with some black for the darkest parts and some outlines. Some final contours were painted in black on top of the red lake while this was still wet locally.

  The white dots on the large red-skinned fruit to the left of the saint's hands were made with an impastoed white paint (containing some blue pigment particles), and afterwards glazed with a red lake. Then this fruit's green 'crown' was painted, with light green highlights and a white accent in between two 'leaves', and finally, black outlines and shadows were applied (see fig. 1.11). The red lake became unintentionally abraded at a later stage, exposing the topmost parts of the white impasto. For some cool-toned surfaces (e.g., the plant that seems to rest on the red-skinned object and the vertical stone left of it; fig. 1.14), the painter applied short dabs or dots of blue paint atop or next to textured white highlights. Some

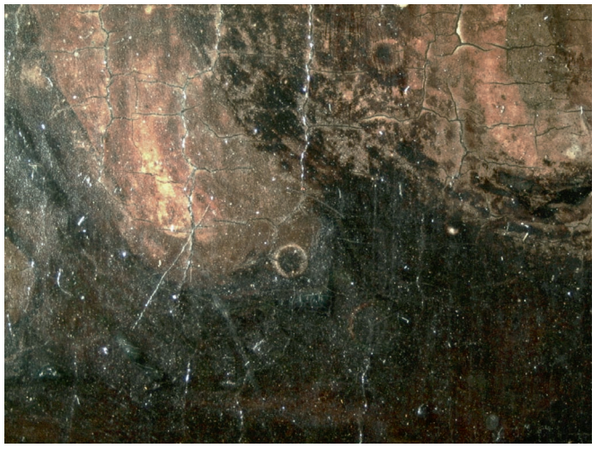
1.9 Mapping of micrographs reproduced here (1.10–15)

1.10 02MICGBM001

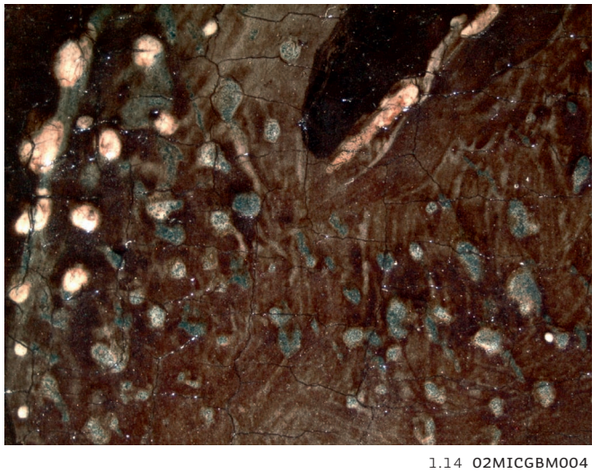
1.11 02MICGBM003



1.12 02MICGBM008



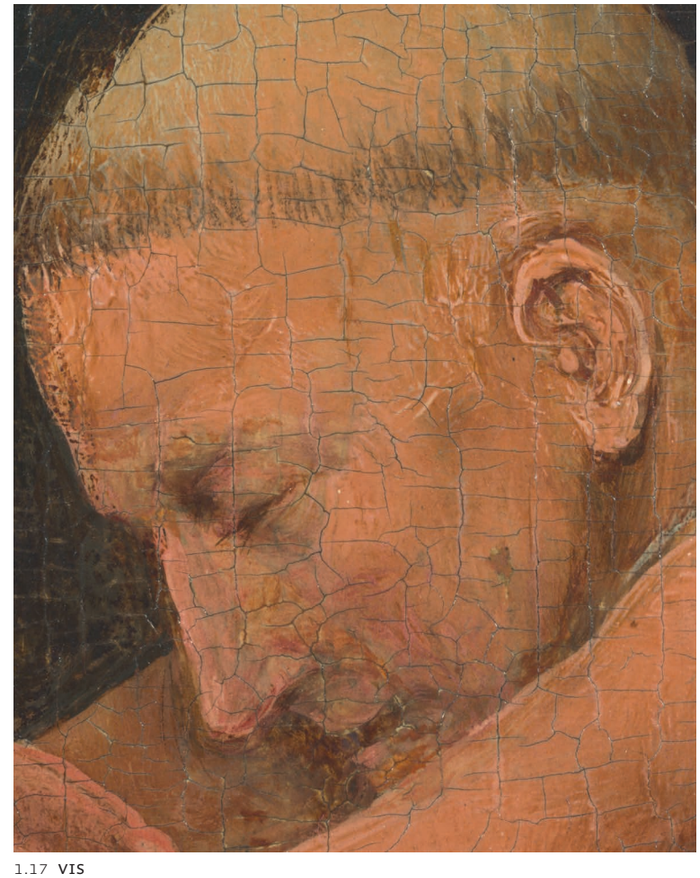
1.13 02MICGBM007



1.14 02MICGBM004

1.15 02MICGBM010

1.16 VIS

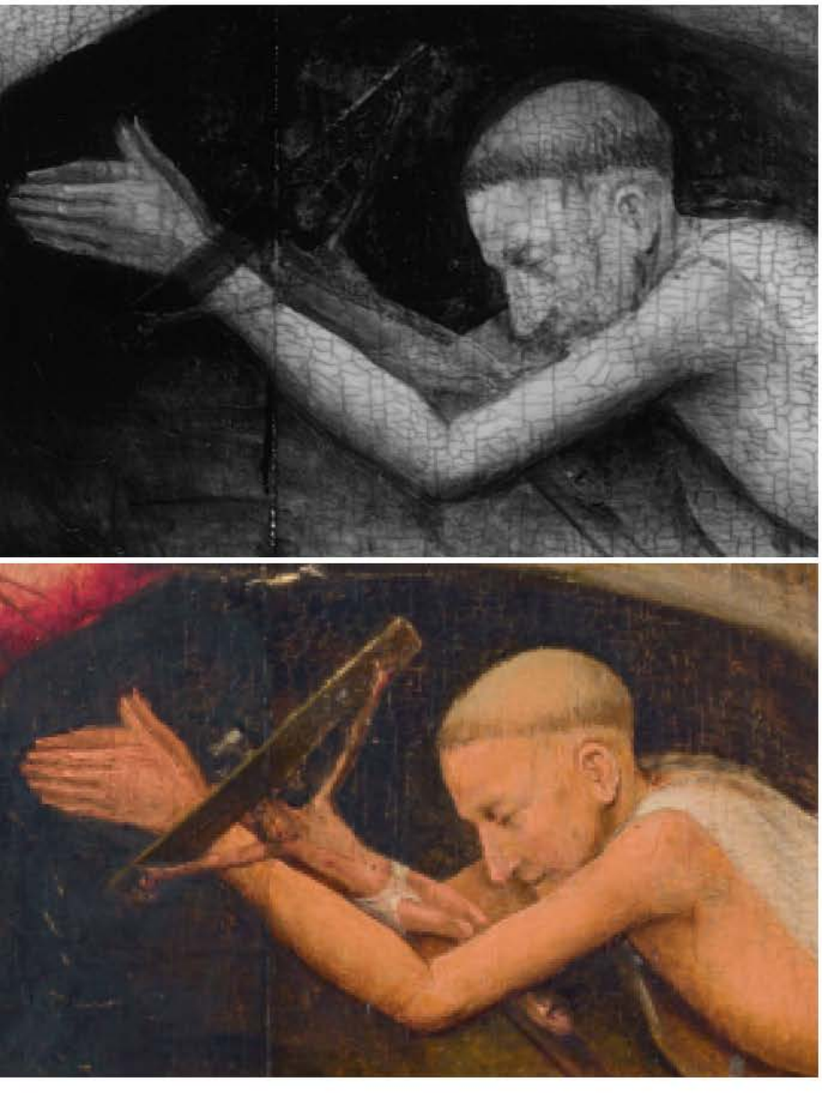


1.17 VIS

of the harder edges of these features were accentuated by additional white highlights, which in the plant were followed by the application of a green glaze that has discoloured to a brownish hue. The low brushes just under the lion (see fig. 1.12) were created by covering the underpainting with a brown layer, followed by green dabs and dots, white highlights, and green glaze, which again has discoloured to a brownish hue. For the trees at centre right, first a thin, dark green layer was applied, followed by white as well as green dots of paint, after which the white highlights and a green glaze (now discoloured) were applied. In the saint's crucifix a purple paint was used suggesting blood, which is most clearly discernible at Christ's left hand.

- ***Changes*** In the figure of Saint Jerome, the ample underdrawing was not closely followed. Some underdrawn features were abandoned at the paint stage, while other painted features were not prepared in the underdrawing. Jerome's crucifix was not planned in the underdrawing (figs. 1.18–19). It was added very late and painted over the already completed background and the saint's arms.[5] Jerome's head was made significantly smaller. His tonsure was painted lower than it was underdrawn, and his nose, and possibly also his mouth, were positioned a bit farther inward. His robe was also significantly changed, and the split exposing the left leg was initially painted in a higher position.

1.18–19 IRR and VIS



Other alterations are also discernible. The top edge of the rectangular stone slab with the lizard at the centre left was lowered, which is visible in raking light, in the XR, and in IRR. The opening of the hollow tree trunk to the right of the saint was extended to the left, the extension painted over the dark red lake of the cloak. Much of the background was also altered. The large tree to the left was painted only after the bluish underpaint had been applied. The foliage was then painted onto the tree trunk, which was made darker at the top, probably to contrast more with the light sky. Surrounding the farmhouse, much was altered as well (fig. 1.20). The very freely applied and roughly brushed-in white lead underpainting of the lake extends halfway through the lower tree line, which had initially been planned farther forwards, too, given the dark green paint shimmering through the field. The farm, in much the same manner as the church, was only added in a later phase.

FRAME

The original, engaged frame has been lost. The rectangular wooden frame (106.6 × 83.6 cm) is modern. It has a brown toning and a gilded inner edge of which the profile at the bottom (the *Wasserschlag*) is bevelled.

CONDITION

The painting was restored in 2015–16, thus after the 2010 BRCP technical examination on which this report is largely based.

Support

- ***Altered dimensions*** The panel has been cropped at the top and bottom. On the bottom to the right, the saw cut extends farther into the panel. The reverse of the panel has been thinned to about 0.5 cm to attach the cradle. At the bottom right of the reverse a deeper saw cut is present, possibly indicating where the wax seals were cut out.
- ***Additions*** A cradle was attached to the reverse of the painting. The vertical members were rigidly glued to the panel, in the direction of the wood grain. The horizontal members, which are supposed to slide, are jammed. The cradle members have a fairly regular spacing, with the exception of the rightmost (seen from the back) vertical members which are farther apart, perhaps to accommodate for the wax seals.
- ***Cracks*** At the front bottom centre, a vertical, slightly opened crack runs parallel to the wood grain, extending 9.5 cm from the bottom edge. This crack runs through the panel, ground, and paint layers and is still active. The crack was most likely caused by stress induced by the sliding members of the cradle being blocked, which inhibits the movement of the wooden panel. This build-up of stress could result in cracking of the wood adjacent to a glued vertical cradle member.
- ***Deformations*** The panel has a convex warp and undulates slightly. The left plank was reglued in an out-of-plane angle.
- ***Joins*** The joins between the planks are mostly closed but somewhat visible. From the damages along the joins (VIS, IRR and XR) it seems that the three planks of the panel have been separated in the past.
- ***Biological damage*** At the bottom, mostly to the right, some old woodworm damage is visible.

Ground and paint layers

- ***Stability*** The ground and paint layers are stable and in good condition, although there are several areas with slightly raised, tenting paint. Just above the tree stump, two patches can be observed with more pronounced but stable raised paint. Around the crack at the bottom centre the paint is less stable. Most craquelure is caused by natural

1.20 VIS

dimensional changes of the panels. The small, circular shapes visible in the lion (see fig. 1.13) and beneath Jerome's leg and appearing as small opaque points in XR are possibly related to lead soap aggregate formation. Expansion of the aggregates may cause them to protrude from the paint surface, resulting in minuscule raised spots and a more granular surface texture. Loss of such metal soap aggregates results in tiny, crater-like holes. A possibly related chemical reaction seems to be taking place between the oil binding medium and lead white pigments in the paint, for instance in the lighter areas of the red cloak, and sections of the sky, the water and the saint, especially his head and lower left leg and foot. The affected areas are opaque in the XR, and mostly follow the wood grain.[6]

- ***Losses*** Most losses are present along the joins and at the top and bottom edges of the panel, but some others can be found in other locations. They have mostly been filled and inpainted, except for the more recent ones around the crack. Larger scratches are present in the tree trunk in the left background and in Jerome's hat.
- ***Abrasion*** The paint surface is somewhat abraded overall, but especially at the highest points of the impastoed areas of skin tone and in the lead-white-underpainted areas of the red robe. The latter results in the presence of (unintended) lighter coloured lines where the red glaze has worn off. The black contour lines are abraded and the painted edges of the panel are slightly damaged. The area of the blue sky is more severely abraded, resulting in its current patchy appearance. The water and the landscape in the foreground appear to have lost some of their original finish. The unevenness in landscape and water seems to have been toned, but especially the landscape locally appears patchy, and the brown ground appears speckled.
- ***Discoloration and increased transparency*** The copper-green lakes and glazes have discoloured and turned brown. As a result, the lizards to the left and, presumably, large parts of the landscape look considerably browner than intended. The red lake, on the other hand, still seems to be in in good condition, although an underdrawn duck shimmers through the red lake paint at lower left (fig. 1.15).[7] An increase in transparency is especially evident in the paints containing lead white, which causes a greater local visibility of underdrawing and other underlying layers, for example in the large tree at upper left. In the light-green area surrounding the pond and extending up to the treeline at the church, many vertical darker lines can be observed along cracks, disrupting the plane of the green fields. In some cases this concerns discoloured retouches (visible in IRR), but more often no later materials seem to have been added.
- ***Filling, retouching, and overpainting*** In addition to a few smaller fills, numerous discoloured retouchings and smaller overpaintings are present throughout, many of which cover original paint, are easily discernible and are quite disturbing. The joins have been retouched almost completely. Two stages of overpainting were observed at the dark-green hills in the upper background, with the section at top right possibly being extended onto the damaged sky.[8] The upper part of the sky is not in very good condition.

Surface finish

- ***Varnish*** The glossy (much discoloured) varnish is modern. Residues of an older varnish are visible in lower areas of the surface and around impastos. The thick and uneven brush-applied varnish appears to be of a natural resin. The thickly applied varnish and older residues are much degraded. The varnish has a somewhat uneven appearance, and does not saturate every part of the paint surface properly.
- ***Surface dirt*** There is only a small amount of surface dirt on the painting, as the painting is displayed behind glass.
- ***Visibility of the original surface*** The combination of a thick, yellowed varnish and local loss of saturation causes a reduced legibility of the original paint surface, which now appears darker. The condition of the sky and the numerous discoloured retouchings further distract from an otherwise very good original paint surface.

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1 One seal bears the arms of the Colbert family, the other is of the city Merville (Meregem) in France. Notes by Georges Hulin de Loo, Révision du 'Catalogue du Musée des Beaux-Arts de Gand' de Louis Maeterlink, 1904, Ghent, University library, Hs.3231 folder 12.

2 Alexander Gabov, René Hoppenbrouwers (SRAL), and Luc Van Muylem also participated in the examination and documentation.

3 Klein 2001, 124.

4 The broad, diagonal lines perceptible in the sky around the bird in the tree (VIS) are probably a result of the ground application, since these do not register in the XR.

5 It is possible that the crucifix was added after the underlying paint layers had fully dried.

6 Similar effects were observed in the Escorial *Christ Carrying the Cross* (cat. 13, RR 89–90). See also BRCP, *Catalogue Raisonné*, Chapter IV.

7 The BRCP thanks Aline Genbrugge, paintings conservator at the Royal Institute for Cultural Heritage (KIK/IRPA), Brussels, for sharing this information (email, 24 June 2015).

8 The BRCP thanks Aline Genbrugge for sharing this information (oral communication, 28 August 2015).

1.21–22 VIS, after treatment

2 *Hermit Saints Triptych*

RESEARCH REPORT 27–31, 40

Hieronymus Bosch
c. 1495–1505

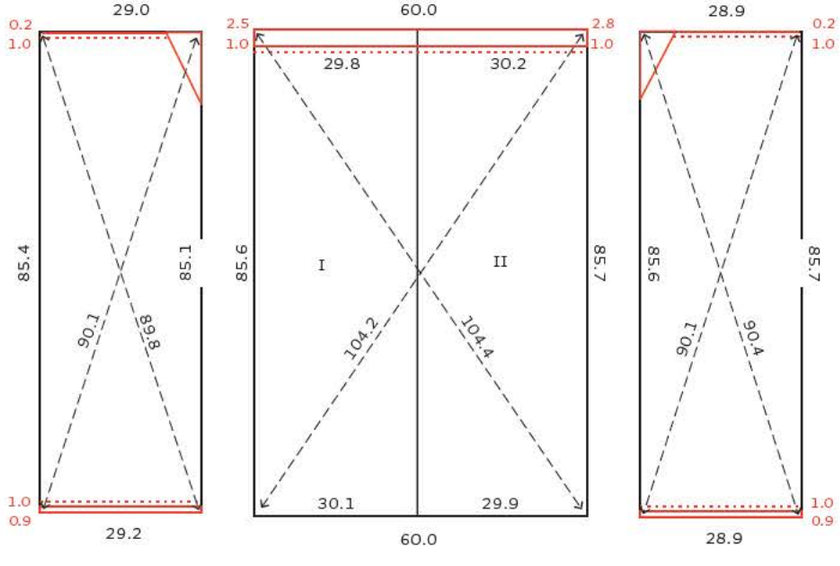
Oil (analysed) on oak (analysed) panel, left wing 85.4 × 29.2 cm, central panel 85.7 × 60.0 cm, right wing 85.7 × 28.9 cm. The original dimensions of all three panels were significantly altered.
Gallerie dell'Accademia, Venice

A full conservation treatment of the painting started in 2013, thus after the 2011 BRCP technical examination of the painting on which this report is largely based.
BRCP, *Catalogue Raisonné*, cat. 2; www.boschproject.org no. 2.

Inscriptions and labels
Central panel, bottom right: *Jheronimüs bosch.*[1]
Reverse: several texts, numbers and labels have been applied to the cradle and the thinned reverse. All three panels have the label *Gemälde Galerie des Allerh. Kaiserhauses N° 1851* and the same illegible two-word text in pencil;
Left wing: 101 and X, written in pencil.
Right wing: a small, square label with *Inv. N°. 25.(490)*. To match the wings with the central panel, the adjacent vertical cradle bars of each were marked with a large dot on one side and a 1 on the other side.
Central panel: in addition to remnants of old labels, there is an exhibition label of the Rijksmuseum Amsterdam and an inventory label just below that. At the top left, a number in red chalk is visible.

SUMMARY OF CONCLUSIONS

The Hermit Saints Triptych *in Venice depicting Saints Jerome, Anthony and Giles can easily be linked with other works in the core of the Bosch group with respect to its painting technique as well as the style and material of the phased underdrawing, although relatively little preparatory drawing was revealed on the wings. The compositions were significantly changed during the subsequent stages of production, which further points to extensive personal involvement of Hieronymus Bosch in that process.*
The central panel was originally arched at the top, over which the wings' half-arches would have closed. These rounded tops were cropped and the three panels made into rectangles.
The original positions of the wings in relation to the central panel were changed in this process: they are now positioned too low. The exteriors of the wings were stripped, but traces of a layer build-up indicate that those surfaces were originally painted a monochrome black, which might have served as the base of a dark grisaille. During the 2013–16 restoration treatment, a rigid metal framework and cradles were removed from the reverses of the three panels, allowing for the ensemble to function again as a folding triptych. The three panels were originally housed in engaged frames, now lost. Dendrochronology indicates that the triptych could have been painted from 1487 onwards, although a date after 1489 is statistically more probable. As further explained in BRCP, Catalogue Raisonné, *cat. 2, we date this work to around 1495–1505.*



2.1 Construction diagram (seen from the front), with later additions in red. The half-lap sections on the reverses are indicated by dotted red lines. In each pair of red numbers, the inner one represents the dimension on the reverse, the outer one that on the front.

RR 29

EXAMINATION DATA

14–25 November 2011 (Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Ron Spronk). The triptych was examined in a studio of the Gallerie dell'Accademia. The panels were studied upright on an easel.

- ***Previous research and documentation available*** See the illustrated articles and reports published by Nonfarmale and by Rossi-Manaresi and Tucci in Limentani Virdis et al. 1992.

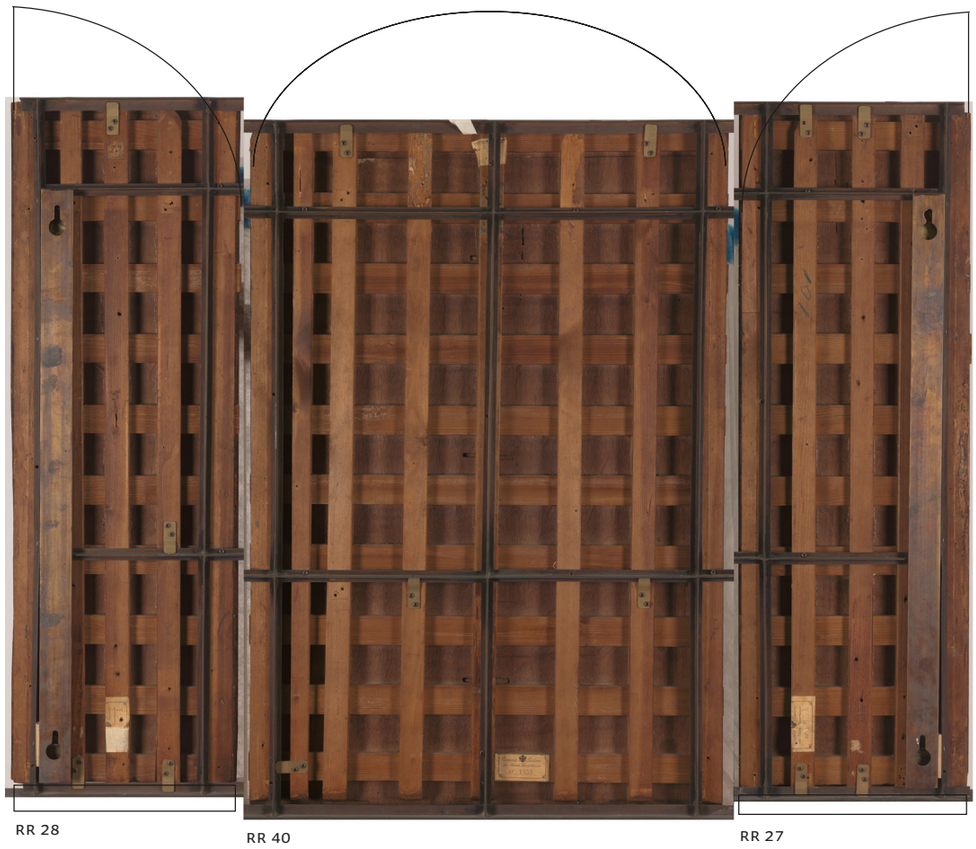
  Several IRR details and nearly complete XRS are kept at the offices of the Soprintendenza. Relatively low-resolution scans of the XRS were used for this report. Cross-sections of the painting were analysed with various techniques by the research laboratory Centro Cesare Gnudi in Bologna and published in 1992.[2]

- ***Previous treatments*** When the paintings from Venice entered the Vienna Gemäldegalerie in 1838, the *Hermit Saints Triptych* was listed with the same dimensions as those of the *Saint Wilgefortis Triptych*, although for the latter those are highly imprecise (see cat. 8, RR 21–26). The triptych was most likely intensively restored during its stay in Vienna (1838–1919), and the positions of the labels on the reverse suggest that the cradle was applied at that time as well. Although the 1878 annual report noted that the picture was highly damaged and needed a new cradle, it was only documented that the painting was in the conservation studio between 2 July 1894 and 17 August 1895 because of brown varnish. In the 1895 note in the conservation registry (*Evidenzbuch*), the current dimensions of the painting were first listed, indicating that the panels were probably cropped between 1878 and 1895.[3]

  In 1951, Mauro Pellicioli and assistants restored the triptych in Venice. The panels were treated again from 1990 to 1992 in a specially

RR 30

RR 31



Reconstruction of the panels' presumed original position. Black outlines indicate cropped sections.

created studio in the Palazzo Ducale. During that treatment, the older reinforcements on the reverse of the triptych were only cleaned, since the cradle did not cause concern at that time. Large losses and lifting paint were consolidated, and 'all later additions were removed in full', although many non-original remains are still evident – especially old, discoloured varnish residues. Fills were integrated using *rigatino* retouching, followed by a final matte varnish applied on both front and reverse of the painting.[4]

SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 2.1). The wood, Baltic oak, was identified through dendrochronology. All three panels were significantly cropped at the top; the two wing panels were also cropped at the bottom (see below, *Altered dimensions*). Each wing consists of a single plank, and the central panel is made of two planks. The quarter-sawn planks are vertical in grain and laid vertically. The curvature of the wood grain indicates the beginning of a knot at the top left of the inner left wing.

  The two planks of the central panel were butt-joined, dowelled and glued. The three panels were cradled after being thinned. Only on the bottom edge of the central panel has a bevelling of 0.4 cm been preserved. Remnants of original paint and ground were observed at some edges.

- ***Dendrochronology*** The youngest heartwood ring of the central panel dates from 1476, which, with the added minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1485 for the tree that produced the wood for that plank.[5] An earliest felling date of 1487 is statistically more probable, however, since that would cover 93 per cent of the range of possibly missing sapwood rings. Assuming at least two more years for drying and transportation, the triptych could have been produced from 1487 onwards, but a production date from 1489 onwards is statistically more probable.

GROUND

- ***Visibility*** The off-white to cream-coloured ground seems to consist of chalk (calcium carbonate – $CaCO_3$) bound in animal glue (not analysed).[6] The ground is present overall and visible under VIS and XR. The ground is only slightly evident in the interstices of the wood grain. It is almost completely covered by the paint layers but discernible at the outer edges (at the damaged barb), near some contours, in losses and in abraded craquelure. It shimmers through the paint surface in several areas, though, which must have been intended as part of the composition. Nevertheless, the ageing of paint layers will have further increased their transparency, and thus the visibility of the ground, especially in lighter areas.

- ***Barb and edges*** The original barbs and ungrounded and unpainted edges are partly intact on all six vertical edges of the three panels, as well as on the bottom edge of the central panel. This establishes that the panels were originally housed in an engaged frame. Barbs and ungrounded and unpainted edges are no longer present where the panels were cropped, i.e. at the three top edges and the two bottom edges of the wings.

- ***Application*** It is not certain how the ground was applied on the three panels, since it hardly registers in raking light and XRS. It might have been applied with a brush and then worked into a very smooth finish.

PREPARATORY LAYERS

- ***Underdrawing*** Very little underdrawing was revealed in the left panel, where ample carbon-containing paints were used. The right wing was better penetrated by IRR/IRP, but here, also, scant drawing was observed.

  Fairly extensive underdrawing was revealed in the central panel; it was used for contours and general modelling throughout, but much less for details. It shimmers through the paint in some areas (in VIS), but is better detected by IRR/IRP. Although the underdrawing locally

seems to play a role in the final composition as a darker undertone for shadows, its visibility in most parts appears unintended and is caused by abrasion and changes in refractive index due to the ageing of the paint film.

- ***Medium and application*** The detectable underdrawing was applied in at least two stages by using a brush and a thin liquid medium (resembling a watery dispersion of carbon, perhaps an ink) for both. The lines of the first stage were part of an early phase of the composition, in which a much larger figure was depicted in the central panel (see below, *Changes*). Some lines from this initial stage of the underdrawing are visible to the naked eye. A certain amount of hatching, indicating shaded areas, was also used at this time. In an IRR macro image (fig. 2.14), there are also traces of what might be a different (dry?) underdrawing medium, which would imply three separate phases in the underdrawing.

- ***Style*** The underdrawing is applied in a somewhat sketchlike manner, in lines that tend to be relatively short. The strokes of the first underdrawing stage are relatively broad, dark, fluent, and defined. Some minor parallel hatching, formed by short lines, indicates shaded folds in the robe of the underlying figure. The lines of the second-phase underdrawing tend to be thinner and softer, often more closely spaced, roughly indicating some darker, shadowed areas. Hatched lines are rare throughout the three panels. Ends of strokes are usually blunt or tipped, without hooks or loops, but some have a slight bend to them. Although the lines follow the drawn features, they are mostly straight.

- ***Revisions in underdrawing and differences from painting stage(s)*** Not enough underdrawing was revealed in the wings (RR 29 and 31) to observe any significant changes between the underdrawing and the paint surface, but IRR/IRP revealed several alterations in paint (see below, *Changes*).

  The central panel shows a much larger underdrawn figure beneath Saint Jerome, whose robe extends into the lower left part of the composition. This figure is not pointing to a crucifix but seems to be holding a large, diagonally placed, beam-shaped object, and his robe appears to be fastened with a thick cord tied into a bow. Since most of these elements were also executed in paint, the changes are described in further detail below (see *Changes*).

  Several painted features were not prepared in either stage of the underdrawing, such as the smaller creatures and other foreground elements. Apparently the entire circular structure to Jerome's right, including the tree that grows out of it and the column at the lower left, were not planned either. Extending from the lion, some underdrawing of the initial composition indicates a feature here, but the structure that rises out of the water behind Jerome was significantly altered. The small, semicircular section of the roof was underdrawn and therefore planned in this location. Between Saint Jerome and his hat, a book was underdrawn but not executed in paint.

PAINT LAYERS

- ***Paint application and painting technique*** The oil paint (not analysed)[7] covers the entire original surface of the three panels, extending onto the barbs where those are still present. It was applied wet-on-dry using a brush, mostly in two stages (not including highlights and shadows). Wet-in-wet phases can be seen in the dark lines on the stone floor. The white V shapes were painted after most of the underlying layer was already dry. Incisions were not observed, but the paint that was applied wet-in-wet often pushed the lower body of paint outwards.

  Paint application is mostly thin, but is thicker for paints containing lead white and azurite pigments. The predominantly fluid, glossy paints appear in both opaque and semi-transparent applications. A thicker paint was used for impastoes and the lead-white undermodelling of several areas with red lake (e.g., the robe of both the underlying and the final figure). Locally, thicker paints were also used for parts of the skin tones (especially for ears; see figs. 2.9 and 2.12) and for landscape (e.g., in the inner left wing bottom left), with the brushstrokes still being apparent. In some areas (e.g., the almost monochrome scenes around the altar-like surface inside the hollow, circular structure resembling a throne), the paint application appears very sketchlike, but in general, the paint layers were applied precisely as well as freely. Brushstrokes were used to render contours and volume in both the underlying and top layers, and are often visible, especially under raking light.

- ***Texture*** Most passages are not smoothly finished because of the frequent use of more or less impastoed paints. Textured brushstrokes are often visible. Besides impastoed highlights, texture is also used for modelling.

- ***Build-up and palette*** The paint was generally applied from light to dark, and often a midtone was followed by a highlight and/or a shadow. However, in several places the paint was built up from dark to light – for example, in the foliage and in other meticulously detailed areas. Part of the composition seems to have been painted from foreground to background; specifically, the main figures were painted before sections of the landscape. Other parts, such as the deer in the right wing, were left in reserve from the background and then painted, thus from back to front. Several figures in the bottom of the left wing were not left in reserve but were painted on top of the background. This is also the case with the smaller frogs and salamanders, which are quite similar throughout the three panels.

  For the background of the central panel and the right wing, the sky was painted first with lead white, gradually making a transition to a blue (azurite) paint layer at the top of the panel. In the right wing, the top left part of the landscape was extended upward after the sky was laid in. The fire in the background of the left wing appears painted with vermilion, lead-tin yellow and red lake, and was applied over a brownish background, with some local blue-grey accents. The fire was only painted after the building was completed. The radiating light of the blaze is reflected in the trees, which were in turn done using a grey base followed by lead-white (and some lead-tin yellow) highlights. The wings of the creature at bottom centre of the left panel were executed in lead-tin yellow, whereas the tail, whiskers and antennae were done in lead white, the latter also having an initial black-grey layer. Glazes were applied in red (e.g., in the fire in the background of the left wing, and in Saint Jerome's robe and hat in the central panel) and possibly green, since remnants of a green glaze seem to be visible at the top right edge of the centre panel. A purplish colour is visible on the small beetle at the lower left edge of the central panel. Contour lines – for instance, those around the fingers – were executed in a dark, reddish brown. The meticulous yellow-brown monochrome scenes on the 'altar' were painted wet-in-wet, with yellowish-brown paint and lead-white highlights, partially mixed with blue. A similar blue-white paint was applied to the adjacent, bluish monochrome scene.

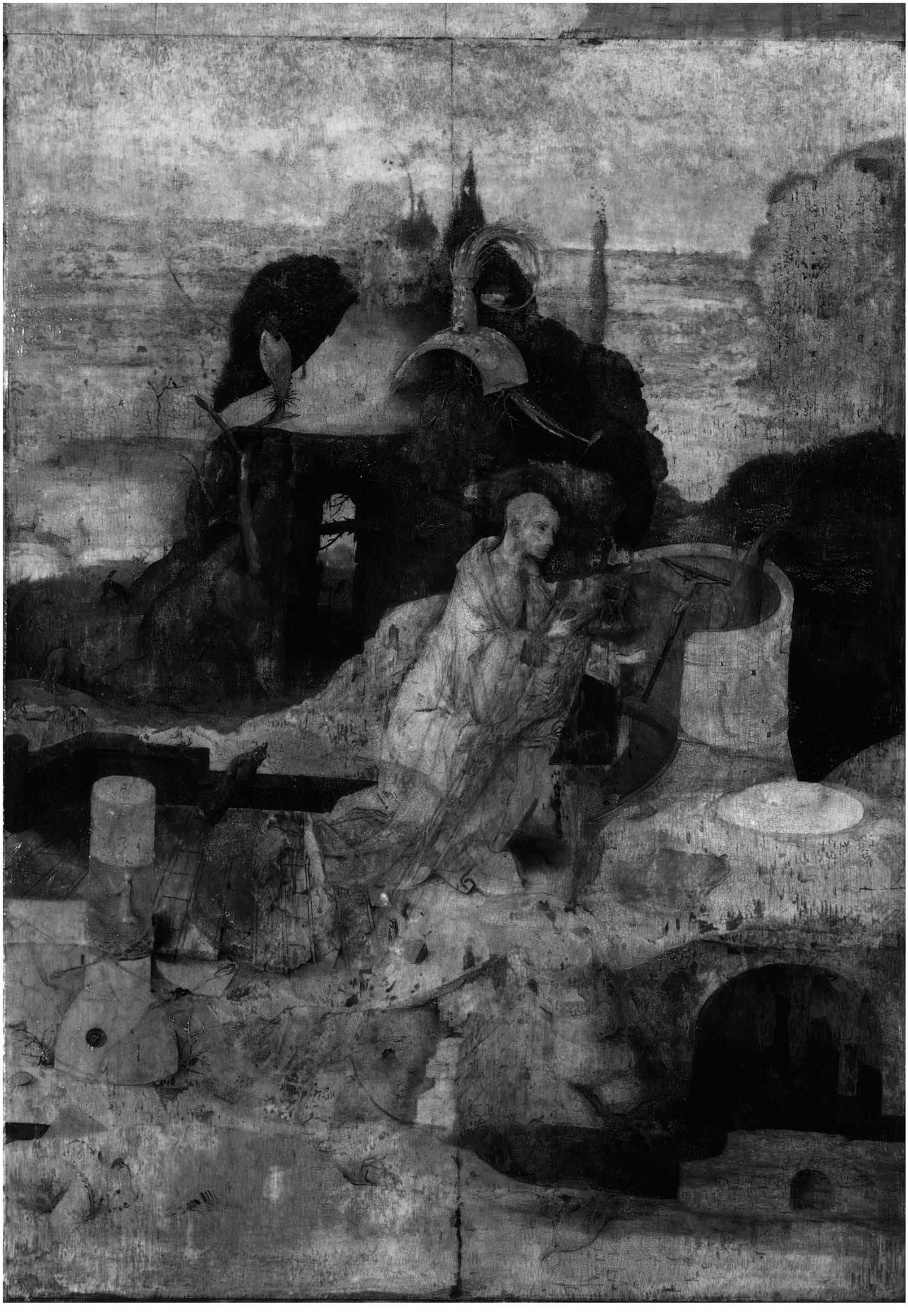
  One of the two previously published cross-sections gives additional insight into the layer build-up and materials used. In the cloak of Saint Giles, only a thin layer (10 μm) containing brown earth, black and lead white was applied on the slightly yellowed ground.[8] The signature was executed in lead-tin yellow.

- ***Changes*** In the left wing, the figure of Saint Anthony appears to have initially been placed lower. An earlier placement of the tau cross, the T revealed by XR at the saint's proper right elbow in the current paint surface, seems to confirm this (see figs. 2.8, 2.10 and 2.15). Right above that is another T, which belongs to the final position of the saint, but currently non-original brown residues cover this feature (see below, *Visibility …*). There is no clear evidence that Anthony, like Jerome and

2.2–3 RR 29, VIS and IRR

2.4–5 RR 31, VIS and IRR

2.6–7 RR 30, VIS and IRR

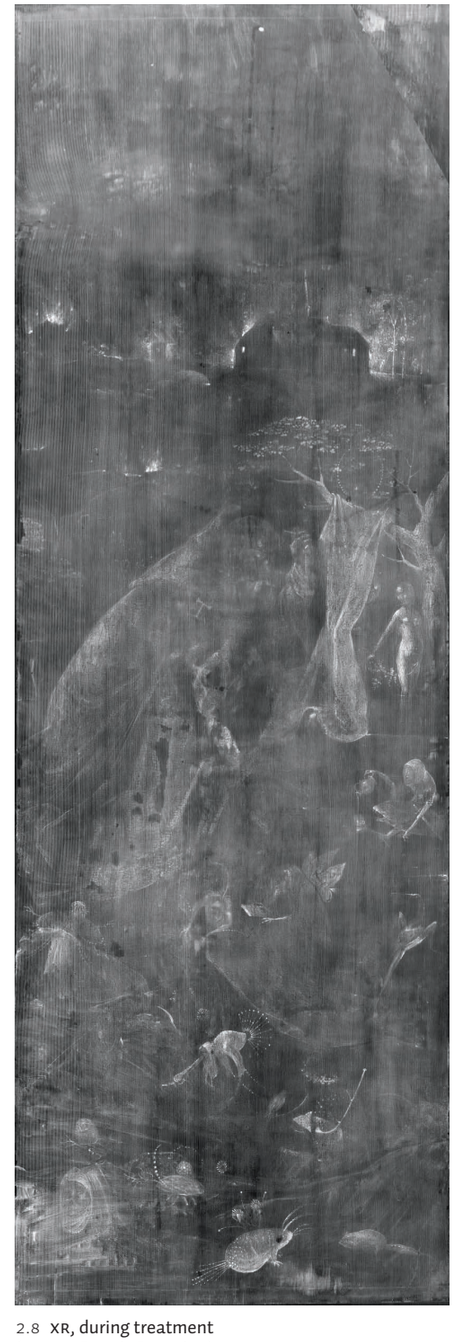


Giles, was originally painted larger. However, a bigger jug was left in reserve in the area that currently appears brown at the bottom left of the tent cloth. Anthony's robe is locally cropped at his back. The landscape in front of the saint was also changed, as diagonal areas are visible in XR and IRR/IRP that do not relate to the current composition (e.g., above the spoonbill; see figs. 2.3 and 2.8).

In the central panel, under the current figure of Saint Jerome, there was first a much larger painted figure that had also been prepared in the underdrawing. This underlying figure is visible in IRR/IRP and XR because of the lead-white underpainting of its robe (figs. 2.7 and 2.8). It is also discernible with the naked eye; both its underdrawing (figs. 2.11 and 2.18) and its paint shimmer through the paint surface that now covers it. The underdrawing for this earlier form seems to have been completely finished, outlining a significantly larger figure. His hands (which are considerably more sizeable than those of the present figure) are together, one atop the other, and placed well below their current position. This figure's much larger head is visible in IRR/IRP and XR, around the current head; the XR also shows the first painted position of the ear. The robe is also much greater in size and extends well into the lower left section of the composition, from the base of the column at left to the bricked wall lower centre. Atop the lead-white undermodelling of this first, larger robe, a red lake was applied, implying that the garment was fully completed or very close to completion when it was changed. The larger saint holds a long, beam-shaped object that was underdrawn and left in reserve from the earlier robe, extending from around the initial position of the hands towards the left foreground. Since the painted crucifix was not underdrawn, perhaps a large cross was originally planned here; some lines perpendicular to the longer beam were indeed observed in the circular structure in front of the saint, and might have indicated its cross-beam. The figure's foot was underdrawn to the right of where the beam-shaped feature ends, and XR indicates that it was left in reserve during the earliest paint stage.

The figure seems to have been set in a much different background. At centre left, horizontal brushstrokes of an underlying layer are visible (in VIS) above the heron. This radio-opaque area, as well as the radio-transparent one below, extends to the right, up to the first placement of the saint's back. Above that, the XR shows a line that suggests rolling hills running through the roof of the hermit's dwelling. In the small dome here, brushstrokes of an underlying layer are also apparent. The dome itself was apparently underdrawn atop the initial landscape. The bluish hills at the horizon in the left part of the panel extended further upward in the initial composition, but can still be seen shimmering through the paint. For the second composition, the background was substantially repainted, probably after the large structure of the hermit's shelter was underdrawn. Several smaller alterations are also discernible within the current composition; in the thumb of Saint Jerome, for example, which was shifted a little to the right, and in the red hat, which was reduced in size.

Major changes were also noted using IRR/IRP and XR on the right wing, where Saint Giles and his dwelling were significantly altered. The head of the saint was reduced in size, and his robe was taken in at the back. He was initially prepared larger, with his robe extending further to the lower right (as seen in IRR), and was apparently in a kneeling position, with one foot close to the right edge (see XR). Giles's hands and the arrow were first painted somewhat lower than they are now, and a book was prepared to the saint's right. An open window and doorway were depicted in the wall behind him, which was apparently made of bricks. The XR shows that the window was initially both wider and higher, and that a large patch of radio-opaque paint was used there, as well as in the doorway. A bit of blue paint in the window and spots of greenish blue in the doorway have become visible again through abrasion. Considering that this panel was originally positioned higher in relation to the central panel, it seems likely that the blue and greenish blue represented distant landscape. A face peeking through the window was left in reserve from the blue paint in the left part of this window. The face was shifted to the right when the window was repainted smaller, and the blue was painted out. The doorway was also painted out. The figure of the saint was thus initially placed in front of a dilapidated man-made structure. To his right, possibly some form of pillar was painted, and the walls to his left were designed narrower. The XR shows that the table continued almost to the left edge of the panel and IRR shows that more of the deer's body (which was slimmer) was visible towards the left. The roof of the decaying structure was changed, and the whole space initially extended further towards the foreground, where several parts of the landscape were also adjusted.



2.8 XR, during treatment
(images Davide Bussolari)

FRAME

The original, engaged frames have been lost. The panels are currently unframed.

A recent auxiliary framework, consisting of a metal grid of T and L profiles, connects the three panels. This auxiliary frame, which extends slightly above and below the painting, is applied with messing clamps that are attached to the cradle members with screws, blocking some of their movement. (Both the metal mounting frame and the cradles were removed during the 2013–16 treatment.)

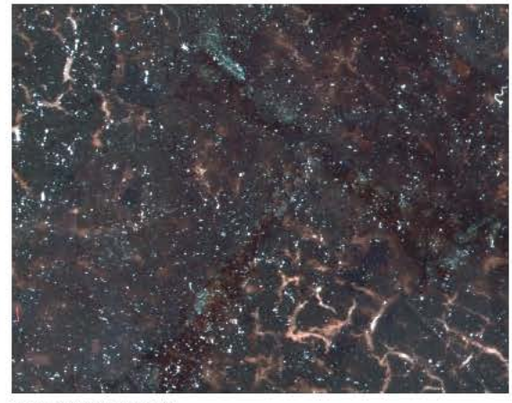
CONDITION

The painting was restored in 2013–16, thus after the 2011 BRCP technical examination on which this report is largely based. For a brief discussion of that treatment, see BRCP, *Catalogue Raisonné*, Chapter IV.

Support

- ***Altered dimensions*** The original format of the panels was significantly altered. The absence of original edges on the top of the three panels indicates that they were all cropped there. Two triangular inserts are present at the top inside corners of the open wings (see figs. 2.1 and 2.17), indicating that these originally had quarter-round arched tops.[9] The bottom edges of the two wings were also cropped. On all five cropped edges, wooden strips were added with a half-lap join, thus removing more original material from the reverse. The reverses of the three panels were thinned considerably to reduce warping and to flatten the painting before applying the cradle. As a result, the three regularly spaced original dowels between the two planks of the central panel became exposed. The flattened shape is maintained by a cradle, apparently applied during the triptych's stay in Vienna. The reverses of the wings were originally painted black directly on the ground and may have had a grisaille composition.

2.9 30MICGBM001, raking light



2.10 29MICGBM001

2.11 30MICGBM003

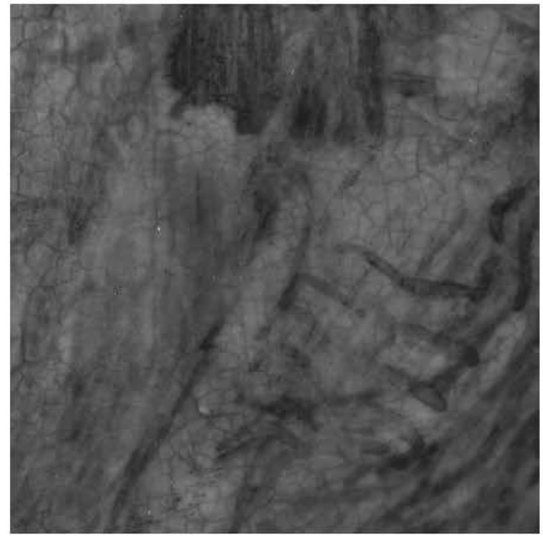
2.12 31MICGBM001, raking light

2.13 Mapping of micrographs reproduced here (2.9–12)

It remains challenging to determine the precise nature and sequence of these structural interventions. When the two Venetian Bosch triptychs entered the Vienna Gemäldegalerie in 1838, they were presented as three separate panels in a single frame and listed with roughly similar dimensions. At some point both triptychs were thinned and cradled. At the time, the horizontal cradle members of the *Hermit Saints Triptych* most likely continued at the same level over the three individual panels, which is no longer the case. Possibly in 1895, the panels were altered again to their current rectangular shapes. Several members of the cradle were partially sawn off at their extremities, while new cradle sections were added at the reverses of the triangular inserts. Also, a number of cradle members of the wings have a bevel that appears to follow the onset of the arched tops (see fig. 2.16). We may assume that all top and bottom ends of the vertical cradle members were bevelled, since these have also been preserved at the bottom of the central panel. The rounded top of the central panel was cropped, but a similar intervention in the right wing would have intersected the hill depicted there. The slight lowering of the wings relative to the central panel enabled the preservation of the hill and sky and made it possible to remove a smaller section at the tops of the wings. At least 6 cm seem to be missing from the wings' longest dimensions. Additionally, a comparison with the bottom edge of the central panel suggests that about 2.4 cm are missing from the bottom edge of the left wing, and about 3.3 cm from the bottom edge of the right wing.[10]

The bottom left corner of the interior of the left wing is slightly damaged, and the right edge of the interior right wing was not sawn straight. There are several nail holes in the unpainted edges of the panels, which seem to relate to a previous framing.

- ***Additions*** A cradle was attached to the reverses of the three panels in their original formats (with half- and quarter-rounded tops), most likely in Vienna. In a (perhaps only slightly) later intervention, wooden strips were added to the cropped top edges of all three panels and to the cropped bottom edges of the two wings. As in the original sections of the panels, the grain of the added horizontal strips runs vertically. During this intervention, two triangular inserts (both with a similar blue underpainting) were added to the top inside corners of the open wings, and the cradle was adjusted (fig. 2.16). At a later stage, in Venice, the auxiliary metal mounting frame was applied.[11] (The cradles and the mounting frame were removed during the 2013–16 treatment.)
- ***Cracks*** At the bottom left of the left wing, a minor crack with a slight surface level difference can be observed running parallel with the wood grain. At the top of the central panel, there are four cracks in the added strip of wood, two of which seem to continue, with a small step, into the original panel. These cracks are a direct result of the cradle's blocking the natural movements of the panel. The clamps of the metal framework also inhibit the movement of the panel to some extent. In the centre top edge of the right wing, a crack extends a few centimetres.
- ***Deformations*** Over time, the attached cradle (possibly abetted by the metal framework) has produced an undulating surface in the panels.
- ***Joins*** The join in the central panel remains almost completely closed, but a slight difference in level is visible, especially near the top and bottom of the panel.
- ***Coated reverse*** A (spray) coat of a somewhat matte varnish was applied to the reverse of the thinned panels.[12] There are also some traces of apparently original ground and black paint near the bottom of the wings. A cross-section from a paint sample of the left wing reverse has been analysed.[13] It has a chalk (calcium carbonate – $CaCO_3$) and animal glue ground, on top of which is a black layer that contains carbon black and some chalk and aluminium-silicate.
- ***Biological damage*** Old woodworm damage is apparent at the top of the reverse on the left wing; an exit hole seems to be present at the top



2.14 RR 30, IRR macro

2.15 RR 29, XR, during treatment

2.16 RR 28, VIS: the bevelled top of the second-to-right vertical cradle member; at the far right is the added vertical member.

of the foreground tree in the front of that panel. At the lower right corner of the central panel's front, there appears to be another exit hole.

Ground and paint layers

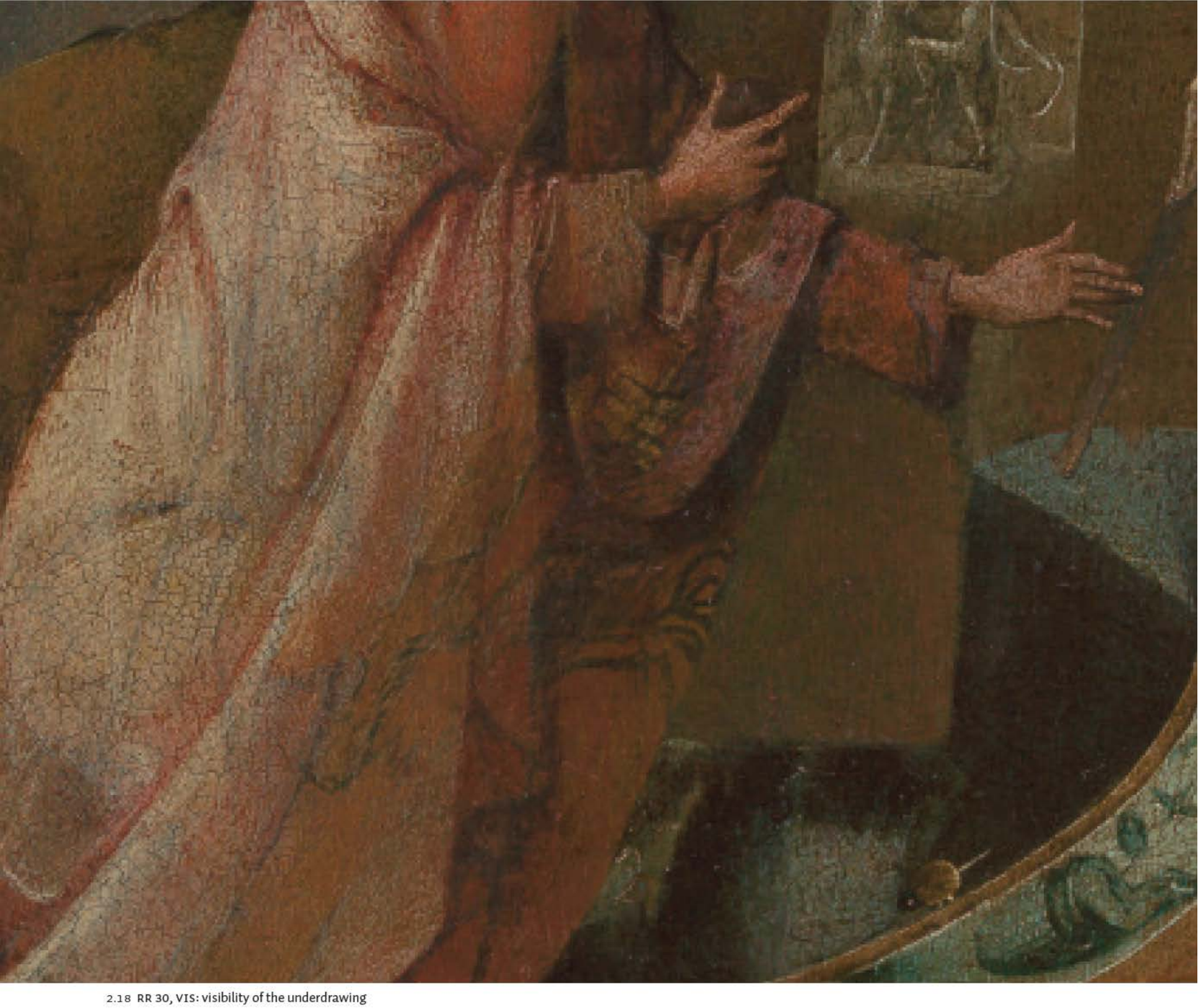
- ***Stability*** The cradle (and perhaps the metal framework) is causing the entire paint surface to undulate. The adhesion of ground and paint layers appears good and stable overall. Some paint blisters are present in the non-original triangular insert in the left wing. Most craquelure is caused by natural dimensional changes of the panels, but in certain areas (predominantly where thick azurite paint with more binding medium was used), broader drying cracks have formed. The larger overpainted figure in the central panel did have some effects on craquelure formation, but youth cracks (drying cracks caused by medium-poor over medium-rich paint application) have not been found.
- ***Losses*** There are many losses to the paint layers of all three panels, but predominantly in the central panel. In a small number of these, the ground is damaged as well. Traces of fire damage, as mentioned by some authors,[14] were not observed. It appears that most of the paint losses occurred around cracks. This, combined with the overall abrasion of the paint surface, suggests that the triptych was at some point subjected to a relatively harsh cleaning. The cleaning agent could have leached and damaged original paint material, progressing from the open cracks in the paint surface.
- ***Abrasion*** The painted surfaces are quite abraded overall, with larger sections of the top paint layers missing, particularly in the sky area of the central panel. Another example is the severely worn face of Saint Anthony. In the left wing, the bottom part of the drapery hanging from the tree also shows serious abrasion. Most of the top layers are missing here, resulting in the now largely light brown area, but there are still remnants of original surface paint. The impastoed highlights have been abraded (for example, in the ear of Saint Jerome), as well as the highest points of other raised areas of paint. Additional mechanical damage is present in the form of scratches, and in the bottom centre of the right wing a slight dent can be detected.
- ***Discoloration and increased transparency*** Copper-green paints have discoloured, resulting in a browner appearance of the landscape. In addition to being abraded, the red lakes also seem to have faded over time. The paints containing lead white have become more transparent, which has caused a greater visibility of the underlayers and the underdrawing (see fig. 2.18). This result of ageing is an unintended alteration. Ageing has also resulted in the darkening of the already dark paint of the vault in the lower right of the central panel, as revealed in IRR/IRP. At the top edges of the left wing, the slightly cooler tone of the background is still evident.
- ***Filling, retouching and overpainting*** Extensive *rigatino*-style retouching can be discerned fairly easily on all panels.[15] Losses were filled and inpainted, and ample retouching was applied on areas of general abrasion. These retouchings stand out quite strongly – some through discoloration and others because the colouring doesn't precisely match. They were mostly applied in short, separate dabs and strokes that, together with the numerous remaining spots of old and severely discoloured varnish residues, result in a disturbingly vibrant effect. This is most strikingly apparent at the top part of the central panel. The sky has been retouched extensively, covering original paint in many places, but in other areas damage has not been retouched, resulting in a rather unbalanced impression of the paint surface.

  At some point in time, an infrared-absorbing greyish surface layer appears to have been applied to predominantly lighter areas of the paint surface.[16] The greyish surface layer seems distinct from the more transparent resin or the glue-like, brownish residues that are present in many other areas of the painting. It seems that the latter are part of a pigmented toning layer, possibly applied during the 1951 Pellicioli treatment.[17]

Surface finish

- ***Varnish*** The appearance of the varnish is uneven and speckled because of a spray application of a somewhat matte surface varnish. Especially in the left wing, but elsewhere too, there is an uneven gloss with varnish drips and several matte areas. The thick varnish layer has yellowed, but the numerous older, severely discoloured varnish residues are especially disturbing. This causes, for example, the dark green spots and the overall greenish appearance of the sky, which was originally blue.
- ***Surface dirt*** There is only a small amount of surface dirt present on the painting, although several brush hairs are trapped in the varnish layer.
- ***Visibility of the original surface*** The saturation of the paint surface varies from reasonable to poor. The sprayed varnish has resulted in a speckled, slightly matte, and generally dull-looking surface. Additionally, there are several unsaturated matte spots, especially in the left wing. The yellowed varnish, and particularly the highly yellowed older varnish residue, causes reduced legibility of the original paint surfaces and a strongly altered perception of the work, notably in the sky, which now appears greenish. This altered perception is strengthened by the ample greenish retouchings and overpaintings of the sky, especially in the central panel. The numerous partial, not precisely colour-matched and/or discoloured retouches and overpaintings greatly distract from the original paint surfaces. The poor state of the original paint surface in general has not been brought into balance by its last treatment. Also, remaining well-preserved areas are currently obscured by later additions. A striking example of this is the original tau cross on the shoulder of Saint Anthony. It is almost indistinguishable with the naked eye at the moment but can be seen through the stereomicroscope and in the XR (see figs. 2.10 and 2.15).

2.17 RR 29 and 31, VIS, raking light: inserts in upper corners of wings (photos Claudio Franzini)



2.18 RR 30, VIS: visibility of the underdrawing

[1] The diacritic mark above the *U* (*ü*) is executed in paint identical in colour and brushstroke to the other letters.

[2] See Rossi-Manaresi and Tucci in Limentani Virdis et al. 1992, 200–01.

[3] The BRCP is very grateful to Alice Hoppe-Harnoncourt for archival research at the Kunsthistorisches Museum in Vienna.

[4] Nonfarmale in Limentani Virdis et al. 1992, 187. This one-page text discusses the treatment of the three Venetian ensembles without referring to specific paintings.

[5] Klein 2001, 125. The youngest or last-preserved ring on each of the two planks of the central panel dates from 1476 and 1473, respectively. The wings were apparently not examined.

[6] Rossi-Manaresi and Tucci in Limentani Virdis et al. 1992, 201 fig. 45.

[7] A cross-section taken earlier from the right wing includes the ground, but its composition was not analysed at the time. Rossi-Manaresi and Tucci in Limentani Virdis et al. 1992, 183–86, 200–01.

[8] Rossi-Manaresi and Tucci in Limentani Virdis et al. 1992, 201 fig. 45. A second published cross-section, fig. 46, shows the relatively thick (100 µm) lead-white undermodelling.

[9] Compare with *Christ Carrying the Cross* (cat. 12, RR 9–10), where a similar insert was found.

[10] Marijnissen's suggestion that the panels were once profiled at the top (similar to that of the Prado *Epiphany*), with an original height of c. 110 cm, seems less likely. Marijnissen 1987, 210.

[11] Three rectangular pieces of Perspex with blotting paper were screwed to the reverses of the panels (on the cradle), but museum staff removed these (24 November 2012).

[12] Nonfarmale in Limentani Virdis et al. 1992, 187.

[13] Analytical report by Enrico Fiorin, 11 April 2015.

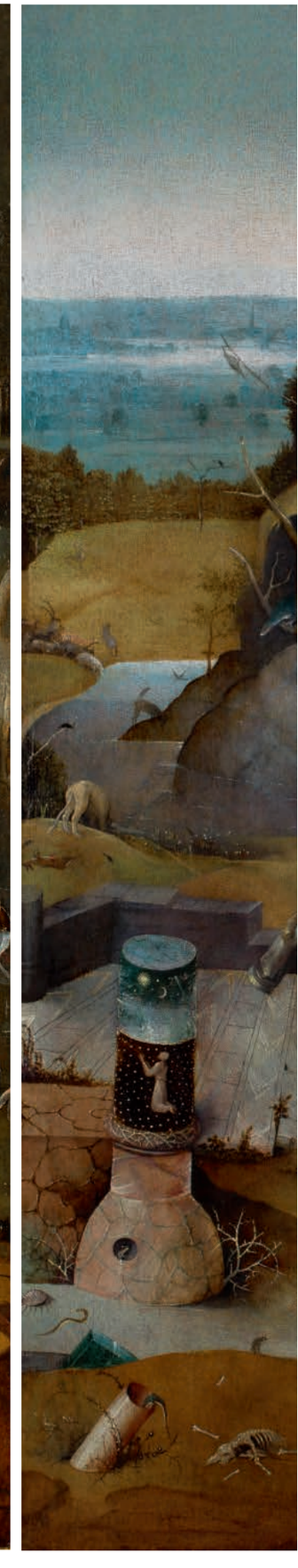
[14] For example Marijnissen 1987, 210.

[15] The retouchings have a tempera base (in either watercolour or egg yolk), followed by a pigmented resin glaze. Nonfarmale in Limentani Virdis et al. 1992, 187.

[16] The exact nature and composition of this layer have yet to be determined, but it seems similar to the grey layer found in the *Saint Wilgefortis Triptych* (see cat. 8, RR 21–26).

[17] Mauro Pellicioli often used glue as a patina and as medium for retouching. Paintings conservator Giulio Bono and head of conservation Maria Chiara Maida, oral communication.

2.19–21 **Reverses after treatment** (photos Matteo De Fina, Venice)



2.22–24 **VIS, after treatment** (photos Matteo De Fina, Venice)

Hieronimus Bosch

3 *The Temptation of Saint Anthony (fragment)*

Hieronymus Bosch
c. 1500–10

Oil (not analysed) on oak (analysed) panel, 38.7 × 25.4 cm
The black-painted wooden frame is modern.
Nelson-Atkins Museum of Art, Kansas City, MO, 35–22

BRIEF RESEARCH REPORT 155–156[1]

BRCP, *Catalogue Raisonné*, cat. 3; www.boschproject.org no. 3.

Inscriptions and labels
A large museum identification label is attached to the cradled reverse. At top right, on the vertical cradle member, *6091 F* (?) is written in black.
There are several markings in pen on the frame reverse.

SUMMARY OF CONCLUSIONS

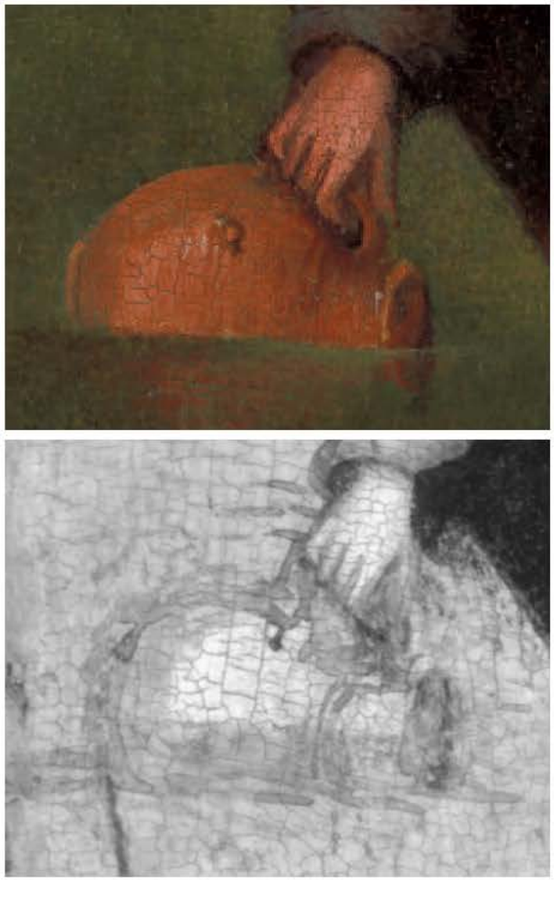
The damaged fragment in Kansas City was heavily retouched and overpainted, but the technical evidence shows that it can be safely attributed to Hieronymus Bosch. The painting technique as well as the style and material of the underdrawing place the panel in the core oeuvre.
The panel was cropped on all sides. Dendrochronology indicates that it could have been painted from 1484 onwards, although a date after 1486 is statistically more probable. The fact that the panel was cropped has to be taken into consideration. As further explained in BRCP, Catalogue Raisonné, *we date this work to c. 1500–10.*

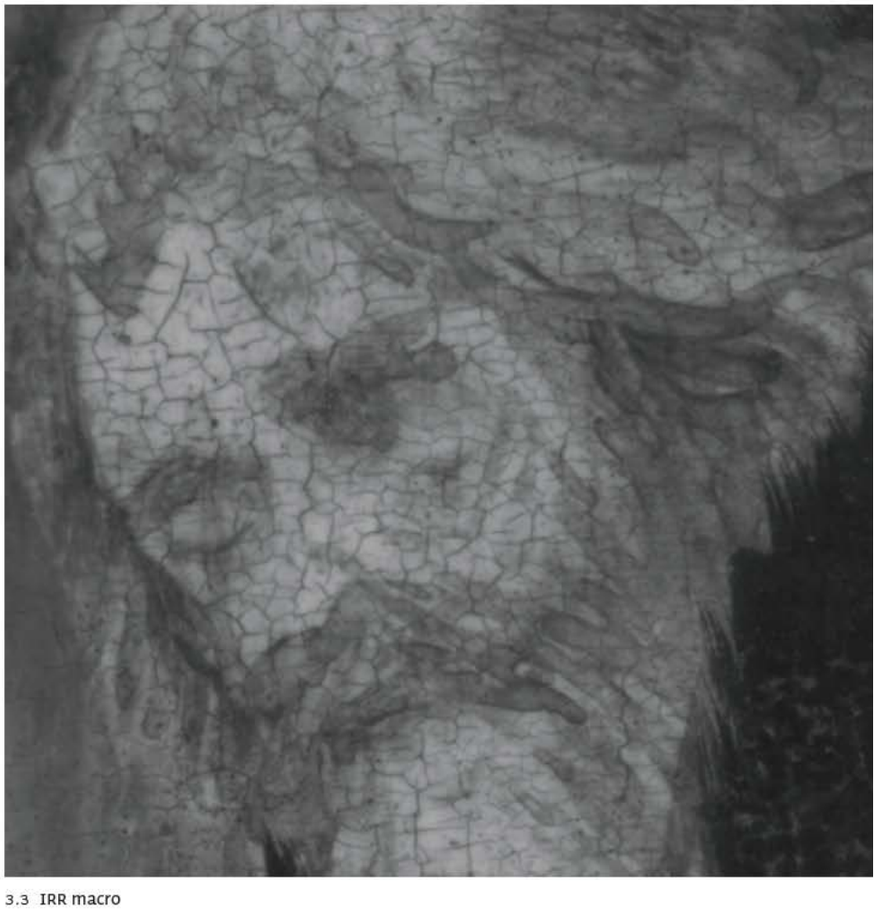
ADDITIONAL INFORMATION

The painting was studied by Jos Koldeweij and Matthijs Ilsink on 28–29 September 2015. This report is based on their observations and notes, as well as on the interpretation of existing and new (photo) documentation.

Dendrochronology indicates that the youngest heartwood ring dates from 1471, which, with the added minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1480 for the tree that supplied the wood.[2] An earliest felling date of 1482 is statistically more probable, however, since that would cover 93 per cent of the range of possibly missing sapwood rings. Assuming at least two more years for drying and transportation, the panel could have been produced from 1482 onwards, but a production date from 1484 onwards is statistically more probable.

3.1–2 VIS and IRR





3.3 IRR macro

RR 155

3.4–5 VIS and IRP

OBSERVATIONS

Support

The cropped panel consists of a single plank, vertical in grain. Dimensions: 38.7 × 25.4 cm. Thickness: c. 0.4 cm.

At some point in time – certainly before 1933 and most probably before 1920[3] – The panel reverse was thinned and cradled.

Preparatory layers

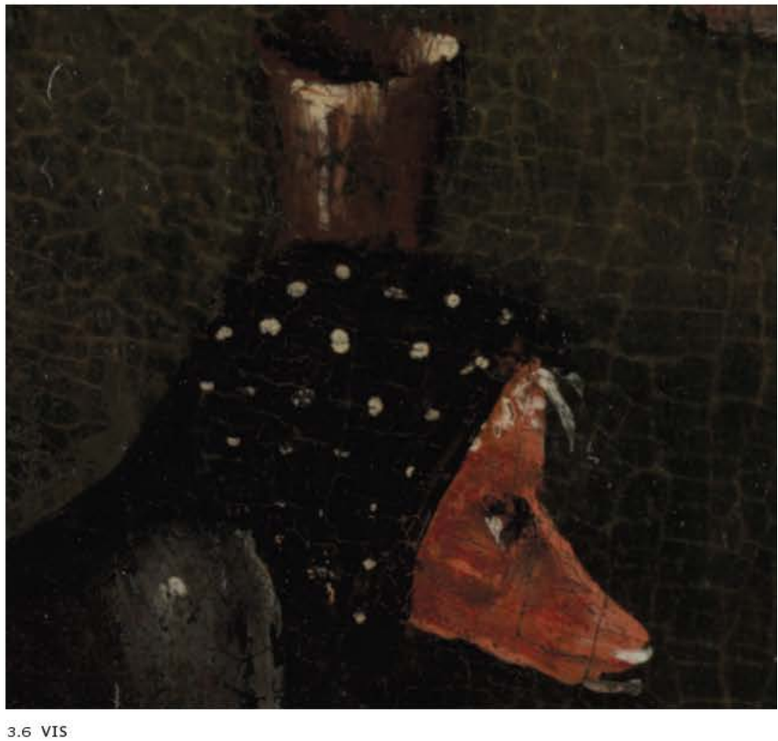
A light-coloured ground appears to be present. It is fully covered by the paint layers and is mainly visible at damaged craquelure.

The underdrawing is perceptible to the naked eye, locally shimmering through the paint layers, but is better revealed with IRP and IRR (fig. 3.10). The detectable underdrawing is characterized by fairly broad but often short strokes. A relatively large brush was used to apply the liquid underdrawing medium, whose fluid nature is, for example, noticeable in the pottery jug (figs. 3.1–2).[4] The underdrawing was apparently applied in at least two stages, and minor hatching is evident in places, for instance in the saint's legs and face (fig. 3.3). The execution is somewhat sketchlike but free, with relatively bold strokes.

Paint layers

The paint was applied using a brush in several stages. The painting was built up from back to front, leaving areas roughly in reserve. Multiple elements, however, were painted directly on top of the green background. This includes many smaller details, as well as the funnel character and the fish in the foreground (figs. 3.4–5). Because the underlying light ground was not utilized beneath the latter two forms, those had to be painted more opaquely and appear somewhat flatter as a result (and also because of abrasion). In Anthony's staff, on the other hand, the background (the robe at his leg) was used as a midtone, and only the lead-white highlight and a brown-black

RR 156



3.6 VIS

3.7–8 VIS and IRR

3.9 VIS

shadow line were added. Where the background could not be used in that way, a grey line was painted.

The artist used both opaque and semi-transparent paints.[5] Vermilion appears to have been mixed in for flesh tones but applied in its pure state for detailing. Bright blue paint was used for the finely painted tau cross and the legs of the skewed bird. It was also used on the bird at left, in the sabre of the funnel figure, and in the fish (see fig. 3.4). Green glazes appear to have served for the landscape, and red lake is evident in multiple areas. It appears most extensively in Saint Anthony's robe, which has a purplish grey appearance, and is also visible near his foot on the right.[6] In addition to several earth pigments, black and lead white were also used. Lead white and lead-tin yellow often served for detailing and highlights, and the latter is also present in the spoonbill's beak (fig. 3.11).

Impastoed highlights can be seen on the hood of the creature on the left and on the cup at the top (fig. 3.6). Here, the paint was applied wet-in-wet, as in the head of the fish and elsewhere, but often paints were used wet-on-dry.

Some changes were observed in the build-up of the layers. When the water was painted, the pottery jug was left in reserve considerably smaller than underdrawn, and the waterline was raised (figs. 3.1–2). When the jug was painted, this waterline was maintained and a reflection was added on the water's surface. However, the length of the jug was expanded beyond its reserve (although much of it is retouched) and now conforms to the underdrawing. Such changes, as well as the pentimento at the saint's foot (figs. 3.7–8), are indicative of a continuous creative process, a key characteristic for the core oeuvre of Bosch.

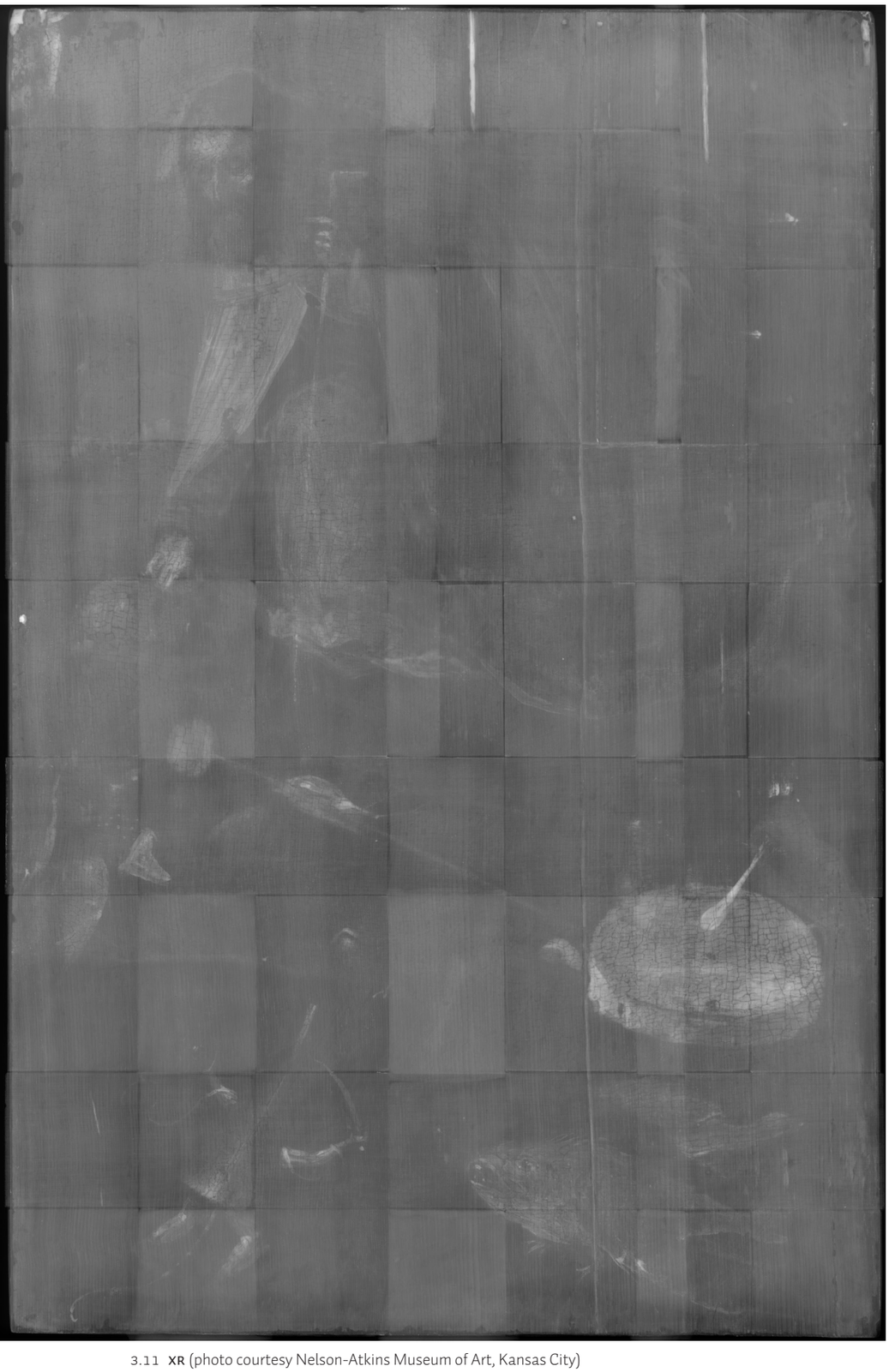
3.10 IRR

CONDITION

The panel was cropped on all sides and its reverse was considerably thinned and rather heavily cradled. Several cracks extend from the top and bottom edges, running along the wood grain. One crack runs the entire length of the panel. This split and some of the fractures are covered by the vertical cradle members. The three additional sections of wood that were applied as reinforcements, however, cover cracks that probably occurred as a result of the blocked cradle. Locally, differences in level were observed on the paint surface at these flaws.

The panel reverse was stained brown, and both panel and cradle were varnished.

The original paint surface is quite abraded and there are many losses throughout, especially in the foreground landscape, at the cracks, and near the top right. The adhesion of ground and paint, however, seems good.



3.11 XR (photo courtesy Nelson-Atkins Museum of Art, Kansas City)

Past treatments have changed the appearance of the painting considerably. In general, it appears rather opaque and flat, with little sense of depth. The funnel figure at bottom left, for example, appears to float in the landscape. The damaged painting was heavily retouched and overpainted during the last major treatment at the museum in the third quarter of the twentieth century.[7] Saint Anthony's hair and beard were extended somewhat with curved or curling lines in a muddy colour (fig. 3.9). His moustache was emphasized and his eye sockets were retouched with brown, making them darker and more expressive.

The varnish layers properly saturated the paint, but the extensive retouching and overpainting of the damaged picture greatly reduce the legibility of the original paint surface.

[1] For a variety of practical reasons, some of our research reports were produced in an abbreviated format, which resulted in a slightly different layout. This concerns seven reports: cat. 3 (RR 155–156); cat. 23 (RR 63–68); cat. 26A–B and 26C (RR 59–62 and RR 109–110); cat. 32 (RR 87–88), cat. S2 (RR 111–112); and cat. S3 (RR 113–114).

[2] Dendrochronology report by Peter Klein, University of Hamburg, Department of Wood Biology, 24 March 2003. The panel was cropped on all sides, during which an unknown number of rings was removed.

[3] Letter from M. Knoedler & Co., London, to Russell Plimpton, Minneapolis Institute of Art, acc. no. 28.04.1933 (Special Collection, The Getty Center for the History of Art and the Humanities: Schaeffer Archives). Documentation, Nelson-Atkins Museum of Art; Nilsen Laurvik 1920, 22 no. 44.

[4] See also, Dunbar and Faries 2005, 191.

[5] None of the pigments were analysed.

[6] We are very grateful to John Twilley of the Nelson-Atkins Museum for providing micrographs of many details.

[7] In 1932, before the panel was acquired by the museum (1935), it was cleaned at the art dealer's. In 1994 grime was removed from the surface and the painting was revarnished. At that time, too, the modern frame was distressed and toned, and the framing was improved.

The Temptation of Saint Anthony

Hieronymus Bosch
c. 1500–10

Oil (not analysed) on oak (analysed) panel, 131.0 × 118.8 cm (central panel). Because the panels could not be unframed, only the central panel could be measured. Size within frame of the interiors and the exteriors of the wings: (RR 11) 130.1 × 51.5 cm; (RR 12) 129.8 × 51.6 cm; (RR 13) 129.6 × 51.6 cm; (RR 14) 129.9 × 117.6 cm; (RR 15) 130.0 × 51.5 cm. Panel dimensions: (RR 16) height (left) 131.0 cm, (right) 130.9 cm; width (top) 118.5 cm, (bottom) 118.8 cm.
Museu Nacional de Arte Antiga, Lisbon, 1498 Pint

BRCP, *Catalogue Raisonné*, cat. 4; www.boschproject.org no. 4.

Inscriptions and labels
Signed, central panel, bottom left: *Jheronimus bosch*
Central panel, reverse: the accession number 1498 is scratched into a batten at the top right. Central frame, outer right edge: accession number 1498, stamped in black.

RR 11

RR 12

RR 13

SUMMARY OF CONCLUSIONS

The genesis of the Lisbon triptych with the Temptation of Saint Anthony *was unusually complex. The exterior grisailles (RR 11–12) were freely underdrawn in a single stage with little hatching, in a material that might also have been used for the subsequent painting, which was mostly done wet-in-wet. The grisailles (but not the interior panels) were executed atop a cream-coloured base layer that was used extensively as midtone. The phased underdrawing in the interiors of the wings (RR 11, 13) is similar in style but more elaborately worked out, and modelling there was prepared with zones of relatively fine parallel hatching. The central panel (RR 14), on the other hand, had an initial design stage in a dry material, after which a brush underdrawing was applied in a way similar to that of the wings' interior, using hatching for modelling. Numerous larger and smaller changes between the underdrawn and painted compositions can be found, especially in the middle and backgrounds of the panels. After the panels were fully completed, the composition of the central panel was dramatically changed again. In the initial underdrawn and painted composition, Saint Anthony was considerably larger; the stone platform and the dilapidated tower with Christ, the altar and the decorated semicolumn did not exist. Instead, the saint was standing on the bank of a larger river, with a tent-shaped form and a column in the middleground. This initial painting was apparently fully finished, as the presence of a varnish layer suggests.*

The new composition – with the smaller saint, the tower, the semicolumn and different figures to the saint's left – was also prepared with underdrawing, executed on top of the previously painted composition. This final-stage underdrawing shows bolder and denser parallel hatching; for example, in the shadow of the tower's roof. This was probably necessitated by its application over an existing paint layer. In areas where this final underdrawing stage did not have to cover paint, as in the decorations of the semicolumn, its style fits seamlessly with Bosch's characteristic drawing style.

There is no reason therefore to question the attribution of the Lisbon triptych to Bosch, as Koreny has done.[1] *The* Temptation of Saint Anthony *is a fully autograph work, and the existence of a large number of copies of the triptych in full or in part testifies to its central place in Bosch's oeuvre. It is possible that two of these panels, now in the Barnes Foundation in Philadelphia and in the Museu de Arte de São Paulo, played a role in the development of the second composition of the central panel.*

The three panels were originally housed in engaged frames. The dendrochronological analysis of the central panel indicates that it could have been painted from 1495 onwards, although a creation date after 1497 is statistically more likely. As further explained in BRCP, Catalogue Raisonné, *under cat. 4, we date this work to around 1500–10.*

RR 14

RR 15

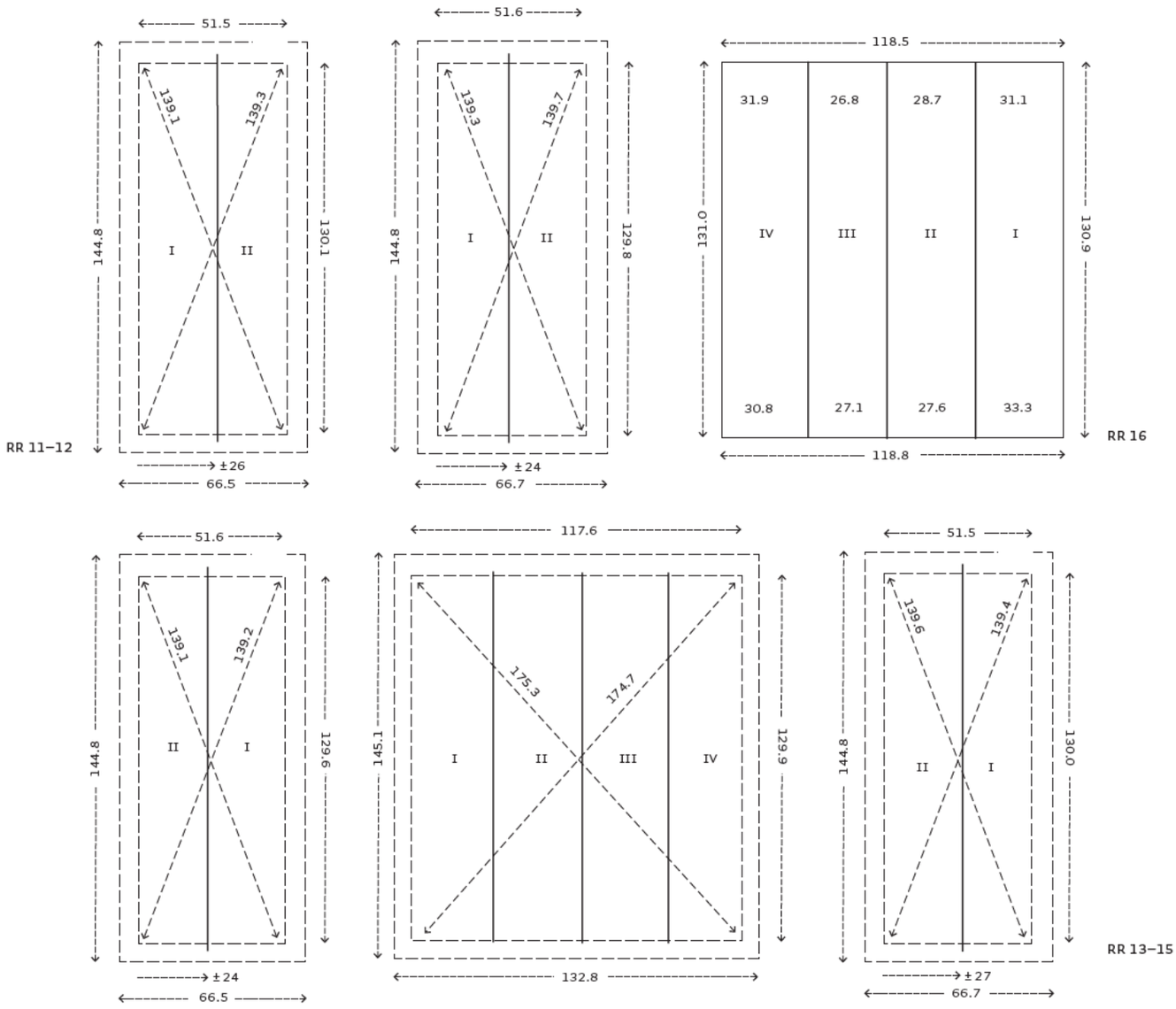
RELATED WORKS

There are numerous known replicas or otherwise closely related versions of the Lisbon triptych or parts thereof.[2] However, the primacy of the Lisbon triptych has rarely been contested. Friedländer suggested in 1937 that two of the related works (both versions of the central panel – one now in the Museu de Arte de São Paulo and the other at the Barnes Foundation in Philadelphia) could also have been painted by Bosch himself.[3] In 1974, Lievens-De Waegh proposed that these two works served as studies for the Lisbon triptych,[4] and a similar opinion on the São Paulo panel was repeated in 2007.[5] Interestingly, the panel in the Barnes Foundation shows a different 'fish-boat' in the lower centre, and XR and IRR have established that these motifs are also present in the Lisbon panel, where they were later painted out. Dendrochronology determined 1503 to be the earliest possible felling date for the tree(s) that supplied the planks for the São Paulo panel, but a dendrochronological date for the work at the Barnes Foundation is not yet available. See also the entry on the Lisbon triptych in BRCP, *Catalogue Raisonné*, cat. 4.

EXAMINATION DATA

4–13 September 2011 (Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Ron Spronk). The triptych was examined in the gallery, in its frame. The panels were studied upright on an easel. The wings were also studied flat on a table. All sides except the reverse of the central panel were easily accessible.

- ***Previous research and additional documentation available*** Files on the triptych (including the report on the 1969–70 treatment, XRS of the panels and possibly samples) are kept at the Department of Conservation–Restoration (DCR) of the Institute for Museums and Conservation (IMC) of Portugal. The treatment and sample analysis reports have been studied and the available XRS have been photographed. (The XRS of the bottom right corners of the wings could not be located, and those of the central panel were taken under different conditions.) Earlier technical publications on the painting focus mainly on the underdrawing and on compositional changes.[6]
- ***Previous treatments*** In the nineteenth century, the triptych was sent to Germany or Belgium for treatment.[7] The frame was replaced



4.1 Construction diagram

RR 16

between 1910 and 1940, possibly in 1911, when the triptych was treated by Luciano Freire.

In 1958 the work was treated for an exhibition in Amsterdam. Between 1969 and 1970, conservation was done by Manuel Guimarães Dos Reys Santos and Maria Fernanda Viana, who observed areas of abrasion. This treatment is extensively documented and the files are accessible at the DCR/IMC.[8] It is also described in the October 1972 exhibition catalogue on the painting.[9]

During the 1990s, apparently some slightly open cracks or joins were treated after a loan to the National Gallery in Washington, DC.[10]

SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 4.1). The thickness of the panels was not measured. The wood species, Baltic oak, was identified for the central panel through dendrochronology. Each wing consists of two planks, the central panel of four planks. The quarter-sawn planks, vertical in grain, are laid vertically. On the reverse of the central panel, two small knots were noted.

  All planks were glued and butt-joined with the use of dowels.

  The wings are painted on both sides; the central panel reverse was planed to attach the battens. No bevelled or half-lap edges have been observed; the panels were studied in their frame.

- ***Dendrochronology*** The youngest heartwood ring of the central panel dates from 1484, which, with the added minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1493 for the tree that produced the wood for that plank.[11] An earliest felling date of 1495 is statistically more probable, however, since that would cover 93 per cent of the range of possibly missing sapwood rings. Assuming at least two more years for drying and transportation, the central panel could have been produced from 1495 onwards, but a production date from 1497 onwards is statistically more probable.

GROUND

- ***Visibility*** The off-white coloured ground is present overall and visible in VIS and XR (barely). It can be seen at the outer edges, near several contours, in losses, and in abraded craquelure. The appearance of the ground shimmering through in several areas was intended as part of the composition, but ageing effects of paint layers may have increased its visibility in specific areas.

- ***Barb and edges*** Although the examination was hindered by the presence of the frames, it could be observed that parts of the original barb are preserved on all sides. The barb at the bottom of the right exterior wing could not be studied because of the frame. Ungrounded and unpainted edges are present at the top of both the interior and the exterior of the right wing (RR 12 and 15). This establishes that the panels of the triptych were originally housed in an engaged frame.

- ***Application*** The ground seems to have been applied with a large brush and worked into a fairly smooth finish that retains slightly perceptible brush marks (see RR 13–15). The exteriors of the wings show a different ground application. On the left wing (R 11), fairly rough brushstrokes are visible and the ground does not seem to have been smoothed much. Also, the wooden support was not worked into a smooth surface before application of the ground. The same goes for the exterior of the right wing (R 12), but there the ground was evidently applied slightly thinner and smoother (with less impastoed brushwork), so that the surface texture of the wooden support is more apparent. The use of this surface for painting was clearly a conscious choice of the artist, independent of who prepared the support.

- ***Composition*** The ground consists of chalk (calcium carbonate – $CaCO_3$), presumably bound in animal glue. In a cross-section taken from the central panel, the ground layer was measured as 70 μm in thickness.[12]

PREPARATORY LAYERS

- ***Underdrawing*** Underdrawing is readily observable in many locations. The drawing is extensive and seems to have been used to form contours, indicate details and shadows, and, with the exception of the grisailles, to provide modelling. The modelling of red lakes

4.2 RR 14, IRR

was prepared with the application of parallel hatching in the darker zones; these areas indicated where little to no lead-white underpainting was to be applied. The large dilapidated tower, which replaced an already-painted red tent-shaped form and a tall column, was also elaborately prepared in the underdrawing.

Underdrawing is discernible in VIS (shimmering through paint layers locally and in losses) and in IRR/IRP. In the darker areas of the grisailles (RR 11–12), and especially in the larger groups in the backgrounds, the underdrawings are less well revealed with IRR/IRP because of the frequent use of carbon-containing paints there. In the lighter zones of the grisailles, the underdrawing is often better visible in VIS than in IRR/IRP. It is not likely that the current level of visibility was intended as such; it was probably increased by changes in refractive index due to the ageing of the paint film and is especially apparent in lighter paints that contain lead white.

- ***Medium and application*** The detectable underdrawing was applied in various stages and in different media.

  In the grisailles (RR 11–12), the underdrawing appears to have been applied with a medium-size brush in a single phase (figs. 4.6–7). The underdrawing material used here might be different from that of the underdrawings on the interior panels, since it seems to be more closely related to the materials on top. Especially in the landscapes it is often difficult to distinguish the underdrawing from a first paint layer, since the layers are very thin and the underdrawing material may also have been used as surface paint.

  In the central panel (RR 14), but not elsewhere, a first underdrawing in a dry medium was observed locally, for example, in the landscape in the left background (see figs. 4.2 and 4.13), where the river was positioned higher and a large, round shape – perhaps a bridge – was underdrawn but not painted. On the interior panels (RR 13, 15; figs. 4.9 and 4.11), the bulk of the currently visible underdrawing was brush-applied with a medium-size brush in a liquid medium, possibly a finely ground carbon black (not analysed) in an aqueous solution (not analysed), as many very small particles can be detected. Generally, contours were apparently drawn first, followed by the placement of specific details such as facial features. Further detailing and modelling followed, with the use of parallel hatching to indicate shadowed areas, also in landscape. Occasionally, some cross-hatching was applied.

  The central panel also received an additional third stage of underdrawing, in which the large alterations that were made here were prepared. A good example of this final-stage underdrawing is the vertical parallel hatching that was used to prepare shade under the dilapidated roof of the tower in the centre, which replaced a tent-shaped form that had been underdrawn and painted in this location. The diagonal parallel hatching of the underdrawing for the tent cloth itself is still detectable in a small, rectangular area under the crucifix on the altar (fig. 4.14).

- ***Style*** The underdrawings of the two grisailles consist of freely sketched contours with little detail, applied in an assured hand. The underdrawing appears to have been quickly applied, with lines that are seldom straight. Unlike in the other panels, no modelling was prepared with hatching in the exterior compositions, but some parallel diagonal lines are visible in the altered figure in the lower centre of RR 12.

  The style of the underdrawings of the interiors of the wings (RR 13, 15) closely relate to each other and to the second-stage (i.e. the first wet-stage) underdrawing of the central panel (RR 14). Most lines are relatively subtle and controlled, which is especially visible in the ample parallel hatching. The underdrawn contour lines are often not very straight – sometimes even jittery – and are not always continuous. The hatched lines do seem more even and uninterrupted, but this could relate to their quick but controlled application. Diagonal hatching was done in both directions, seeming to follow the forms in the composition. These parallel lines vary in length; some are remarkably short.

  More decisive and intense lines are evident in what appears to have been a final stage of underdrawing in the central panel. There, many more elements of the composition were changed than in the other panels (see also below, *Revisions …*). The lines of this second wet-stage underdrawing (i.e. third-stage, overall) are notably bolder and less controlled than those of the previous wet stage and appear more jittery. The shaded areas in the top of the large tower were prepared with such dense hatching in broad strokes that it starts to resemble a wash. This underdrawing phase could well have been applied in such a manner because it had to cover underlying paint. There are no compelling reasons to assume that the detectable wet underdrawing was executed by different hands.

- ***Revisions in underdrawing and differences from painting stage(s)*** In the grisailles, many smaller and larger corrections can be discerned between the underdrawings and the painted surfaces, although it is sometimes difficult to distinguish the underdrawing from the very thin paint layers on top, especially in the larger groups in the background. The underdrawing was followed generally in the paint

4.3 RR 14, VIS

application phase but not exactly, and the paint is often positioned adjacent to the underdrawn contour, with features shifted in numerous areas. In the grisaille of the Carrying of the Cross (RR 12), for example, the child on the shoulders of the man at top right initially had a larger head, and its outstretched arm was positioned lower. Numerous larger changes are also discernible; for example, in the figures to the left of Christ, which were initially planned larger, with their legs underdrawn lower and over to the left. The ladder was not planned in the underdrawing, and the scythe was prepared diagonally. More figures were planned at the back of the group. The three figures at centre right were also planned larger and slightly to the right. The figure behind the blindfolded thief was looking up and was apparently wearing a different hat. A larger alteration is visible in the lower centre, where the standing figure was initially larger and positioned higher, with his legs farther apart and bent more, leaning more markedly towards the other thief. The man in the lower right and the tau cross were underdrawn further to the right, the former with an arm extending under the cross. In comparison, there were far fewer large changes in the foreground and middleground of the Arrest of Christ (RR 11; fig. 4.6), but there were numerous smaller alterations within the large group of figures in the background. For example, the curious harness of the helmeted figure to Christ's left was not prepared as such.

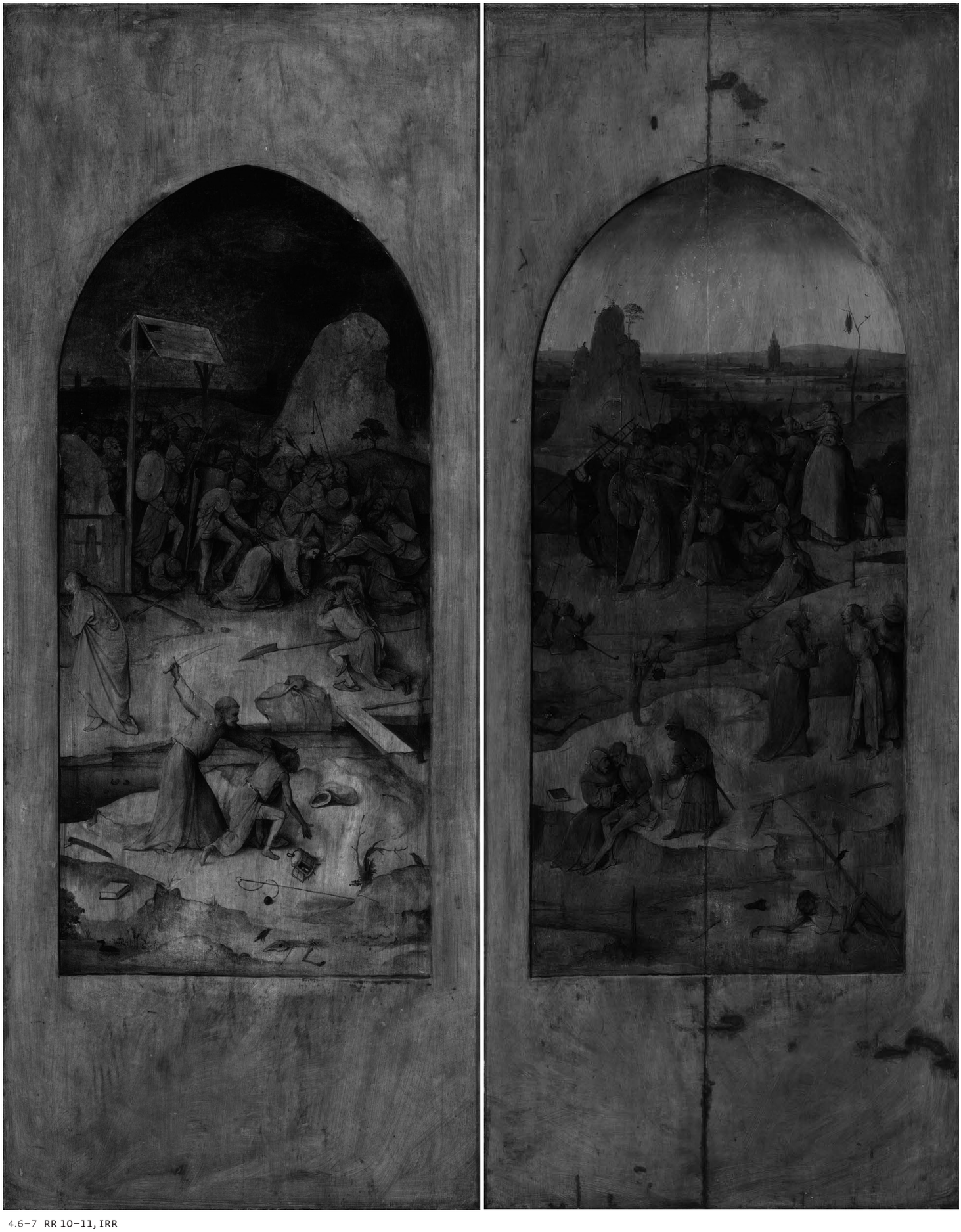
In the open left wing (RR 13; fig. 4.9), although numerous contours were shifted, the composition in the fore- and middleground was mostly planned as it was painted. It seems that the area with the kneeling giant was planned differently. At the barrel to the left of the entrance of the cave, underdrawing resembling a small group of people and perhaps a tree was not followed in paint as such. Additional changes were observed in the background. The sinking ship was initially positioned more to the foreground, and the water did not continue all the way to the left edge of the composition as it does now, but instead a landmass was planned there. At top right, underdrawn foliage is visible around the beacon, most clearly at the edge of the cliff. It appears to have been part of a large, underdrawn tree, the base of which is at the path at the centre right of the panel. Around this base, more underdrawing is visible that does not relate to the final composition. Examples of smaller changes in the foreground and middleground are the hands of Saint Anthony, which were prepared lower and larger, and the hand of the deer-shaped monster at the right edge, which was initially prepared on the back of the figure to his left.

A similar approach can be seen in the interior right wing (RR 15; fig. 4.11), where the underdrawn composition was also largely followed in paint, although many changes are still detectable. Saint Anthony's staff was prepared longer and his foot was positioned lower, which might indicate that the foreground landscape was not yet fully planned at this stage. The figure in the lower right foreground was not stabbed by a knife, but in its place an underdrawn eye was pierced by an arrow. The painted eye atop this figure's red hat was not underdrawn. The standing nude was moved slightly to the left when painted, with her face turned more in profile and her elbow in a higher position. The landscape in the middleground was also changed. It was initially blocked off with a low wall at the right, behind which a broader river and a narrow bridge in front of the tower door were planned. The besieged building on the right and the background architecture were also changed considerably.

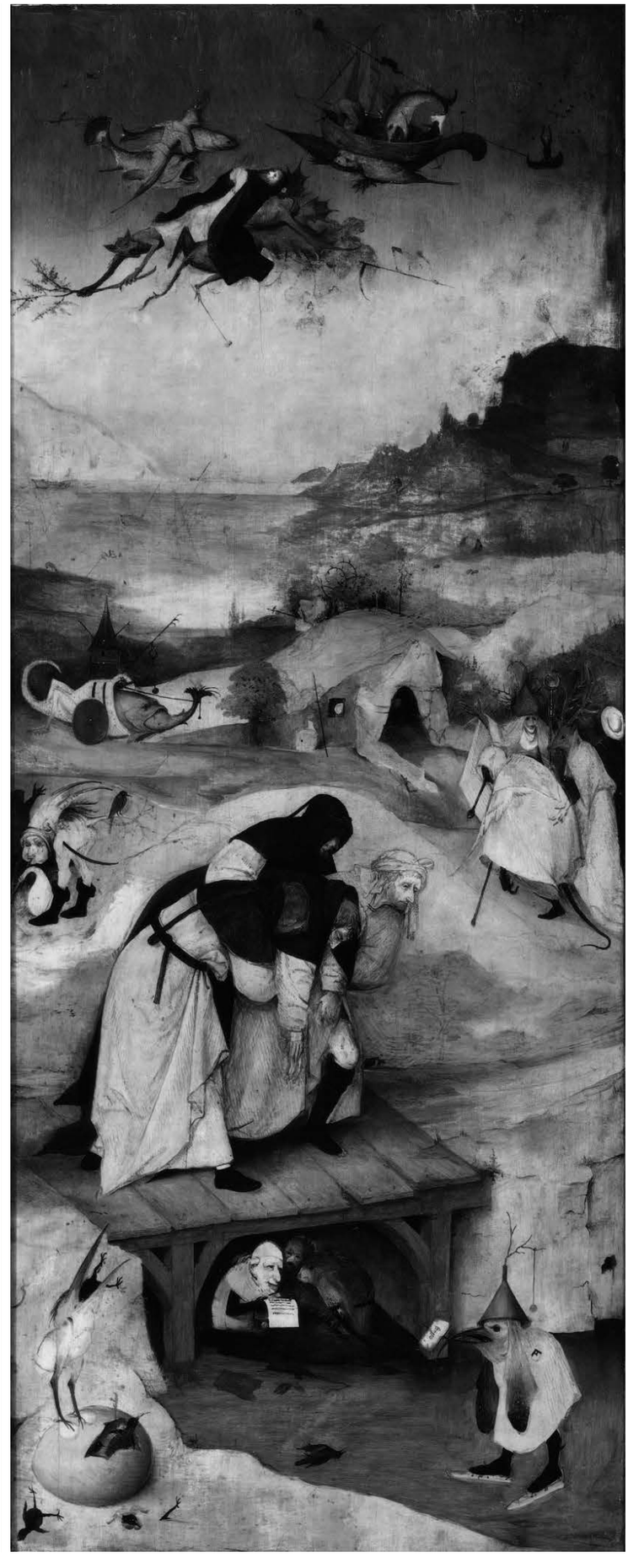
The centre panel (RR 14; fig. 4.13) shows many radical changes, some of which are rather bewildering and difficult to interpret, since many of these changes are multilayered and concern the underdrawings as well as subsequent, multiple paint layers. Large parts of the composition were repainted, but many of these new features were also prepared in a second underdrawing campaign.

The large stone platform with the arched opening in its front was not initially planned. Instead, the water continued up to the two rounded steps to the right of Saint Anthony, and possibly also halfway through the large column as it is currently painted. In the underdrawing, a large lizard is crawling up these steps. Just below Saint Anthony's staff, a spit of land was planned, on which there are two additional lizards. The architecture in the centre middleground and right background was also dramatically altered. Some of these changes have already been described and published, but numerous new changes were found, and many earlier observations can now be corrected.[13] The rightmost building was initially higher and quite anthropomorphic, with underdrawn large, armlike extensions that were left in reserve from the initial paint stage and held up a sphere in front of an additional spire. The large, dilapidated tower in the centre was changed dramatically. Close comparison of the IRR/IRP and the XR shows that in its place, a large, tent-shaped form was underdrawn and painted there. Behind the tent cloth, four figures are distinguishable around a table, which are better distinguishable in XR (figs. 4.14–16). The large column at centre right, which forms the right part of the tower and is also a later addition, was underdrawn

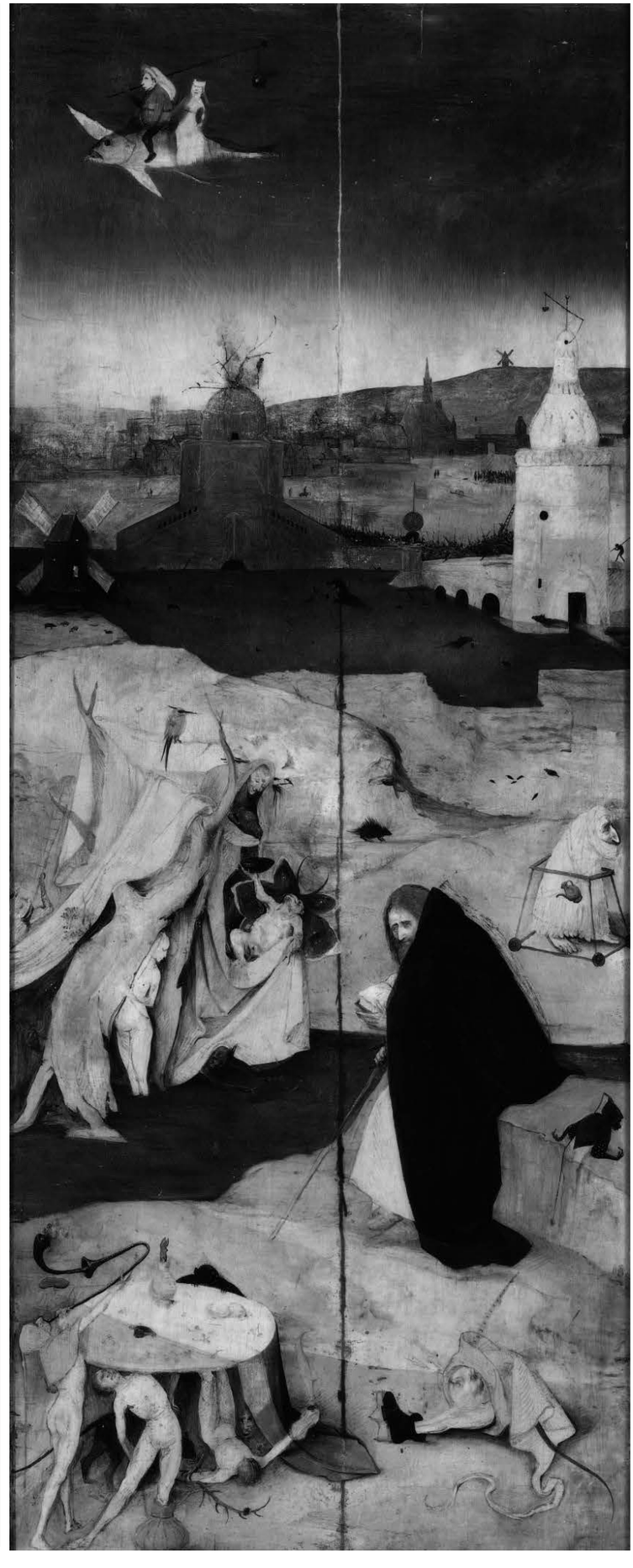
4.4–5 RR 10–11, VIS



4.6–7 **RR 10–11, IRR**



4.8–9 RR 13, VIS and IRR



4.10–11 RR 15, VIS and IRR

4.12–13 RR 14, VIS and IRR

Hieronimus bosch

extensively yet many details were changed in the paint application phase.

In addition to these major alterations, numerous other changes were observed as well. The landscape in the left middleground was revised, and it appears that the riverbed continued towards this area. Additional figures were prepared in the group to the left of Saint Anthony. What appears to be a large toad and another figure above it were underdrawn (and painted; it is actually better visible in XR) in front of the figure with the hurdy-gurdy, behind the little dog. Behind the hurdy-gurdy man stands another large, devilish figure that was never painted, but its underdrawn snout is positioned immediately to the left of the painted owl. In the IRR, between the figure with the hurdy-gurdy and the tree figure to his left, an angry mob is approaching with weapons and a gallows, which were painted but later covered over. At the position of the goldfinch in the lower left foreground, a bent-over figure peering from between his legs was underdrawn and left in reserve. Several adjustments were also made in the birdlike sky-ship. This listing is far from exhaustive. Major alterations to the paint are further discussed below (see *Changes*).

- ***Intermediate layers*** In the closed wings of the triptych, broad, diagonal brushstrokes of a slightly impastoed creamy-greyish layer are detectable under the paint but atop the ground. This layer is visible in VIS, IRR/IRP and XR. It consists of lead white and carbon, along with other pigments. This pigmented isolating layer seems to be present on the entire surface of the grisailles. It is possible that at least one of the stages of the underdrawing was applied before the isolating layer, since the underdrawing was not damaged by the small paint losses (13MICGBM001).

  In the panels of the open triptych, an underlying layer is observable as well, although it seems to be thinner and of a different tone. The often diagonal or vertical brushstrokes are detectable in XR but not in IRR, indicating the absence of paints containing carbon. This layer is visible under those of the paint, shimmering through in many areas, and is exposed at several paint contours where paint layers are abraded. In the central panel it has more of a creamy to slightly brownish colour (clearly visible where it was left in reserve). The left interior wing seems to have a more cream- to flesh-toned underlayer in areas (13MICGBM003).

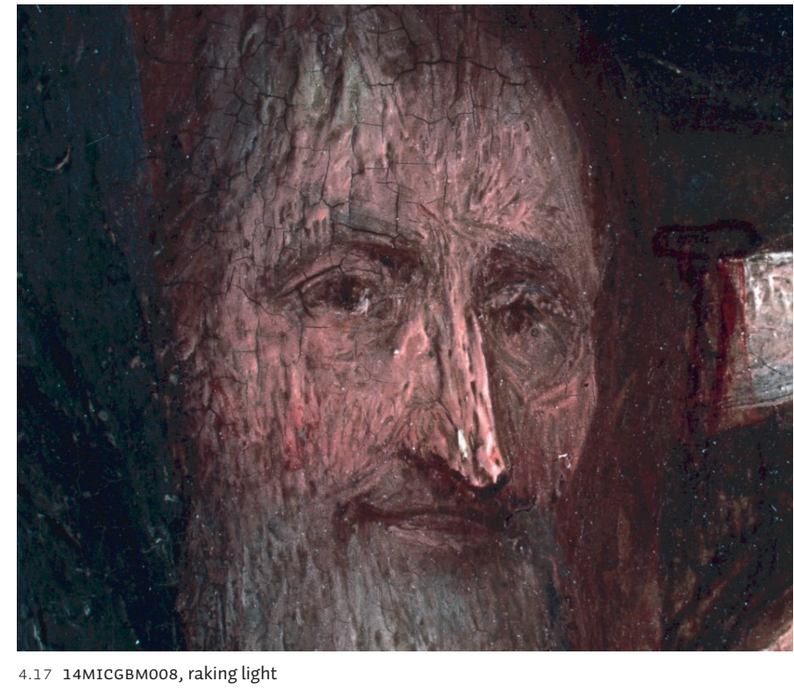
  Metal soap aggregate formation was observed throughout (see *Stability*) and is probably related to the underlying layers observed in the triptych. We may therefore assume that a pigmented isolating layer was applied overall and that it contains metal-based pigment(s), presumably lead white, which was also observed in the grisailles. The appearance of these layers shimmering through was undoubtedly meant by the painter as part of the composition. In many sections, though, it has become more apparent because of the ageing and increasing transparency of the paints, especially in those that are lighter in colour.

4.14–16 RR 14, IRR, VIS and XR

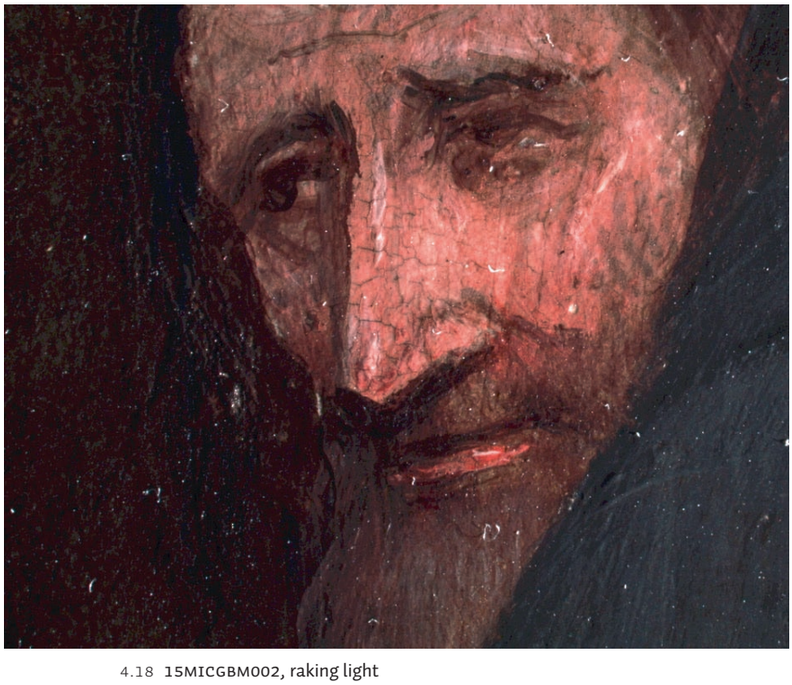
PAINT LAYERS

- ***Paint application and painting technique*** The brush-applied paint covers most of the panel surfaces. It was laid on in several stages, mostly wet-on-dry but also frequently wet-in-wet. The paint extends onto the barb, as the panels were originally painted in an engaged frame. In many areas of the grisaille on the left wing and, to a lesser extent, in that of the right wing, small, soft brush hairs are distinguishable that seem to be trapped in the paint. Such hairs have not been observed in the open triptych.

  Several incisions were found. At top centre in the exterior left wing, a small compass mark (centre point and circle) is visible, which might be related to the use of a spacer (11MICGBM010). In the interior of the left wing, the small pole at the left edge of the water



4.17 14MICGBM008, raking light



4.18 15MICGBM002, raking light

in the background was incised. In the central panel the diagonal lines in the stone flooring are incised. These lines can be traced and converge, not precisely in a single vanishing point, but in a small area just right of the top centre of the large column. A small hole, probably related somehow, is visible in XR just left of where the lines converge. Incisions also extend from the light point in the niche or window at the left of the ruin. A circular incision is present below the vault and is part of a previous composition (see below, *Changes*).

The grisailles were largely painted wet-in-wet, and the paint was applied in a much quicker and more sketchlike fashion than in the interiors of the triptych. Most passages were painted thinly with medium-rich, fluid paints, also utilizing the tone of the underlying pigmented isolating layer. Several linear features were painted with parallel black-and-white lines with some space in between, using the background as a midtone. This is most clearly visible in the poles of weaponry and torches. Coloured detailing was only used for the torches and candle in the grisaille on the left wing.

The interior panels were worked out to a much higher degree of finish, but with a similarly high speed of execution. Thin, fluid paints were frequently applied wet-in-wet. For examples of this, see – in RR 13 – the tears of the creature on skates at bottom right and the text on the letter in his beak; in RR 14, the extensive

4.19 Mapping of micrographs reproduced here (4.17–18; 4.21–27)

wet-in-wet painting of the large column; and in RR 15, the resin dripping from the tree to the left of the nude, the scratching of the writing in the saint's book, and the army on the bridge (fig. 4.28). Some thicker paints were used for impasto, especially for detailing (e.g., the numerous lead-white and lead-tin yellow dots). In the central panel, thicker and slightly less fluid paints were also used for the faces and clothing, mainly in the central group of figures, which were part of a later painting phase. The mostly fluid, glossy paints were used in both opaque and semi-transparent applications. Glazes were added in red (for red and purple areas) and green (for the copper-green robe). Strikingly, the artist used somewhat irregularly applied short, red lake hatching to model the long train of the woman's robe behind Saint Anthony in the central panel. In most red lake areas, a lead-white underpaint was laid on with a stiff brush, creating a sharp and impastoed texture that, after the paint had set, was covered with the red lake. Here, abrasion has caused the textured underlayer to become more visible. Brushstrokes were used to render contour and volume throughout the painting with apparent ease. The strokes were applied in multiple directions, in a rather quick manner, and they do not always accord with the many areas that were left in reserve. Several of the small figures were painted on top of background paint. Black contour lines were hardly used; however, brown lines indicating physiognomic details are visible. There is no reason why the panels could not have been painted by the same hand. For example, the highlights on several of the cheekbones are similar throughout all panels and paint stages. The slightly different paint application of the later phase could be explained by the presence of underlying paints that needed to be covered (e.g., compare the face of Saint Anthony in the central panel with that in the right wing in figs. 4.17 and 4.18).

4.20 RR 13, VIS

- ***Texture*** Most passages in the grisailles, as well as those in the open triptych, do not have a smooth finish, as textured brushstrokes are often visible. Besides impastoed highlights, which are relatively thin and fluid, texture is also used for some modelling. The texture of the wood grain is also visible in several locations.

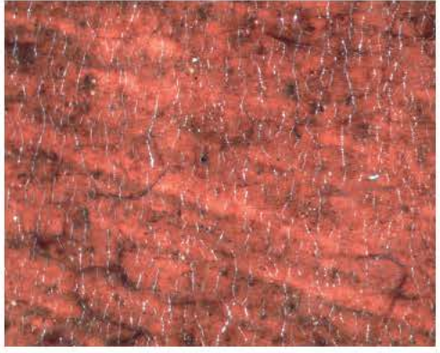
  In the central panel, a possible fingerprint is detectable in IRP, to the left above the small bovine in the water.

- ***Build-up and palette*** The paint was applied mostly from light to dark, followed by detailing and highlights. Generally, the paint application was planned, with areas being left in reserve during build-up. The painting was generally executed 'back-to-front', but there are numerous locations where the painter returned to make minor adjustments with additional background paint.

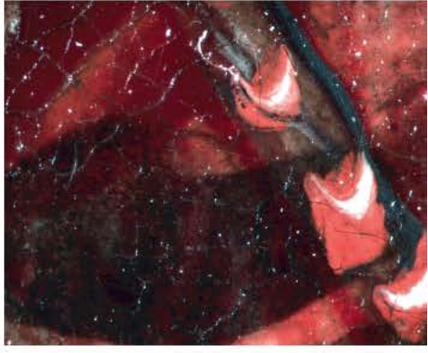
  The grisaille paints (RR 11–12) were applied on a creamy-greyish pigmented isolating layer. Most elements seem to have been painted swiftly and wet-in-wet, often using the background colours as a midtone. Coloured detailing was only used for the torches and the lantern's candle in the Arrest of Christ (RR 11). The large, brown fields around the actual grisailles are not original, and neither are the yellowish lines on the right and bottom edges of the pointed-arch 'windows' through which both grisaille scenes are seen. Originally, these large areas seem to have been painted with an imitation of stone or marbling. Several traces of this warm, brownish marbling on a cream-coloured underlayer are discernible at the edges and in losses (see fig. 4.21).[14]

  In the interior of the triptych, a coloured underlayer applied atop the pigmented isolating layer was often used to fill in larger areas, leaving elements in reserve. In both interiors of the wings, and in

4.21 11MICGBM004

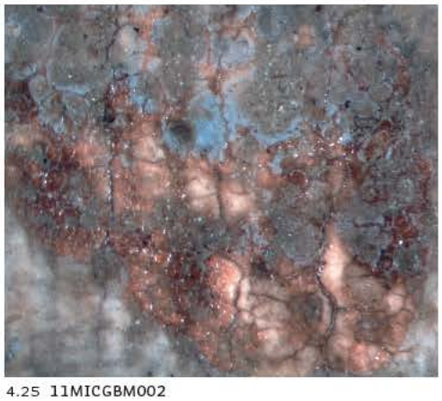


4.22 13MICGBM010



4.23 13MICGBM004

4.24 11MICGBM001



4.25 11MICGBM002

4.26 11MICGBM003

the right section of the central panel, the top sections of the sky have a distinctly grey underpainting, leaving figures and creatures in reserve (see, e.g., the airship and its flag in RR 14; see also the IRRs). In the right-hand panel, the wings of the flying fish were left in reserve from the grey underpainting of the sky and later covered by the sky's blue, presumably to paint them out. The underpainting makes a gradual transition from grey to lead white, which extends to just below the horizon in the three interior panels. The brushwork of this underpainting is visible in XR and IRR. In the left-hand background of the left wing (RR 13), the top section of the water, the hill and the large boat were painted over the sky and its lead-white underlayer, while the hills on the right were largely left in reserve.

For the central panel, the grey to white underpaint of the sky seems to have been applied first. In addition to both airships, the top of the column at the tent-shaped form was also left in reserve. This confirms that the current structure of the large, dilapidated tower was not part of the initial planning stage, even though it too was later prepared by means of underdrawing. The top part of the currently visible ruin was painted over the sky. The blue of the sky was then applied over the dark grey to lead-white underpainting (as abraded sections reveal these colours underneath) – first a thin, light blue, succeeded by darker azurite blue in the top right. The darker colours on the left were painted atop the light blue sky, followed by the creatures and further detailing. The army in the top left corner was not left in reserve but painted over the dark sky, with an ensuing final layer of background paint in dark brown around the flying fish. After the sky, background paint was applied, which often covered some of the blue.

Large sections of land were thinly underpainted in brown, from which areas of water and the background landscape were left in reserve, following the underdrawing. The landscape was further modelled by painting areas with darker brown, greenish and greyish hues, then putting in additional detailing. Some final landscape paints were applied after the figures were done (e.g., the one with the walking frame in the right wing). The foliage of the trees to the left of centre in the left-hand wing was also painted after the fish-insect was completed in the left middleground. Foliage was painted in short-spaced, impastoed dabs of dark and light greens. Sometimes lead-tin yellow was mixed in as well (e.g., in the tree on the back of the giant) and was followed by a locally applied copper-green glaze. At the right-hand part of the central panel, both azurite and malachite pigments seem to have been used for the background landscape paints. In the brown foreground of the left wing, some red lake was probably mixed in, since some red-dyed fibres of wool shavings were detected there (fig. 4.22) as well as in the marbling on the closed left wing.[15]

Red glazes were frequently used for clothing and other surfaces, but also to paint blood, and to indicate shadows and contour lines in several faces and fingers. For several lighter red lake areas, a stiff lead-white underpaint was applied, later followed by a red glaze. Abrasion has caused the textured white underlayer to become more visible. Under the bluish arms of the creature holding the fish to the right of the standing nude in the right wing, a red-purple lake was used for contours (15MICGBM005). In places, red lake was followed by opaque, inorganic red paint with some lead white; for example, in the feathers of the headdress of the figure with the blue bagpipes in the left middleground of the left wing (see fig. 4.23). In several areas, the artist mixed some light blue pigment with lead white to create cool white to slightly greyish tones (e.g., the egg lower left in the left wing). The IRR/IRP indicates that the painter made considerable use of black pigment for many darker and greyish areas (as in the water). When the frozen water in the lower right corner of the left wing was painted, the skating figure was left in reserve. In the final stage, the edges of the ice were locally reinforced, spreading slightly over the red robe. The letter in the skater's beak was first painted in lead white, followed by a red dot, applied wet-in-wet, and black writing that was pushed by the brush into the still-wet paint underneath. Similar paint application is visible in the small barrel in the centre of the left wing, to the left of the kneeling giant. Saint Anthony's hair was built up with a brown underlayer, followed by dark, greyish-pink hairs applied wet-in-wet. The sleeve of his left arm was painted first, and its paint seems to include smalt (not analysed). The red robe of the figure behind him was then painted, followed by the hand, both slightly covering the sleeve.

In the large column to the tower's right (RR 14), most of the imagery was painted wet-in-wet. For the greenish sections, the figures were painted atop a green base, with brown outlines brushed into the still-wet paint, touches of lead-tin yellow and lead-white highlights. Locally, more green paint was added between the figures. In a later

phase, in the top section of the large column, the blue and white of the sky was painted around the figure of Moses. Blue pigments were observed in several grey areas; for example, in the cone-shaped building at centre right and on the central platform, where V-shaped ornaments were applied in a light blue between incised lines.

The signature in the lower left corner of the central panel was applied in black over the already-set paint of the light brown background (14MICGBM011). No guidelines or incisions have been detected there. The appearance, craquelure and adhesion of the signature are fully comparable to those in the rest of the painting, although it is actually better preserved and shows less abrasion than the surrounding areas.

- ***Changes*** In general, the painter did not follow the underdrawing very closely in the exterior grisaille scenes (especially RR 11), but heeded it more in the interior of the triptych, at least as far as the first painting stage was concerned. Still there are numerous alterations, both large and small, observable in the subsequent paint stages, as seen in visible light, IRR/IRP, and XR. The composition of the central panel, especially, was dramatically altered after a first paint stage, and even despite our most recent examinations, some of these changes are not fully understood.

In the exterior grisailles, although it is often difficult to distinguish between the underdrawing and the paint stages, the thin paint layers seem to have been applied largely wet-in-wet, in a single campaign. Hence, no changes in the paint layer were observed.

In the left wing, Saint Anthony's back was reduced in size twice – once after underdrawing and again during the painting phase, and the tail of his robe was positioned higher. The leftmost figure supporting the saint was initially painted with a red hood that covered his entire head (see fig. 4.20), and the hill behind this group was higher originally. In a first painting stage, there was no bank at the lower right foreground, and the ice continued to the right edge of the panel there. The bridge and path leading from it were wider, and no foreground vegetation extended onto the surface of either end of the bridge. Another creature was painted directly behind the figure with the bagpipes, but was later covered with the green of the landscape. The tower on top of the insect-fish in the left middleground was not left in reserve. The background landscape was also altered in paint: the hills in the far left background were painted over the sky, as were the two leftmost hills on the right bank. At the left-hand edge of the water a bank was left in reserve, and the horizon of the water was initially painted lower, following its position in the underdrawing. The face of the kneeling giant was painted over the background, as were the trees to the left behind him. It appears that paint from an earlier stage may have been scraped away in the area above the giant.

Changes in the paint layers were also observed in the right wing. Saint Anthony's hood originally covered less of his head, his back was painted smaller than it was left in reserve, and his robe was cropped at the bottom. The book was enlarged to the right, where it was partly painted over Saint Anthony's robe. In the left foreground, the rightmost section of the white cloth on the table was painted over with purplish lake, which was later mostly lost through abrasion. The most significant alteration in the composition concerns the landscape in the right middleground behind the figure with the walker, where an angular stone wall with a small, rectangular bay built into it, and a narrow bridge were planned between the middleground landscape plane and the fortification behind it. The bridge was partly left in reserve from a wider section of water and in a later stage the water and the wall were overpainted by the greenish riverbank.

Many radical changes in paint can be found in the central panel, where the entire centre section was repainted. Some of these alterations have already been noted and published, but those observations can be improved upon, now that several additional changes have been found.[16] Both the first and the second compositions were prepared with underdrawing. Instead of the current dilapidated tower, a large, tent-shaped form was depicted. The XR shows the tent cloth, indicating that radio-opaque paint was used, while the IRR/IRP shows the interior, for which darker pigments were used (figs. 4.14–16). The XR also shows a long column protruding above that was left in reserve from the underpainting for the sky. A cross-section taken from the tent cloth indicates that it was fully completed before it was painted out. It showed the following layer build-up: a chalk (calcium carbonate – $CaCO_3$) and glue ground (70 µm thick); an orange-red vermilion-based layer (10 µm); a red madder-based paint (10 µm); a dark red madder glaze (10 µm); a translucent intermediate layer (18 µm); a brown layer containing lead white, ochre and black; a thin varnish layer; and brownish material with ochre and lead white (10 µm).[17] The 'translucent intermediate layer' on top of the uppermost red lake layer might well be an original varnish, which would indicate that some time must have passed between the initial and final compositions being painted. The group of figures that were painted in the tent-shaped form are also fully detailed in the XR, which further supports the notion that the composition was completed, then was changed dramatically.

The XR of this detail (fig. 4.16) reveals a woman positioned behind a table, addressing a man immediately to her left, whose face is painted in profile. To their right is a creature with a spoon-shaped beak and a lute and an elaborately decorated headdress. Another man is seated in front of the table (he was actually painted over it and not left in reserve); his legs are also visible in the XR. Looking out from below the tent cloth at the beholder, he seems to hold a drinking glass in his right hand. He is wearing a green robe and a blue-green cap, and his pink skin tone is visible in areas of abrasion, which again indicates that the figures were probably completely finished before the composition was changed. Christ, the altar, and the crucifix were painted in a later stage, atop the red tent cloth. At the bottom, Christ's robe appears to have been painted over background paint, but he was not added to this area of composition in a later stage, as the rays of light are incised into his robe, whereas the dark bottom section of the altar was applied after that, with paint running into the incisions.

In XR, the red tent cloth continues under the head of Saint Anthony, while the face and the headdress of the figure above him were carefully left in reserve from the red cloth. IRR/IRP also indicates that Saint Anthony was not originally planned in his current location. Instead, he was prepared larger and standing up, with his dark robe extending to the edge of the platform, to where the high-hatted figure sits now (fig. 4.13). The curve of the saint's back runs through the round table, and his face was initially planned just to the left of the female head behind the saint's current location. Thus, it was not the woman's face that was left in reserve from the tent cloth here, but Anthony's. The rectangular shapes left in reserve at the bottom of the dark robe relate to the saint's legs. As seen in IRR/IRP, one foot in profile and the tip of another were also apparently left in reserve from a warm brown background. The large saint was thus initially standing and probably completely painted, although his head in the underdrawing appears comparably small. Subsequently the robe was redrawn higher up, and in the new empty space, turtle-like creatures were underdrawn. These were never executed in paint, though, and Anthony's robe was painted a second time in the current, even smaller version.

Significant changes can also be found in the figural group at the round table behind Saint Anthony. As shown in IRR/IRP and XR, to the left of the figure with the hurdy-gurdy, an angry mob with weapons and a gallows and a figure with an extended arm were painted. In front of the hurdy-gurdy man, a large toad is painted with arms

reaching upward. Between his claws, a head in blue with a collar in white was painted, apparently belonging to a figure with legs outstretched. (A blue leg and foot are visible in the hurdy-gurdy and in the lute.) Its arms are crossed in front of the toad; they are visible in IRR as being left in reserve and in VIS as being painted in blue. The lower highlights of the round white collar are still visible in the paint surface. To the left of the head, another semi-opaque form below the surface is visible in the XR; it was observed with the microscope that this shape was painted red. Where the small dog is, the position of (presumably) the toad's leg was changed twice, and part of a painted foot is still discernible. Another creature with a hand reaching out was depicted in front of the figure with the lute, immediately to the right of the small dog. Further to the left, the 'tree-helm' was added afterwards, and painted over the earlier headwear, which is opaque in XR. The buildings to the right of the tower were also changed dramatically in paint, but in this area we need to rely entirely on the XR, since the dark grey paint of the buildings remained opaque to infrared. The XR shows that behind the naked figure who is descending the stairs, initially a large cylindrical form was painted using opaque paint. This indicates that land was probably planned there, and the XR indeed seems to indicate a coastline or riverbank continuing from below the descending man to the large semicolumn that forms the right edge of the dilapidated tower.

There are indications that this semicolumn was also not originally planned. The lower half of it shows as a dark, monochrome area in IRR/IRP, implying that this major feature was also significantly altered in paint. The change has not been identified with certainty yet, but it might be related to an earlier, higher position of the water there, which was painted grey. The large stone platform with the vaulted opening in front was never planned, and the grey paint (or underpaint) for the water might have continued up to the currently visible rounded steps to Saint Anthony's right. Curiously, a large, recumbent creature appears to have been left in reserve at the position of the steps. The bent legs of this creature, which lies on its back, can be seen to the right, while to the left, an extended arm with open hand is visible. An oval shape detectable in IRR appears to enclose this figure, but neither one is executed in paint. The figure might be lying on a red painted cloth, the lighter form of which is evident in XR and IRR. This entire section was later covered by the grey paint of the stone platform that we see now.

Around the vault in the plateau and around the 'fish-boat' (fig. 4.3) in the lower centre, many other alterations are evident in VIS, IRR/IRP, and XR. The embankment was adjusted multiple times, with the river widened at least twice. Above the fish-boat, XR and IRR reveal a bird resembling a great tit; a finned fishtail; two arms (one on the join and another stretched upward, holding a fish by the tail); to the right, a smaller bird in flight; and below it, a figure blowing a horn from between his buttocks (see BRCP, *Catalogue Raisonné*, figs. 4.19–21). Initially, the 'fish-boat' was painted with a much larger, curved tail, roughly following the vaulted arch. The large circle of the sphere at the tail's end was incised, encompassing the bird and the figure with the horn. A figure lying on its back with its mouth wide open, was prepared below the tail-section of the boat, grasping it with an extended arm. All this was covered up at a later stage, but the version of the painting in the Barnes Foundation still shows many of these features.[18] The finned fishtail, the two arms (with one stretching upward, holding a fish by the tail), and the smaller bird in flight were not detected there, and together they might well belong to an even earlier form. To the right, on the adjacent boat, the sail was enlarged beyond the area kept in reserve. It initially had a longer trumpet as a mast, and instead of a scroll, a book was underpainted. In the São Paulo version this boat does show the trumpet, but not the book.[19] The section around the high-hatted beggar is quite damaged, but this also seems to be related to the changes made there. Originally the area was painted in a warm brown landscape colour. When the larger saint was painted out, the low wall with the rounded steps next to the current position of the saint was added, and the landscape was covered with the greyish paint for the stone platform. The beggar was painted afterwards, and the higher end-section of the wall there partly overlapped his red robe.

Summarizing, there were at least two but probably more major stages in the development of the composition in the central panel. The first consisted of the underdrawing and execution in paint of the entire painting, with the most notable differences compared to the final stage being the tent-shaped form and the larger figure of the saint standing on a riverbank in the centre. This initial painting seems to have been completely finished, as the presence of a varnish layer suggests. The second stage consisted of numerous alterations, with new underdrawing applied for many features on top of the previously painted composition. These were then executed in paint, compositionally changing the central section with the ruin and the figure of Saint Anthony. However, with the currently available data set, it is not yet possible to map all these changes exactly, especially in the areas that remained opaque to infrared, and it is even more challenging to establish the exact sequence of all these changes.

4.27 14MICGBM004, raking light

FRAME

The rectangular gilded wooden frame is historically important but not original. As indicated by the presence of barbs and unpainted edges, the painting originally had an engaged frame. The neo-Gothic frame covers these barbs, thus reducing the panels' visible size (by about 2 mm on average).

The side panels have grooved frames that are closed on the top. The central panel has a rabbeted frame. The framing does not allow for natural out-of-plane movements of the panels.

CONDITION

Support

- ***Altered dimensions*** The central panel was thinned by about half its original thickness in order to flatten the painting and reduce the warp. In the process, the original dowels between the planks became exposed (and were also thinned by about half; some are now missing). The frame made it impossible to observe any dimensional alterations of the wings, but none were obvious.
- ***Additions*** The flattened state after the thinning of the reverse of the central panel (RR 16) was maintained by the addition of horizontal

battens, which also reinforced the weakened structure of the panel. Currently, nine horizontal battens are visible (alternating pine and mahogany), which may not all have been applied in the same treatment. The 1969–70 treatment report noted that the battens blocked the movement of the panel and resulted in the formation of cracks. The restoration consisted of adapting the battens by making several vertical cuts in them to allow more in-plane movement of the panel. It is uncertain whether the two sliding oak bars and metal clamps now present were also added at that time, but they must have been applied after the two vertical slats on the sides. In several areas there are V-shaped inserts that have a colour similar to that of the panel reverse. To repair the woodworm-damaged areas around the joins, other V-shaped tracks were carved in the panel, and similarly shaped wedges were glued in. This also reinforced the three joins of the planks; it was done before the addition of the battens and after that of the six non-original dovetailed inserts. These dovetailed inserts only bridge the two joins on the right (seen from reverse). On opposite sides of the left join, small holes are identifiable. An older XR reveals that these are the result of screws used to attach short, vertical slats to cover the join (in between the horizontal battens). The slats formerly covered all the joins but have been removed. At present, the horizontal battens, combined with the framing method, still restrict the natural dimensional changes of the central panel.

- ***Cracks*** No recent cracks have been noted in VIS and XR. In the open triptych, the left wing has an old crack top centre. In the central panel, several cracks of varying length extend from the top and bottom edges of the panel, running along the wood grain. (One runs the entire length of the panel.) These were probably largely caused by the horizontal battens blocking the natural movement of the wooden panel. Locally, some of the cracks are slightly open. In the right wing, two small cracks are visible at the top and bottom edges.
- ***Deformations*** In the wings there are only minor deformations. Their stability is reasonably good, in part due to the panels having been 'sealed' on both sides with paint. The central panel, however, has a slightly convex, undulating shape, in part caused by the old battens restricting the natural dimensional panel changes.
- ***Joins*** The joins are closed. In the central panel there are some minor differences in level around the joins, as well as on both sides of the right wing. From the XR and the IRR/IRP, it seems that the boards of the central panel and the right wing came apart at some point, but not those of the left wing.
- ***Coated reverse*** The reverses of both wings are painted. The original central panel reverse was thinned and currently appears fairly clean. In some areas, wax and glue residues are detectable. The light wood colour is probably caused by the removal of the vertical slats.
- ***Biological damage*** In the central panel there are some woodworm-damaged areas around the joins. Woodworm tunnelling is visible in XR.

Ground and paint layers

- ***Stability*** Overall, the ground and paint layers seem stable. Their adhesion is excellent and recent paint losses or issues with raised paint have not been noted. At certain cracks and joins some old, slightly raised paint is evident, as well as small, old losses (14MICGBM010). Most craquelure is caused by natural dimensional changes of the panels. There is hardly any craquelure in the grisailles due to the very thin and possibly medium-rich paint application.

  Lead soap aggregate formation, which can appear as small opaque points in XR, has been observed throughout the painted surfaces of the triptych. Expansion of the aggregates may cause them to protrude from the paint surface, resulting in minuscule raised spots and a more granular surface texture. Loss of such metal soap aggregates results in tiny, craterlike holes that appear dark in XR. Over time, accumulation of dirt and varnish residues in these holes causes them to appear dark in VIS and IRR/IRP.
- ***Losses*** There are only a few losses in the paint, sometimes including the ground. Damage can be observed along the edges, for example, at the top right of the central panel, around the joins and at the cracks.
- ***Abrasion*** The framing has caused some damage to the edges, mostly to the raised barb. The paint surfaces are somewhat abraded overall, typically with the highest points of the paint layer being worn. Locally, abrasion is more severe – for example, in the red fruit lower left in the central panel, where the original red lake paint is scuffed, revealing the tops of the underlying impastoed lead-white brushstrokes. Also on this plant's blue sepals, the darker blue outer section is largely abraded. In the central panel, the plateau and several other areas around it are more damaged as well. The multilayered build-up and changes in these areas have probably played a role in such abrasions.

  On the whole, the interiors of the wings are in a better state of conservation. Of the grisailles on the exterior, the left wing (RR 11) is somewhat more abraded overall, with smaller damaged and retouched areas. The right exterior wing (RR 12) has more pronounced abrasion around the figure of Christ, and in the top section there are several small scratches and dents.

  The signature is better preserved and shows less abrasion than the surrounding areas. This suggests that it might have benefited from selective cleaning in the past, i.e. cleaning around it.
- ***Discoloration and increased transparency*** Both red and green glazes have held up well, as only slight changes are evident (e.g., in the red 'fruit' at the left edge of the central panel). A major increase in transparency can be found in the lighter paints containing lead white, which causes the increased visibility of underdrawing and underlying layers. This effect is further strengthened by the thin application of paint in many of these areas.
- ***Filling, retouching and overpainting*** Most of the losses in the original paint layer have been filled and inpainted, but some of these retouchings have discoloured over time. The areas around cracks and joins stand out and are clearly discernible now. Areas of abrasion damage have received no or very little retouching. The brown outer fields of the grisaille panels are later additions, which cover an original stone imitation there as well as part of the contour line of the 'windows' for those scenes. A yellower, overpainted line largely covers the original light contour line on the bottom and right sides of these 'windows'.

  There are several original paint drips or splatters of organic and inorganic reds below the grisaille paint in the Arrest of Christ (RR 11; see figs. 4.24–26), although these might stem from the original stone imitation outer fields. On the horizon of the interior left wing, above the sinking ship, the use of a very liquid retouching material is evident. The visible underdrawing of the lowest part of Saint Anthony's stick in RR 15 was retouched at some point.

Surface finish

- ***Varnish*** The yellowed modern varnish appears to be of a natural resin; it has a glossy and relatively uneven appearance. It was irregularly and rather thickly applied using a brush, with some visible drips. The saturation of the paint surface is generally good but seems slightly matte because of the microcraquelure of the varnish. An additional old varnish layer is still present on the signature. It may be similar to the small, square patch of old varnish (just to the right of the skating figure in the left wing), which was purposely left during the 1949 treatment. In some areas, superficial

scratches are visible from wiping of the surface, and there are some losses in the varnish layer itself. More disturbingly, there is ample old varnish residue, which is also present in the interstices of the paint. This has discoloured a good deal, resulting in an altered, more greenish appearance, notably in the sky areas (rather than the intended blue visible underneath; see RR 13) as well as many spots in the grisailles.

- ***Surface dirt*** There is a small amount of surface dirt on the painting. A brush hair seems to be stuck in the paint layer (13MICGBM007).
- ***Visibility of the original surface*** The visibility is reasonable. However, the highly yellowed old varnish residues, the abrasions, and the defective colour-matching or discoloured retouching (mostly on joins) all cause a reduced legibility of the original painted surfaces.

4.28 **RR 15, VIS**

[1] See BRCP, *Catalogue Raisonné*, cat. 4.

[2] See Friedländer 1924–37, vol. 5, 149–50; Friedländer 1967–76, vol. 5, 85–86; and Unverfehrt 1980, 253–54, 261 and 272–73. The most extensive survey is offered by De Vrij 2012, 470–90, listing forty-one works.

[3] Friedländer 1924–37, vol. 14, 99–100; Friedländer 1967–76, vol. 5, 71–72.

[4] Lievens-De Waegh 1973–74, 152–75.

[5] Hitner 2007, 353–57.

[6] De Sousa 1949 (who published XRS of the central panel); R. Van Schoute in Steppe et al. 1967, 77–78; Sonkes 1970, 222; Filedt Kok 1972–73, 151, 153–54; Van Schoute 1973; Lievens-De Waegh 1973–74, 152–75; Van Schoute and Van Schoute-Verboomen 1982, 172–73, 175–76; Van Schoute and Van Schoute-Verboomen 1992, 53, 55, 60; Mesquita e Carmo and De Sousa 2003, 9–15.

[7] According to Vieira Santos, the triptych was sent to Germany in the second half of the nineteenth century by King Ferdinand II of Portugal because of its precarious state of conservation; see Vieira Santos 1958, 21. According to Hugo Xavier, it might have been restored in Belgium; see Caetano 2014, 79 and 80 n. 5.

[8] The Departamento de Conservação e Restauro (DCR) of the Instituto dos Museus e da Conservação (IMC) was formerly the Instituto Português de Conservação e Restauro (Portuguese Institute of Conservation–Restoration, or IPCR), and before that, the Instituto José de Figueiredo.

[9] We are grateful to Teresa Serra e Moura, conservator at the Museu Nacional de Arte Antiga (MNAA), for sending this data.

[10] Joaquim Caetano, oral communication, September 2011.

[11] Analysis (central panel only) was done by Peter Klein (before 2001).

[12] In 1969, the Instituto José de Figueiredo examined the painting and also analysed a cross-section from the central panel (in a background area around Christ, where the red 'tent' was overpainted).

[13] See De Sousa 1949; Van Schoute 1967; Sonkes 1970; Fernanda Viana 1972; Filedt Kok 1972–73; Van Schoute 1973; Lievens-De Waegh 1973–74; and Mesquita e Carmo and De Sousa 2003.

[14] The marbling is similar to that in the exterior wings of the *Temptation of Saint Anthony* triptych in the Musées royaux des Beaux-Arts de Belgique in Brussels, which Stroo et al. 2001 (84–117) considered to be a Bosch workshop copy from around 1520–30.

[15] For more information and literature on the production of red lakes, see Wallert 1991, 74–83, and Hofenk De Graaff, Roelofs and Van Bommel 2004, 344–52.

[16] See De Sousa 1949; Van Schoute 1967; Sonkes 1970; Fernanda Viana 1972; Filedt Kok 1972–73; Van Schoute 1973; Lievens-De Waegh 1973–74; and Mesquita e Carmo and De Sousa 2003.

[17] See published technical and treatment study of the *Temptation of Saint Anthony* in Fernanda Viana 1972. Information about layer thickness is taken from the sample analysis report in the IMC/DCR of Portugal.

[18] *The Temptation of Saint Anthony*, panel, 69.9 × 51.8 cm. Barnes Foundation, Philadelphia, PA, inv. BF962. See further BRCP, *Catalogue Raisonné*, cat. 4.

[19] *The Temptation of Saint Anthony*, panel, 127.5 × 101.5 cm. Museu de Arte de São Paulo. See further BRCP, *Catalogue Raisonné*, cat. 4 and fig. 4.23.

5 *Saint John the Baptist*

RESEARCH REPORT 47–48

Hieronymus Bosch
c. 1490–95

Oil (analysed) on oak (analysed) panel, 48.5 × 40.5 cm (including extruding cradle bars). The panel was cropped on all sides.
Museo Fundación Lázaro Galdiano, Madrid, 8155

BRCP, *Catalogue Raisonné*, cat. 5; www.boschproject.org no. 5.

Inscriptions and labels
Reverse: 8155 written in ink on a horizontal cradle bar top left; a label with 22 (upside down) is attached to a vertical cradle bar in the centre. On the reverse, top left, a damaged Rotterdam exhibition label is still attached. Just below that is a small, unidentifiable label. 8155 is written in white on the underside of the frame.

SUMMARY OF CONCLUSIONS

The technical evidence is in full agreement with the assertion that the Saint John the Baptist *in Madrid was painted by Hieronymus Bosch. The painting technique as well as the style and material of the underdrawing place the panel in the core of Bosch's oeuvre. It is assumed in this study that the panel was the pendant of the* Saint John on Patmos *in Berlin (cat. 6), which has a similar composition.*
Perhaps while the Madrid panel was still in the workshop, the large figure of a male donor to the left of Saint John was painted over with a fantastic, thistle-like plant, with the man's head being covered by the plant's seedpod. The current panel is very thin, suggesting it was originally a double-sided painting that was split lengthwise to separate a grisaille on its reverse, now lost. The Berlin panel has such a grisaille on its reverse, indicating that these panels together functioned as the folding wings of a larger ensemble. The barbs and unpainted edges on the Berlin panel indicate that the wings were originally housed in engaged frames, now lost.
The Saint John the Baptist *was cropped on all four sides, which affects the outcome of the dendrochronological analysis, since in so doing several annual rings were removed from the wood. The Berlin* Saint John on Patmos *still has its original dimensions, and its dendrochronological dating can therefore be applied to both works. That panel could have been painted from 1489 onwards, although a date after 1491 is statistically more probable. As further explained in* BRCP, Catalogue Raisonné, *cat. 5–6, we date both works to around 1490–95.*

RELATED WORK

Cat. 6: *Saint John on Patmos* (63 × 43 cm), Gemäldegalerie, Staatliche Museen zu Berlin.

Baldass (1943) first suggested that these paintings belonged together, and that they formed a (stationary) diptych.[1] According to Koldeweij (2001), they might have been the upper painted wings of the carved altarpiece by Adriaen van Wesel for the Brotherhood of Our Lady in 's-Hertogenbosch.[2] This thought is elaborated upon in BRCP, *Catalogue Raisonné*, cat. 5–6.

EXAMINATION DATA

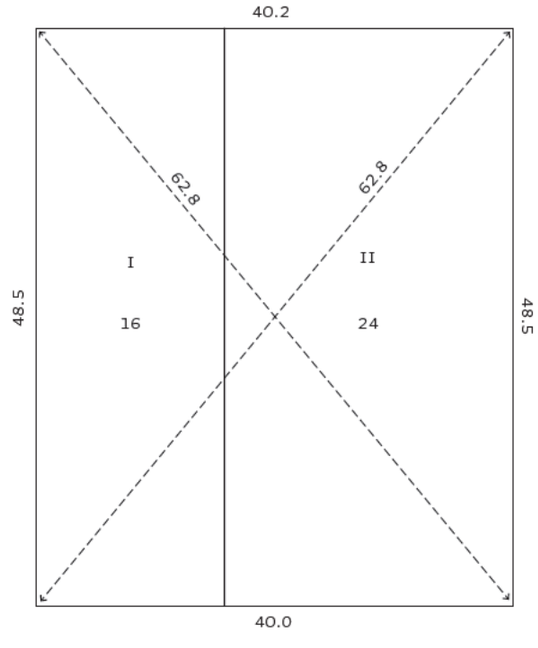
20–23 February 2012 (Robert Erdmann, Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Ron Spronk).

The painting was examined out of its frame, both upright on an easel and flat on a table under strong illumination, in the auditorium of the institute. Both front and (cradled) reverse were easily accessible.

- ***Previous research and documentation available*** Some images of the painting, including an IRR detail and an almost complete XR, were published by Dolores Fuster Sabater.[3] Besides technique and conservation, the publication also discusses the results of chemical analyses.

  The Museo Fundación Lázaro Galdiano holds a research and treatment report and a CD-ROM with images (XR and IRR) of the painting. Material analyses have been performed by the Instituto del Patrimonio Cultural de España (IPCE; previously ICRBC, Instituto de Conservación y Restauración de Bienes Culturales), consisting of energy-dispersive X-ray fluorescence (ED-XRF); Fourier-transform infrared spectrometry (FT-IR); gas chromatography (GC); and 15 cross-sections, which are kept at the institute.[4]

- ***Previous treatments*** In 1995 the painting was treated by Dolores Fuster Sabater at the ICRBC (currently known as the IPCE). During this treatment, evidence was found of at least two earlier restoration campaigns, the dates of which are unknown.



5.1 Construction diagram. Dimensions are those of the currently remaining area of the original panel (seen from the front).

RR 47

SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 5.1). Thickness: c. 0.3 cm along all edges (thinned or cut panel). The panel was cropped on all sides.

  The wood species, Baltic oak, was identified through dendrochronology. The panel consists of two quarter-sawn planks, vertical in grain, laid vertically.

  The two planks were glued, but the method of connection could not be identified because the panel has been thinned excessively and a cradle member covers the join. There are no traces in XR of dowels or a half-lap join.[5]

  The entire panel reverse has been thinned or cut and is currently cradled. There are non-original parallel marks (mostly diagonal) of a tooth(ed) plane or chisel.

- ***Dendrochronology*** The youngest heartwood ring dates from 1463, which, with the minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1472 for the tree that produced the wood for that plank.[6] A felling date after 1474 is statistically more probable, however, since 93 per cent of the possibly missing sapwood rings would be covered by this range. Assuming an additional minimum of two years for drying and transportation, the panel could have been produced from 1474 onwards, but a production date from 1476 onwards is statistically more probable.

GROUND

- ***Visibility*** The off-white ground is present overall. Its surface is almost entirely covered by the paint layers but it can be seen in VIS in losses and some abraded areas. The tone of the ground layer seems to shimmer through in the grey area of the raised plateau, perhaps intentionally, but is otherwise hardly visible.

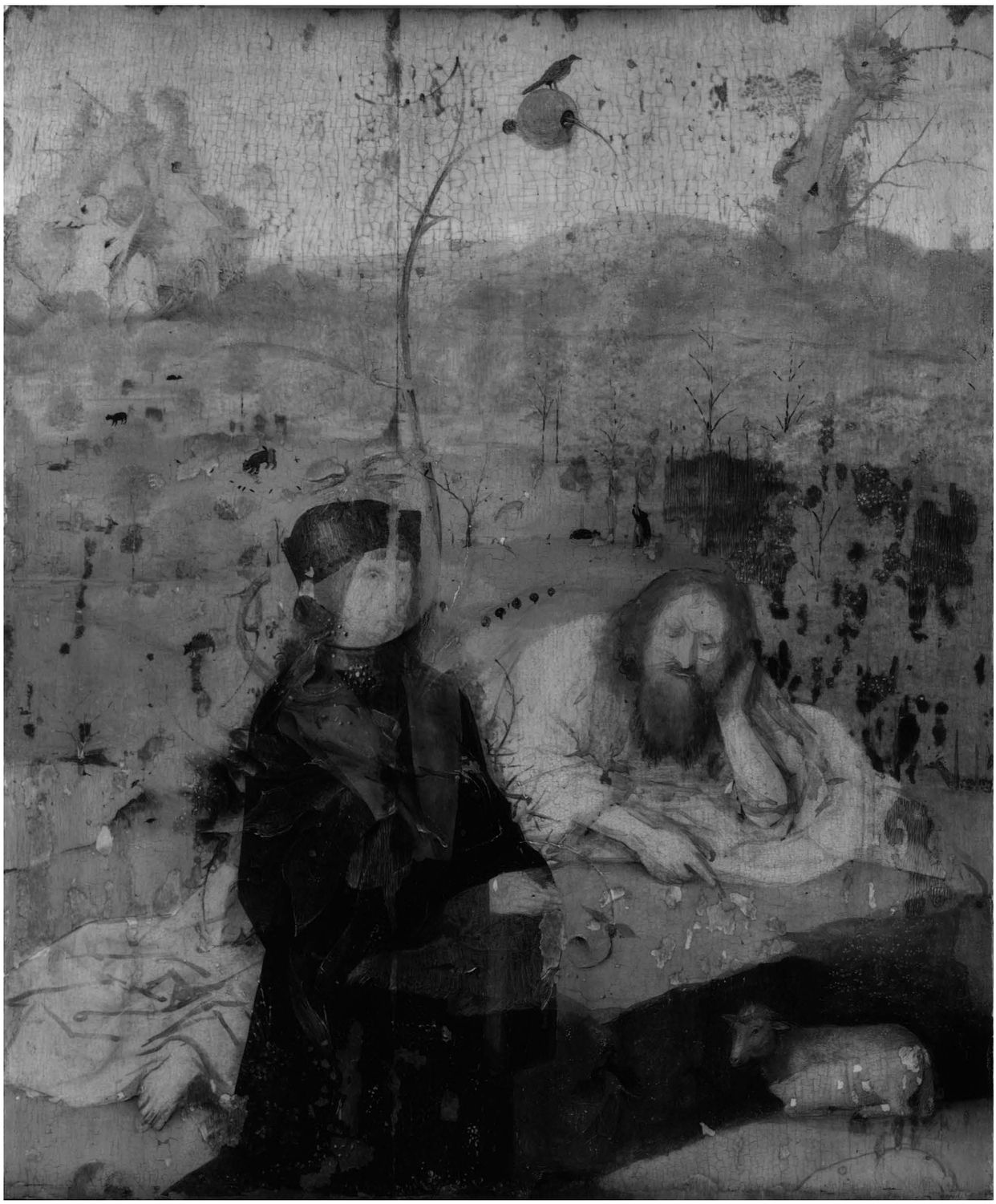
- ***Barb and edges*** Barbs and ungrounded and unpainted edges are not present. Assuming that the panel was initially outfitted with an engaged frame, this indicates that the panel was cropped on all sides.[7]

- ***Application*** The ground was thinly applied and worked into a smooth finish; (brush) marks of the application of the ground have not been observed.

- ***Composition*** The ground was analysed and found to consist of chalk (calcium carbonate – $CaCO_3$), bound in animal glue.[8] The cross-sections also seem to indicate that the ground was built up in at least three layers, with a maximum total thickness of 150 µm. This thin layer does not completely conceal the wooden panel.

PREPARATORY LAYERS

- ***Underdrawing*** Underdrawing is slightly visible in VIS, locally shimmering through the paint surface, but shows much more clearly in IRR/IRP. It is observable in most sections of the painting, but to a lesser extent in the middleground and the background,



5.3 IRR

where only the main planes of the landscape were roughly indicated with a large brush (fig. 5.3). The figure of Saint John is the only part of the composition where elaborate underdrawing was revealed. Some small areas of underdrawing can also be observed in the figure of the donor, especially in his chin, mouth and hands, although the possibility remains that some of these lines relate to the paint application phase. The figure of the donor might well have been extensively underdrawn too, but IRR/IRP did not penetrate the dark paint of his cloak and headwear. The underdrawing was used to prepare major compositional elements such as the contours of Saint John, the folds in his garment and some planes in the landscape.

- ***Medium and application*** The detectable underdrawing was possibly applied in two stages. The underdrawing was executed with a relatively large brush in a watery medium bearing what appears to be a finely ground carbon black.[9] The underdrawing was also observed in two cross-sections.[10] For the upper background, only broad indication lines in a wet medium have been observed, whereas the saint might have been underdrawn in two stages. The bold outlines above the painted shoulder of the saint, the broad and dark lines near his foot and chest, including the washes, could all have been done in this first stage. The lines in his face might have been executed with a smaller brush, and could thus represent a second stage.
- ***Style*** The lines in the saint's face are comparably thin and carefully placed. The underdrawing of his garment was executed with bolder

5.2 VIS

RR 48

strokes, possibly with a larger brush. These lines are freely and confidently executed, showing great variety in shape and length. Long contours are often underdrawn in several shorter lines. Line endings are mostly straight (blunt or tipped), but some end in a hook or loop. Hatching has not been observed, but in the deepest shadows, multiple brushstrokes seem to converge into darker washes to prepare those areas (fig. 5.13).

- ***Revisions in underdrawing and differences from painting stage(s)*** The underdrawing is only roughly followed in the paint application phase, and most lines merely function as general indications. The underdrawing of the main landscape planes was not followed, and the horizon was prepared lower. In IRR long underdrawn strokes are visible to the lower right of the grey tree-like structure in the right background. They indicate the branches of a narrow, tall tree that seems to have its base at the lower right of John's elbow (fig. 5.5). (A similar tree is depicted to the right of Saint John the Evangelist, cat. 6.) The Baptist's shoulder and back were underdrawn substantially higher. His face was tilted more to the right, and he had a bigger moustache in the underdrawing. The preparation of the folds in his cloak was also largely ignored in paint. At bottom right, an underdrawn rounded shape – perhaps indicating the original position of the lamb – was abandoned in the painting stage after being left in reserve from the green background (fig. 5.3). For the donor and the plant, see below, *Changes*.

- ***Intermediate layers*** Cross-sections seem to indicate that the underdrawing is positioned on top of a substantial proteinaceous (animal-glue) isolating layer.[11] The conservation report mentions the absence of a reflecting lead-white underpainting under the colours, but does mention that this underpainting appears under the green paints.[12]

  In XR, some local, vertically oriented features were observed that appear to have the shape of paint strokes; see, for example, below the hand of the donor (fig. 5.12). These areas are characterized by a very coarse and unusually grainy texture, the granules of which are radio-opaque. They were also observed (in VIS and XR) in cat. 6B, the grisaille side of the *Saint John on Patmos* in Berlin, where they are present to a much larger extent and spread over the entire panel.

PAINT LAYERS

- ***Binding medium*** Both egg and oil were identified by the ICRBC analyses, but it could not be confirmed with certainty that these were the binding media of the original paint layers. Linseed oil was found in the greens, and oil and egg in the reds; in the clear blue sky, only egg was detected.[13]

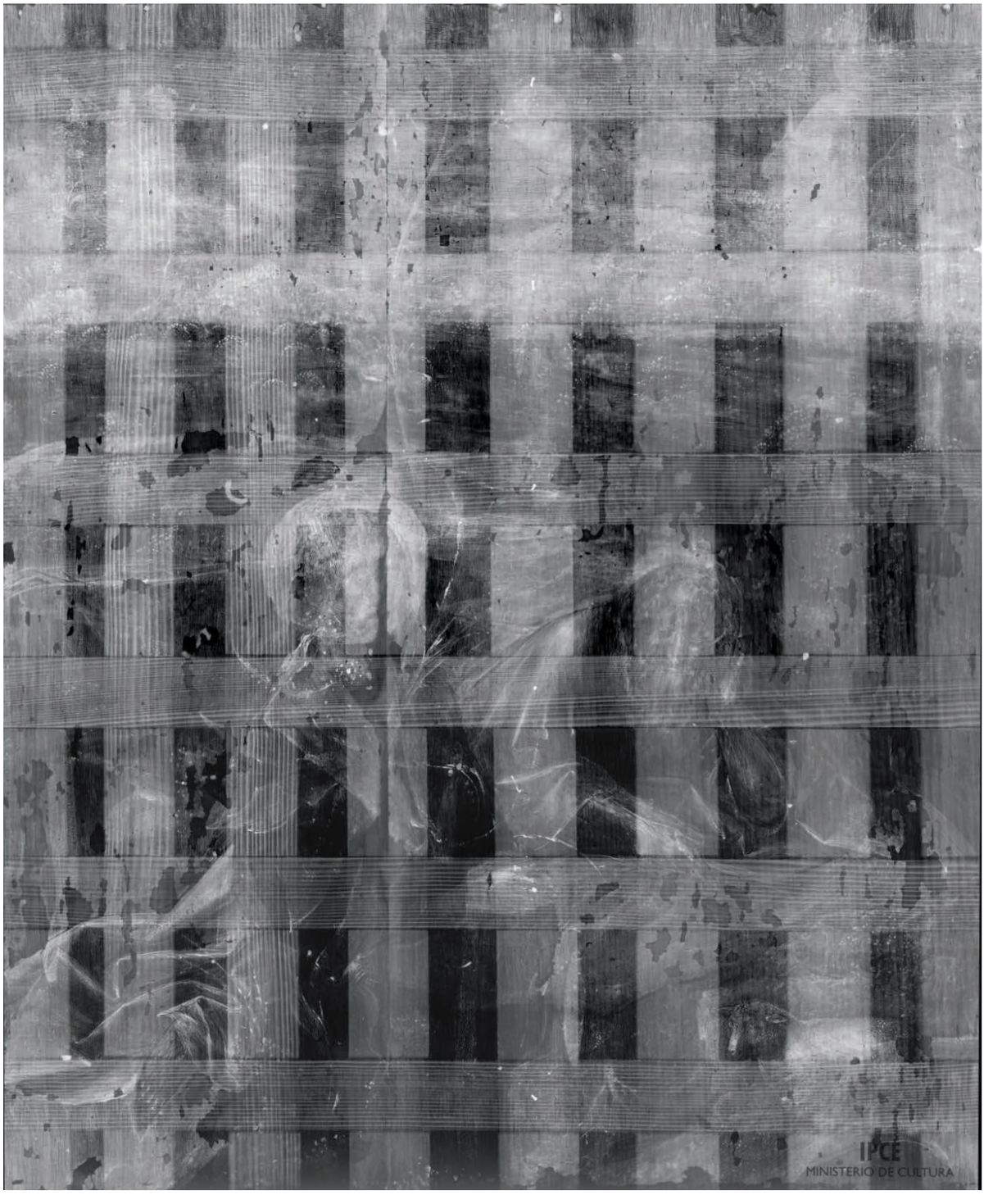
- ***Paint application and painting technique*** The paint was brush-applied up to the currently remaining edges, but the panel was cropped on all sides. Paint was usually applied in two stages, followed by detailing, mostly wet-on-dry, with some wet-in-wet (e.g., the rocky feature top left; and fig. 5.8). Original incisions have not been observed; the indentations in the wet paint at the back of the lamb could have been created with a stiff brush.

  The paint generally appears wet and glossy, and its application is mostly opaque or semi-transparent. Green and red glazes are confined to dark green areas and the saint's robe, respectively, and more purplish tones can be seen in the (overpainted) area of the large plant in the foreground. The paint was applied in different degrees of fineness, and it is sometimes applied less precisely in the larger areas, such as the greenish plains and the blue hills. The meticulously done foliage and the detailing of the saint's proper right undergarment sleeve are good examples of a more precise application. The over-painted plant is rendered in a slightly less refined manner, which might indicate a different hand.[14] The poor condition of the paint also affects its appearance.

  Mostly applied in one or two layers, the paint covers practically the entire surface. An underlying layer is sometimes visible at the interface between different colours, as well as shimmering through locally (fig. 5.9). The first layers were applied relatively freely over the lines of the underdrawing, while brushstrokes in the upper layers generally follow the contours of the composition. Visible in XR in the upper half of the painting, roughly horizontal brushstrokes stand in contrast to the fine dots of the background foliage. In the red robe of the saint, an undermodelling that contains lead white is present in varying thickness, rendering contours and volume with strokes of a stiff brush. XR also shows that this undermodelling is present in the entire robe, except for the darkest areas around Saint John's face and on his chest, which were indicated as such in the underdrawing stage by the darkest strokes or washes. The undermodelling of the section of the robe to the left of the plant generally does not follow the underdrawing, which indicates that the drawing was not meant to play a role in the final composition and that the red lake glaze only follows the undermodelling in paint. The glaze is thicker in areas of shading and does not seem to contain carbon black, which would show up in IRR/IRP. In these areas the undermodelling paint was applied thinly. Besides the lead-white-based undermodelling, slightly thicker, less fluid paints were also used for impasto.

  Overall, brushstrokes of the upper paint layer are more visible in the overpainted areas. It seems that a drier paint was used there, in contrast to the wetter, fairly fluid application in the rest of the picture. In the upper part of the large seedpod covering the head of the donor, as well as in the lower left twigs of the plant that are highlighted in lead-tin yellow, two imprints are discernible from what looks like a fine, evenly woven cloth (fig. 5.10). Dark lines were only rarely used to strengthen contours, although they were applied locally to emphasize certain physiognomic details, such as the lower contour of the nose, some fingers, and parts of the arm.

- ***Texture*** Most passages do not have a smooth finish, and textured brushstrokes are regularly visible throughout. Mostly, these are related to more impastoed underlying layers and highlights, or they can be seen in foliage. Texture is also used for modelling, as in the lead-white-based brushstrokes of the layer underlying the red lake glaze of the robe.



5.4 XR

- ***Build-up and palette*** The paint was applied mostly from light to dark, but also from dark to light (as in the foliage, lighter details and some highlights). The paint layers are thin, 15–20 µm on average, and are no thicker than 60 µm.[15] Their application was largely planned, leaving areas in reserve, but not strictly 'back-to-front'. It seems that the garments of the figures were painted first, with heads and arms left in reserve, followed by the background, and finally the skin tones, hair and the rest of the detailing. Locally the final green surface paint of the landscape slightly overlaps the red robe of Saint John, whereas the hair of the figures overlaps that green layer. The donor figure was left in reserve from the underpainting of the saint's robe, indicating that he was planned in the original composition. In the foot and hand of the saint, dark green and black lines strengthening contours and shadows follow brownish contour lines indicating physiognomic details. The fingers of the donor appear to have been reinforced in a similar way, since the dark lines of the IRR match the painted dark lines visible through losses in the green overpainting of the donor's hands. Excluding the foliage and the large plant, highlights were only applied sparingly. For example, some lead-white highlights can be distinguished at the edges of the saint's camel-hair undergarment sleeves.

  In the background, the lead-white underpainting of the sky was applied first, with both horizontal and vertical brushstrokes, the latter extending to just below the horizon. This horizon continues from left to right at the same level, approximately at the tree line in the left part of the painting. Then the blue of the sky was applied,

consisting of azurite paint mixed in varying degrees with lead white. The azurite paint was used more purely towards the upper part of the sky. The base colour of the background foliage was painted next, overlapping the lead-white underpaint of the sky. Azurite paint was then used more thickly for the background hills, leaving the rocky feature to the left in reserve but overlapping the greenish foliage. The rocky feature also overlaps the sky and the blue hills. The black dot to the right of the tree on the far right of this rock seems to represent a little figure. The large, tree-like structure at the top right was painted over the finished sky.

ICRBC identified the whites as lead white and the yellows as lead-tin yellow. Red lake areas are underpainted in lead white mixed with some red lake and occasionally vermilion. Skin tones were painted in lead white and traces of vermilion only. The green fields in the middleground have a lead-white underpainting, followed by mixtures of lead white, lead-tin yellow and copper resinate for the yellower areas, and sometimes covered with pure copper resinate for the darker areas and yellow or white highlights.[16]

From our examination, it appears that a green glaze was used for the lake or marsh in the centre left. It is also possible that some highlights in the face of Saint John were underpainted before the flesh tones were applied (fig. 5.9). For his face, mixtures of lead white and vermilion were used, with a purer vermilion applied on his cheeks and more lead white on his nose and forehead. Both pigments were used fairly unmixed on his lower lip. Further modelling was done using brownish paints, and blacks were used for the areas of deepest shadow.

- ***Changes*** The main alteration is in the figure of the donor, who was painted over with the large plant in the foreground (figs. 5.2–4). Traces of this donor can be seen in visible light, as he is not completely covered by the paint layers of the plant. For example, his long hair, ranging from brown to a cool dark brown, is visible to the left of the bird on the plant. His hair overlaps the green background paint and other areas were left in reserve, indicating that the donor was fully planned and executed with the rest of the composition. The fact that the donor figure is shimmering through is partly due to the thin paint layers of the plant covering him, but mostly has resulted from the ageing of the later paint layers, causing increased transparency, mainly of the pink seedpod. Abrasion and damage in the upper paint layers reveal other parts of the donor, as in the losses that reveal the underlying skin tone of his hand to the right of the plant (47MICGBM003).

The donor is much more visible in IRR/IRP and XR. Combining this information with the stereomicroscopic examinations, we can conclude that his figure was fully planned and completed. In addition to his hair, a detail of his robe can be seen between the salamander and the bird on the plateau; this is a vertical border or piping of the robe, containing brown, black, red lake and vermilion pigments. The donor's headpiece as well as his robe are black: a small section to the left of the plateau remains uncovered. Stereomicroscopic examination also reveals that he has a brownish fur collar with some grey added to it. The salamander and bird are not original, but date from the time when the plant was painted, and the donor's black robe is visible at the bird's tail (fig. 5.11). Similarly, the light green overpainting of the extended plateau was feathered out over the deeper green original paint. The craquelure in the white highlights at the outer left centre of the plant seems only partly to follow the underlying craquelure (47MICGBM002). Furthermore, a canvas-like imprint is visible in several small areas of the plant (fig. 5.10).

According to the conservation report, a cross-section taken in the area with the underlying face of the donor shows two thin layers of lead white mixed with vermilion, with the top layer being darker. Then a layer of varnish separates the paint of the donor from the lead-

5.5 IRR

white first paint layer of the seedpod.[17] This intermediate varnish layer, which is possibly the original one, indicates that at least some time had passed before part of the plateau, the plant, the large seedpod, the long offshoot with the grey seedpod and bird, and the wilted flowers, were added.

There are some changes in the saint, too. His robe was slightly cropped at his back after it had already been painted with red lake, since this colour can be seen shimmering through the green background paint. The saint's arms, initially left in reserve from his clothing, were painted or underpainted higher up at first, more closely following the underdrawing, before their position was shifted somewhat (as seen in XR). Then the red robe was extended onto his arms.

The XR and IRR show that the lamb was not planned in its current location. Instead, the green landscape extended up a bit further and the rock face was completely painted. The lamb was not left in reserve, but was painted over the background. Also, the bush to the right was added at the same time to create a better transition, although an increase in transparency has resulted in more clearly visible underlayers. It seems more likely, therefore, that the shape in the bottom right of the IRR (fig. 5.3) was an indication of the lamb, rather than a rock.[18]

FRAME

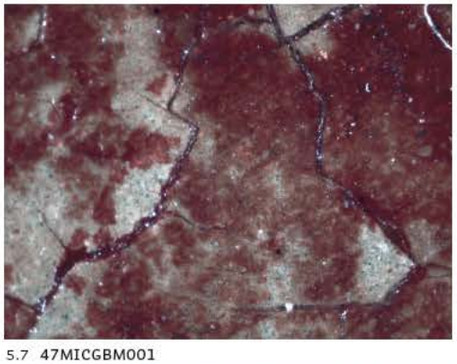
The original, engaged frame has been lost. The modern, black-painted wooden frame (60.6 × 52.3 × 8.7 cm; 6.6 excluding build-up) has a gilded inner edge.

CONDITION

Support

- ***Altered dimensions*** The original reverse of the panel has not been preserved. Given the thinness of the panel, it is quite possible that in the past the painting was separated from an originally painted reverse. All four sides of the panel were then cropped, probably to fit its new purpose. The left and right sides were more unevenly reduced in size. The cradle was applied afterwards, as it was designed for the panel's current dimensions. On the reverse there are marks of a tooth(ed) plane or chisel.[19] Seen from the front, the top left corner and some areas along the edge are slightly damaged. The painted composition also indicates a reduction in size, since the donor and the object at the bottom left were clearly cropped. Also, the underdrawn and underpainted element in the bottom right seems to have been cropped.
- ***Additions*** A dense cradle has been attached to the reverse of the panel, consisting of eight vertical and six horizontal members. Clearly visible in XR, metal nails in a central vertical bar (possibly partly removed) were used to fix the sliding cross-members of the cradle. This should not affect the natural dimensional movement of the panel as long as other vertical cradle members are not blocked.
- ***Deformations*** There is minimal overall warping but in raking light, cradle-induced wave-pattern deformations are clearly visible. The compression of the panel has also resulted in raised paint problems in the direction of the wood grain (see also below, *Stability*). Along almost the entire join, a major dent-like deformation is visible that partly coincides with areas of paint loss.
- ***Joins*** The join in the centre of the panel is closed, but there is a level difference. This and the fact that the paint does not continue over the join indicate that the panel was probably rejoined in the past.
- ***Coated reverse*** The remaining original panel reverse has not been coated, but microcrystalline wax has been applied to the cradle.[20]
- ***Biological damage*** Extensive old woodworm damage is present on the reverse of the panel, especially in the right and upper parts of the painting. The tunnelling has caused serious damage to the paint surface as well. On the reverse, several of the tunnels were filled with a wood-coloured filler (Rexina epoxy, Araldite).[21] On the front, the woodworm damage was filled and subsequently retouched.

5.6 Mapping of micrographs reproduced here (5.7–10)

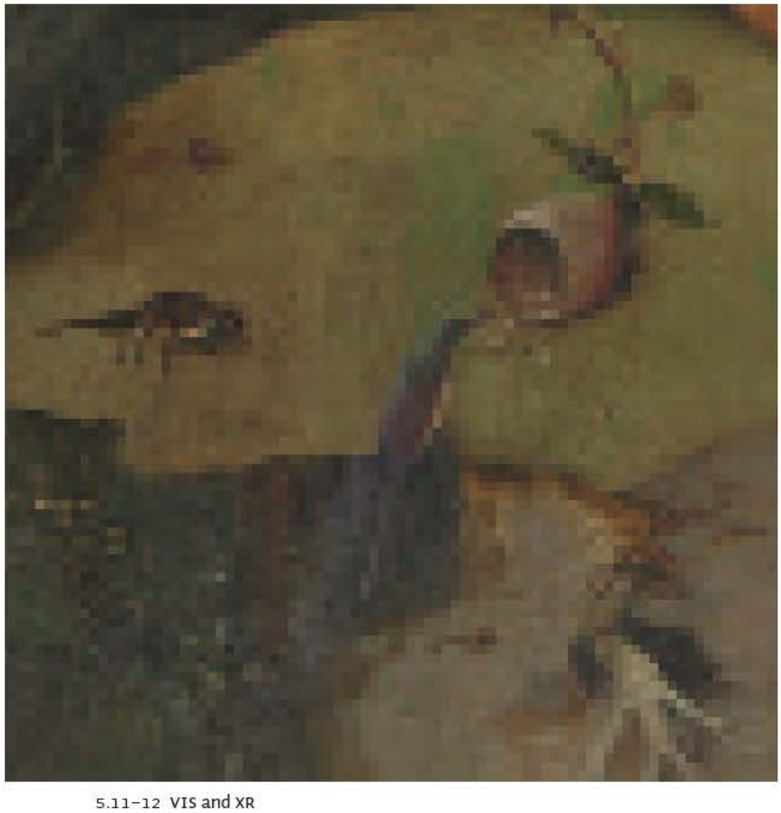


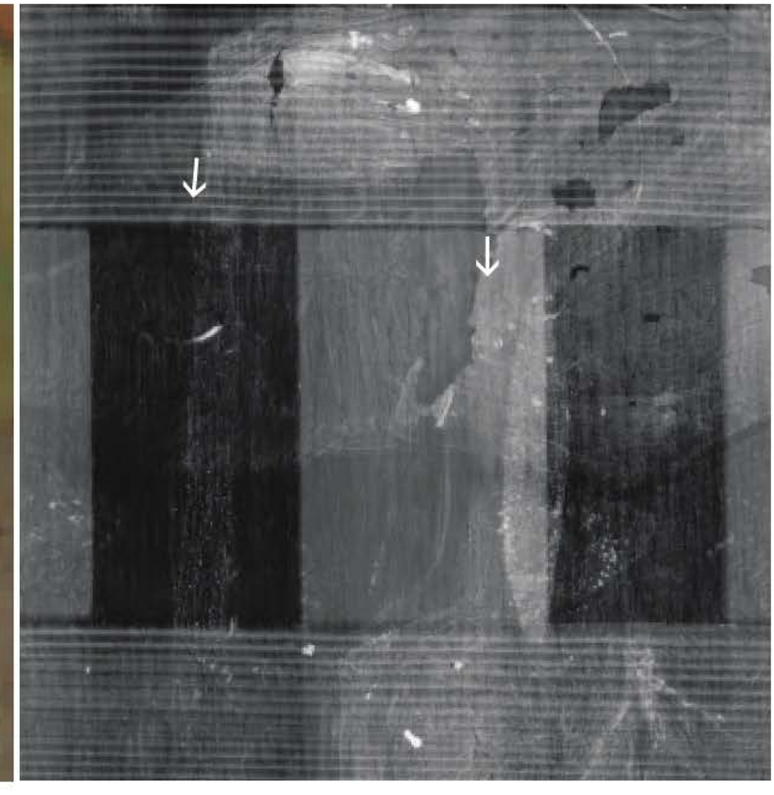
5.7 47MICGBM001

5.8 47MICGBM004

5.9 47MICGBM006

5.10 47MICGBM007, raking light





5.11–12 VIS and XR

Ground and paint layers

- ***Stability*** The presence of a cradle is clearly visible in the paint surface due to deformations in the form of an undulating surface. The stresses in the wooden panel have also led to raised-paint issues. Overall, the painting is not very stable and the losses to both ground and paint layers indicate a relatively poor adhesion. Most craquelure is caused by natural dimensional changes of the wooden panel. In the donor figure, broader cracks as well as a very fine maze of cracks were formed, which seem to be the result of cleaning, possibly due to solubilization of the intermediate varnish layer and subsequent undercutting of paint.
- ***Losses*** There are many small and larger losses, which have mostly been filled and retouched. The losses are spread over the paint surface, but are smaller and fewer in the upper background and the figure of the saint. Possibly the thicker paints used there resulted in a better adhesion. The join has separated in the past, resulting in several losses along it. Also, there are losses near the edges, probably from when the panel was reduced in size. Horizontal scratch marks at the top and bottom edges may have been applied to indicate how much the painting was to be reduced in size.
- ***Abrasion*** The paint surface is only slightly abraded overall. Areas with an impastoed underlayer, such as the sky, the saint's robe, and especially the overpainted donor, are somewhat more abraded, partly because of the paint being on a higher plane and thus more susceptible to abrasion.
- ***Discoloration and increased transparency*** The red lake on the saint's robe has faded slightly, and the paints containing copper green have become somewhat browner. The lighter paints (e.g., those containing lead white) have increased in transparency.
- ***Filling, retouching and overpainting*** The majority of the losses have been (filled and) inpainted, although several areas of damage have not been treated and the abraded areas are still exposed. For filling, a gesso-and-rabbit-skin glue mixture was used. Retouching was first done with watercolours, followed by dry pigment with Paraloid B-72 as a binding medium.[22] Two styles of retouching can be observed. Integral or imitative (invisible) retouching was used for some losses, and hatched (*tratteggio/regattino*-like) inpainting was used for others. The second style was primarily used where it is more difficult to discern the original composition, but the effect of the alternating vertical lines and colours is somewhat disturbing, especially above the saint's head (fig. 5.2). Both types of retouching stand out, as their colours differ from those of the surrounding paints. The green retouchings are generally somewhat more vivid, and thus distract from the original paint surface. The distinct brown-red lines in the top section of the plant are also retouchings and were applied at a later stage, as the paint ran into the ageing cracks of the original paint. For the same reason, some red paint can be identified as retouching on the object at the lower left (fig. 5.7).

Surface finish

- ***Varnish*** There are multiple (slightly discoloured) modern varnish layers present. The varnish layers seem to have been rather thinly applied to the entire painting. The final varnish consists of two coats. First, a brush-applied Winsor & Newton Retouching Varnish. This was followed by a thin spray varnish, a mixture of one part Winton Wax Varnish (matte, containing wax) and two parts Retouching Varnish (both of the Winsor & Newton brand), to create a more even-appearing surface.[23]

  Although the overall appearance of the varnish is relatively even and glossy, there are several matte spots from retouchings. At the edges of the painted surface there are small residues of older, darker and oxidized varnish. At the hind leg of the lamb, a ballpoint pen scribble is visible (47MICGBM008).

5.13–14 IRR and VIS

- ***Surface dirt*** There is hardly any surface dirt on the painting because it is displayed behind glass.
- ***Visibility of the original surface*** The saturation of the paint surface is good and the slight yellowing of the varnish is not disturbing. The matte spots and the generally more intensely coloured retouchings, especially in the greenish landscape, do, however, distract from the original painting.

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[1] Baldass 1943 (ed. 1959), 44, 239.

[2] Koldeweij 2001, 70–80.

[3] Fuster Sabater 1996, 77–86.

[4] Dolores Fuster Sabater, paintings conservator, IPCE (oral communication, February 2012).

[5] Fuster Sabater 1996 (79–80) mentions a slight step at the join, and extrapolating from the lack of a dowel, suggests that some pieces or reinforcement bars are missing.

[6] Klein 2001, 124. The analysis of the narrow board did not yield results.

[7] Baldass 1943 (ed. 1959), 44, 239 suggested that only the top and bottom were cropped.

[8] Fuster Sabater 1996, 78.

[9] Fuster Sabater 1996, 78.

[10] Fuster Sabater 1995, 11.

[11] Fuster Sabater 1996, 78. The text mentions the ground and what appears to be a proteinaceous layer, and that the drawing is applied directly on the preparation (and thus on the isolating layer?).

[12] Fuster Sabater 1995, 10.

[13] Fuster Sabater 1995, 11.

[14] Cf. Koreny 2012, 86.

[15] Fuster Sabater 1995, 11.

[16] Fuster Sabater 1995, 11. The copper resinate is much more likely a glaze with verdigris pigment that over time dissolved in the oil medium. See further, Eikema Hommes 2004, 51–89, and BRCP, *Catalogue Raisonné*, Chapters III and IV.

[17] Fuster Sabater 1995, 12.

[18] Fuster Sabater 1995, 14.

[19] This woodworking tool was used in the past to scrape hard wood, and the grooves were also thought to improve the glue bond, in this case of the cradle.

[20] Fuster Sabater 1995, 18.

[21] Fuster Sabater 1995, 18.

[22] Fuster Sabater 1995, 18.

[23] Fuster Sabater 1995, 19.

6 *Saint John on Patmos / Passion Scenes*

RESEARCH REPORT 51–52

Hieronymus Bosch
c. 1490–95

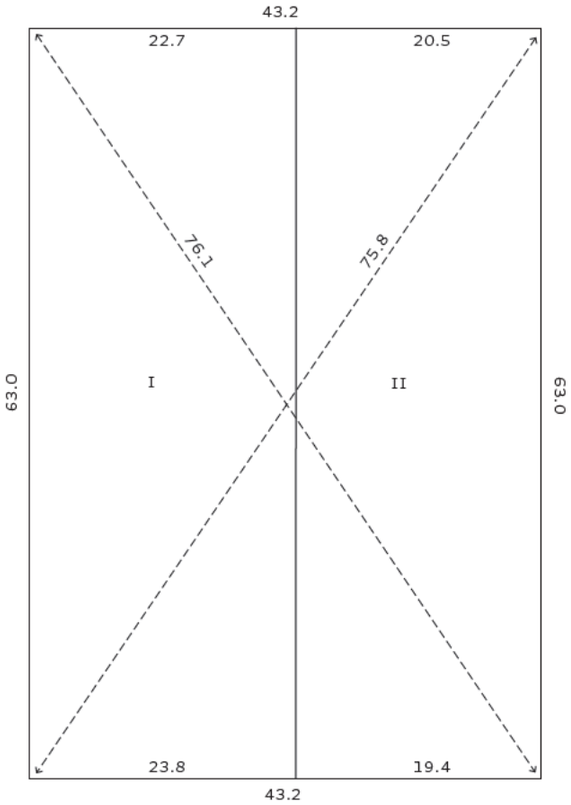
Oil (not analysed) on oak (analysed) panel, painted on both sides,[1]
63.0 × 43.2 cm
Staatliche Museen zu Berlin, Gemäldegalerie, Berlin, 1674A

BRCP, *Catalogue Raisonné*, cat. 6; www.boschproject.org no. 6.

Inscription
Signed bottom right (RR 52): *Jheronimus bosch* (damaged)

SUMMARY OF CONCLUSIONS

The technical evidence is in full agreement with the attribution of the Berlin Saint John on Patmos, *with scenes from the Passion in grisaille on its reverse, to Hieronymus Bosch. The painting technique as well as the style and material of the underdrawings place the panel in the core of the oeuvre. It is assumed in this study that the panel was the pendant of the* Saint John the Baptist *in Madrid (cat. 5), which has a similar composition.*
The work's barbs and unpainted edges indicate that the Saint John on Patmos *was originally housed in an engaged frame, now lost. Because the panel is double-sided, we may conclude that it functioned as a folding wing of a larger ensemble, of which the Madrid* Saint John the Baptist *formed the other wing. Dendrochronology established that the panel could have been painted from 1489 onwards, although a date after 1491 is statistically more probable. As further explained in* BRCP, Catalogue Raisonné, *cat. 5–6, we date both works to between 1490 and 1495.*



6.1 Construction diagram (seen from the scene with Saint John)

RELATED WORK

Cat. 5: *Saint John the Baptist,* Museo Fundación Lázaro Galdiano, Madrid. Baldass (1943) first suggested that these paintings belonged together, and that they formed a (stationary) diptych.[2] According to Koldeweij (2001), they might have been the upper painted wings of the carved altarpiece by Adriaen van Wesel for the Brotherhood of Our Lady in 's-Hertogenbosch; see also BRCP, *Catalogue Raisonné*, cat. 5–6.[3]

EXAMINATION DATA

21–23 March 2012 (Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Ron Spronk).

The painting was examined out of its frame and upright on an easel under strong illumination, in the photo studio. Both front and (painted) reverse were easily accessible.

- ***Previous research and additional documentation available*** The Berlin Gemäldegalerie has a recent IRR image as well as an XR of the painting.
- ***Previous treatments*** On 9–10 April 1974 the painting was treated by Alexander Lobodzinski, who removed the varnish from both sides, filled the losses, retouched damages and applied a final varnish layer.[4]

SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 6.1). Thickness: mostly 0.3–0.4 cm along all edges, with a maximum of 0.5 cm at top centre.

  The wood species, Baltic oak, was identified through dendrochronology. The panel consists of two quarter-sawn planks, vertical in grain, laid vertically. The two planks were butt-joined and glued, with the use of dowels, one of which can be detected in XR, 22 cm from the bottom edge.
- ***Dendrochronology*** The youngest heartwood ring dates from 1478, which, with the minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1487 for the tree that produced the wood for that plank.[5] A felling date after 1489 is statistically more probable, however, since 93 per cent of the possibly missing sapwood rings would be covered by this range. Assuming an additional minimum of two years for drying and transportation, the triptych could have been produced from 1489 onwards, although a production from 1491 onwards is statistically more probable.

GROUND

- ***Visibility*** The light-coloured ground (not analysed) is present overall. The ground layer is evident in visible light (VIS), although its surface is almost entirely covered by the paint layers. It is discernible in

RR 52

RR 51

losses, at edges, in craquelure, and at contours, especially in the grisaille. In multiple areas of the double tondo, the tone of the ground shimmers through the grisaille, apparently by design. Most likely, ageing effects of the light-coloured paints play an unintentional role here as well, making the underlying ground more conspicuous.

- ***Barb and edges*** The original barbs and the ungrounded, unpainted edges have been preserved on all four sides of both the front and the reverse. This indicates that the painting originally had an engaged frame. The unpainted edges' width is very similar for both front and back, which means that the visible size within the original frame was the same on both sides. Maximum widths of unpainted edges, RR 52: (top) 0.6 cm; (bottom) 1.2 cm; (left) 1.3 cm; (right) 1.1 cm; RR 51: (top) 0.6 cm; (bottom) 1.3 cm; (left) 1.2 cm; (right) 1.2 cm.
- ***Application*** The ground seems to have been fairly thickly applied and worked into a smooth finish. In some areas, such as the sky of the centre tondo, slight brushmarks in the ground application can be discerned.

PREPARATORY LAYERS

- ***Underdrawing*** Very scant underdrawing is detectable in the grisaille (RR 51). Some initial placement lines appear to have been drawn – for example, to indicate the contours of the rock in the central tondo, as well as at bottom right in the grisaille, in the lower left side of the robe worn by the figure standing with arm outstretched in front of Christ. However, many lines revealed in IRR/IRP do not involve underdrawing but correspond with the thicker ridges of brushstrokes that have pulled along carbon-containing paint. It seems that in the initial painting stage, which partly functioned as underdrawing, the compositional elements, contours and volumes in certain areas were defined. Some elements were altered later in the painting process, such as the façade of the long building at left centre, which was reduced in height.

  Ample underdrawing was used on the scene with Saint John, especially in the figure of the saint, and, to a lesser degree, the landscape surrounding him (fig. 6.3). The angel on the hill and the sun surrounding the Woman of the Apocalypse[6] in the top left corner were also planned in the underdrawing stage. Underdrawing is clearly visible in IRR/IRP as

6.3 RR 52, IRR

6.2 RR 52, VIS

6.4 RR 52, IRR

6.5 RR 52, IRR

well as shimmering through the paint surface in VIS, mainly in the saint's red robe. The underdrawing is not worked out to a high degree of detail. It is used to indicate the placement of the figures and the main contours and planes in the landscape, and to prepare some areas of the darkest shadows. The underdrawing's current visibility is likely caused by changes in refractive index due to the ageing of the paint film.

- ***Medium and application*** In the *Saint John on Patmos*, the detectable underdrawing appears to have been applied in two stages. Several main contour lines were applied with a smaller brush (e.g., in John's upper arm), but many others were applied with a broader brush (e.g., the first underdrawn contour of John's face; see fig. 6.5). Possibly during the first stage, some areas of deep shadow were also indicated with a relatively large brush, perhaps with ink or a finely ground carbon black suspended in a watery medium.

- ***Style*** The figure of Saint John was freely sketched, with a high level of confidence. A large variation in line thickness is observed. The underdrawing is executed with both broad and firm strokes, the aqueous medium of which has pooled in places resulting in locally more opaque areas, as well as thin and fine lines that are more diluted and relatively short. Some small areas of vertical and diagonal parallel hatching can be seen in the saint's robe (fig. 6.4), and a shadowed zone on the plateau behind the saint was prepared with horizontal parallel hatching. In general, the darker areas in the painting were indicated by denser underdrawing, with clusters of closely placed lines that sometimes overlap. Long contours are often underdrawn in several shorter lines. The lines tend to be slightly curved. Their endings are mostly straight (blunt or tipped), but some end in a hook or loop.

- ***Revisions in underdrawing and differences from painting stage(s)*** The underdrawing was not followed precisely in the paint application phase. Saint John's robe was altered in several places; most notably, his left foot was underdrawn but later covered by his robe, and his cape-like shoulder coverings were not prepared in the underdrawing. Instead, his upper left arm was indicated with faint, wet lines in the first underdrawing stage, followed by some darker hatching, both visible in IRR/IRP. In the underdrawing, his proper left sleeve was wider and rather than the proper right sleeve fell over the book. His head was underdrawn tilting up more (fig. 6.5). The angel was underdrawn larger, and was possibly also looking at the Woman of the Apocalypse, whose sphere of light was indicated a bit higher.

  The landscape was significantly changed in the foreground and middleground at the left edge of the composition. The exact nature of these changes is difficult to interpret, although it appears that a plateau was prepared in front of the saint, and a shadow above it might have represented a cave (fig. 6.4). It is also tempting to recognize a small hooded, kneeling figure at the left edge of the panel. This might have been the initial placement of the devilish figure at the lower right, which itself was apparently not underdrawn in its current position. Underdrawing is not discernible in the eagle (the saint's attribute), nor in the pen case.

- ***Intermediate layers*** An isolating layer, now slightly yellowed, was applied to the ground, as is illustrated in a loss at the top right edge of the *Saint John on Patmos* (52MICGBM001). Whether the underdrawing was positioned above or below this layer could not be determined.

  It appears that the entire grisaille tondo has a light, cool-toned underpainting that does not seem to be present under the dark background (51MICGBM006). This layer is also exposed in the bottom centre of the tondo, at the outer edge. The underlayer has a lead-white component, since the broad brushstrokes are slightly radio-opaque and visible in XR (fig. 6.6) in mainly dark areas of the grisaille. However, fairly broad, textured strokes of later applied paint in light areas of the grisaille dominate the XR image.

6.6 RR 52, XR

6.8 RR 51, IRR

6.7 RR 51, VIS

In VIS (on the exterior grisaille side) and especially in XR, numerous vertically oriented features were observed over the entire panel. These enigmatic areas appear to have the shape of paint strokes and are characterized by a highly coarse and unusually grainy texture, the granules of which are radio-opaque. Similar features were to a lesser extent observed in the XR of *Saint John the Baptist* in Madrid (cat. 5).

PAINT LAYERS

- ***Paint application and painting technique*** The oil paint (not analysed)[7] was applied using a brush and extends up to the barb. The inner and outer contours of the double tondo were indicated with incised lines; a (filled and retouched) compass mark is visible in the centre (51MICGBM008–009). The lighter areas of the grisaille, such as the central tondo and the upper part of the outer tondo, were mostly painted in a single stage on top of the light-toned underpainting, all wet-in-wet. The darker part of the outer tondo was painted in distinct stages. First, darker brownish-grey areas were quickly laid on, after which lead white, black and grey paints were applied. This second stage was done mostly wet-in-wet. Finally, some detailing was applied. The entire dark area surrounding the double tondo seems to have been painted in a single stage.

  In the *Saint John*, paint was predominantly applied in two stages, followed by detailing – mostly wet-on-dry, with some wet-in-wet.

  The generally wet and glossy paints were mostly opaque in application, but some were semi-transparent. The red glaze is confined to the robe of Saint John, while green glazes are present in the foliage and some areas of the landscape. The artist painted in different degrees of fineness, but in the grisaille and the dark area surrounding it he also used a rougher, more sketchlike style, followed by finer detailing. The meticulously done foliage, especially on the *Saint John* side, is a good example of the more precise painting technique. Paint covers nearly the entire surface, although underlying layers are sometimes visible at the interfaces between different colours (e.g., at the saint's wrist) and shimmering through locally (especially in the grisaille tondo).

  In general, the small-scaled features on the grisaille were painted in a quicker, more sketchlike fashion, with paint applied fairly thinly and predominantly wet-in-wet. Nevertheless, attention to detail is apparent, for example, in the reflection of the fire in the water below it in the central tondo. Some objects in the grisaille were painted with adjacently placed black and white lines, using the background as a midtone. This is most visible in the pole of the halberd and in the long trumpet.

  The dark zone outside the double tondo was painted very rapidly. The hellish features embellishing this zone are hardly visible to the naked eye, but are revealed by IRR/IRP. These elements were created with very little colour, if any, brushing into the still-wet dark underlayer, pushing it aside. This lower layer was brushed on with an exceptionally large brush and contains some black pigment, but large areas remain transparent to IRR/IRP. Small red, white, yellow and light grey highlights were applied afterwards (fig. 6.12).

  In a number of places in Saint John's mantle, lines were pushed into the still-wet lead white, revealing the layer underneath – for example, in the broad diagonal just above his proper right arm. In the lower area of the sky, several horizontal brushstrokes appear in the light blue layer, and they seem to have slightly displaced the lead-white underpaint, which had not entirely set. Similarly, in the book, the grey paint indicating text was applied on a wet lead-white underlayer. Some of the grey lines indicating text were broken up by scratches, which dragged through both the grey and the white layers (fig. 6.10). The first paint layers were applied relatively freely, while brushstrokes in upper layers generally followed the contours. In all but the darkest sections of the red robe of the saint, however,

an undermodelling containing lead white was used to render contours and volume, with strokes of a stiff brush still apparent. A red lake glaze applied later utilized the undermodelling and was applied thicker in areas of shading. The red lake paint appears to have a fine speckled appearance, which may reflect the use of cloth for dabbed paint application. Hatching with red lake paint was used in a few folds of John's robe. The painter applied numerous short, roughly parallel, hatched lines in red lake to further model the folds suggesting shadow. Brown lines were in some locations used to strengthen contours of physiognomic details, as seen under the saint's nose and chin and around some of his fingers.

- ***Texture*** In the grisaille the underlying cool-toned paint seems quite textured. Because of this, layers that were applied later have deposited more material atop the paint ridges. This is visible in the lower part of the grisaille, where lines of darker paint have formed. Less-textured areas have also formed due to displacement of paint during wet-in-wet paint application. An unusual impression in the paint can be found in the dark brown-black colour around the fire in the central tondo, which is possibly the result of dabbing with a mostly dry brush or perhaps a piece of cloth.

  On the grisaille side, two partial fingerprints are discernible in the top right corner, and a less distinct one seems to be present in the top left corner; all were pressed into the dark background paint while it was still wet (51MICGBM001). They do not relate to the painting technique and probably result from handling the painting.

  In general, most passages do not have a smooth finish, as textured brushstrokes are regularly visible. These are often the result of impastoed underlying layers, but they also occur in highlights and foliage. Texture is used for modelling too, as in the lead-white-based brushstrokes of the layer underlying the saint's red robe. The diagonal lines visible in the lower part of the robe are from lead-white-bearing strokes applied more roughly to a larger area, after which further modelling took place.

- ***Build-up and palette*** It seems that the incision for the inner tondo was made after the cool-toned underpainting was laid atop the ground and isolating layer. The double tondo was generally painted wet-in-wet, from background to foreground, and often from dark to light with final highlights. Some light-to-dark paint application with shadows is visible too. Coloured detailing was only used for the two torches and the fire in the grisaille. There are, however, many coloured details in the dark area surrounding the double tondo. Primarily in the upper part and the left and right edges of the panel, plants typically made up of four small dots in green, lead white or vermilion (not analysed) are depicted (fig. 6.12). The same colour red also appears in the figures that mainly occupy the upper part of the panel, as well as in the creature crawling towards the deer at bottom centre. Green paint was used for the large fish in the upper right, the foliage, and the wings of the figure seated on the fish at lower right. In the toothed maw of this fish, two types of white may have been used: pure lead white for the teeth and a coarser ceruse (lead white and chalk) for the contour of the beak.[8]

  For the foliage in the grisaille tondo, dark grey dots preceded those of lighter grey. The two burning torches and the fire in the centre reveal a similar build-up: a black background, to which were added first red vermilion, then a bright orange paint, and finally (except in the torch at right) a dot of lead-tin yellow. The artist painted a dark brown to black outline at the left side of the central tondo and a light grey to white outline at the right side (fig. 6.7). This suggests a directional light source and creates a three-dimensional window effect.

  On the *Saint John*, the paint was generally applied from light to dark (as in the sky, areas of glazes and shadows), but also from dark to light (with a final application of lighter details and some highlights). The paint application was largely planned, leaving certain parts in reserve, but not strictly back-to-front: first came the lead-white-based undermodelling of Saint John's robe and book (which was initially larger), then the red lake. The background was painted next, leaving the figure's head (in its initial position) and hand in reserve. His skin tones, blue eyes, hair and the rest of the detailing were then applied. Locally, the green surface paint of the landscape slightly overlaps the saint's red robe, whereas his hair partly overlaps the green. In his hands, dark brown and black pigments were used for the painted lines strengthening contours and shadows – much darker in the lower hand – after which brownish lines were added for physiognomic details. Thick, black contour lines are visible in the book, where they partly cover the saint's red robe. Highlights were used extensively in the foliage, but can also be found in the angel (fig. 6.9), the elements in the foreground, and (to a smaller extent) in the saint's hands.

  In the background, the lead-white underpainting of the sky was applied first, with vertical brushstrokes extending to roughly the same level, just below the top of the green hill. Then the blue of the sky (azurite paint mixed with varying degrees of lead white) was applied. The azurite paint was used more purely towards the upper part of the sky and then applied more thickly on the background hills, also colouring the water but leaving the angel and the entire hill in reserve. The figure of the angel was also roughly left in reserve from the green hill and the sky, although the wings were painted atop the background and sky. The large tree in the right middleground was painted over the finished sky. Its greyish trunk (whose entire length remains opaque in IRR, although XR indicates that lead white was used, especially in the lower half) was laid on over the greenish base colour of the middleground, after which the landscape's detailing and foliage were painted. A similar build-up is visible in a loss that also reveals a lead-white underpainting applied over the ground (52MICGBM002).

  For the foliage in the middleground, green paint was dotted on a brownish or greenish base colour, followed by light green, and local highlights in small dots of white, blue and lead-tin yellow. A green glaze of varying thickness was used to adjust the colour and create overall gradations accentuating different landscape planes. The green glaze is most visible at the base of the large tree and in lines of glaze used in certain places to indicate shadows (for example, below the saint's robe).

  When the blue sky was painted, the space for the sun behind the Woman of the Apocalypse was left in reserve smaller than it was underdrawn. Her face was then underpainted in light blue (as the entire area may have been), and the darker blue mantle was painted afterwards. The lead-tin yellow background was next applied, then the skin tones of the Virgin and Child, and after that her hair and detailing. The crescent moon and the white clouds below were

6.10 RR 52, VIS

6.9 RR 52, VIS

painted last. For the darker areas to the lower left of this scene, black and grey paints were laid on over the sky and clouds.

The eagle, the pen case and the demon with a *krauweel*, or meat hook – none of which were prepared in the underdrawing or left in reserve – were all painted over the background. The signature, too, was applied over the background, but the underlying paint was not disturbed. Considering its appearance, craquelure, state of degradation and adhesion to underlying layers, there is no reason to doubt its originality. Above and below the signature, two guidelines had first been incised – not straight, but slanting down towards the right. The black signature was then added, running into these incised lines (52MICGBM012). It is notable that another incised line is detectable at bottom left, which could indicate that the signature was envisioned there earlier. This line also slants towards the right. On the grisaille, the horizon slopes in the same direction.

- ***Changes*** The saint's head was underdrawn tilting up more and was left in reserve in that position when the green hill was painted. When the skin tones were added, his head was adjusted to a lower angle and the back of his head and hair were extended, covering part of the hill (see XR). Additional green paint covers the change. The saint's proper left knee was at first painted higher, following its position in the underdrawing. The cape-like robe hanging from his shoulder originally continued below his proper right hand, up to the book. The book itself was reduced on two sides, at its top and right edge.

FRAME

The original, engaged frame has been lost. The modern gilded wooden frame (77.9 × 57.4 cm) has an engaged inner frame that holds the painting in place. The inner frame is painted black, while the outer one is gilded, with its exterior edge painted dark brown.

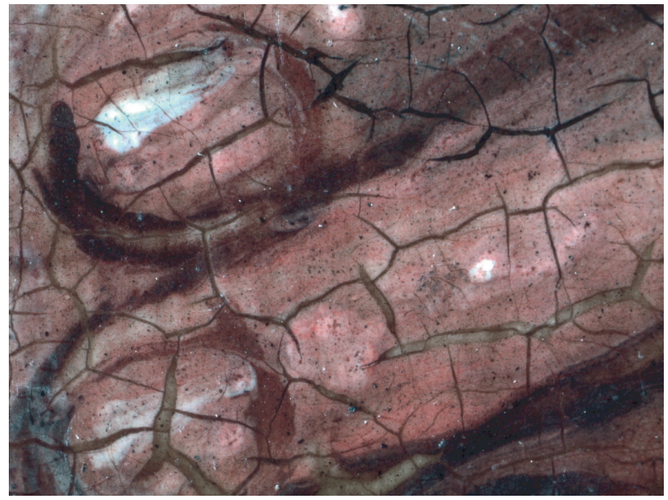
CONDITION

Support

- ***Altered dimensions*** The panel has been almost completely preserved, with only its unpainted top edge apparently somewhat reduced in size. The other three unpainted edges have a maximum width of about 1.2 cm, while the top edge has a maximum width of only 0.6 cm. There are two small holes piercing the panel – one in the top left corner and another in the top right.
- ***Deformations*** Probably because the panel has been painted on both sides, there is only minimal overall warping.
- ***Joins*** The join in the centre of the panel is closed. The planks have never been separated since the painting was finished, as the paint layers in most areas still continue over the join.
- ***Biological damage*** Woodworm damage has not been noted on either side of the panel, except perhaps for a tunnel and exit hole at top centre on the *Saint John* side and two small holes at the bottom. The top left and bottom right corners of the panel are slightly damaged.

Ground and paint layers

- ***Stability*** Overall the painting is stable. No issues of recently raised paint have been observed, but traces of old and stable cupping are visible on both sides. Most craquelure is caused by natural dimensional changes of the panel, although locally larger drying cracks have been observed, as in the middle finger of Saint John, where the underdrawing is exposed (fig. 6.11).



6.11 52MICGBM004

- ***Losses*** Recent losses to paint or ground have not been detected, with the exception of one in the sky at top right. The side with Saint John has several smaller, old losses, and some that are larger, mainly in the area of the signature and the lower sky. There are a few scratches, and on the grisaille there are many old pinpoint losses as well as a number of medium size, primarily to the right of the tondo. The losses are mostly to the paint layer itself. Extending from the top right edge, old cracks in the paint and ground layers can be seen, along with small, old losses. There is a larger crack with a few pinpoint losses at centre right in the grisaille, and there are several small losses along the bottom half of the join.

6.12 RR 51, VIS

- ***Abrasion*** The paint surfaces are only slightly abraded overall. Areas with an impastoed underlayer, such as the sky, the saint's robe, and especially the impastoed dots of the foliage, are somewhat more scuffed. This is mainly due to the paint's being on a higher plane and thus more susceptible to abrasion.

- ***Discoloration and increased transparency*** Because black paints darken slightly in ageing and the lighter paints (e.g., those containing lead white) increase in transparency, this has certainly resulted in a somewhat greater contrast between the grisaille and the dark surrounding area.

  The red lake on the saint's robe seems to have faded noticeably, especially where applied very thinly. The paints that contain copper green, and especially the glazes, appear to have become somewhat browner, which is evident in the landscape. An increase in transparency is also evident in the lighter paints.

- ***Filling, retouching and overpainting*** In the grisaille, many of the smaller losses and damages have not been filled and/or inpainted. During the last treatment, the restorer isolated losses with shellac before filling them with chalk and retouching with watercolours (see above, *Previous treatments*). Most of the larger losses were retouched, often in a base tone, and typically have a slightly different colour from that of the surrounding paint.

  The bright red reinforcements on the lips of Saint John do not seem to be original, as the paint appears to continue over the craquelure. Multiple losses on this side have not been filled and/or inpainted, either. For example, the light spot below the eye of the eagle is an unretouched fill. Other losses were only partially inpainted, and most of the retouchings slightly cover the original paint. In the large losses in the left part of the sky, imitation craquelure was drawn in with pencil.

Surface finish

- ***Varnish*** The modern varnish seems to have been fairly thinly applied by brush over the entire painting. It consists of mastic resin dissolved in turpentine. The appearance is relatively uneven, being glossy with several small, matte spots spread over the surface. Especially in the black area surrounding the grisaille, many matte spots and fingerprints are present on the surface of the varnish. In addition to old, discoloured varnish residues, there are visible scratches, abrasions, and damages in the varnish. The unevenness of the surface coating is also clearly visible under UV radiation.

- ***Surface dirt*** There is very little surface dirt on the painting, as it is displayed behind glass; there are, however, some stains on the varnish. At the right edge, just above the centre, the remains of an original brush hair can be seen stuck in the paint.

- ***Visibility of the original surface*** The saturation of the paint surface is fairly good and the slight yellowing of the varnish is not in itself disturbing. The old, discoloured varnish residues and the damaged surface of the varnish do impede the visibility of the paint surface to some extent, though. Furthermore, the incomplete and uneven retouching distracts from the painting and also slightly covers the original paint surface. The main issue, however, lies with the residues of an old, now greyish surface layer that is visible in many areas (52MICGBM003 and 52MICGBM007–010) on the *Saint John*. All these residues result in the uneven and 'dirty' appearance of this paint surface and are also distinguishable in UV (52PUVFLU001).

[1] For this report the side with Saint John is referred to as the front and the semi-grisaille side as the back.

[2] Baldass 1943 (ed. 1959), 44, 239.

[3] Koldeweij 2001, 70–80.

[4] The Museum's files hold a typed card with a brief description of the treatment. For the integral German text, see www.boschproject.org no. 6, RR 51–52.

[5] Klein 2001, 125. The youngest or last-preserved rings on each of the two planks of the panel date from 1478 and 1475, respectively.

[6] Revelation 12:1.

[7] Local drying cracks indicate that a drying oil was used as a binding medium, at least in those areas.

[8] No pigments were analysed except by visual inspection via microscopy and through their appearance in XR, IRR/IRP and UV, so all identifications remain tentative.

7 Saint Christopher

RESEARCH REPORT 7

Hieronymus Bosch
c. 1490–1500

Oil (not analysed) on oak (analysed) panel, 113.7 × 71.6 cm
Museum Boijmans Van Beuningen, Rotterdam, St. 26

The painting was restored in 2015–16, thus after the 2011 BRCP technical examination of the painting on which this text is largely based.

BRCP, *Catalogue Raisonné*, cat. 7; www.boschproject.org no. 7.

Inscriptions and labels
Signed, bottom left: *Jheronimus bosch* (damaged).
Reverse: two small, round stamps at the lower centre – one on the panel and one on a horizontal cradle bar. There are three paper identification/exhibition labels on the reverse of the (modern) frame.

SUMMARY OF CONCLUSIONS

The technical evidence is in full agreement with the attribution of the Rotterdam Saint Christopher *to Hieronymus Bosch. The painting technique, the style and material of the underdrawing, and traces of a creative process in all stages of its production place the panel in the core oeuvre, and there are no indications of any workshop involvement. The landscape was largely developed during the painting stage. The large tree with the hermit's dwelling on the right and the landmass bearing the signature were also not initially planned. The panel was originally housed in an engaged frame, now lost. Dendrochronology indicates that the panel could have been painted from 1490 onwards, although a date after 1492 is statistically more probable. As further explained in* BRCP, Catalogue Raisonné, *cat. 7, we date this work to around 1490–1500.*

EXAMINATION DATA

23–26 May 2011 (Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Ron Spronk).[1]

The painting was examined in the gallery, out of its frame, both upright on an easel and flat on a table, under strong illumination. Both front and cradled reverse were easily accessible.

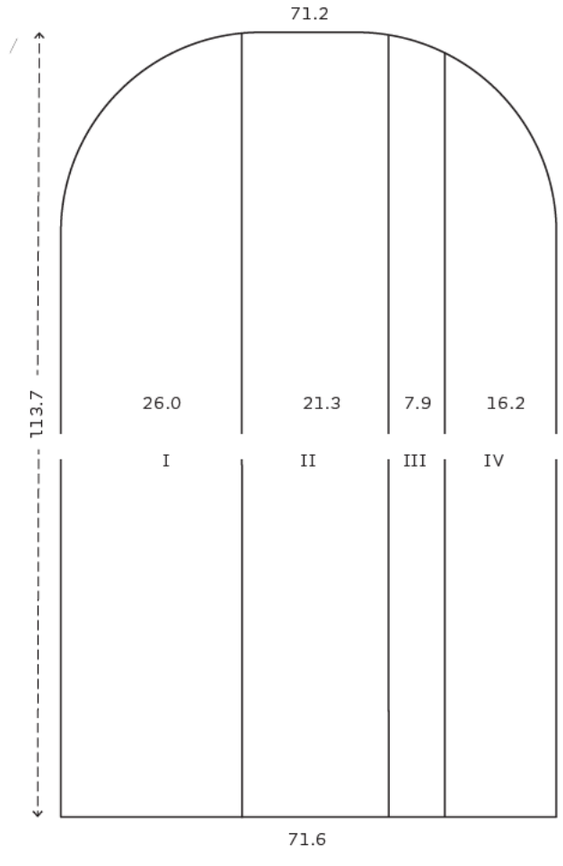
- ***Previous research and additional documentation available*** The museum holds several files with information on the painting, including previous treatments. They include photography, XR and IRRS (by J. R. J. van Asperen de Boer, now archived at the RKD, The Hague, AB 1202/6–AB 1204/5). Earlier IRRS by J. R. J. van Asperen de Boer and J. P. Filedt Kok, made in 1971–72, were published by Filedt Kok in 1972–73. Additionally, the museum files contain paint samples (A321/1–6). BRCP members have studied the report,[2] but not the paint samples themselves. Jeroen Giltaij's catalogue entry in Lammertse 1994 (pp. 84–89) holds ample technical information.
- ***Previous treatments*** The last major treatment could have occurred just before the painting came into the museum's collection in 1940. One minor treatment has been documented since then. On 11 June 1982, P. F. J. M. Hermesdorf removed a small ink stain just below the image of the fish by using moisture.

SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 7.1).

  The wood species, Baltic oak, was identified through dendrochronology. The panel consists of four quarter-sawn planks, vertical in grain, laid vertically. The planks were butt-joined and glued. Dowels are not visible on the thinned reverse, for the joins are covered by the vertical members of the cradle. A single dowel is visible in XR (in the lower hand of Saint Christopher). An unused dowel hole is distinguishable in board III, in the belly of the fish, but not in the corresponding part of board II.

  The reverse is not in its original condition, having been thinned and cradled.
- ***Bevelled or half-lap edges*** Slight bevelling – probably original – can be seen at both the top and bottom (horizontal) edges.
- ***Dendrochronology*** The youngest ring dates from 1479, which, with the minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1488 for the tree that produced the wood for that plank.[3] A felling date after 1490 is statistically more probable,



7.1 Construction diagram (seen from the front)

RR 7

RR 7, reverse

however, since 93 per cent of the possibly missing sapwood rings would be covered by this range. Assuming an additional minimum of two years for drying and transportation, the panel could have been produced from 1490 onwards, although a production date from 1492 onwards is statistically more probable.

GROUND

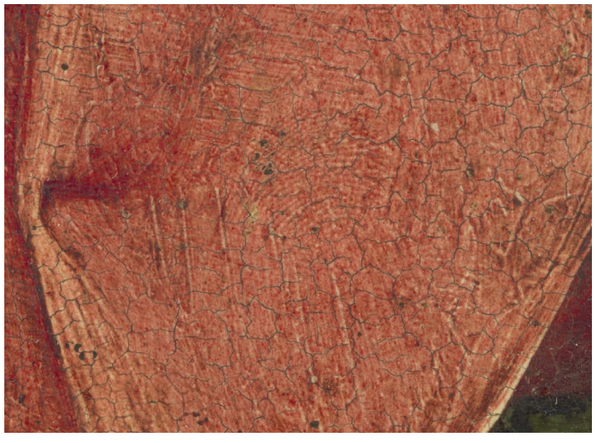
- ***Visibility*** The off-white to cream-coloured ground, which seems to consist of chalk (calcium carbonate – $CaCO_3$) bound in animal glue (not analysed), is present overall. It can be seen in VIS and XR. It is almost completely covered by the paint layers, but is discernible in losses and many abraded areas, as well as along the edges and shimmering through the paints. Visibility of the ground was possibly intended as part of the composition (showing through and creating a light undertone), but ageing effects and abrasion have increased the transparency of the paint layers.
- ***Barb and edges*** The original barb has been preserved on all four sides. The ungrounded and unpainted edges are also still present, but these are locally slightly reduced; they are between 0.1 and 0.9 cm wide. This implies that the panel originally had an engaged frame, now lost, and that the painted surface has retained its original dimensions.
- ***Application*** The ground seems to have been thinly applied with a brush and worked into a smooth finish.

PREPARATORY LAYERS

- ***Underdrawing*** Underdrawing is detectable throughout the foreground and middleground, and, to a smaller degree, in the background. It is visible in both VIS and IRR/IRP.[4] In the robes of the main figures,

7.2 VIS

7.3 IRR, during treatment



7.4–5 XR and VIS

7.6 VIS

the underdrawing is elaborately worked out to quite a high degree of detail, providing contours and some modelling for the folds in the garments (see fig. 7.3). Underdrawing was also used to indicate some planes in the landscape. A possible broad horizontal mark on the left edge, just under the painted horizon, might have indicated the placement of that feature, and there seems to be another such mark on the right edge. A single underdrawn stroke is also visible in the centre atop the background hill. Generally, the areas that were underdrawn to prepare the darkest zones in the red robe did not receive the lead-white underlayer (see below, *Paint application …*). Besides functioning as a compositional indication, the underdrawing might also have served as a dark undertone for shadows in the red lakes. The current degree of visibility of the drawing in several other parts was probably unintended, since the location of painted contours sometimes deviates from those in the drawing (e.g., in the saint's staff, which originally extended upwards a bit farther, and in the hair and the face of the Christ Child). In several areas, its visibility is probably significantly increased, caused by changes in refractive index due to the ageing of the paint film.

- ***Medium and application*** The detectable underdrawing was brush-applied, possibly in two stages, but differentiating between these stages is not straightforward.[5] The liquid medium, possibly ink or a finely ground carbon black in a watery solution (not analysed), often pooled at the end of a brushstroke. The primary contour lines and some modelling appear to have been applied in a first stage. During the final (?) stage, contours were reinforced and certain areas of darker shadows were also indicated.
- ***Style*** The underdrawing was applied with a medium-size brush and with irregular lines in a somewhat sketchlike manner. In what appears to be a final stage, some of the underdrawing was altered or reinforced with broader, more opaque strokes, and minor hatching was used to indicate some folds and shadow areas. Hatching was often done with roughly parallel lines that were drawn freely in many directions, mostly with short strokes. Darker areas in the clothing were indicated by a denser underdrawing, with clusters of closely placed lines that sometimes overlap. Hatching is only used in the two main figures. The underdrawn lines are not very even and are sometimes curved, depending on the feature drawn. Line ends are usually straight (blunt or tipped), without hooks or loops. Often a 'puddle' of ink can be discerned at the end of a line.
- ***Revisions in underdrawing and differences from painting stage(s)*** With the notable exception of the large tree on the right, which was not planned, the underdrawing was relatively closely followed in the paint application phase although numerous smaller changes can be detected between the underdrawn and the painted composition. Several folds in the clothing of both figures were changed, and the Christ Child's cloak was extended to the left and upwards. Christopher's back was initially underdrawn in a higher position in both stages. The top edge of the saint's staff was higher, and his lower hand significantly larger. It appears that his proper left knee was positioned further over to the right and lower. The large tree to the right was not underdrawn, as it was added in a later phase of painting. The smaller animals and the mast of the sunken ship in the lower left corner were not underdrawn. The landmass at the bottom right corner was smaller in the underdrawing.

PAINT LAYERS

- ***Paint application and painting technique*** The oil (not analysed) paint was applied using a brush and extends up to the edges of the barb. It was laid on predominantly in two, sometimes in three stages (including detailing), and was mostly done wet-on-dry, with some wet-in-wet (e.g., in parts of the ruins). Incisions were noted in several areas.

  The mostly wet and glossy paints were applied in both opaque and semi-transparent layers. Glazes were done in green and red. Also, dark pigments were mixed in with the red lake for a more purplish colour. The artist painted in both fine and rough manners, mostly in a few layers, covering nearly everything. Slightly thicker paints (e.g., lead-white undermodelling and lead-tin yellow highlights) created more impasto. The paint application in the foreground is less sketchlike, and the detailing decreases towards the background. Underlying layers were applied more freely, while brushstrokes in upper layers generally followed the contours in the composition. In the lighter sections of the red and purple robes, an undermodelling containing lead white was applied with a stiff brush. For the darkest areas of the red lake paint, where there was no or very little underpainting, the painter utilized the denser underdrawing and applied the red lake more thickly. The water in the foreground was quickly executed, and broad brushstrokes are perceptible in all directions. In pale, greyish areas of the large tree, vigorous, wet strokes were used. The layer was also incised in several spots, possibly with the back of a brush. A similar incision is present in

7.7 XR

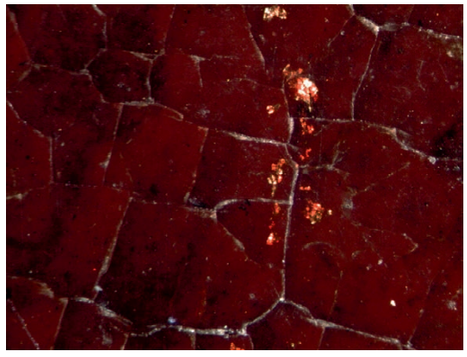
the centre of Christ's robe, just above the upper diagonal fold. The halo of the Christ Child was incised with a sharper tool, and a small indentation from the leg of the compass is still visible at its centre (07MICGBM003–005). Red lake detailing, possibly mixed with some lead white, was applied onto the still-wet lead white of the naked figure in the left background, pushing the underlying paint aside (see fig. 7.6).

- ***Texture*** Most passages do not have a smooth finish, as textured brushstrokes are frequently visible. Besides impastoed highlights, texture was also used for modelling (e.g., lead-white brushstrokes in the first layer of the lighter areas of the red and purple robes). Texture is also apparent in other areas with ample lead-white paint, such as the water close to the bottom and in the lowest section of the sky. The latter was very roughly underpainted with bold, generally vertical strokes of lead white, leaving a distinctly toothed line of impastoed paint near the horizon.

  A fingerprint was observed in the radio-opaque lowest part of the enormous tail-fold of the saint's cloak, just left of the robe's centre. It is pressed into the lead-white underpainting, with the red lake that was applied later running into the interstices (see figs. 7.4–5). Perhaps the fingerprint is from the artist, checking if the underpaint was dry enough before continuing.

- ***Build-up and palette*** The paint was generally applied from light to dark (e.g., glazes, shadows), with the exception of the lighter touches in Saint Christopher's hair, the foliage and highlights. The heads of Saint Christopher and the Christ Child were first painted in an ochre colour, followed by flesh tones containing lead white. This ochre undertone shows through and may have been used to indicate shadow areas. Initially the head of the Christ Child was left in reserve, but part of the flesh tone now overlaps the blue background. Some brownish shadows and wet-in-wet vermilion (not analysed) accents were added in the lips and around the eyes. For the saint's face a similar build-up was used, but with darker-toned paints.

  The lighter sections of Saint Christopher's robe have an undermodelling that contains lead white, which was followed by a red lake glaze. The red lake was applied more thickly in the darkest areas of the robe, where the lead-white underpainting was lacking.



7.8 07MICGBM002

7.9 VIS

It is notable that minute golden speckles are discernible in or under the red glaze (see fig. 7.8). The sash around Saint Christopher's waist was painted in a dark blue-green colour, extending via a pink paint to a lead-tin yellow edge (fig. 7.9). The transition between the blue and pink was smoothed with some light blue brushstrokes, with ensuing short blue and white dabs and lead-tin yellow dots. The red robe of the Christ Child has an undermodelling containing black and blue pigments mixed in with the lead white. Dark pigments were mixed in with the red lake on top as well to achieve a more purplish colour. The glaze was partially applied over the light blue of the river.

The river was painted in a single light blue azurite layer, as determined by Van Asperen de Boer.[6] The blue extends quite far under the left background riverbank and into the right foreground; for example, it shimmers through the roof of the hermit's shelter at upper right. Additionally, blue pigment was mixed in with the radio-opaque paint of the landmass around the naked figure (see fig. 7.6). For the background landscape, green (malachite? – not analysed) and blue (azurite) paints were used, partially over an XR-transparent ochre underpainting, with the blue hills also overlapping the lead-white underpainting of the sky. Azurite paint was also used in graduated thickness (possibly also mixed with varying degrees of lead white) for the upper parts of the sky, with the lead-white clouds and the figure with the beehive painted afterwards. For the water in the foreground, more lead white was mixed in with the blue close to the bottom. A dark green glaze followed the light blue layer and was applied more thickly to indicate areas of shadow. The darker foreground water gave the landscape a greater sense of depth. The painter seems to have used a slightly brighter copper-green glaze on the land just above the flying fish. Originally, only the landmass at the bottom right was planned. It was initially left in reserve and has a light green underlayer, topped by a brownish layer that was painted larger, overlapping the dark green glaze of the water. The landmass at the bottom centre and on the left was not left in reserve; its layers were applied atop the light blue paint and dark green glaze of the water (07MICGBM001).

Finally, the detailing was applied. Highlights were painted with lead white or lead-tin yellow, with added brown to black contour lines, which were also used to accentuate physiognomic details. There is no reason to doubt the originality of the signature, considering its appearance, craquelure, state of degradation and adhesion to underlying layers (07MICGBM006).

- ***Changes*** Several alterations have been observed using the naked eye, IRR and XRS. The current, predominantly vertical folds in the red robe around Saint Christopher's hip differ from the horizontal folds in the lead-white underpainting. The thumb of the saint's left hand was reduced in thickness, and his index finger is no longer around the tree but positioned alongside it. Major changes were made in the background areas to the left and the right of the saint. Just above the figure hanging the bear, the land has a completely dark green underlayer. Possibly a green landscape plane was painted out, as a similar dark green is visible in an underlayer around Christ's left hand. The bushes under Christopher's arm were not planned but were painted over the radio-opaque field that extended to the left. The fish on the saint's staff was left in reserve from that field. From the staff, just below the position of the saint's lower hand, a branch extended to the right.

  The large tree at right (see fig. 7.2) was not initially planned in the underdrawing or left in reserve, but painted over the background. The group of trees to the centre right was much more compact, with a radio-opaque field between it and the saint's arm (see fig. 7.7). In general, it seems that the artist embellished a more traditional initial composition by adding scenes such as the bear-hanging and the tree with the hermit's refuge, as well as elements like the flying fish and the sunken ship. These elements were added as part of the creative process: the tree's long offshoot with the climbing figure was applied onto the still-wet paint of the water and the blue of the horizon, displacing some of the underlying paint.

FRAME

The original, engaged frame has been lost. The rectangular, gilded wooden frame (123.6 × 83 × 5 cm), which is rounded at the top, is modern.

CONDITION

The painting was restored in 2015–16, thus after the 2011 BRCP technical examination of the painting on which this text is largely based.

Support

- ***Altered dimensions*** The reverse of the panel has been thinned to attach the cradle. Some of the edges were damaged, and the ungrounded, unpainted edges were slightly reduced.
- ***Additions*** In a previous treatment, a cradle was attached to the reverse of the panel. The vertical members were glued rigidly to the support in the direction of the wood grain, but the sliding horizontal members are now jammed. At the bottom, two horizontally grained, dovetailed wooden reinforcements were inserted into the back of the thinned panel; they are not original. A small insert was added to the bottom right, and in the bottom left corner, a small, triangular replacement was nailed to the panel (both seen from the front).

- ***Cracks*** At the bottom of the panel, a few smaller cracks can be observed running parallel to the wood grain. The larger crack at bottom centre runs through panel, ground and paint layers, and is still active (07MICGBM007). The blocked sliding members of the cradle inhibit the movement of the wooden panel, causing a build-up of stress.
- ***Deformations*** The panel has a minor convex warp and is undulating with the cradle.
- ***Joins*** The joins between the planks are closed but somewhat visible (mostly because of discoloured retouching). The planks of the panel have been separated in the past and small, reinforcing metal pegs were applied to strengthen the three joins during a previous treatment.
- ***Coated reverse*** The reverse and the edges have been coated with wax. At bottom left and at right centre, overlapping the edge, two pieces of canvas have been adhered with wax and/or glue to the thinned panel.
- ***Biological damage*** Woodworm damage has been observed, mostly near the edges of the panel.

Ground and paint layers

- ***Stability*** Besides some fragile raised paint around the crack at the bottom centre, there are areas of raised paint in the sky, mostly around previously restored joins. In all other areas, the ground and paint layers adhere well and seem relatively stable.

  Metal soap aggregate formation, which can appear as small opaque points in XR, has been observed in many areas of the painting, but not throughout. Expansion of the aggregates may cause them to protrude from the paint surface, resulting in minuscule raised spots and a more granular surface texture. Loss of these metal soap aggregates results in tiny, craterlike holes that appear dark in XR. Over time, accumulation of dirt and varnish residues in these holes causes them to appear dark in VIS and IRR/IRP.
- ***Losses*** There are only a few minor losses, which are located near the joins (paint loss at top centre) and cracks (loss of paint and ground at the bottom). Around the edge of the painting there are several pinhole losses and a few scratches. Several very small pinholes can be found on the surface (e.g., to the right of the staff in the foliage), perhaps indicating a previous attempt at consolidation using a syringe.
- ***Abrasion*** The paint surface is significantly abraded overall. Paint layers are partially missing (e.g., in the river in the background) and many of the topmost points of the paint are damaged, which has also resulted in the increased visibility of the whitish, impastoed lines (e.g., in the red and purple robes). The severe abrasion of the thin green glaze on the water in the foreground has also led to the distinct visibility of brushstrokes in the slightly impastoed light blue underlayer. At the far edges of the water, this green glaze has been better preserved, mostly at the right side of the panel, which indicates a harsh cleaning while the panel was still housed in its original, engaged frame.

  At the base of the large tree, to the left of the trunk, some sort of pile is distinguishable, painted over the light green landscape. Something was intended there, since the artist left it in reserve from the thin, darker green paint. The high degree of abrasion in that area has damaged most of the original paint though, and what remains are primarily retouches. The raised barb and areas at the top edge of the painting are worn as well. The signature shows damage similar to that of the surrounding paints.
- ***Discoloration and increased transparency*** The red lake seems to have faded only slightly, but a change is visible in the robes, where underdrawing that does not contribute to the final composition shimmers through. Some of the copper-green lake paints have in part discoloured and turned slightly brown. An increase in transparency is evident in the lighter paints – for example, those with earth pigments or those that contain lead white, which causes the increased visibility of underdrawing (e.g., in the head of the Christ Child). In the large tree to the right, the increase in transparency is very apparent, now showing the initial composition that was altered (see fig. 7.2).
- ***Filling, retouching and overpainting*** There are very few fills. The overall abrasion of the paint surface motivated retouching/overpainting, but it does not account for the extensive yet sometimes thin overpainting of several larger parts of the paint surface, as in areas of water, the landscape in the central background and the white robe (see also the IRR images). In addition to several smaller retouchings (e.g., on the cracks), the heron or egret at the lower left is almost completely retouched, as are the joins. At the lower right edge, the area to the right of the saint's pole is overpainted, with the craquelure artificially scratched into the surface. This is observable in several other areas as well. Many of the overpaintings and retouchings have discoloured over time and are clearly evident now.

Surface finish

- ***Varnish*** The modern, glossy, brush-applied varnish appears to be of a natural resin. It has significantly yellowed, especially in the scattered, older varnish residues. The appearance is uneven, showing scratches, losses (07MICGBM008), matte areas and obvious craquelure (e.g., at bottom right). The edges are damaged, mainly at the bottom. The saturation of the paint surface could be improved.
- ***Surface dirt*** There is some surface dirt, resulting in a slightly matte appearance of the painting.
- ***Visibility of the original surface*** The yellowed varnish plus the many discoloured retouchings and areas of overpainting cause a reduced legibility of the original paint surface and complicate accurate interpretation. The surface dirt also reduces visibility. The muddled overpaintings result in unintended alterations to the appearance of the paint surface.

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[1] René Hoppenbrouwers of Stichting Restauratie Atelier Limburg (SRAL) also participated in the examination and documentation.

[2] Minor bachelor's thesis, James 1991. IRR and investigation of paint samples were undertaken by Van Asperen de Boer.

[3] The youngest or last-preserved ring on each of the four planks dates from 1441 (I); 1469 (II); 1461 (III) and 1479 (IV), respectively. Klein 2001, 125.

[4] The underdrawing is sometimes obscured by the artist's use of black paint in his mixtures (e.g., in the robe of the Christ Child), which makes it sometimes difficult to distinguish between underdrawing and paint layers.

[5] The application sequence of the underdrawing in the landscape is even more difficult to ascertain because of the abraded surface there and the presence of many retouches.

[6] One cross-section from the river and another from the blue landscape were studied in 1991. See James 1991, samples A321/4 and A321/5.

8 *Saint Wilgefortis Triptych*

Hieronymus Bosch
c. 1495–1505

Oil (analysed) on oak (analysed) panel, left wing 105.2 × 27.5 cm,
central panel 105.2 × 62.7 cm, right wing 104.7 × 27.9 cm
Gallerie dell'Accademia, Venice

A full conservation treatment of the painting started in 2013, thus after the 2011 BRCP research of the painting on which this report is largely based.
BRCP, *Catalogue Raisonné*, cat. 8; www.boschproject.org no. 8.

Inscriptions and labels
Signed, central panel, bottom left: *Jheronimus bosch* (partly damaged).
RR 21, on cradle, text in pencil: *A Sinistra Porta* (*entrando*);[1] RR 22, on cradle: a Rijksmuseum Amsterdam exhibition label; RR 26, on cradle: a Rijksmuseum Amsterdam exhibition label; a small square label, *Inv. N°. 25.* (465); a faded text, ending in 39; a text in pencil, *A Sinistra Porte* (*entrando*); and on thinned reverse (RR 26), label: *Gemälde Galerie des Allerh. Kaiserhauses N° 1850.*

SUMMARY OF CONCLUSIONS

The Saint Wilgefortis Triptych *in Venice was painted by Hieronymus Bosch. The painting technique and the style and material of the underdrawing can easily be linked with other works in the core of the oeuvre oeuvre, especially on new, during-treatment* IRRs *that show much improved results over the pre-treatment images. Nevertheless, the paint layers remain unusually opaque to* IRR *in several areas.*
It was probably still in the Bosch workshop that the compositions of the wings, which originally depicted large male donor figures, were extensively repainted with the current images. The triptych still has its original dimensions, but the exteriors of the wings were stripped. Traces of a layer build-up indicate that these surfaces were initially painted a monochrome black, which might have served as the base of a dark grisaille. During the 2013–16 restoration treatment, remnants of the saint's original beard were revealed, confirming her identification as Wilgefortis or 'Uncumber'. Its original format of a folding triptych was also restored.
The three panels were first housed in engaged frames, now lost. Dendrochronology indicates that the triptych could have been painted from 1491 onwards, although a date after 1493 is statistically more probable. As further explained in BRCP, Catalogue Raisonné, *cat. 8, we date this work to around 1495–1505.*

EXAMINATION DATA

14–25 November 2011 (Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Ron Spronk). The triptych was examined in a studio of the Gallerie dell'Accademia. The panels were studied upright on an easel.

- ***Previous research and additional documentation available*** See the illustrated articles and reports published by Giovanna Nepi Scirè, Ottorino Nonfarmale, Raffaella Rossi-Manaresi and Antonella Tucci, and Roger Van Schoute and Hélène Verougstraete-Marcq in Limentani Virdis et al. 1992.

  One IRR detail and a set of ten nearly complete XRS are kept at the offices of the Soprintendenza. Relatively low-resolution scans of the XRS were used for this report. Cross-sections of this painting were

RR 23

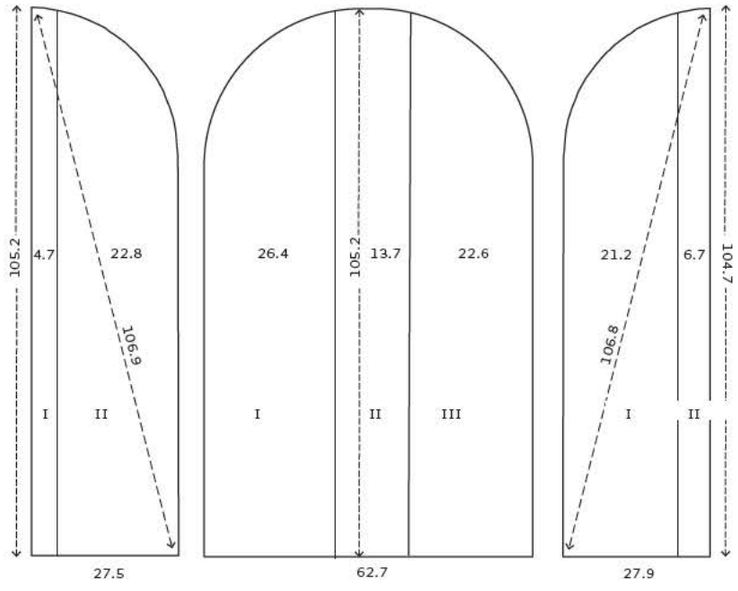
RR 24

RR 25

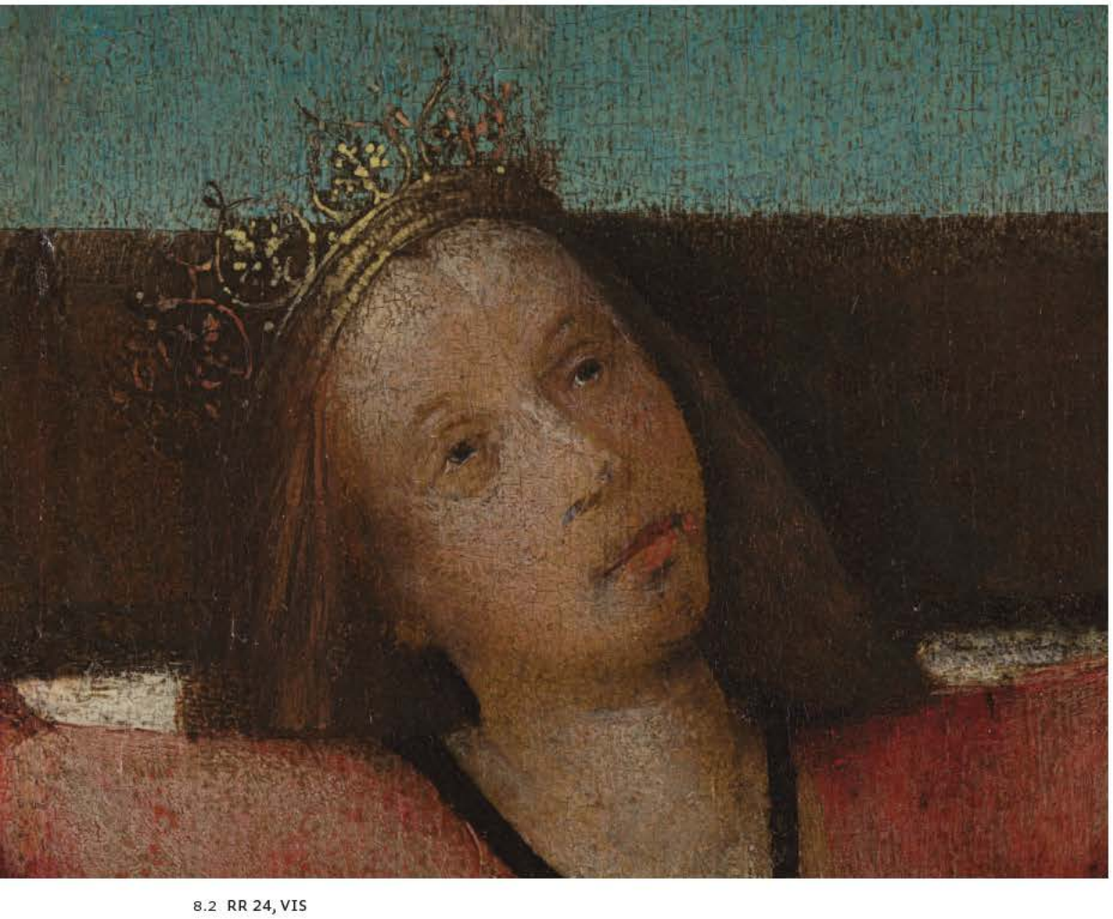
analysed with various techniques by the research laboratory Centro Cesare Gnudi in Bologna and published in 1992.[2]

- ***Previous treatments*** The triptych was most likely intensively restored during its stay in Vienna (1838–1919), and the positions of the labels on the reverse suggest that the cradle was applied at that time as well. The 1878 annual report (discussing the *Hermit Saints Triptych*, cat. 2, at the same time) noted that the picture was highly damaged and needed a new cradle. The paintings were documented as being in the conservation studio between 2 July 1894 and 17 August 1895 because of brown varnish. In 1897 and 1898, respectively, the central panel and right wing were treated because of raised paint.[3]

  In 1951 Mauro Pellicioli restored the triptych in Venice, when the painting was in a precarious state of conservation. Pellicioli removed varnish and oil retouchings, and filled and retouched the losses.[4] The panels were treated again from 1990 to 1992 in a specially created studio in the Palazzo Ducale.[5] During that treatment, the older reinforcements on the reverse of the triptych were only cleaned, since the cradle did not cause concern at that time. Large losses and lifting paint were consolidated, and 'all later additions were removed in full', although many non-original remains can still be observed, especially old, discoloured varnish residues. Fills were integrated using *rigatino* retouching, followed by a final matte varnish application on both the front and reverse of the painting. Some surface cleaning and consolidation by Gianfranco Mingardi took place in 2009, in preparation for an exhibition in the Palazzo Grimani.[6]



8.1 Construction diagram (seen from the front; diagonals measured from barb to barb)



8.2 RR 24, VIS

8.3 RR 22, 26 and 21

SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 8.1). Thickness, RR 23 and 25: 0.5–0.9 cm (inside to outside edge); RR 24: 0.5 cm.

  The wood species, Baltic oak, was identified through dendrochronology.

  The wings consist of two planks (one broader plank and a narrower strip), the central panel of three planks, quarter-sawn, vertical in grain, and laid vertically. All planks were butt-joined, dowelled and glued.

  The panels were all cradled after being thinned. Remnants of original paint and ground were observed at some edges (see *Coated reverse*). In the top centre of the central panel a dark stain is visible, possibly caused by the tannins in the oak after the splitting of the tree trunk.

- ***Bevelled or half-lap edges*** Bevelling can be observed on all edges except on the two long sides of the wings. On the left wing reverse, the bevel at the bottom measures about 0.3–0.6 cm. At the left edge, the bevel is about 1.0 cm wide and it decreases irregularly on the arch to about 0.4 cm near the top. On the central panel reverse, the bevel at the bottom measures about 0.5–1.1 cm. At the left and right edge, the bevel is on average 0.8 cm wide, and it decreases irregularly on the arch to about 0.4 cm near the top. On the right wing reverse, the bevel at the bottom measures about 0.4–0.6 cm. At the left edge, the bevel is about 0.8 cm wide, and it decreases irregularly on the arch to about 0.4 cm near the top.

- ***Dendrochronology*** The youngest heartwood ring dates from 1480, which, with the added minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1489 for the tree that produced the wood for that plank.[7] An earliest felling date of 1491 is statistically more probable, however, since that would cover 93 per cent of the range of possibly missing sapwood rings. Assuming at least two more years for drying and transportation, the triptych could have been produced from 1491 onwards, but a production date from 1493 onwards is statistically more probable.

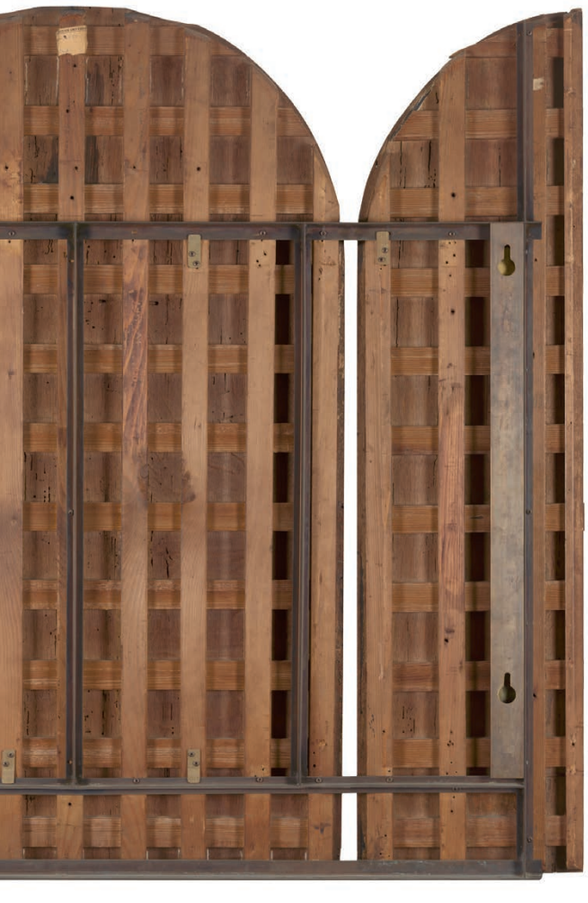
GROUND

- ***Visibility*** The off-white to cream-coloured[8] ground is present overall. As seen in VIS, the surface of the ground layer is fully covered by the paint layers, and the ground is now only evident at the extreme outer edges and in losses. However, it shimmers through the paint surface in several areas – for example, in some of the faces and hands and in the light brocades, where its light tonality was efficiently used (see fig. 8.12). This appears to have been an intended effect, although the transparency of the paint layers will have increased with ageing, especially in the lighter areas.

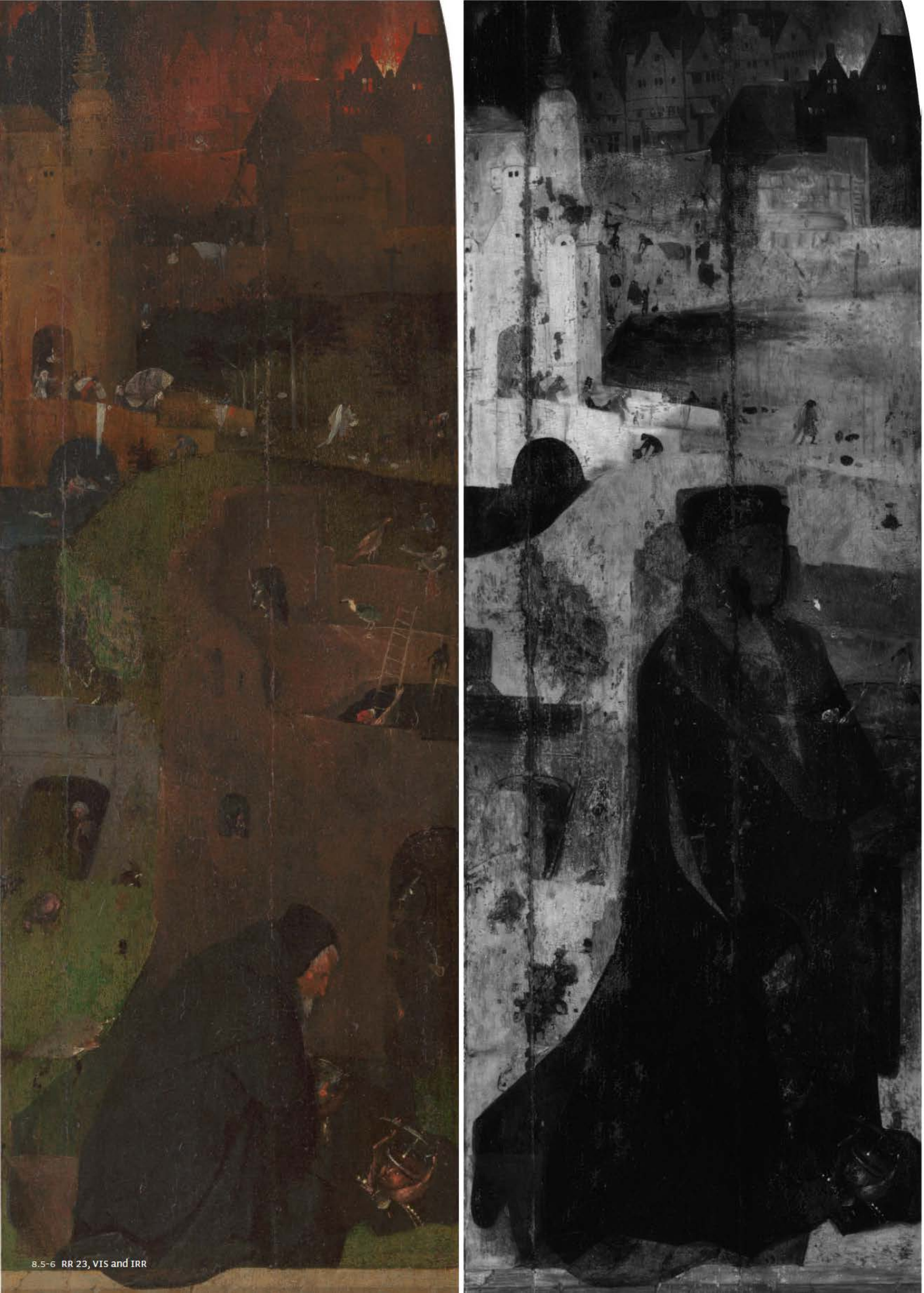
- ***Barb and edges*** The original barb and ungrounded and unpainted edges have been preserved on all sides of the three panels, which establishes that the panels were originally housed in an engaged frame. These ungrounded and unpainted edges vary in width between 0.4 and 1.1 cm, with an average of around 0.7 cm.

- ***Application*** The ground was applied in two or more coats and worked into a smooth finish. Possible brush marks in the ground application can be observed in the left arm of the man with the brocade headpiece on the left in the central panel.

- ***Composition*** The ground consists of chalk (calcium carbonate – $CaCO_3$), bound in animal glue.[9]



8.4 RR 22, VIS



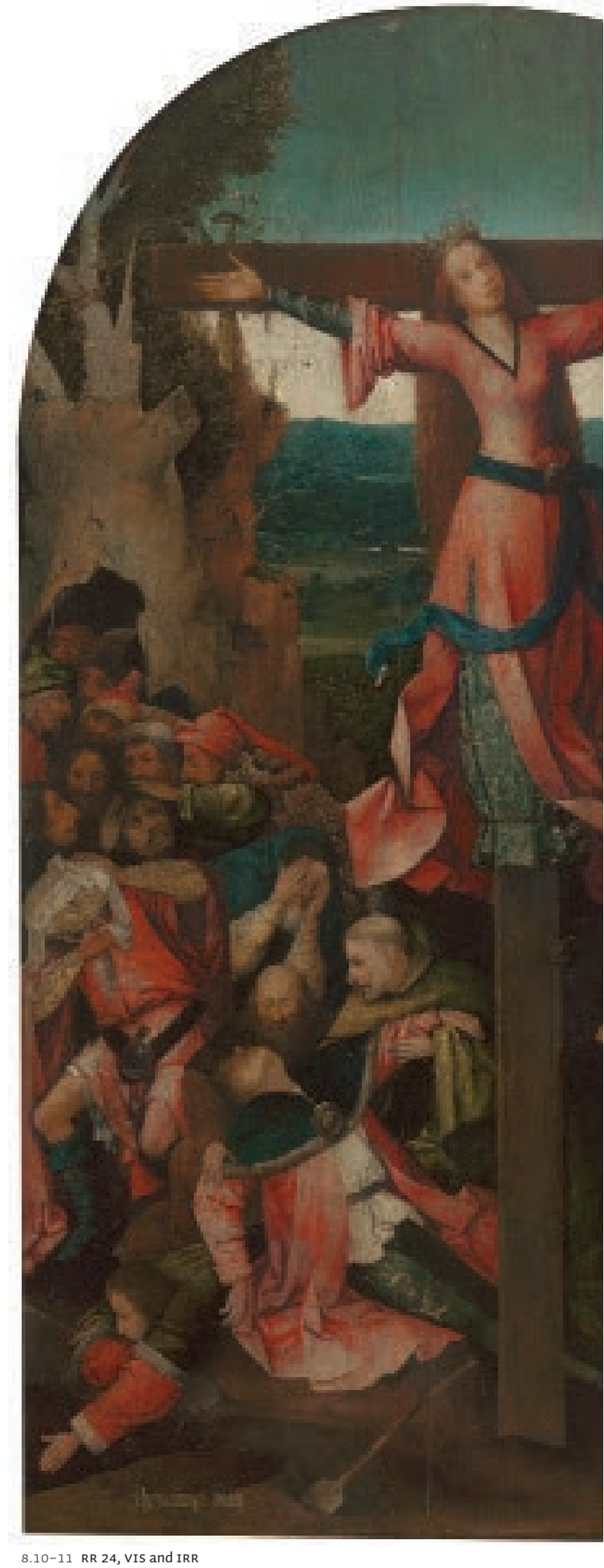
8.5-6 RR 23, VIS and IRR

8.7–8 RR 25, VIS and IRR

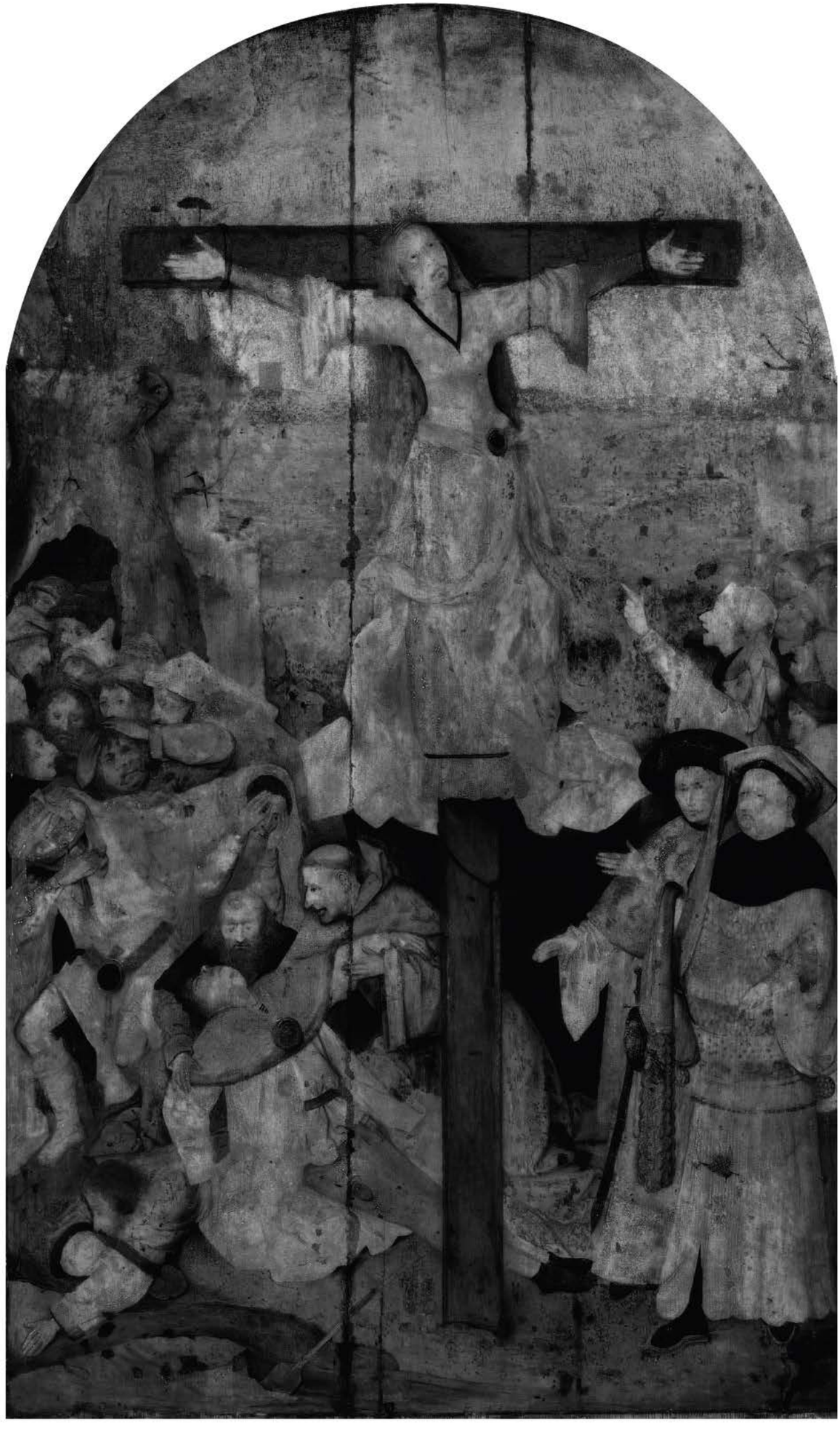
PREPARATORY LAYERS

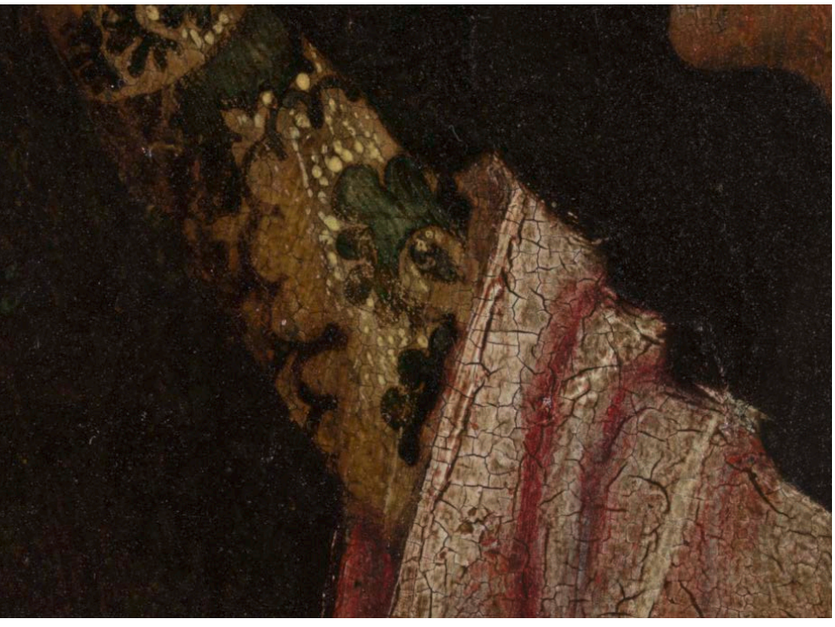
- ***Underdrawing*** In some areas, as in the face of Saint Wilgefortis, the underdrawing shimmers through the paint surface and shows in VIS. The current perceptibility of the underdrawing in light areas under VIS is probably caused by the changes in refractive index due to ageing of the paint film, resulting in increased transparency. The paint layers remain remarkably impenetrable with IRR/IRP, revealing very little underdrawing. This is largely the result of remnants of a non-original greyish surface layer. Some underdrawing was revealed beneath paint in a number of locations by using IRR/IRP, mostly in the central panel – for example, in certain faces and in the red cloak of the man who has fainted at the foot of the cross. However, other red areas, such as the robe of the martyr, remain substantially opaque to IRR/IRP. The underdrawing seems to have been used to indicate contours of selected facial features and folds. The hair of a tonsured man was also underdrawn (see fig. 8.9).
- ***Medium and application*** The small amount of underdrawing that was revealed was applied with a brush and executed in a highly fluid liquid medium, perhaps of an aqueous nature, since small puddles and drips are evident. This suggests the use of a diluted medium, perhaps an ink. Interestingly, the underdrawing is generally more opaque and thus better visible in IRP than in IRR, where it appears to become more transparent.
- ***Style*** Too little underdrawing was revealed for an accurate description of its style, although that of the folds in the red robe to the left of the foot of the cross does provide some information. Here we find bold outlines for the major forms, and smaller zones of parallel hatching to indicate shadows. The hatched lines are oriented both diagonally and, in the angle of the cross and the left leg of the fainted man, vertically.
- ***Revisions in underdrawing and differences from painting stage(s)*** Although not enough underdrawing could be revealed to describe this aspect in full, some changes between the underdrawing and the composition in paint have become apparent. The folds in the red robe to the left of the foot of the cross were not painted as underdrawn, and another such case is the position of the proper left hand of the man in the right foreground.
- ***Intermediate layers*** No isolating layer has been observed in VIS, IRR/IRP, XR or the published cross-section analyses.[10] An intermediate layer has been observed in a paint cross-section from the exterior of the left wing (see *Coated reverse*).

8.9 RR 24, IRR, during treatment

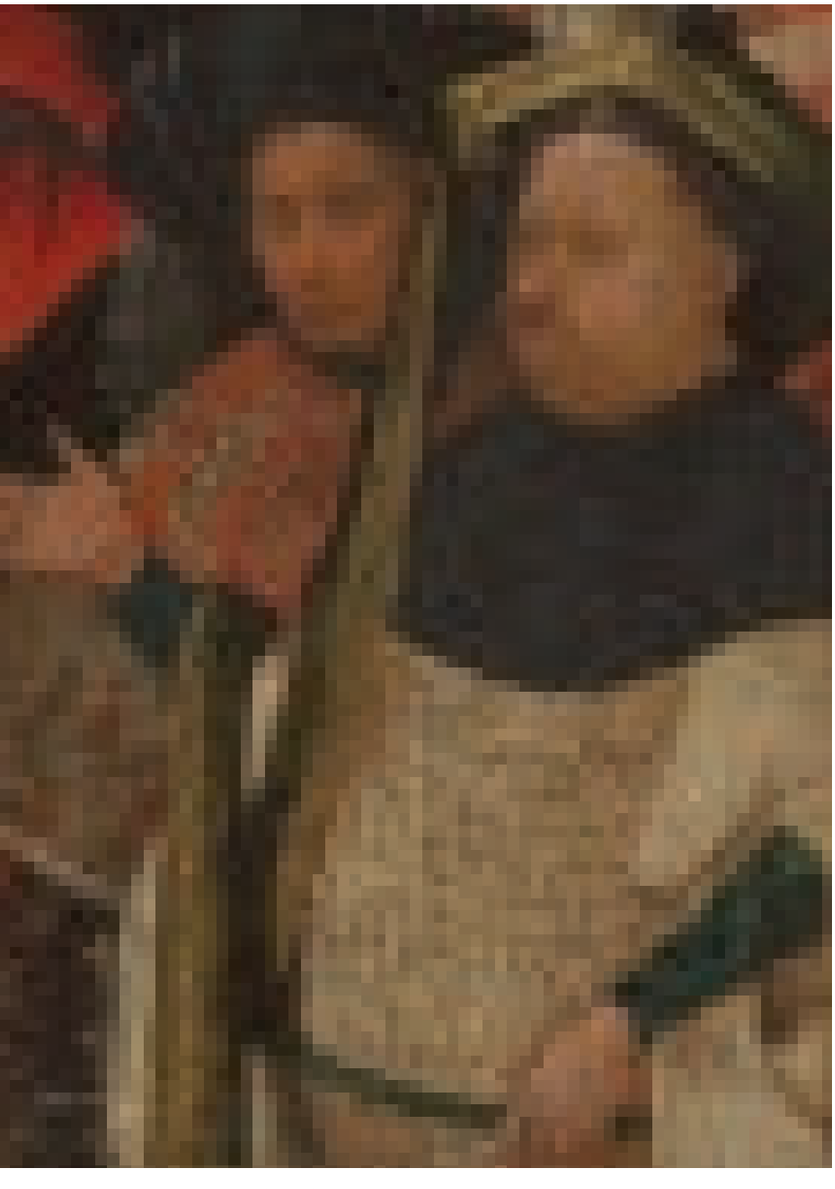


8.10–11 RR 24, VIS and IRR





8.12 RR 24, VIS



8.13 RR 24, VIS

PAINT LAYERS

- ***Paint application and painting technique*** The brush-applied oil paint (analysed)[11] covers almost the entire surface of the panels and extends onto the barbs. The underlying ground is sometimes visible at the interfaces between different colours, as well as in light brocades and in the flesh tones, where it shimmers through the paint (see figs. 8.12 and 8.13). Paint was applied in several stages, mostly wet-on-dry, but also with some wet-in-wet (e.g., the tonsure of the figure below the martyr, and the towers in the right wing). A sharp incision was made in the set paint just above the cross, indicating its top edge (see *Build-up and palette*).

  Paint was mostly applied in thick, opaque layers. In some areas a thin, transparent paint layer was used (e.g., the tree trunk in the central panel). Medium-rich, fluid and glossy paints were applied in opaque as well as semi-transparent layers. Drier paints were used for the lead-white modelling atop many bright red parts, and were typically followed by red glazes, now faded (e.g., in the martyr's robe). Relatively dry paint was also used rather often for impasto (as in the lead-white and lead-tin yellow highlights and floral motifs in the martyr's green garment). The paint was generally built up to a maximum of two layers, with the exception of certain highlights, shadows and additional detailing. The forms were laid in fairly precisely with vivid brushstrokes, using predominantly red and some green glazes. Brushwork was used to render contours and volumes throughout the painting.

  In several faces, modelling was achieved with just a few pinkish highlights (e.g., on forehead, cheek, chin and nose) and some dark accents, using the underlying layer or the light tonality of the ground. The overpainted areas show a different build-up, since the light base layer was not available for use there and a more opaque covering of the surface was required (see *Changes*). In the central panel, some contours (for example, between fingers) are strengthened by delineation with a dark brown paint containing carbon black. These brown lines occasionally serve a dual purpose in indicating a fingernail without any additional highlights. In the central panel, the tree trunk at left and the rock at right act as coulisses, giving the landscape more depth. The tree trunk was painted thinly, though, whereas the rock may have a local, greenish underlayer followed by a more opaque, yellowish paint.

- ***Texture*** Most passages do not have a smooth finish, and textured brushstrokes are often visible. Besides impastoed highlights, texture is used for modelling. For instance, dry, lead-white brushstrokes are used atop several red areas and in the face of the martyr.

- ***Build-up and palette*** The paint was applied mostly from light to dark. Dark-to-light application is visible where a darker base paint precedes lighter touches of detailing and highlights. The paint application appears to have been largely planned, but was executed in both 'back-to-front' (the sky being painted before the cross and the martyr) and 'front-to-back' (the landscape at left being painted after the martyr was completed). Several areas were left in reserve. As seen in the XRS, the cross and the martyr were left in reserve from the lead-white (under) painting of the sky area and from the middleground landscape. XR also shows that the horizon continues in all three panels at approximately the same height. The top layer of lead-white paint in the sky (already containing a small amount of high-quality azurite pigment particles)[12] seems to have been gradually mixed in to produce a gradation from deep blue. Azurite was used quite thickly for the upper part of the sky and landscape. The white (remnants of) clouds visible at the tops of the central panel and the right wing may belong to the final compositional phase of the triptych.

  The white and blue of the sky in the central panel were painted before the incision above the cross was made. The cross had been left

8.14 XR, during treatment (images Davide Bussolari)

in reserve at that point, so the incision only indicated more accurately the upper limit for the application of its brown paint, which partially overlaps the sky. The upper part of the tree and the foliage to the left of the martyr were painted over the finished sky at a later stage (see *Changes*). In the right wing, the boat and the central tower were not left in reserve from the water. At right, possibly a different building was left in reserve, wider and lower, but not executed in paint. The right tower was then added, with its top painted over the lead white of the sky. The darker blue-green of the landscape was applied afterwards, up to the towers but atop the existing landscape at the horizon.

In the central panel, the blue-green paint of the landscape was laid on after the figure of the martyr was nearly complete. The blue-green overlaps the vermilion robe, blue sash (which was left in reserve from the red) and brown hair, but was applied before the hair was extended to the left and the highlights were added there. The lower part of the cross was left in reserve and painted after the saint's richly decorated robe was executed. The lighter areas of this robe consist of a mixture of copper-green glaze with lead-tin yellow.[13] The white robe of the figure at lower right was partially painted atop the red of the one behind him and was followed by the blue sleeve slightly overlapping the white. The white dots around

his waist were followed by dabs of dark paint, slightly overlapping or adjacent to the highlights. In most red clothes in the central panel, whitish modelling (consisting mainly of lead white and a little red lake pigment) was applied onto a bright red base of vermilion mixed with red lead.[14] A red lake glaze (now faded somewhat; see below, *Discoloration and increased transparency*) was usually applied afterward, and more thickly in shadowed areas of folds, which were often reinforced with dark (black) paint. The final contours were determined with black paint for the unpainted shadow areas.

The saint's crown was painted in lead-tin yellow, using small dashes of a pinkish red for the shadow areas. The sword hilt and scabbard fittings as well as the shield rim of the left-hand figure lower right in the central panel are decorated in a similar way. Part of that figure's robe consists of a greenish grey followed by a reddish, glazelike paint, imitating a shot colour (*changeant*) effect. In some areas, a purple paint appears as well. Black was used both in paint mixtures (e.g., for dark red, brown or grey) and in its pure state (as in the sword in the central panel and certain details such as eyes).

The signature was applied between thin, possibly incised lines at its top and bottom. It was painted over the fully set paint of the background, perhaps using a mixture of lead white and lead-tin yellow. The signature's appearance, craquelure, state of degradation and adhesion are consistent with those of the rest of the painting.

- ***Changes*** At least three painting phases can be distinguished in the triptych. In the first one, large donor figures were depicted in both wings (see figs. 8.5–8 and 8.14). These are revealed in IRR/IRP and XR, and are also detectable in VIS, shimmering through the paint surface. They were left in reserve from the original background, which was also altered. The first phase appears unfinished, lacking overall detailing and perhaps some background features. In a second phase, adjustments were made and the painting was completed. Pentimenti can be seen, for example, at the donor figures, in the left wing apparently adding a hat and in the right wing altering the round cap – in both cases a flat-topped biretta with raised sides. In the third phase, the donors were painted out, the landscape of the wings was largely changed, and areas of the central panel were overpainted as well.

On the left wing, the background was completely overpainted, while the imitation stone base or wall was part of the original composition.[15] Originally the donor was set in a green landscape, extending approximately to the same position as in the current composition. There seemingly was an initial form of the gate building to the left, a bridge and water below it extending to the top right, where it blended in with land nearer the right edge. At the horizon, the underlying landscape is more bluish in tone, with buildings in front of it, followed by a sky in gradations of white to blue. The donor is dressed in a dark blue robe lined with brownish fur. Since it is fully opaque in IRR/IRP, the robe must have been underpainted or mixed with black. This figure wears a reddish shirt, and a cross-section from the area showed atop the ground a thick, pink layer (200 µm) containing lead white and vermilion, followed by a red-lake glaze.[16] In the second phase, the donor's hat was apparently added and his shoulders were painted as less sloping, which also made the open fold of the fur-lined coat stand out more conspicuously. The donor and the entire background were overpainted in the third stage, and the figure of Saint Anthony, sitting on a bench, was added. His brown robe is partially resting on the imitation stone base or wall.

In the central panel, the neck of the martyr was altered, probably at an early stage. Her gown originally had a roundish neck or collar executed in an impastoed lead-white paint, which was later covered with a red lake, with a black reinforcement of the current V-shaped neck. In the third phase, the branches and foliage were added to the hollow tree on the left, covering the already-painted sky. The white-to-grey clouds may also have been put in at this time. In the shadowy area just below the martyr, a stone formation and a small plant are discernible in the IRR/IRP image, although a dark brown paint covers them. A similarly deep brown paint was used to cover the green foliage in the central middleground to the right of the saint, behind her sash, but this was not applied to her left. These elements might have been painted out during the third phase, perhaps to create a better transition to the dark, overpainted left wing.

Of the right wing, roughly the bottom half (excluding the parapet) was altered. In the first phase, the donor was set in a green background with sloping hills at the height of his shoulders. He was wearing a black robe, and his green shirt and sleeves had a red-brown, glaze-like paint, probably imitating a shot colour effect. His straight shirt-collar was decorated with an embroidered motif. A comparison of the IRR/IRP and the XR seems to show that behind him and the hills, a seashore and water were painted, with a tongue of land at left and a higher shoreline, which ended roughly at the tip of the mast of the sinking ship at right. A bay or perhaps a tree, extending roughly up to the area of the tower, may have been painted at the right edge. In the second phase, the water was painted more towards the foreground.[17] The XR shows that the upper part of the water has longer, more horizontal brushstrokes, whereas the lower part (slightly overlapping the upper) is somewhat more radio-opaque, with shorter brushstrokes in several directions. This alteration included the whale with the figures and the sinking ships. In this second phase, too, the hills around the donor were revised to a kind of plateau with green lake paint on top. The foliage on the left was added and the donor's hat was modified. In the third phase, the donor was painted out. At this time, the dark brown paint was added around his head, as well as the rock formation and the tree on the right, and everything below, to the parapet.

It is not entirely clear when the third-phase changes occurred. There are similarities and discrepancies in build-up and technique of elements from this phase when compared to earlier phases of the wings and the central panel. In general, the central panel is painted more precisely, with more assurance and virtuosity, utilizing large-scale features, yet with refined detailing. The wings include many smaller components that were painted skilfully, but with less detail and precision. In the right wing, for instance, the cords of the sword of the figure at the lower right do not meet up properly at the sword-hanger, and the lead-tin yellow and lead-white highlights are placed more crudely than the lead-tin yellow and red (lead?) detailing of the sword in the central panel. The spiked club is painted less accurately, and the oval rings of the chain mail are positioned more randomly than those of a similar motif in the lower right figure in the central panel.

The build-up of the red sleeve consists of a grey layer (covering the black of the donor), followed by a red layer, and wet-in-wet lead white for highlights. Some additional modelling was done with red lake. Since it was impossible to use the ground layer in this location, a different build-up technique was required for the skin tones. In such areas, there are some similarities with the central panel – mainly the pinkish highlights for the faces and the impastoed paint for the fingers, although the applied dark brown outline is not present. Previous cross-section research had revealed an intermediate resinous layer that fluoresces under UV. This could be a varnish or perhaps a saturating adhesive layer, suggesting that the extensive repainting of the wings was executed some time after its initial completion. We may assume that the figures of donors and other overpainted areas have become more visible over time because of the ageing of the paint and damage to the later overpainting.

FRAME

The panels are currently unframed. At the top right edge of the central panel, some red material was found on top of the ground but under the original paint layers (24MICGBM001). This could be a remnant of

a red bole, which would suggest that the original, engaged frame, now lost, was gilded.

A modern metal framework consisting of T and L profiles rigidly connects the three panels. Messing clamps are screwed onto the cradle members, blocking the movement of some of them. The auxiliary mounting frame does not extend above and below the painting. (Both the metal mounting frame and the cradles were removed during the 2013–16 treatment.)

CONDITION

The painting was restored in 2013–16, thus after the 2011 BRCP technical examination of the painting on which this text is largely based.

Support

- ***Altered dimensions*** The central panel was thinned considerably, leaving most dowels intact, presumably to enable the flattening of the warped panel and the application of the cradle. The wings were thinned and cradled as well, but there the dowels have been exposed. The inner sides of the open wings currently have a thickness of about 0.5 cm, whereas the outer sides are about 0.9 cm thick. Several of the panel edges have been damaged to some extent (left wing: bottom left and right; central panel: bottom left; right wing: bottom left and right, and top centre). There are several nail holes in the unpainted edges of the panels. There are no signs of the fire damage that was suggested by some authors.[18]
- ***Additions*** A cradle was attached to the three panels, presumably in Vienna, and was later followed by an auxiliary metal mounting frame (see *Previous treatments*).
- ***Cracks*** In the left wing, a crack running the entire length of the panel can be distinguished (about 16.2 cm from the left side, seen from the front). In the central panel there are three cracks: one in the top centre, a longer crack in the bottom centre, and a smaller one at the bottom right. In the right wing, two small cracks with a difference in level are visible at the top and bottom right (seen from the front). On the reverse of the panels, as revealed by XR, the vertical cradle members cover the cracks.
- ***Deformations*** Over time, the attached cradle (and possibly also the metal framework) has resulted in an undulating surface of the panels.
- ***Joins*** The join in the left wing is partially open (mostly at the top). The XR examination of the central panel shows paint losses along the entire length of the join between the left and centre planks, indicating that the left plank was separated and readhered at some point. This is further supported by the presence of an empty dowel hole in this join (just above the centre), and by the fact that the lowest dowel hole contains half a dowel in the left plank, while the hole in the right plank is empty. The left join is only slightly open (top and bottom), but there are differences in levels, further confirming that the left plank had indeed come apart from the central one at some point. The right join remains mostly closed except at the top, where there are also level disparities.
- ***Coated reverse*** A spray coat of slightly matte varnish had been applied to the reverse of the thinned panels.[19] There are also some traces of ground and black paint near the bevels on the upper parts of the wings, which appear to be original (fig. 8.4). A cross-section from a paint sample of the left wing reverse has been analysed.[20] It has: (1) a chalk (calcium carbonate – $CaCO_3$) and animal glue ground; (2) an oil isolating layer (possibly part of layer RR 3); (3) a pigmented isolating layer consisting of lead white and some chalk and ochre pigments; (4) a bluish-black layer with carbon black and some chalk and aluminium-silicate. A non-original residue atop this build-up is similar to that found on the open triptych panels.
- ***Biological damage*** Old woodworm damage is evident on the reverses of the central panel and the left wing. On the front of these two panels some small exit holes spread over the painted surfaces can also be made out.

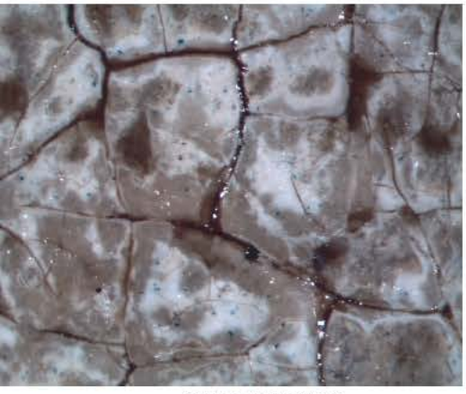
Ground and paint layers

- ***Stability*** The cradle is actively causing damage to the triptych. All three support panels are undulating. Paint is damaged and raised along cracks and joins. An overall rippling of the paint surface can be seen, and some slight cupping is visible, especially in the sky area of the right wing (see fig. 8.17).[21] In general, the adhesion of paint and ground is relatively good, with the exception of some blisters and raised paint. These areas are predominantly located in the left wing and the central panel, where they are spread over the surface but more concentrated around the martyr's left hand. Most craquelure is caused by natural dimensional changes of the panels. Where thick azurite with more binding medium was used, slightly broader cracks have formed in drying. In some parts where lead-white paint was applied on top of red, youth cracks – drying cracks caused by the application of medium-poor over medium-rich paint – are also visible.

  Although lead-soap aggregate formation was observed in paint cross-sections and as opaque points in XRs in a number of areas spread over the surface of the painting, disturbing surface defects

8.15 RR 24, VIS

8.16 RR 25, VIS



8.17 25MICGBM001

8.18 24MICGBM003, raking light

8.19 24MICGBM004

8.20 Mapping of micrographs reproduced here (8.17–19)

other than increases in transparency were hardly observed. Expansion of the aggregates may cause them to protrude from the paint surface, resulting in minuscule raised spots and a more granular surface texture. Loss of such metal soap aggregates results in tiny, craterlike holes that appear dark in XR. Over time, accumulation of dirt and varnish residues in these holes causes them to appear dark in VIS and IRR/IRP. Such holes are visible to a limited extent, for example in the clothing of the man at the bottom right of the central panel.

- ***Losses*** There are many smaller losses to ground and paint that can be disturbing; for instance, in the white surface layer over the red robe of the martyr. Larger filled and inpainted losses are present in both wings, where they are mostly restricted to areas of landscape, especially around the large boat and the tower in the right wing.

- ***Abrasion*** The paint surfaces are severely abraded overall. The rippling and slight cupping of the paint have worsened this. In the central panel, the whitish modelling and red lake top layer covering many red areas has lost much of its originally subtle toning effects, and a similar issue is evident in several of the faces. Portions of the wings are abraded even more, which might well be related to the overpainting of the donor figures and large parts of the landscape there. Locally the barbs are slightly abraded as well.

- ***Discoloration and increased transparency*** The green glazes seem to have held up fairly well. Red glazes have faded somewhat, especially where applied thinly (e.g., on lead-white modelling of red clothes). Some paints containing lead white (including the skin tones) appear to have increased in transparency, causing greater visibility of the underlayers and/or ground layer and an unintended change of appearance. Especially in the sky area of the right wing, this effect may have been worsened by abrasion of raised paint (previous cupping; see fig. 8.17). A good example is in a sleeve (see fig. 8.15) that was left in reserve but subsequently enlarged with white paint, and which has now become largely transparent. The greenish appearance of the upper sky area is in part caused by discoloration of the ample oil binding medium of the azurite paint (see also below, *Varnish*).

- ***Filling, retouching and overpainting*** Extensive *rigatino*-style retouching is fairly easily discernible on all panels, even at some distance. These retouchings have a tempera base (in either watercolour or egg yolk), followed by a pigmented resin glaze.[22] The modern synthetic pigments chrome green (chromium oxide) and titanium white (titanium dioxide) have been identified in the retouches.[23] Losses were filled and inpainted, but most retouching was done on abraded areas. These retouchings have discoloured somewhat, but, in addition, they often do not match the original colours very well. They were mostly applied in separate dabs or strokes which, together with many remaining spots of old and severely discoloured varnish residues, result in an inappropriate and disturbingly vibrant effect. The uniformly whitish sky, for example, currently appears distractingly uneven. Furthermore, the retouchings regularly cover parts of the original paint. Many areas have not been inpainted properly (see fig. 8.16), further increasing the unbalanced impression of the surface.

  At some point in time, an infrared-absorbing greyish surface layer has been applied to predominantly lighter areas of the paint surface.[24] The greyish surface layer seems distinct from the more transparent, resinous or glue-like brownish residues that are present in many other areas of the painting. It seems that these are part of a pigmented toning layer, possibly applied during the 1951 Pellicioli treatment.[25]

  Questions have been raised in the past as to whether or not the female martyr portrayed here had a beard, which would make her identification as Saint Wilgefortis indisputable. The condition of the painting in 2011 did not allow for a definite answer in this regard, but the saint's chin and jaw are clearly abraded and appear to have been worked on and inpainted multiple times in the past. The raking-light micrograph indeed shows an irregular feature on her chin that is dissimilar to the surrounding paint (fig. 8.18), and the visible-light micrograph reveals a thick, resinous feature there (fig. 8.19). After removal of the discoloured varnishes, retouchings and non-original residues in this area in 2014, remnants of a subtle beard have become visible, confirming the identification of the saint (fig. 8.27).

Surface finish

- ***Varnish*** The appearance of the modern, brush-applied varnish is somewhat uneven, and the surface is speckled by a spray application of a slightly matte varnish. The thick varnish has yellowed, but the severely discoloured varnish residues of an underlying older layer are generally more disturbing, since they contribute to the greenish appearance of the blue sky, for example.
- ***Surface dirt*** There is only a small amount of surface dirt on the painting, and there are some remaining brush hairs from varnish application.
- ***Visibility of the original surface*** The saturation of the paint surface is relatively good, but darker areas are difficult to read. The yellowed, degraded varnish layers, especially the highly yellowed older varnish residues, have reduced legibility of the original paint surface, leading to a distorted perception, especially of the sky area. Some bright blue paint has been exposed near the top edge, which is now covered by discoloured oil medium and a thick oxalate-crust and have resulted in a green appearance. The combination of the inadequate retouches and the old overpaintings that have discoloured over time strongly distracts from the original surfaces.

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1 The text in parentheses could not be deciphered with certainty.

2 See Rossi-Manaresi and Tucci in Limentani Virdis et al. 1992, 200–01.

3 The BRCP is very grateful to Alice Hoppe-Harnoncourt for archival research at the Kunsthistorisches Museum in Vienna.

4 See Nepi Scirè in Limentani Virdis et al. 1992, 176.

5 See Nonfarmale in Limentani Virdis et al. 1992, 187, who discusses the treatment of the three ensembles attributed to Bosch in the collection as a single work, without referring to specific paintings and panels.

6 Paintings conservator Giulio Bono and head of conservation Maria Chiara Maida, oral communication.

7 Klein 2001, 126. The youngest or last-preserved rings on the three planks of the central panel date from 1477, 1467 and 1480, respectively.

8 Possibly yellowed from excess glue.

9 Rossi-Manaresi and Tucci in Limentani Virdis et al. 1992, 184, 200–01.

10 Rossi-Manaresi and Tucci in Limentani Virdis et al. 1992, 184.

11 Rossi-Manaresi and Tucci in Limentani Virdis 1992, 183–86, 200–01.

12 For the water area in the right wing, a lower-quality, less pure azurite was mixed with lead white. Rossi-Manaresi and Tucci in Limentani Virdis et al. 1992, 184.

13 According to Rossi-Manaresi and Tucci in Limentani Virdis et al. 1992, 184, 200, and fig. 42, Type 1 lead-tin yellow was probably used here.

14 Analyses by Enrico Fiorin, chemist at the Soprintendenza di Venezia, identified both cinnabar (or vermilion) and red lead (or minium) in a cross-section made from a sample taken from the red robe of the figure bottom right of the central panel. The red lake appears to be of insect origin (carmine of either cochineal or kermes lake, based on its UV fluorescence). It was precipitated on an aluminium hydroxide base (determined by energy-dispersive X-ray spectroscopy [EDS]). The red lake glaze contains grains of silica, probably ground quartz, used to alter the working and drying properties of the paint. The cross-section also revealed lead-soap formation processes occurring (see *Stability*).

  It is quite possible that this fast-drying lead-white layer on top of a more slowly drying vermilion could account for the broader youth cracks. See Van Schoute and Verougstraete-Marcq in Limentani Virdis et al. 1992, 181.

15 Modern retouchings are also present, however, in brown and titanium white. The original parapet consists of a greyish layer (30 µm thick), containing lead white and some brown pigments. Rossi-Manaresi and Tucci in Limentani Virdis et al. 1992, 200 fig. 40.

16 Rossi-Manaresi and Tucci in Limentani Virdis et al. 1992, 200 fig. 39.

17 A cross-section was taken from the water area, revealing lead-tin yellow, verdigris and lead-white pigments in a layer underlying a mixture of lead white and azurite paint. Rossi-Manaresi and Tucci in Limentani Virdis et al. 1992, 186, 200 fig. 42.

18 Baldass 1959, 237; Marijnissen 1987, 260.

19 Nonfarmale in Limentani Virdis et al. 1992, 187.

20 Analytical report by Enrico Fiorin, 11 April 2015.

21 Issues with raised paint were treated extensively during the last treatment. Nonfarmale in Limentani Virdis et al. 1992, 187.

22 See Nonfarmale in Limentani Virdis et al. 1992, 187.

23 Rossi-Manaresi and Tucci in Limentani Virdis et al. 1992, 186.

24 The exact nature and composition of this layer have yet to be determined, but it was applied onto old fills as well. The greyish layer seems similar to the one found in the *Hermit Saints Triptych* (see cat. 2, RR 27–31, 40).

25 Mauro Pellicioli often used glue as a patina and a medium for retouching. (Paintings conservator Giulio Bono and head of conservation Maria Chiara Maida, oral communication.)

8.21–23 VIS, after treatment

8.24–26 VIS, reverses after treatment (photos Matteo De Fina, Venice)

8.27 VIS, after treatment

9 *The Adoration of the Magi*

Hieronymus Bosch
c. 1491–98

Oil and egg (analysed) on oak (analysed) panel. Size within frame, closed: (RR 134) 135.3 × c. 32.5 cm; (RR 135): 135.5 × 32.4 cm. Size within frame, opened (RR 136): 135.2 × 32.4 cm; central panel (RR 137): 133.5 × 71.3 cm; right wing (RR 138): 135.5 × 32.7 cm.[1]
The frames of the wings are original. Some sections of the frame of the central panel were replaced, but this is also largely original.
Museo Nacional del Prado, Madrid, P02048

The painting was restored in 2015–16, thus after the 2014 BRCP technical examination of the painting on which this report is largely based.
BRCP, *Catalogue Raisonné*, cat. 9; www.boschproject.org no. 9.

SUMMARY OF CONCLUSIONS

The Adoration of the Magi Triptych *in the Prado is a key work in the core of the Bosch group. The painting technique can easily be linked with other autograph works, as can the style and material of the phased underdrawings in the open triptych. The compositions were significantly changed during the subsequent stages of their production, especially in the interior scenes, further pointing to extensive personal involvement of Hieronymus in that process.*
The wings are still housed in their original engaged frames, and the engaged frame of the central panel is also largely original. The Mass of Saint Gregory *on the closed wings was painted as a continuing composition over the two protruding vertical central frame members. The two male donors on this grisaille were roughly left in reserve and thus have always been integral parts of the composition. The construction of the panel and frames is apparently unusual, which might point to the possibility that the framed panels, commissioned by the donors, were produced outside of 's-Hertogenbosch and delivered to Hieronymus for painting.*
Dendrochronology indicates that the triptych could have been painted from 1472 onwards, although a date after 1474 is statistically more probable. As further explained in BRCP, Catalogue Raisonné, *cat. 9, the identification of the donors as Peeter Scheyfve and Agnes de Gramme allows for a relatively precise dating of this work: between 1491 and 1498.*

EXAMINATION DATA

1–5 September 2014 (Robert Erdmann, Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Hanneke Nap, Ron Spronk).

The triptych was examined in its frame in an empty gallery space. The wings were separated and the paintings studied upright on an easel under strong illumination. The central panel was temporarily placed face down on a table for dendrochronological examination. Both front and reverse were accessible, with the exception of the panel edges, which were blocked from view by the engaged frame.

- ***Previous research and additional documentation available*** XRS were available for study. See also the information in Garrido and Van Schoute 2001; Van Schoute, Verougstraete and Garrido 2001; Parra Crego 2001; and Van Schoute, Garrido and Cabrera, in Van Schoute and Hollanders-Favart 1985, 211–15.

Inscriptions and labels
Signed, central panel, bottom left: *Jheronimus bosch*. Due to incorrect retouching with gold paint, it currently reads, *Jheronnmis bosch*. The non-original number *444* is applied twice, once in black (older) and once in red, at the bottom left corner, beneath the signature.[2] In the lower left of the open left wing, the inscription *een voer al* and the coat of arms of Peeter Scheyfve are applied, and in the lower right of the open right wing, the coat of arms of Agnes de Gramme.[3]
In the top centre of the central panel's reverse, *No. 2048* is applied in black.
To the right, on the reverse of the central panel frame, a metal Prado inventory label reading *m. n. prado // 02048* is attached with two screws.
An incomplete, non-original label is attached to the frame (bottom centre) of the closed left wing.[4]

RR 134 RR 135

SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 9.1). Due to the largely original engaged framing, the panel dimensions could not be measured. From the reverse of the central panel, however, it could be determined that the panel's maximum dimensions are about 133 cm high and 72 cm wide.

  The wood species, Baltic oak, was identified through dendrochronology. The quarter-sawn planks are vertical in grain and laid vertically.

  The central panel consists of three vertical planks, whereas the wings consist of two vertical planks each. In the centre of the closed wings, the composition continues over the engaged vertical framing elements (see below, FRAME).

  The planks of the central panel are butt-joined and reinforced internally at each join with three small, square wooden plates running parallel with the panel. Each plate is secured by four short dowels that are perpendicularly placed, two on either side of the join. The dowel holes were drilled from the back of the panel but do not extend to the front and are not visible in the paint surface. The planks of the wings appear butt-joined and glued.

  The wings are painted on both sides. The central panel reverse was originally planed to achieve a relatively flat surface. Marks of a dented plane have been preserved.

- ***Bevelled or half-lap edges*** The entire circumference of the central panel has been worked to a half-lap edge. Measured from the back of the panel, the lap is between 0.0 and 1.3 cm deep. XRS indicate that the lap is about 1.5 cm wide. The wing panels have a wide, slight bevel on the surface (covered by ground and paint), as the plank is only thicker in the centre.

RR 136

RR 137

RR 138

RR 139

- ***Dendrochronology*** The youngest heartwood ring in the central panel dates from 1461, which, with the added minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1470 for the tree that supplied the wood for that plank.[5] An earliest felling date of 1472 is statistically more probable, however, since that would cover 93 per cent of the range of possibly missing sapwood rings. Assuming at least two more years for drying and transportation, the panel could have been produced from 1472 onwards, but a production date from 1474 onwards is statistically more probable.

GROUND

- ***Visibility*** A possible sizing layer was observed in the hole of a previous sample location (137MICGBM007). The off-white ground is present overall.

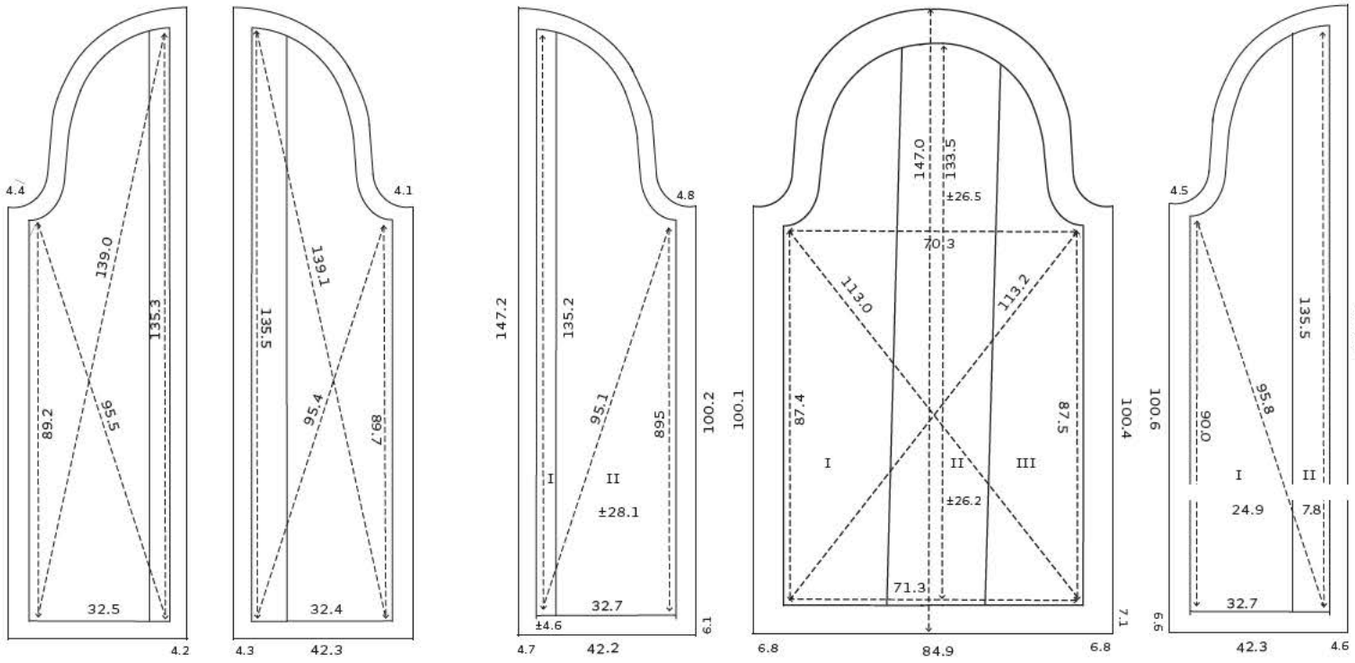
  The paint layers generally cover the ground layer. Locally the ground can be observed in VIS at several painted contours, in losses and along panel edges. In places the underlying layer is also detectable in drying cracks, for example in the black robes. Visibility of the ground tone shimmering through slightly may have been intended in certain areas. Nevertheless, the ageing of paint layers has probably increased their transparency and thus the perceptibility of the underlying strata, especially in lighter zones.

- ***Barb and edges*** The edges were not fully accessible because of the engaged frames, but barbs and ungrounded edges appear to be present throughout. The barbs, however, have been damaged. Shrinkage of the panels has exposed large parts of the ungrounded and originally unpainted edges, which have been retouched and overpainted.

- ***Application*** The ground was worked to achieve a generally smooth finish. In some areas, visible brushmarks appear to be within the intermediate layer on top of, rather than in, the ground layer. With ageing, the vertical grain and texture of the wooden support have become more apparent, mainly in the central panel.

- ***Composition*** Analysis indicates that the ground consists of chalk bound in animal glue.[6]

9.1 Construction diagram (seen from the front)



RR 134 RR 135 RR 136 RR 137 RR 138

PREPARATORY LAYERS

- ***Underdrawing*** Underdrawing was not observed in the grisaille on the closed triptych (RR 134–135). The relatively rough manner in which the young man in the closed right wing was left in reserve from the altar and floor also suggests that no underdrawing was used here.

  In the grisaille, multiple incised lines were used to indicate some main compositional elements. The inner bevel of the painted, imitation-stone window frame was completely incised. Although the inner and outer contour lines of the altarpiece were not thus delineated, the horizontal lines at the altar itself were. The incision below Saint Gregory's hands extends slightly under the figures to the left and right of the altar.

  The composition of the open triptych was almost fully underdrawn and incised lines were noted only in one location (see below, *Paint application* ...). The preparatory drawing shimmers through the paint surface in many lighter areas; for example, to the right of Joseph's back and in the lighter colours of the background landscape and hut in the central panel. It is also evident where it is not fully covered by the paint. The current visibility (in VIS) of the underdrawing is likely caused by the changes in refractive index due to the ageing of the paint film, resulting in an increased transparency. Through IRR/IRP, underdrawing was revealed beneath paint more clearly and was found to be present throughout the painting.

  The underdrawing determined the composition and aided in modelling via parallel hatching in differing densities to indicate shadowed areas. It appears that hatched areas in the red robes also roughly indicated those zones where little to no lead-white-based underpainting was to be applied. Despite the extensive underdrawing, the artist often deviated from it in the paint application phase.

- ***Medium and application*** The detectable underdrawing was brush-applied in a liquid medium, possibly a finely ground carbon black in a watery solution, as many tiny particles are discernible locally (138MICGBM002).[7] The underdrawing was applied in multiple stages, using brushes of different size. It appears that contours were drawn first, followed by indications of elements such as folds and facial features. These brushstrokes can be quite broad and the material rather deep black (e.g., at the initially underdrawn position of the magus at the back). Following these lines, further detailing and modelling were applied. Parallel hatching was used to indicate shadows. In several faces and in the folds of Saint Agnes's garments, hatched lines are slimmer. Generally speaking, however, the strokes of the second stage were more irregular and often shorter than those of the first one, as evident in the underdrawn head in the wall of the hut to Mary's right. In several areas, the lines were placed adjacent to one another, appearing as washes and filling areas with underdrawing. In many other sections, the underdrawing material was very fluid and broadly applied as washes. This might have comprised an additional stage and can be seen in shadows (as between the magi and Mary) and in the background (as above the hut in the left background). The flowing material pooled in places at the bottom or even dripped slightly, indicating that the panels were not lying flat when those areas were underdrawn.

- ***Style*** Although the composition of the open triptych is almost fully underdrawn, it shows ample artistic invention. The lines were applied swiftly and generally appear freely sketched and self-assured. The longer strokes, mostly found in contours, are fairly straight but sometimes consist of multiple sections. Most lines, however, are rather short and irregular, and can be broad. For the most part, line ends are straight (blunt or tipped), but they can have hooks as well. Hatching was applied in both verticals and diagonals that sometimes overlap or are closely spaced. In several parts, very wide strokes or washes were used to fill areas in the composition.

  It does appear that the underdrawing style of Saint Agnes's robe is different, as the lines appear straighter, and more even and regular, especially compared to the underdrawing of Saint Peter.

- ***Revisions in underdrawing and differences from painting stage(s)*** There are many smaller and larger changes in the underdrawing, as well as deviations from it in the painted surface.[8] Most notably, the painted cityscapes and background buildings in the three panels of the open triptych were initially underdrawn significantly lower and/or differently.

  Especially in the left wing (RR 136), the drawn buildings are dissimilar to those that were painted. The area with the dancing figures was initially planned full of foliage, and the ruin with Joseph was changed (see below, *Changes*). Saint Peter's keys were drawn lower, a longer fold or split was indicated in his robe on his chest, and slight differences from the paint stage were noted at his armpit and the bottom of his mantle.

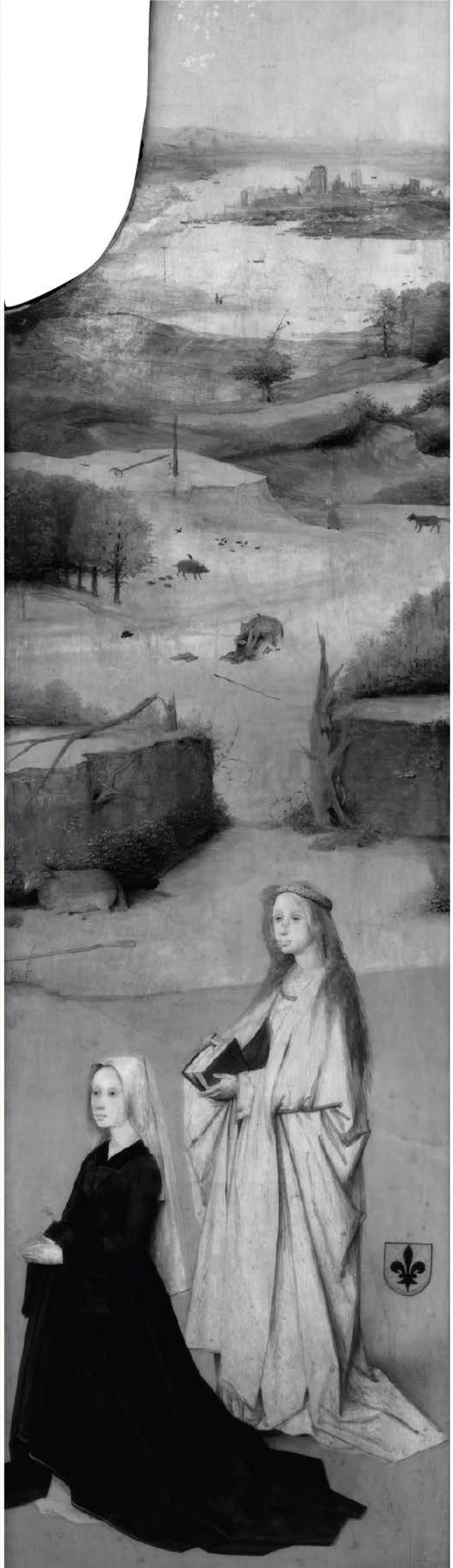
  In the central panel (RR 137), several of the drawn buildings were also executed higher up in paint. Curved underdrawing lines and foliage at the right were also detected at the current level of the horizon, as well as what appears to be faint underdrawing of much taller structures. Several alterations are also detectable to the left and right of the hut's roof, which was initially less peaked. The horsemen and bridge at right were underdrawn more to the left, and the water appears to have continued behind the hut towards the left side. In the now-empty part of the hut's dark doorway, an additional large, standing figure was underdrawn, apparently a man leaning on a staff. The five background figures here were all underdrawn or at least indicated, but were later painted atop a dark layer. The black magus's mantle was prepared with a series of rings from his neck to his lower abdomen, where a split started. From this level down, the entire mantle was decorated with rings. This was not executed in paint, but a similar pattern was painted at the chest of the page, whose robe was underdrawn differently.

  In the red-robed magus, only small changes were observed, but the magus behind him was dramatically revised. He was first underdrawn lower, with a different mantle and without the lavishly decorated shoulderpiece (figs. 9.8–9). The ornamented headpiece to the left of his head does not belong to this magus but to the figure of the Antichrist who holds it,[9] as another decorated helmet was underdrawn on the ground to the right of the magus, but never painted. The Christ Child was initially larger, with his arm positioned further to the right and his left leg extended. To the right of Mary's head, a gap in the wall with an underdrawn face was never painted but can be seen shimmering through the paint. At the same level, to the right, another face was indicated, just below that of the painted shepherd.

  The cityscape in the background of the right wing (RR 138) was underdrawn in a somewhat different manner and larger, with a landmass at the right edge (above the current trees) and a large feature to the right of the two figures at the water's edge. The landscape in the plane with the wolves also varies slightly from the underdrawing. The face of Saint Agnes was positioned more to the left, drawn more in profile, and tilting downwards somewhat. The face of Agnes de Gramme was also drawn a little more in profile.

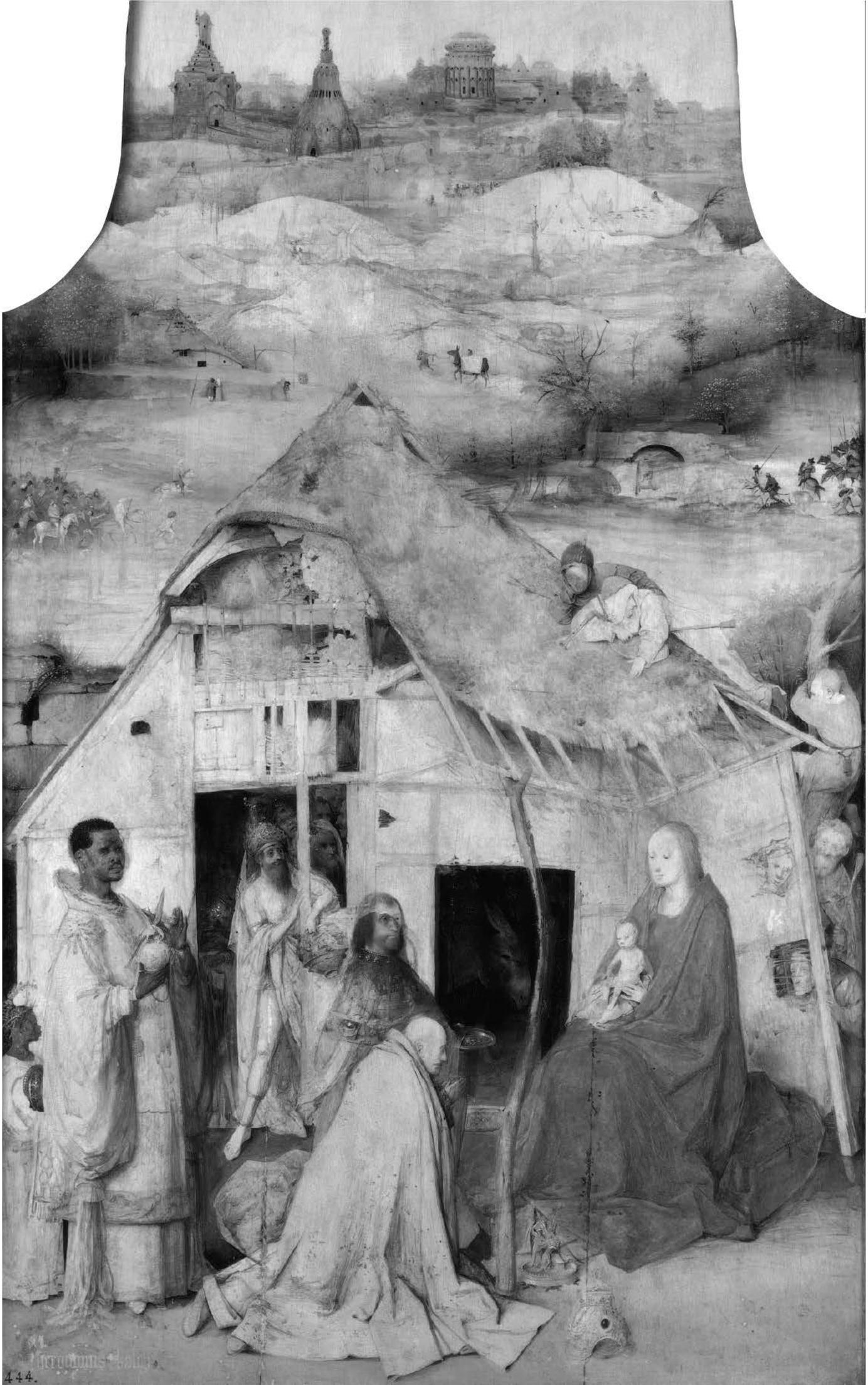
- ***Intermediate layers*** In several losses, a light grey base layer is discernible under the final paint layers of the grisaille. This pigmented isolating layer was applied overall and consists of lead white and organic black. It is visible, for example, at the rear contour of Pope Gregory, where the painted contours of his back

9.2–3 RR 136,
VIS and IRR



9.4–5 RR138,
VIS and IRR

9.6–7 RR 137, VIS and IRR


444.

9.9 RR 137, XR

and the altar do not fully meet (134MICGBM003). IRR reveals the streaky nature of this intermediate layer.

In the open triptych, the underdrawing was applied atop the ground, which appears lightly impregnated with medium, as detected in some of the existing paint samples previously taken.[10] A whitish intermediate layer seems to shimmer through the paint layers. Although not visible in the published paint cross-sections, this could be a lead-white-pigmented isolating layer.

PAINT LAYERS

- ***Binding medium*** Mixtures of linseed oil (analysed) and egg (yolk and/or white) were reportedly used as binders.[11]
- ***Paint application and painting technique*** The brush-applied paint covers almost the entire surfaces of the panels. It was applied on the original edges of the panels and locally continues slightly onto the frame edges. The grisaille paint covers the entire surface of the closed triptych; both the panel and the engaged frame members are painted. The underlying preparatory layer is sometimes visible at the interfaces between different colours. Paint was applied in several stages, mostly wet-on-dry but also frequently wet-in-wet (for both, see fig. 9.11). Incisions in the ground were noted in the grisaille but not in the open triptych. There, only the contours of the fleur-de-lis in the coat of arms in the right wing were incised into the background paint (138MICGBM003).

While painting, the artist deviated considerably from the underdrawing, especially in the background, but followed it more closely in the foreground. Areas left in reserve were mostly filled in with paints that overlap only slightly. (There are some exceptions; for example, see the young man on the closed right wing, who was only roughly left in reserve from the background paint.) The composition was worked out to a high degree of finish. Paints – mostly medium-rich, fluid and glossy – were applied primarily in opaque but also in semi-transparent layers. Glazes were done in red (for red and purplish areas) and in green. In the landscape, more of a brownish-green glaze appears to have been used. In areas of red lake, regular and very closely spaced dots of lake are discernible, which appears to indicate that the glazes were blotted with cloth. Locally, the paint does not fully cover the underlying layer. In the mule in the background of the central panel, for instance, the local visibility of the landscape colour was clearly unintentional.

Generally, the size of the brush used depended on the feature being executed (e.g., with larger brushes being employed in the background). This is more clearly visible in the pale yellow or greenish base layer of the landscape, which was brushed on rapidly in different directions. For example, in the central background behind the three figures in the open left wing, broad horizontal, vertical and diagonal strokes are visible. These brushstrokes have become more evident because of abrasion in the copper-green glaze on top, exposing the ridges of the underlying impastoed paint. Dotted paint application is detectable in the foliage, with gradually more

9.8 RR 137, IRR

elongated dabs or strokes used towards the background. The style of the foliage appears consistent throughout the entire open triptych, although some of the finest dots can be found in the central panel. In the centre of the open right wing, at the left side of the tree trunk's base, green imprints from dabbing are discernible. Similar marks are present in the grey-black at the right of the shelter. It is possible that the artist used his fingers to apply these prints. The red lake paint in all of the robes generally has a rather speckled appearance where applied more thinly. It is particularly the quite regular pattern in Saint Agnes's dress that evokes the use of very fine cloth in a dabbed paint application. Brushstrokes were employed to render contour and volume throughout the painting. They were applied in multiple directions but generally follow the forms in the composition.

The composition was built up in two to three paint layers. The Passion scenes on the closed wings were painted onto a still-wet underlying layer, which functioned in the final composition as a base for the subsequent black or brown and white lines, as well as the highlights and details in white and black or brown that together make up the grisaille. This rapid wet-in-wet painting technique utilizing the underlying layer is visible in many of the details (see, for example, fig. 9.12). The trees in the Passion scenes on the altarpiece consist of dabs applied back and forth, followed by the tree trunk and then highlights, all painted wet-in-wet. The thickness of the layers appears, to a great extent, dictated by the paints used and the extent of impastoed modelling. The lead-white and lead-tin yellow paints were applied more thickly than those with earth pigments. Areas with azurite consist of thick but medium-rich paint, as dictated by the coarseness of the pigment.

Red lake was frequently mixed with lead white, often somewhat roughly, for several robes in the background. For the main red robes, a somewhat dry lead-white underpaint was applied, creating a sharp and impastoed brush texture, which after the paint had set was covered with red lake. Slight abrasion has caused the textured white underlayer to become more clearly visible. On the closed right wing, red lake detailing was applied onto the still-wet vermilion of the young donor's hat, slightly pushing the underlying paint aside and creating ridges (see fig. 9.13). The long, vertical fold in the veil of the female donor in the open right wing was painted wet-in-wet with a grey paint, pushing aside the white underneath. The dark adjustment at her shoulder was painted shortly after the veil, as some of its white paint was dragged along and got intermixed. In a few instances, two parallel lines of highlight and shadow, respectively, were applied to indicate volume, without an added midtone, but instead utilizing the background. This can be seen, for instance, in the spear of the foremost horseman at the right in the central panel. Black contour lines were hardly used, although black pigment appears mixed in for several dark contour lines. In places, brownish strokes were sparingly used to indicate physiognomic details. The use of ample paint, mostly for the portraits and detailing, along with the wet-in-wet technique, together result in a fine relief.

- ***Texture*** Many passages have a relatively smooth finish. The extensive use of thick lead-tin yellow and especially of paints containing lead white, however, has resulted in many impastoed brushstrokes and highlights. These are most distinct in the fully modelled faces of the donors.

- ***Build-up and palette***
  134–135 In the closed triptych, the painted imitation-stone inner frame continues over the protruding central framing elements and functions as a window through which the scene is viewed. Highlights and shadows on the painted inner 'bevels' of the *trompe-l'œil* window indicate a directional light source from upper left. This is generally consistent with the rest of the composition. It appears that the front face of the stone window was painted in an early stage, extending under the painted bevel and slightly under the donor in the left wing. The bevel was done in a final stage, overlapping the grey, as well as the brown of the background figures and the black robe of the donor. The latter establishes that the donor was integral to the composition, and not added later as has been suggested in the literature.[12] His black robe overlaps the background, with its fur lining revealing a cool brown base, elaborated by warm brown and light details at the edge. At the bottom of the robe, the fur was denoted by repeated short, brown brushstrokes. It appears that only the centre of the donor's hand was left in reserve. In each of his eyes, atop a skin-tone base, a grey iris and a black pupil were painted, then a grey contour above each eye and a white one below. Red lake was applied at the lips and under the nose.

  The face of Christ on the engaged frame of RR 134 has a base that contains lead white, over which a grey-brown and a brown paint were added, with a final black touch for the pupils of the eyes. The angels around him were executed in lead white with thin, brown-grey shadows, and details, such as the lines in the forehead, with ensuing lead-white highlights. The altar and altarpiece were painted in an early stage, followed by the dark grey background. The strongly foreshortened curtains overlap the base colour of the decorated altarpiece and the dark grey background. The latter extends under the background figures, which in turn overlap the curtain. The paint of the raised floor extends a bit over the altar and curtain, but is overlapped by the foreground. The young donor was only roughly left in reserve from the raised floor; the step in the floor continues uninterrupted beneath his robe. His skin tone was painted after the black robe, and then the brownish hair and the red hat. Overall, mainly lead white, organic black, and brown iron oxide were used, the latter two especially for darker areas or shadows. Only the candle in the lantern (135MICGBM002), the fires above it in the background and on the demon's head, and the two donors were executed in slightly more vivid colours.

The composition of the open, full-colour triptych was painted after the red-brown bole and the gilding of the frame were put on (136MICGBM005). The paint was applied from light to dark, but also from dark to light, as in the foliage. Highlights and shadows were put in later. The painting phase was completely planned and was executed mainly from 'back to front', with the background painted before the figures, mostly following the underdrawing, and leaving areas in reserve.

In the central panel and wings, the white area of the sky was painted first, with vertical brushstrokes. Working from the horizon to the top, more azurite pigment was gradually added and apparently just slightly less lead white, as the sky remains rather radio-opaque up to the top. Blue areas in the background landscape also appear to consist of lead white and azurite.[13] The landscape in the three panels of the open triptych was generally built up in two, or sometimes three, layers. First laid on was a light-coloured base layer with lead-tin yellow and/or lead white. In some areas, green pigment was evidently mixed into this layer as well, as it generally has a pale yellow to greenish tone of varying intensity. Brown iron oxide has been detected as well.[14] This stratum was locally followed by green or greenish-brown glazes, as supported by a cross-section of the central panel background.[15] Only the initially more opaque paint of the path behind the very top of the hut in the central panel was applied over the copper-green glaze.

The light-hued base paint of the landscape has a fairly cool tone and is exposed in places at the foot of the hill with the cross in the left wing. Over this foundation, the artist applied the basic hues of the greenery, which vary from one group of trees to the next and range from light green (mixed with white) via a pure green to a darker one (mixed with brown or black). The trees in the middleground of the

central panel primarily have a somewhat brighter green base. A dark green glaze was applied in places to enhance shadow areas, then the trunks and branches were added, plus several branches painted just after the first dots of foliage. For the branches and particularly the tree trunks closer to the foreground, multiple colours were used: brown, grey, green, black and orange/yellowish tones. Most trunks were modelled, either with a light brushstroke or a dark one (sometimes of green glaze) or both, usually indicating a directional light source from the left. Often, highlights were also painted on trunks in the middleground, with several short horizontal or vertical dabs. The foliage was then put in with green dabs and dots, often followed by light green dots applied here and there (136MICGBM004). Some trees only have leaves in different shades of (discoloured?) greenish brown, with lead-tin yellow dots for highlights. In others, dabs of dark green glaze can be found. The plant resembling bamboo at the right centre in the central panel was done in a manner similar to that of the trees, but some plant stems and leaves were completed before others were painted on top. The paints for the branches and the foliage of the trees and shrubbery were often applied wet-in-wet. Most of the shrubbery foliage shows a similar build-up to that of the trees. In the centre of the right wing, at the green woodpecker, the dark lines of the bushes were done in pure green lake. The final green or greenish-brown glazes used for the landscape were typically applied after most of the foliage was completed.

136 The tower roof in the left wing has a light blue base, which was followed by white, yellow and blue dabs painted wet-in-wet. At its top, a black window and a touch of red lake were applied. The bluish roof of the shelter has a comparable build-up, with additional black lines to indicate the tiling. The upper paint layer of the landscape overlaps the base paint of the central building. The latter's detailing, with paints that contain vermilion and/or red lake as well as lead white, yellow and brown pigments, overlaps the landscape.

To achieve the cool tone of Joseph's robe, blue pigments were added to the paint mixture. The azurite blue hood overlapped his robe and his white hair. Joseph's face was painted with a mixture of vermilion and lead white, and his chin with grey and lead white. Black was used under his eyes and nose, whereas brown was used for his eye sockets and upper lip. Red lake accentuates the darker edges of his nose. Black and brown contour lines are visible at his neck and arm. The upturned basket appears to have been painted after the robe. It has a modelled grey-brown (ochre) base, followed by vertical lines applied wet-in-wet. Horizontal hatching was then applied, slightly wet-in-wet, with a few whitish highlights. The fire has a gold-leaf base in the centre, followed by plentiful vermilion and then red lake paint. After highlights of lead white mixed with some vermilion, detailing in lead-tin yellow, red lake and black ensued.

Saint Peter's head was left in reserve from the background, although a correcting grey contour line at the top was added after its completion, reducing its size. A similar grey contour was painted at his ear, followed by curly white hair overlapping the already dry background. Peter's face was fully modelled; the eye sockets were not left in reserve. The saint's extended hand partly overlapped the green of the landscape. Brown and black contour lines appear in both hands, also indicating fingernails. These contour lines, as well as the brown shadows on the hands, were painted after the red lake of the robe. The same goes for the keys, which were not left in reserve. The robe has a lead-white-based underpainting, which also seems to contain vermilion and red lake.[16] This underpainting not only functioned as a light undertone, but its texture and modelling also play a role in the final appearance of the robe. The lead also acted as a siccative for the otherwise slow-drying red lake. This lake was applied thicker for darker areas, and in places, black paint was applied (or mixed in) for the darkest areas of shadow and for contour lines. It appears that the lead-white-based modelling of the robe was painted before the landscape. The red lake overlapped the landscape paint, but green reinforcements were applied locally afterwards, sharpening the contours.

The black clothing of the donor appears in places to overlap the red lake of the saint's robe. The fur collar of the donor's overcoat has a light-hued edge at the left, detailed with thin brown strokes that extend over the black and green background. The donor's hair and skin tones overlap the black and the landscape. Red lake and brown were used in the lips; black for the nostril and eyes. The white of the eye was followed by more vermilion-rich skin tone at the left. The brown hairs at the rim of the hat appear to contain red lake and black pigments. The black hat itself was left in reserve but partly overlaps the hair and green background. The dark contour line at the right of his face was also painted at this time. The donor's hands are larger than their reserve, and the light underlayer is partly exposed at the wrist. Over the skin-tone base, multiple impastoed and mainly horizontal brushstrokes were laid on in different shades of pink. These and the brown lines indicating physiognomic details were painted wet-in-wet.

137 The blue in the cityscape of the central panel was applied after the three largest buildings were painted. It extends from the left edge to the centre of the panel, only locally overlapping main structures such as the city wall. The smaller buildings were painted over the blue. The largest were executed in greyish paint mixtures, partly overrunning the already-set paint of the sky. Semi-transparent orange-brown paints were used as well, while more pinkish and blue paints were employed in the roofs of the buildings behind the wall. The vertical black dots or dashes indicating windows were done partly wet-in-wet. Besides the general detailing with paints that contain lead white, there is often a light-coloured line or dash extending from one of these windows.

The cross alongside the road in the background has a cool brown base, which was followed by lines applied wet-in-wet for white highlighting and black shadow. In the pole bearing the sign of a swan in lead white on a vermilion red field, different paint mixtures were used. The upper vertical section, however, only consists of a white highlight and a black shadow, omitting a midtone. A similar approach can be seen in the two halberds and two of the spears, while other spears were only done in black or sometimes white.

Although the hut was left in reserve from the green background, the stone wall to the left was not. Close examination reveals the green colour shimmering through the grey paint, and an owl peeping out from a hole in the wall.

The brown skin tone of the page was painted over the red lake of an apparently altered neckline. The red rings were done primarily in red lake, mixed with vermilion, or occasionally pure vermilion on a pink base. In the centre of most rings and along the top and bottom edges of the decoration, lead-white detailing was applied. At the bottom of the robe, the decoration was added in red lake, lead white and black on a vermilion base, locally followed by thick red lake for the shadows of the folds. Vermilion was also detected in the skin tone of the black magus. The base white of his robe was laid down before the hut, but the detailing overlaps the hut's creamy brown. The pearls in the grisaille decoration consist of light grey dots detailed with lead-white highlights and grey shadows (see fig.9.14).

The red robe of the figure standing in the doorway was cropped at the left side by the dark paint of the floor overlapping the robe. The headgear in his hand was painted after the robe, and the wall of the hut was done after the headgear. At his foot (whose toes were delineated in a purplish hue), the green of the landscape extended over all surrounding paints. Previous research had reported that the skin tone of the figure in the doorway was initially completely

9.10 Mapping of micrographs reproduced here (9.11–19)

red,[17] but our examination showed that the vermilion-bearing paint was applied locally, possibly as modelling for shadow areas. In many places, the light skin tone was laid directly onto the light preparatory layer, as is visible from the increased transparency of the light paints. Furthermore, the redder tone at the neck and chest was applied afterwards and overlaps the light skin tone. The Antichrist was left in reserve, but the other figures inside the hut were painted over the black background.

The robes of both kneeling magi have a red lake glaze. They were not painted from back to front, as the azurite-blue base of the purplish robe overlaps the red lake of the red one. The purplish garment also extends over Mary's blue one, which may contain a small amount of lazurite (natural ultramarine), in addition to lead white and mostly azurite.[18] The pole supporting the hut's roof was roughly left in reserve from the first blue paint layer of the mantle, as were the Christ Child and the white cloth. The paints of the hut and the Christ Child (137MICGBM010) overlap the first blue layer, with the white cloth painted afterwards. The second blue layer extends onto the pole and overlaps the white cloth, the skin tones of the Christ Child and Mary, and the white undergarment visible at her chest. Blue paint was used in a later stage for adjustments, as well; for example, at the shoulder of the Christ Child. Mary's hair was painted after the robe. It has a brown base, followed by ochre and umber lines, with ochre highlights and some lead white at the top of her hair. The skin-tone paint indicating the parting of her hair was applied onto the still-wet paint of the tresses. For her eyes, brown-grey lines were added wet-in-wet to the black pupil. The left eye has a brown underlayer that was not observed in the right one. Red lake was used in the lips and nose, and black paint indicated the nostril. Seen close up, the distinction between the bridge of her nose and her cheek is hardly discernible, but it is convincing from a regular viewing distance.

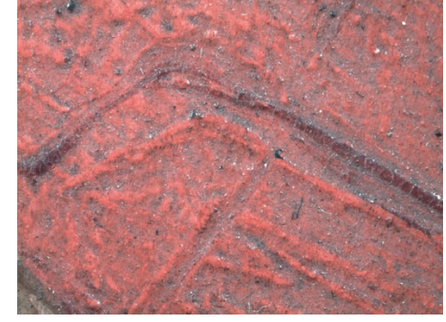
Of the two figures on the roof of the hut, only the front one was planned. The other one was painted over the completed roof. In his face, the diagonal roof edge can be seen shimmering through (fig. 9.20). These and the four additional figures at the right side of the hut were painted in more muted colours, almost resembling a grisaille. The face of the man at the lower right edge was fully modelled, with the lighter paints used for the cheeks, nose and forehead, and darker paints used for the eyes, nose and side of the head. Some red lake paint was observed in the nose, as well. Red lake was employed quite extensively in the face of the standing shepherd above him, and some lead-tin yellow was used for his nose.

The rectangular red gem in the sumptuous headgear at the foreground (see fig. 9.15) was built up with vermilion, red lake, lead white, red lake again, a lead-tin yellow contour (wider on the left), and a black contour (wider at the bottom right), with some spacing. Finally, a light greyish-blue correction was made to the black contour at the left side, probably to make the angle of light more convincing.

All background figures were painted over the landscape. They were typically executed in a single stage, with extensive wet-in-wet paint application (see e.g. fig. 9.16). In the mule, the landscape is visible due to the paints' not fully covering the background. Both the muleteer (137MICGBM002) and the mule were painted largely wet-in-wet. The animal's coverlet consists of a vermilion base with lead-tin yellow diagonal lines, followed by a lead-white contour line and detailing. In the upper right background, the white horse on the hill among the trees appears to have been roughly toned in a semi-transparent brownish colour. The group of cavalry in the far centre background, in front of the windmill, was painted in dark

9.11 137MICGBM006

9.12 135MICGBM001



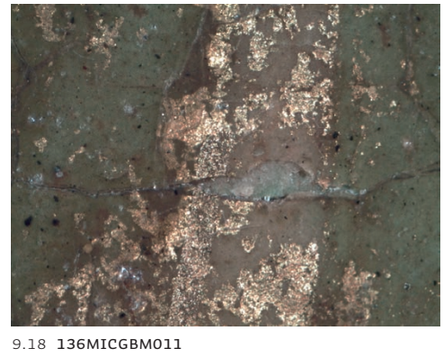
9.13 135MICGBM003

9.14 137MICGBM013

9.15 137MICGBM012

9.16 136MICGBM007

9.17 136MICGBM014



9.18 136MICGBM011

9.19 136MICGBM010

brown, white, pink and red on a grey-brown base. The cavalry in the middleground, approaching from the right, has more subdued colours, with mainly red lake and some lead-tin yellow and azurite, whereas the army at left has not only more diversity of colour but also stronger contrasts, with azurite, vermilion and green (fig. 9.20). The water under the bridge contains black, white and blue pigments. The black shadow overlaps the warm, creamy white of the bridge. The grey-white reinforcement of the arch was applied lighter and thicker towards the right. There, the side consists of pink, pinkish grey, and light and dark grey brushstrokes suggesting stones. Some of these at the edge are delineated with a dark greyish-brown paint.

138 The paint build-up in the open right wing is comparable to that of the rest of the open triptych. The water area in the background initially extended further down. The greyish sections of the landscape, including the spit of land, overlap much of the water. At the path in the centre left of the panel, the build-up of the green landscape is visible, as the green surface layer does not fully cover the underlying lighter layer, which also has an impastoed, diagonally brushed texture. The fractured tree below it was highlighted with lead white and pink, and some red lake and black paints were used at the break as well. The lamb was not left in reserve but painted over the grey and green bases of the background. It is, however, an integral part of the original painted composition, as the shrubbery was added after the lamb. The shepherd's staff there is a light grey shaft, which, for the shadowed side, was followed by dark grey, black and brown paint, all applied wet-in-wet. Lead-white highlights were applied on its metal scoop. The red lake of the saint's robe, consisting of Polish cochineal mixed with madder,[19] locally overlaps the black robe of the donatrix. Skin-tone paints were applied after the black of the robe and the green of the landscape. Similarly, Saint Agnes's book and hands were painted after the red lake. The small, pinkish section of the landscape behind her was executed atop the green background.

For the coat of arms in the right wing, first the contours of the shield and the fleur-de-lis were incised (138MICGBM003). Then an unpigmented adhesion layer, possibly oil, was applied over the green paint of the background, accumulating at the bottom edge of the shield. The silver leaf, currently damaged and oxidized, was adhered to it, overlapping the incised line. The fleur-de-lis was painted in black. The coat of arms in the left wing was applied on top of the green background, slightly overlapping the red robe. Incised preparatory lines were not noted. Silver leaf was used in the helmet and in the top half of the coat of arms. The metal is damaged and oxidized, but its original bright, glimmering effect is still visible in one area coated with green lake (see fig. 9.17). The paint of the coat of arms continues onto the barb. Lead-tin yellow and, locally, lead white were applied over the extensive and relatively thickly applied copper-green lake. Vermilion was put on, with red lake glaze afterward. The black contours, hatching and white details were then applied, with everything being painted partly wet-in-wet. The inscription *een voer al* has a fairly impastoed cream-coloured base applied over the green background (see fig. 9.18). Gold leaf was added onto this mordant. In the centre of the panel, gold leaf served as a glimmering base for the fire. In the central panel, the star in the sky was oil-gilded, followed by lead-white detailing. The signature *Jheronimus bosch* at the bottom left of the central panel was oil-gilded as well. The mordant base is very similar in colour and thickness to the inscription on the left wing. Incised lines have

9.20 RR 137, VIS

not been observed here. Although the extensive gold retouching (on the star, as well) hinders the legibility of the original signature, its appearance, craquelure, adhesion and state of degradation appear comparable to those in the rest of the painting. The end of the J makes a full curl and was later covered by the black paint of the inventory number and the gold retouching (137MICGBM014).

- ***Changes*** Beneath the sarcophagus depicted in the grisaille, a rectangular predella was initially painted. Cropping and the addition of semi-arches increased the illusion of depth in the sarcophagus. The hat of the donor in the closed left wing was adjusted, making it slightly wider with an additional black brushstroke. Similar black paint overlapping the brown of the background was used to reinforce the shoulder of this figure. The robe of the figure behind the young donor in the right wing was slightly cropped at the elbow.

  Originally, the support beam of the sheltering awning/roof in the open left wing extended a bit further under the hanging axe. The roof itself was painted much lower at first. The doorway of the ruin was also altered. The arch with the wall section above it and the brown back wall were not painted at first; green landscape paint can be distinguished under these pentimenti. The angle of the light was altered, although it is still incorrect in front of the portal, and the back doorway was painted black.

  In the central panel, the man in grey with the shepherd's staff was added on the finished roof (fig. 9.20). In the darkness behind the hut's doorway, several vivid spots are visible. A small, round shape and, above that, horizontal lines, a fire and diagonal lines are discernible in the XRS as well. The artist apparently toned down some elements selectively and overpainted others. The highest points of the impastoed paints have become abraded over time, resulting in unintended bright spots. The colours in the lower areas of the fire are still legible, suggesting that the artist intentionally tempered the fire, reducing the contrast with the black background and increasing its appearance of depth. To the right, both the ox and the ass were painted, but the forelegs of the ass were prepared more to the right. At the lower left edge, the page was at first painted with a gold neckband.

  As seen in IRR, the dress of the female donor in the right wing earlier had a V-shaped neckline, which was covered after the black of the dress was painted. She also had a lower, rounded neckline showing more skin tone (visible in XR). The black of the current, higher V-necked collar covers it, but abrasion reveals the pink paint underneath. Saint Agnes's dress also had a V-shaped neckline, as this shape was left in reserve from the lead-white-bearing underpainting (138MICGBM001). When the red lake was applied, this shape was altered and lead white was added. Green lake was then painted atop the white and part of the skin tone, but it is now much abraded. The saint's head was initially left in reserve following the underdrawing, but was changed in the painting stage. Besides these, several other, smaller pentimenti were noted in the triptych.

FRAME

The frames of the wings are original. Some sections of the frame of the central panel were replaced, but this is also largely original. Dimensions: left wing (RR 136): 147.2 × 42.2 cm; central panel (RR 137): 147.0 × 84.9 cm; right wing (RR 138): 147.0 × 42.3 cm. The frame of the wings is about 4.2 cm thick. The framing elements of the wings are about 4.1–4.8 cm wide, with the bottom element being about 6.1–6.6 cm wide. The elements of the central panel are c. 6.8–7.1 cm wide. The central panel frame is about 5.7 cm thick.

The wooden frames of the closed triptych are flat and painted, whereas the frames of the open triptych are profiled and gilded. All panels are set into an engaged frame. The framing elements are connected with tenons at the bottom and dovetailing at the top.[20] Of the central panel frame, the top element and the straight side pieces are fully original. The two ogee elements have been replaced. Of the bottom framing component, the front section was preserved (although damaged), and the back section was replaced. It appears that the central panel was removed from its frame in the past. The painting's barb at the bottom framing element appears cut. The front edges of this component were planed or cut down, possibly to allow for the refitting of the panel, as it did not go back in all the way.[21] The frame elements

on the open triptych are profiled and gilded and have a curved bevel or quirk at the bottom.[22] In the central frame, this bevel consists of a curved and a straight section. The sides are painted black. The elements on the closed wings are flat and painted in grisaille, and locally, original paint can be found continuing onto the frame's inner edges. The composition on the closed triptych continues across the two closed wings, atop the central framing elements. Where the closed wings meet, two dowel holes can be found at the same level in each wing, positioned at 15 cm from the top and 8.2 cm from the bottom of the wings. They are 9 mm wide in the left wing. In the right wing, two protruding pegs enabled the locking of the wings; these 8 mm-wide pegs have been preserved but are damaged. The gilded sections of the frame have been almost completely covered by non-original bronze paint, which in places is strongly iridescent. More of the original gilding remains on the inside frame sections adjacent to the panels, but there they are covered by thick, glossy varnish.

In the wing panels local attachment of the barb to the frame indicates that the panels have never been unframed. The four metal hinges that allow the opening and closing of the wings are original. They are nailed onto the frames in a slight rabbet. Multiple original wrought-iron nails remain, although modern screws have replaced several of them.

In the top section of the central frame, a hole likely relates to an early hanging or fastening system.

CONDITION

The painting was restored in 2015–16, thus after the 2014 BRCP technical examination of the painting on which this report is largely based.

Support

- ***Altered dimensions*** The panels have retained their original dimensions. Natural shrinkage of the wood has led to the visibility of the unpainted panel edges within the engaged frames.
- ***Additions*** On the reverse of the central panel, the joins were locally reinforced with oakum, which is not original.
- ***Cracks*** In the open right wing, an old crack extends somewhat from the right part of the bottom edge.
- ***Deformations*** Each side of the double-sided painted wings has a convex shape, which is a result of the original bevelling of the plank surface (see *Bevelled or half-lap edges*).
- ***Joins*** The joins in both wings are closed. Slight level differences can locally be observed in raking light in the join in RR 134. The two joins in the central panel are partly open. Seen from the reverse, the left disjoin extends about 35 cm from the bottom, whereas the right disjoin extends about 50 cm from the bottom.[23] There is also a slight step at each partial disjoin. The continuation of the paint film over the joins in the upper part of the panel indicates that the planks have never been separated. Tiny but more recent paint losses appear to indicate that the partial disjoin was or is not stable.
- ***Coated reverse*** The wings are painted on both sides. Possibly a thin coating of animal glue was applied to the reverse of the central panel. A thicker glue coat was applied to adhere the non-original oakum.
- ***Biological damage*** On the panel reverse, several small areas of woodworm damage are visible in places.

Ground and paint layers

- ***Stability*** In general, the adhesion of both paint and ground appears good. Locally, mainly around the coat of arms in the left wing, issues with tenting paint are perceptible (136MICGBM012). Slight rippling is also evident, which is a result of panel shrinkage. Most craquelure has been caused by natural dimensional changes of the panels. In some areas with black paint or thicker azurite paint that contains more binding medium, slightly broader drying cracks have formed. The floral motif on the donor's black undergarment was done with a more medium-rich black paint that has shrunk upon setting, resulting in an unintended

visibility of the light preparatory layer at the edges of the motif. A different craquelure pattern is discernible in the long sleeve of the black magus. Although another design can be detected in that area with infrared, there are no apparent disparities in paint build-up. Instability of the panel join has led to both old and more recent damages to paint and ground.

- ***Losses*** Investigation found only small losses to paint and ground, with the exception of the sky area in the wings of the triptych. There, primarily in the left side, many small and medium-sized losses are evident. Examination of the lower right of the left wing and the upper right of the left wing's grisaille reveal damages in those areas, as well. There are a number of old scratches and dents in the painted surfaces of all the panels. Most damages have been restored in the past, but a few appear to be more recent (136MICGBM009). In several small losses in the wing panels of the open triptych, blue particles or tiny paint chips are discernible that appear to originate from the sky area, perhaps displaced during a cleaning of the painting. There are also some losses at the partial disjoins in the central panel. Those in the upper part of the left join include the ground, but others are often just in the paint layer. In the centre of the right join are a few tiny but more recent losses.
- ***Abrasion*** Overall, the painting is only slightly abraded. It is mainly the painted frames of the grisaille, and especially the edges and the hands of Christ in the centre, that are more severely abraded. This could relate to the work's handling.
- ***Discoloration and increased transparency*** Discoloration is present, but only to a minor extent. In areas of landscape, for example, a copper-green lake applied on a lead-tin yellow base appears to have turned slightly brownish. Red glazes have faded somewhat, and an increase in transparency is evident in some lighter paints, resulting in the shimmering through of the underdrawing. This is visible, for instance, in the hut in the central panel, where at the right an underdrawn but unpainted head has become more apparent. Increasing transparency is more evident where paint was applied thinly, as in the water at the bridge in the central panel, and especially in the red cloak of the foremost horseman.
- ***Filling, retouching and overpainting*** Most areas of the painting are well preserved. The generally small losses to paint and ground are mostly old, but not all are filled or inpainted. Extensive retouching can be found in the more damaged sky areas of the open triptych wings. The central panel sky and the star are considerably retouched as well, but are not so damaged. It appears that retouching paints that contain zinc white have been used quite extensively, as many areas have turned more whitish over time. Most of the originally unpainted edges that are currently exposed have been overpainted. In these areas, too, bronze paint from the overpainting of the frame can be found on the panel. Large areas of the foreground landscape have also been extensively retouched and/or overpainted. There are multiple retouchings in the grisailles, and some areas along the edges are overpainted, especially in the left wing. Most of the retouching and overpaints stand out because they are not precisely colour-matching and/or discoloured. In the open left wing, just below the fire, a light-hued and modelled oval object was painted out in the past but is currently more visible due to abrasion (see fig. 9.19). This could have been an original change, as the brown paint appears to resemble the paint of the dots on the wall to the left, which are now retouched with light paint.

Surface finish

- ***Varnish*** The varnish is thickly and unevenly applied. It was brushed onto the paint surface, partly covering the sides of the engaged frames. There is a pigmented varnish on the closed triptych wings that appears to contain finely ground black and red-brown particles. A somewhat similar but less pigmented finish seems to have been applied to the panels of the open triptych as well.

  The appearance of the varnish is quite irregular. It has an uneven gloss, several thick drips and a local patchiness (e.g., at the horizon in the open right wing) where the notably yellowed varnish is very apparent. Many old, dark varnish residues also appear to be present locally, especially in the interstices of the paint. In places, scratches and losses can be seen in the surface coating. The thick varnish layer has its own craquelure. A grey, presumably non-original surface layer is present, mainly in the light (whitish) sky areas of the open triptych. It primarily remains in the interstices of the paint (136MICGBM001–002).
- ***Surface dirt*** There is some surface dirt on the painting, and fibres (of cotton?) are locally stuck in or on the surface of the varnish. Several matte spots, fingerprints and smudges are visible (e.g., the black smudges in the centre of the left wing's grisaille).
- ***Visibility of the original surface*** The paint film is reasonably well saturated in most places, but the surface coating is damaged, for example at the head of the middle magus. Overall, the painted surface of the triptych is rather poorly legible. This is especially the case for the grisailles, which are covered by a dark-pigmented varnish (134MICGBM004). In the open triptych, the highly yellowed varnish and many old varnish residues cause a reduced legibility of the original paint surface. For example, in the literature, the ox is notably absent from the scene, but close study of the painting reveals its presence behind the ass, facing left. The aged varnish also causes the dark colours to look brighter and less deep (as the black clothes of the donors look slightly greenish in places), and the lighter parts to look darker, resulting in an imbalance when viewing the picture. These dark residues in the interstices of the paint and the lighter colours of slightly abraded high points in the paint surfaces result, by juxtaposition, in a strong contrast. This is particularly apparent in the faces of the main figures (134MICGBM002 and 135MICGBM004), and it interrupts the fluent modelling of the skin tones. The residues not only cover the original paint but also result in an unintended appearance, exaggerating the streaky effect of the paint application. The many not precisely colour-matching and/or discoloured retouches and overpaints also distract. Several losses, however, have not been retouched, and cause misperceptions, as in the odd white in the eye of the black magus.

9.21 RR 134, VIS

[1] Measurements of the painting were taken by Robert Erdmann and Hanneke Nap of the BRCP.

[2] Garrido and Van Schoute (2001, 99) state that 444 is the painting's reference number in the Royal Collection inventory and in the Prado catalogue drawn up between 1854 and 1858. Their source is *Museo del Prado: Inventario General de Pinturas; I La Colección Real*, Madrid 1990, 134.

[3] See the entry in BRCP, *Catalogue Raisonné*, cat. 9.

[4] The label holds a description of the main scene in Spanish. It was likely written using iron gall ink, as the handwriting is not visible in IRR. Older photographs exist of the closed triptych with the complete label.

[5] The youngest or last-preserved ring on each of the three planks of the central panel dates from 1419 (I), 1460 (II) and 1461 (III), respectively. Additional examination of XRS from the wings resulted in the dating of plank II of the right wing, with its youngest heartwood ring being from 1458. Report by Peter Klein, 15 September 2014.

[6] Garrido and Van Schoute 2001, 113; Parra Crego 2001, 230.

[7] In a paint cross-section, carbon of organic origin was identified. Garrido and Van Schoute 2001, 113.

[8] Contra Garrido and Van Schoute 2001, 103: 'As a rule, these [modifications] are only alterations of form or adjustments to details, as no real changes in the composition are seen.'

[9] See the entry in BRCP, *Catalogue Raisonné*, cat. 9.

[10] Garrido and Van Schoute 2001, 113; Parra Crego 2001, 244.

[11] Parra Crego 2001. A drying oil and protein (mostly egg) emulsion was reportedly used for the light blues (p. 234), and a linseed oil and egg emulsion for pink undermodelling of red lake areas (p. 244) and for organic black paint (p. 245). The presence of protein in a binder is in itself insufficient to conclude that that binder contains egg; see BRCP, *Catalogue Raisonné*, Chapters III (esp. note 82) and IV.

[12] See the entry in BRCP, *Catalogue Raisonné*, cat. 9.

[13] Garrido and Van Schoute 2001, 115.

[14] Garrido and Van Schoute 2001, 115.

[15] Parra Crego mentions that a coat of verdigris was applied onto the base layer, in some cases with an ensuing copper-green glaze. The cross-section, however, shows a copper-green glaze applied directly onto the base colour. Parra Crego 2001, 244 and 235 fig. 12.

[16] Contra Garrido and Van Schoute, who state that, 'In some mantles such as that of Melchor, in the foreground, vermilion was not detected as they were painted only with organic red lake.' Garrido and Van Schoute 2001, 114.

[17] Garrido and Van Schoute 2001, 114, state that the selectively overpainted '"Antichrist" was initially much redder in tone …'.

[18] Garrido and Van Schoute 2001, 115; Parra Crego 2001, 245 fig. 32.

[19] Parra Crego 2001, 244 and 245 fig. 31.

[20] According to Verougstraete and Van Schoute (2001, 211), 'The dovetail joint is unusual. It has been found in samples of skilled carpentry from Brussels from the last quarter of the 15th and beginning of the 16th centuries. In five instances this assembly was found in frames with the Brussels mark.'

[21] A few millimetres of the unpainted panel edge are visible at the top.

[22] Normally these *Wasserschlag* or 'rainsill' elements are straight. Verougstraete and Van Schoute (2001, 211) state that 'Curved quirks are also seen in the frames of paintings by Massys and his milieu.'

[23] Contra Garrido and Van Schoute (2001, 101), who state that 'The different components are perfectly joined and the joins have caused no visible damage to the paint layer.'

10 *The Adoration of the Magi*

RESEARCH REPORT 55–56

Hieronymus Bosch
c. 1470–80

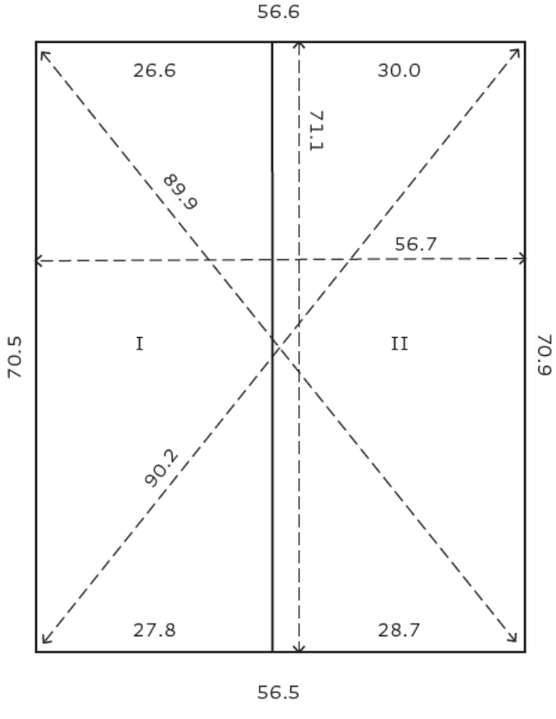
Oil (not analysed) and gold on oak (analysed) panel, 71.1 × 56.7 cm
New York, The Metropolitan Museum of Art, 13.26

BRCP, *Catalogue Raisonné*, cat. 10; www.boschproject.org no. 10.

Inscriptions and labels
The vertical cradle members are numbered at the bottom (stamped 1 to 8, upside down).

SUMMARY OF CONCLUSIONS

The technical evidence is in agreement with the attribution of the Adoration of the Magi *in the Metropolitan Museum of Art to Hieronymus Bosch.*[1] *The painting technique and the style and materials of the phased underdrawing place the panel in the core oeuvre. The presence of traces of the creative process in all phases of its production further supports this attribution. A single-point perspective system was applied, which is not encountered elsewhere in Bosch's work.*
The panel was originally housed in an engaged frame, now lost.
Dendrochronology indicates that it could have been painted from 1468 onwards, although a date after 1470 is statistically more probable.
The abundant use of mordant gilding also suggests an early dating.
As further explained in BRCP, Catalogue Raisonné, *cat. 10, we date this work to around 1470–80.*



10.1 Construction diagram (seen from the front)

EXAMINATION DATA

16–17 April 2012 (Robert Erdmann, Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Ron Spronk).

The panel was examined out of its frame in a seminar room of the paintings conservation studio. It was studied upright on an easel and flat on a table under strong illumination. Both front and reverse were easily accessible.

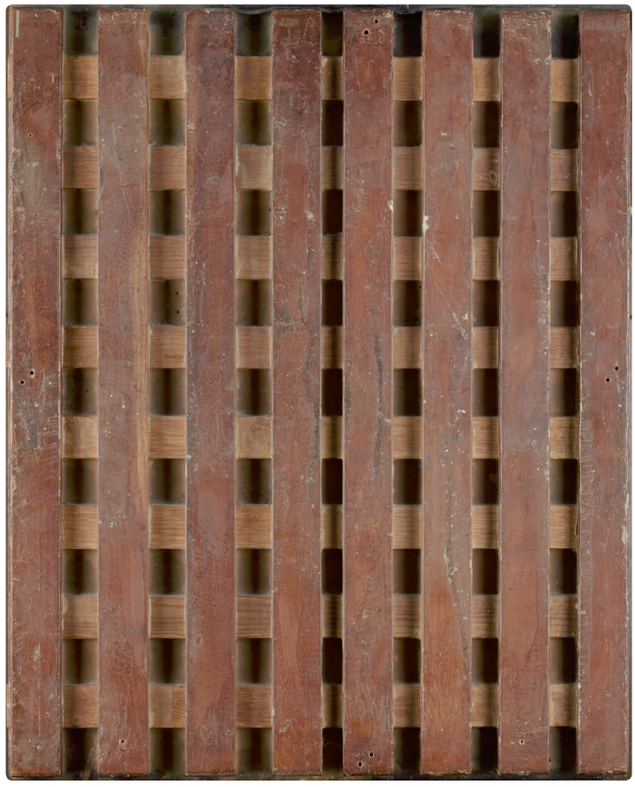
- ***Previous research and additional documentation available*** The museum's documentation on the painting includes complete XRS, a 1944 examination record of the painting, plus treatment notes and several photographs of the 1946 and 1958 restorations. See also Ainsworth 1992 and the 2012 catalogue entry on the museum website under 'object information'.
- ***Previous treatments*** The panel came into the collection in 1913, at which time it was cleaned and repaired. Following a succession of paint consolidation treatments (twice in 1914; in 1916, 1917 and 1934), the back of the painting was waxed in 1936.[2] Consolidation was then done in 1940, 1944 and again in 1946 during a full treatment of the painting. In 1953 old restorations were retouched, and in 1958 the painting was fully restored.[3] Between August and September 1998, Hubert von Sonnenburg cleaned and restored the picture.[4] At that time the damaged original overpainting (pentimento) of the angel in the tower window was retouched.[5]

SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 10.1). Thickness along edges, c. 0.5 cm. The wood species, Baltic oak, was identified through dendrochronology.

  The panel consists of two quarter-sawn planks, vertical in grain, laid vertically. The two planks were butt-joined, reinforced internally by three dowels, and glued. In XR, the dowel holes appear to be empty.
- ***Reverse*** The panel reverse is not original, as it has been thinned and cradled. It is coated with a thick layer of wax.
- ***Bevelled or half-lap edges*** Bevelling appears to be present at the left and right sides of the panel reverse, although vertical cradle members largely cover these areas.
- ***Dendrochronology*** The youngest heartwood ring dates from 1457, which, with the added minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1466 for the tree that produced the wood for that plank.[6] An earliest felling date of 1468 is statistically more probable, however, since that would cover 93 per cent of the range of possibly missing sapwood rings. Assuming at least two more years for drying and transportation, the panel could have been produced from 1468 onwards, but a production date from 1470 onwards is statistically more probable.

RR 55



RR 56

GROUND

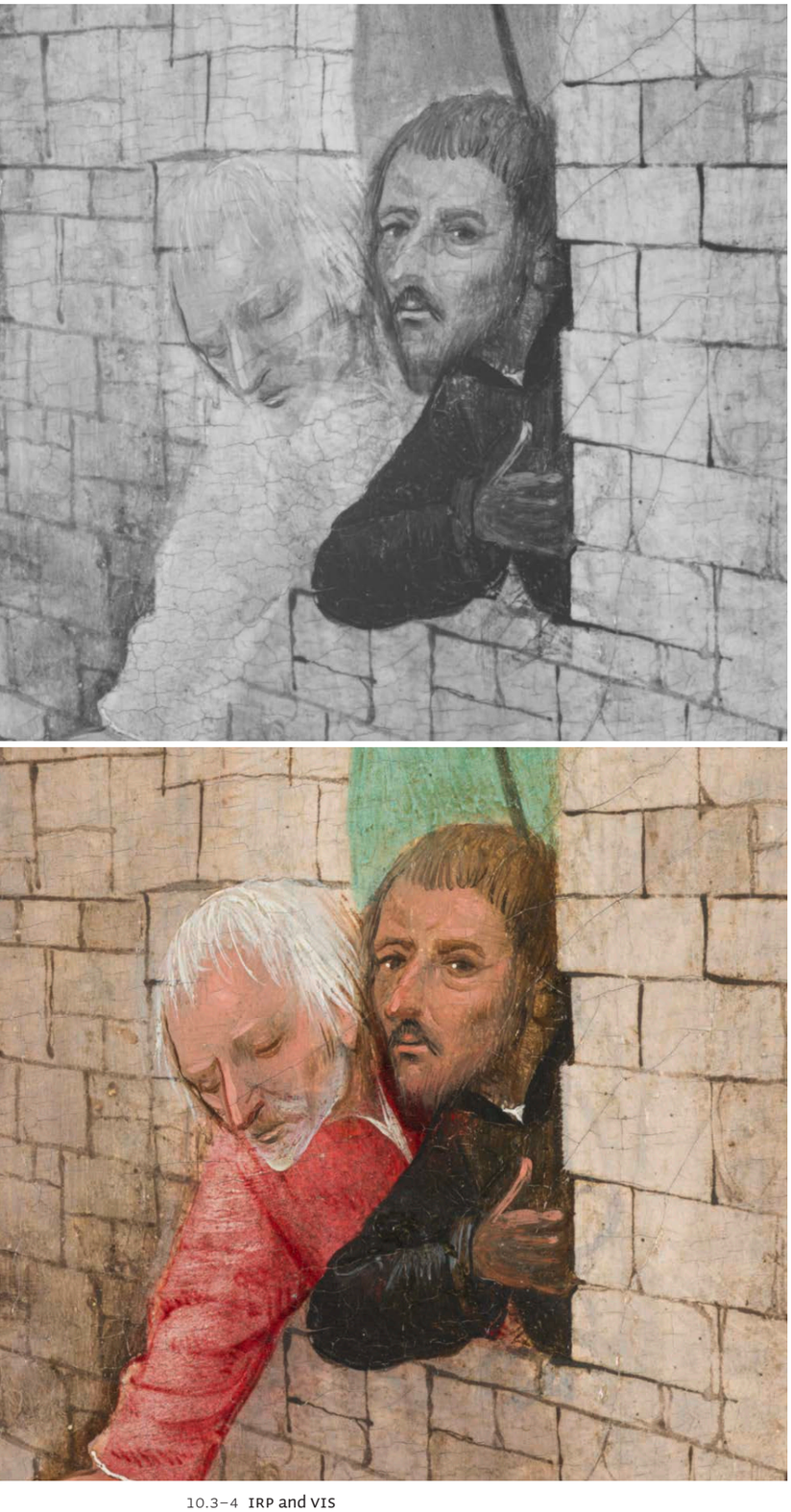
- ***Visibility*** The off-white ground (not analysed) is present overall. The paint layers generally cover the ground layer. Locally the ground can be observed in VIS at paint contours, in losses and along panel edges. Visibility of the ground tone shimmering through very slightly in some areas could have been intended as part of the composition. Nevertheless, the ageing of paint layers may have increased their transparency, and thus the visibility of the underlying layers – for example, in the white robe and the stone walls.
- ***Barb and edges*** Sections of the original barbs appear to have been preserved on all sides; ungrounded and unpainted edges have only been partly preserved on the left and right sides of the panel, but not at the top and bottom. As the presence of barbs and ungrounded edges indicates, the painting originally had an engaged frame. A slight indentation runs along the left and right sides, which is possibly a result of the removal of excess ground at the interface of panel and frame.
- ***Application*** The ground appears to have been applied evenly and somewhat thickly, and was worked into a fairly smooth finish.

PREPARATORY LAYERS

- ***Underdrawing*** Underdrawing does shimmer through the paint surface slightly in VIS, mainly in lighter areas – for example, in the white robe of the black magus and where the paint surface is damaged. The current visibility (in VIS) of the underdrawing is likely caused by the changes in refractive index due to the ageing of the paint film, resulting in an increased transparency. Through IRR/IRP, underdrawing was revealed beneath paint more clearly and was found to be present throughout the painting. The functions of the underdrawing were to determine the composition (even the architecture in the distant background) and also to aid in modelling via parallel hatching to indicate shadowed areas. Above the doorway of the tower, hatched lines were also used to prepare a shaded area in the architecture.
- ***Medium and application*** The detectable underdrawing was applied using a brush in a liquid medium – possibly ink, as many lines are very even, and/or a very finely ground carbon black in a watery medium (see fig. 10.7). Underdrawing appears to have been applied with different-size brushes in at least three stages. First, in very wet strokes, the setting and mainly the architecture seem to have been roughly indicated with a large brush. Above the barred doorway, for example, there are some very broad lines of underdrawing that prepared an arched opening there. The fluidity of the medium is apparent in the narrow face of the wall behind the magi, where a drip mark is visible below three short, horizontal strokes. Some contours of the figures were also indicated in this first stage; for example, in the forehead of the magus who gazes at the beholder, as well as in a number of folds in the red robe of the kneeling magus. This is distinct from the other stages of underdrawing, in which primarily small- to medium-size brushes were apparently used in the figures, in the walled structure and in the background. Most folds were also underdrawn in the same manner, followed by one or two stages of hatching. For instance, at the chest of the black magus, both horizontal hatching and diagonal lines were noted. The diagonals are rather soft, whereas the horizontal lines are more sharply defined, further suggesting that these parallel hatchings were applied in two separate stages.
- ***Style*** The underdrawing is very extensive and detailed (see e.g., Joseph's head). It was applied in a variety of ways, using brushes of different size and possibly different media. The initial drawing (mostly of the architecture) is rough, with broad, bold strokes in a black and very fluid medium. In some instances, where these lines are close together, the underdrawing resembles a wash, as in the columnar structures at the corners of the far wall.

  Ample underdrawing was also applied in a rather sketchlike manner, usually in fairly short, soft strokes. Longer lines are freely drawn, also soft and fairly broad. Long, sharp and narrow lines, such as in the diagonal outside the far contour of the shed, are rare. Hatching was done in mainly short- to medium-length parallel lines in several directions. They are often regularly spaced, but the shorter lines in particular were drawn freely and closer together, or overlapping where a darker area with more shadow was intended. The lines themselves are fairly straight to slightly curved, depending on their lengths and the shape of the form (e.g., compare the chest and leg of the ox, or the hatching on the chest of the Christ Child, fig. 10.12). Line ends are mostly blunt or tipped, but are fairly straight and rarely have hooks.
- ***Revisions in underdrawing and differences from painting stage(s)*** The underdrawing was fairly closely followed in the paint application phase, although numerous revisions are discernible. In the paint layer, the head of the Virgin inclines slightly more towards the Christ Child, whose head is larger than the version left in reserve (figs. 10.5 and 10.10–11). In the underdrawing, the face of the magus in the foreground was turned more towards the Virgin and Child, but it was painted more in profile. His sleeve was underdrawn shorter but wider, and in the lower part of his robe, several folds were changed. The headwear of the magus who looks at the beholder was prepared lower on his forehead. The long, vertical folds in his robe were underdrawn, but the brocade pattern was not. The gilded shoulderpiece of the black magus was underdrawn wider on his proper left shoulder, while his left sleeve appears to have been painted wider. This may indicate that this figure was painted before

10.2 IRR



10.3–4 IRP and VIS

the background. His headwear was underdrawn much larger and more ornate.

Several changes can also be detected in the architecture and the landscape. In the slate shed at left and in the top of the wall above it, the perspective was made less steep. The man in the window at left appears planned, but the window itself was underdrawn larger. In the tower at left, an additional small, rectangular window was prepared, while the narrow window with the egg was not underdrawn. A pointed arch or window was prepared above the barred doorway. A small angel was underdrawn and left in reserve from the sky behind the angel who holds the green cloth at left. The top contour of the back wall was also changed, and the columnar form at right appears to have had a rounded top. The narrow face of the high wall at right might have been planned with a slim semicolumn. The two shepherds in the window were also significantly changed (figs. 10.3–4). The head of the rear figure was designed smaller and perhaps lower and was painted after the architecture, overlapping the masonry. The first-stage underdrawing of one of these men is visible near the lower right part of the window but was not executed in paint there. The hand was leaning on the wall and the proper left arm extended farther out. The low wall at right was apparently not planned at all, and the planes in the landscape behind it were not followed in paint. In the cityscape in the left background, a hill and a larger tower with spire were planned.

- ***Intermediate layers*** A whitish lower layer is visible in the bottom section of the sky at right, where the top paint layer is damaged. This lower layer is probably a pigmented isolating layer, that appears rather thin and might have been applied over the entire surface of the ground. Although brushstrokes visible in XR seem to be related to subsequent paint layers, the pigmented isolating layer does probably contain some lead white, as is indicated by the presence of metal soap aggregates (see below, *Stability*).

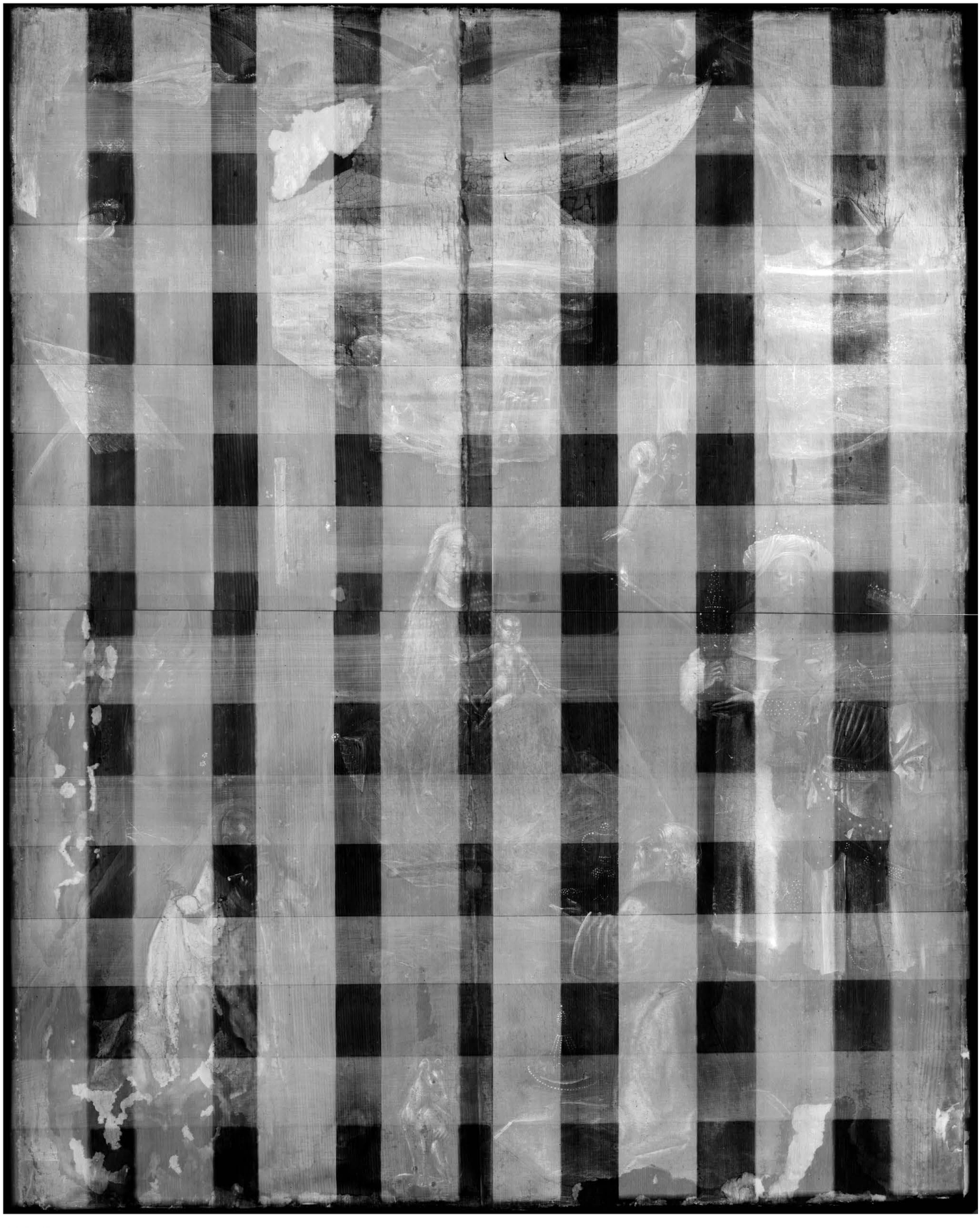
PAINT LAYERS

- ***Paint application and painting technique*** The brush-applied oil paint (not analysed) covers almost the entire surface of the panel. The underlying preparatory layer is sometimes visible at the interface between different colours (i.e. contours). Paint was applied in several stages, mostly wet-on-dry, but also frequently wet-in-wet, for example in the red lines on Mary's white pillow.

  Incisions were used to indicate the rows of bluish slate tiles of the shed (which appear dark in IRR) and the brownish stone floor tiles (which are lighter in IRR). Some diagonal lines, whose function remains unclear, extend from the upper right of the sumptuous cloth-of-gold carpet on which Mary sits to the white turban of the magus; these were incised before paint was applied.

  Both thick and somewhat thin applications of paint are present. The faces were often modelled with slightly drier, thicker paint strokes that contain more lead white. The faces of Mary and the Christ Child, for example, were applied on an already light-hued, opaque base layer, whereas the faces of the men in the window were applied in modelling paint on a darker, thinner base. Generally fluid and glossy paints were laid on in opaque as well as semi-transparent layers. Glazes were used frequently in red (and also for most of the gilded areas, such as the cloth-of-gold carpet) and green (e.g., in the brocade robe of the magus, the robe of Joseph, the foliage on the ruin and the large cloth above). Brushstrokes of drier paint are present as well, as evident in the lead-white-based undermodelling of the larger areas of red lake. The red lake paint in these sections typically has a rather speckled appearance where laid on more thinly, which may reflect the use of cloth for dabbed paint application. The undermodelling was not put on thickly, as those sections are only slightly radio-opaque.

  A special technique of hatching with red lake paint was used exceptionally often in this painting. After indicating the fold pattern of the Virgin's splendid carpet with longer lines of red lake on the gold, the artist used numerous short, parallel, hatched lines in red lake to further model the folds with the suggestion of shade. Such hatching is also detectable on the golden boot, sword and helmet of the black magus and on the gold robe of the angel. Short, red lake



10.5 XR

hatching was also used extensively on the red robe of the magus and, to a lesser extent, on the red sleeve of the man in the window. Similar red lake lines also appear on the red wings of the angels, where they mainly indicate forms and feathers.[7] Some red hatching is also applied onto the blue *chaperon*, or hood, of Joseph. For the darkest red hatching in areas of deep shadow, IRR/IRP seems to indicate that no carbon black was added.

The composition was worked out to a high degree of finish. Thick, impastoed dots and hatchings were used for the numerous lead-white and lead-tin yellow highlights. The artist painted very precisely, and often with quite fine, controlled brushstrokes. These were applied in multiple directions, but frequently in a linear fashion. The thin lines often have the appearance of hatching and are usually short. Brushstrokes were used to render contour and volume throughout the painting. In many parts the artist painted wet-in-wet; for example, several strokes in grey paint were pushed into the still-wet flesh tone and white paint of Joseph's hair.

Single-point perspective was employed for incised lines in the tiled floor behind the Madonna and in the bluish shelter at left. These incisions converge fairly accurately in a single vanishing point, not on the horizon but at the staff below the two dancing figures. The filled nail (?) hole of the central point is visible in XR, though original landscape paint covers it. For many of the drawn lines of the walls this vanishing point was used, too, although they follow it less precisely. The incised lines in the slate shed at left were made after the blue base paint was applied. They were used to delineate the rows of the slate tiles and were followed by black-painted contour lines and yellow detailing, both locally running into the interstices of the incisions. The central vanishing point was also used to correct the perspective of the shed at left and the top of the wall above it, which was underdrawn differently (see further *Changes*).

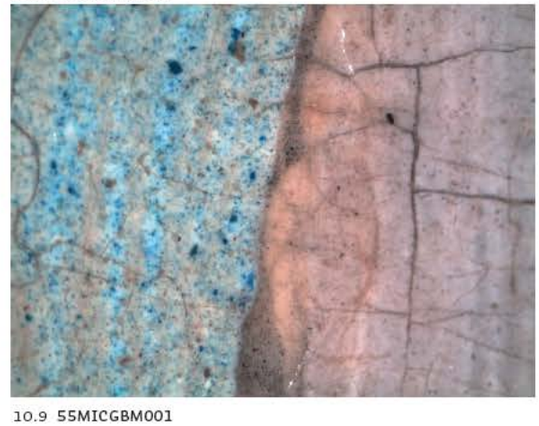
10.6 Mapping of micrographs reproduced here (10.7–9)

For all gilded areas, even the large area of the Virgin's golden carpet, gold leaf was adhered with a yellow- to red-brown mordant. The mordant was brush-applied, and the slight texture of the brushstrokes is visible in the gold.

- ***Texture*** Many passages have a relatively smooth finish. The extensive use of thicker lead-tin yellow and particularly of lead-white-bearing paints, however, has resulted in many impastoed areas, especially in detailing and highlights. Brushstrokes are frequently visible and some are textured (e.g., in the forehead of the central magus), but hardly any such texture is evident in the undermodelling of the robes.
- ***Build-up and palette*** The paint was applied mostly from light to dark, utilizing the light tone of the overall whitish intermediate layer. Dark-to-light application is visible where a darker base paint precedes lighter touches of detailing and highlights. The paint application was largely planned. It was executed both 'back-to-front', leaving areas in reserve, and 'front-to-back'. The latter seems to be the

10.7 55MICGBM005

10.8 55MICGBM004



10.9 55MICGBM001

10.10–11 VIS and XR

case for the black magus and the red robe and shoulderpiece of the other two magi, which were all painted in an early stage.

For the paint of the sky, gradually less lead white was mixed in towards the top of the panel and more azurite pigment was added. This paint was evidently applied onto the lead-white intermediate layer, with very light blue paint near the horizon. The angels and especially their wings were roughly left in reserve from the sky. Both the mordant and the gold leaf overlap the blue in some locations, but were also followed by blue reinforcements. Much of the dilapidated structure (including the dark lines indicating brickwork, which were frequently applied wet-in-wet) appears to have been painted before the background landscape (fig. 10.9). The top part of the landscape overlaps the light blue of the sky. The grey side of the plateau with the tree in the centre middleground, and possibly the plateau in its entirety, were painted over the pale green landscape. Overall, the landscape has a rather blue tone. The foliage was first indicated in a blue, followed by extensive lead-tin yellow, light blue and also lead-white highlights. For the single hollow tree in the centre, white highlights followed the yellow dots. Tree trunks and some branches were painted before the blue, while other branches were painted afterwards, but before the highlights.

Generally the work is remarkably colourful, with bright, contrasting hues as well as gold. The fire on the platform was built up as follows: bright red, lead-tin yellow, orange, red lake and a brown smoke painted around the hand (the red-brown contour line at the thumb appears to have been painted afterwards). The slate shed at left was painted with a blue mixture, then with black to denote roof tiles, details in lead-tin yellow, and lead-white highlights. These highlights appear to have been applied unmixed, with only few exceptions. For the pink-brocaded motif in the shadowy area of the red shoulderpiece, the artist purposely mixed in red lake with the lead-tin yellow (fig. 10.8). The paint composition was not analysed, but red-dyed fibres of wool shavings were observed.[8] Lead-tin yellow and lead-white pigments were used frequently, and Joseph's robe, the background landscape and the green curtain over the ruin are somewhat pale in colour. With the exception of some more greyish or brownish bricks, the masonry is fairly monochrome.

The Christ Child was left in reserve from the blue robe. Generally, areas of light flesh tone have a pink to greyish base and the tone of the intermediate layer seems to shimmer through. Skin-tone paint was then applied more opaquely and partly wet-in-wet, mostly in somewhat impastoed brushstrokes. These are lighter in colour and are more thickly impastoed for highlights, such as those on the foreheads (fig. 10.10–11). For the hands and face of the magus at the rear, these lighter touches are abraded, revealing more of the base layer. Contour lines ranging from reddish- to dark brown were added for physiognomic detailing; for example, in the ears (55MICGBM006). Red, black and white detailing were also applied locally.

10.12 IRR macro

- ***Changes*** The angle at the bottom of the blue shed at left and the top of the wall above it was corrected to follow the perspective (see further *Paint application …*). This was done after the roof and the struts were painted, as the latter were not altered along with the roof. The top of this wall was also revised to conform to the central perspective. This implies that the perspective system was only applied after the painting stage had already commenced.

  Some of the modelling at the edges of the rich, gold carpet of the Virgin and Child was apparently not planned from the outset, as the mordant was applied onto a slightly larger area and with straighter edges. With gold leaf more modelled edges were formed and the small fold to the right of the Christ Child's hand was added in the paint stage, with background paint covering gold.

  XR has revealed a figure, presumably another angel, in the tower window at top left (see fig. 10.5 and *Previous treatments* above). It appears completely finished but was painted out with black, and the pigeon was painted wet-in-wet on top. The large tower was originally depicted with a more irregular, dilapidated top. The edges were later straightened, except for the part below the right angel, and the paint of the top right wall overlaps the angel's red robe. Below that, the opening of the arched window was painted higher, as bluish paint currently shimmers through it. The position of the rearmost shepherd in the window was changed; part of his head and his hand were painted over the stones. Some green paint is visible in places at the bottom left of the black magus's robe, where the black paint is abraded. Some white is also discernible there, where brushstrokes from the white robe extended beyond their planned contour and were painted out by the black. The head of the Christ Child as left in reserve was smaller (figs. 10.10–11).

FRAME

The original, engaged frame has been lost. The modern wooden frame (80.0 × 64.4 cm; thickness c. 7 cm, including frame build-up on reverse) has a black exterior and gilded interior.

CONDITION

Support

- ***Altered dimensions*** Although the original paint surface remains intact, the panel was cropped on all sides, removing the greater part of the original unpainted and ungrounded panel edges, especially at the top and bottom. The panel reverse was also considerably thinned, presumably to enable the flattening of the warped panel and the application of the cradle.
- ***Additions*** Three strips of wood were added to the thinned panel reverse. The strips at the sides run the entire length of the panel and appear added to fill the gap between cradle and panel. The strip in the centre covering the join was examined at the top of the panel, where it measures 5 cm in width and 0.3–0.4 cm in thickness.

  A wooden cradle was attached to the reverse of the panel before 1913. It is composed of eight numbered vertical mahogany members glued to the panel reverse and eight horizontal oak members (the 'runners'). The cradle appears blocked by the thick layer of wax on the reverse, inhibiting natural dimensional changes of the panel.
- ***Cracks*** An old crack is present in the upper right side of the panel.
- ***Deformations*** The panel has a slight undulation.
- ***Joins*** The join in the panel is closed, but the two planks have been separated and rejoined in the past with slight differences in levels.

- ***Coated reverse*** A thick coating of wax was applied onto the cradled panel reverse.

Ground and paint layers

- ***Stability*** In general, the adhesion of both paint and ground appears good. Locally, there are issues of old, raised paint. A variety of craquelure patterns seems to have been caused by natural dimensional changes in the panel. An old oblong crack is present in the right column at the back wall of the ruin, and there are some smaller old cracks.

  Metal soap aggregate formation, which can appear as small, opaque points in XR, has been observed throughout the painting and is thus most likely related to the lead white in the intermediate layer. Expansion of the aggregates may cause them to protrude from the paint surface, resulting in minuscule raised spots and a more granular surface texture. Loss of these metal soap aggregates results in tiny, craterlike holes that appear dark in XR. Over time, accumulation of dirt and varnish residues in these holes causes them to appear dark in VIS and IRR/IRP.[9]

- ***Losses*** There are many losses of differing size in the painting. Very large losses to paint and ground are present close to the bottom edge and the lower left edge, especially in the lower part of Joseph. The scratches in his white hair seem to be damages, too. Another large loss is present in the left part of the green cloth over the ruin. There are smaller losses below that, as well, in the landscape and in the stone flooring, as well as along the join. Small losses are spread over the paint surface, and at top right some damages have resulted from framing. Tiny, round damages are detectable in places, mainly in the red robe, in areas of old, raised paint. They are the result of previous consolidation treatment using a syringe to inject glue. Most damages in the painting were restored in the past.

- ***Abrasion*** Overall the painting is only somewhat abraded, but locally abrasion is more severe. This is visible in the pinkish highlights applied to the greyish base skin tone in the face of the magus at the back (fig. 10.13). In the sky area just above the horizon at right, a particularly substantial amount of the top paint layer has been lost.

- ***Discoloration and increased transparency*** Brown discoloration of paints containing copper-green lake is visible, in particular where it was applied thinly and as a glaze, as in the patches of foliage on the ruin and in a large part of the brocaded robe of the magus.[10] An increase in transparency is evident in some lighter paints, such as those in the ruin and in the lead-white robe of the magus, most notably where applied thinly. Red lake was used in the dark paint indicating folds and shadows in Joseph's hood, or *chaperon*, which might have appeared more purplish.

- ***Filling, retouching and overpainting*** Most losses were filled (several of them unevenly) and inpainted. Some small losses were not. Retouching is extensive but has discoloured somewhat; for example, on the join.

Surface finish

- ***Varnish*** There are two varnish layers present that are in good condition. The modern, glossy varnish appears fairly even. The varnish seems to have been applied regularly and thinly onto the entire paint surface. The appearance of the modern varnish is quite regular and the paints are saturated well. It is only slightly yellowed but there are matte spots in the varnish and on areas of retouch.

- ***Surface dirt*** There is slight surface dirt on the painting. Locally, too, tiny fibres are stuck in or on the varnish.

- ***Visibility of the original surface*** The paint film is well saturated in most places and has an even surface appearance. The matte spots and discoloured retouching distract somewhat from the otherwise good visibility of the original paint surface.

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1 Before 2012, the museum's attribution was 'Style of Jheronimus Bosch, about 1550'. See Ainsworth 1992 and Ainsworth and Christiansen 1998, 258 (entry by Della C. Sperling).

2 From this and the apparent completeness of the registered treatments listed on a typed sheet in the museum's file on the painting, we may assume the cradling treatment occurred before 1913.

3 Restorer Gerhard G. Wedekind cleaned the painting with acetone, filled the losses with gesso, retouched the work with pigments in an oil and methacrylate binder, followed by a brushed Taelen's (*sic* – Royal Talens?) varnish and a Vinylite spray varnish.

4 There are Kodachromes on file, but no report. Email communication with Michael Gallagher, Conservator in Charge of Paintings Conservation at The Metropolitan Museum, 28 July 2015. Sophie Scully, Paintings Conservation Research Scholar, retrieved the information.

5 See the before-treatment image on the museum website, http://www.metmuseum.org/collection/the-collection-online/search/435724 (last visited 15 August 2015).

6 The youngest or last-preserved ring on each of the two planks dates from, respectively, 1456 (I) and 1457 (II). Report by Peter Klein, University of Hamburg, Department of Wood Biology, 12 May 1997.

7 Perhaps the red lake hatching in these areas was used in this way because the indistinct undermodelling in lead-white-bearing paint, coupled with the limited visibility of the underdrawing, did not provide enough contrast.

8 For more information and literature on the production of red lakes, see Wallert 1991 and Hofenk De Graaff, Roelofs and Van Bommel 2004, 344–52.

9 These should not be confused with the slightly larger and more grouped, localized needle holes from previous consolidation treatment using a syringe to inject glue (see also *Losses*).

10 Additional yellowish or brownish glaze paints could have been added as well (not analysed).

11 *Ecce Homo*

Hieronymus Bosch
c. 1475–85

Oil (not analysed) on oak (analysed) panel, 71.4 × 61.0 cm
Städelsches Museumsverein, Frankfurt am Main, 1577

BRCP, *Catalogue Raisonné*, cat. 11; www.boschproject.org no. 11.

Inscriptions and labels
Bottom left, in gold letters: *salva nos xp[ist]e r[e]de[m]ptor*; top left: *ecce homo*; centre: *crucifige eu[m]*
Reverse, lower right, a sticker reads *Städel Museum* // [bar code] // 1577.
On the reverse of the frame, top right, a red seal from the frame manufacturer.
At lower left, there is a yellow museum sticker with a bar code.

SUMMARY OF CONCLUSIONS

The technical evidence is in full agreement with the attribution of the Frankfurt Ecce Homo *to Hieronymus Bosch. There are relatively few differences between the phased underdrawing and the paint layers, with the notable exceptions of the background (which was initially blocked off with a wall) and the group of hecklers on the right. The painting technique and the style and material of the underdrawing place the panel in the core oeuvre.*
At some point in time, the figures of a male and a female donor and their children at the lower left and lower right were removed, but the remnants of these figures were made visible again in the 1983 restoration treatment.
The panel was originally housed in an engaged frame, now lost, and the bottom edge was cropped somewhat. Dendrochronology indicates that it could have been painted from 1470 onwards, although a date after 1472 is statistically more probable. As further explained in BRCP, Catalogue Raisonné, *cat. 11, we date this work to around 1475–85.*

RELATED WORKS

Several (partial) copies or paintings with similar compositions are known, most notably the *Ecce Homo Triptych* in Boston (see cat. 24, RR 77–84) and a version in the Rijksmuseum Amsterdam (see RR 111–112).[1]

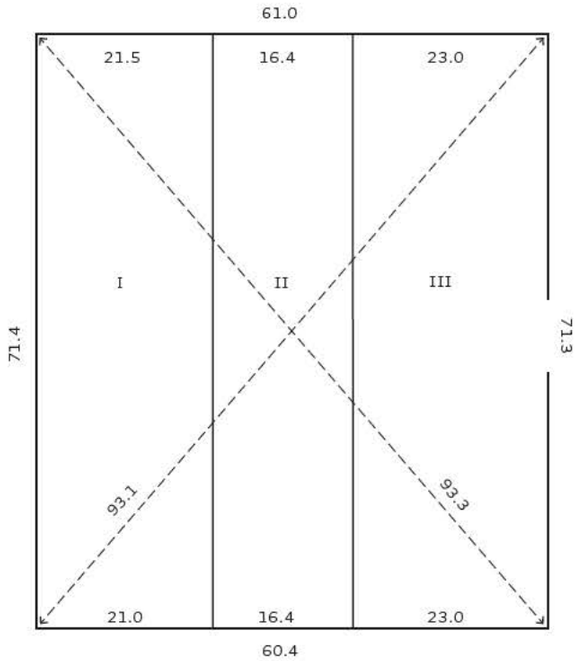
EXAMINATION DATA

19–20 March 2012 (Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij).

The painting was examined in the conservation/photo studio. The panel was studied both upright on an easel and flat on a table, under strong illumination.

- ***Previous research and additional documentation available*** Jochen Sander's 1993 catalogue includes ample technical information.[2] An OSIRIS IRR image made by the museum in 2009 was available. A set of six (incomplete) XRS from 1932 are kept at the museum. These only show the bottom section of the painting.

RR 50



11.1 Construction diagram (seen from the front)

RR 49

11.2 VIS

A complete XR composite image was published.[3] Three cross-sections of this painting were analysed by Andreas Burmeister at the Doerner-Institut, Munich, on 2 January 1984. Burmeister found lead-tin yellow in the overpaint of the donors, indicating it was likely applied before the second half of the eighteenth century.

- ***Previous treatments*** The painting was restored by Peter Waldeis between August and November 1983. During this treatment, the yellowed varnish and discoloured overpaints were removed, and the presence of highly damaged images of a male and a female donor and their family members at lower left and right was emphasized (fig. 11.2).[4] Retouching was done with watercolour, followed by dammar resin.

SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 11.1). Thickness 0.3–0.5 cm (thinned panel, excluding the cradle).

  The wood species, Baltic oak, was identified through dendrochronology. The painting consists of three quarter-sawn planks, vertical in grain, laid vertically. The planks were butt-joined, dowelled[5] and glued.

  The panel was cradled after being thinned (see below, *Altered dimensions*). No original tool marks are distinguishable on the thinned reverse. The thinning exposed the dowel holes.

- ***Bevelled or half-lap edges*** Possible remains of bevelling can be observed on the left, top and right sides of the panel.

- ***Dendrochronology*** The youngest heartwood ring dates from 1459, which, with the minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1468 for the tree that produced the wood for that plank.[6] A felling date after 1470 is statistically more probable, however, since 93 per cent of the possibly missing sapwood rings would be covered by that range. Assuming an additional minimum of two years for drying and transportation, the panel could have been produced from 1470 onwards, although a production from 1472 onwards is statistically more probable.

GROUND

- ***Visibility*** The off-white ground (not analysed) is present overall. It can be seen in VIS. The surface of the ground layer was fully covered by the paint layers and is now only exposed at the outer edges and in damages (49MICGBM005). However, it shimmers through the paint surface in multiple areas and is also discernible where painted contours do not exactly meet. The visibility of the ground does not appear to have been intended, and has become more pronounced because of the increased transparency of the paint layers upon ageing, especially in the lighter areas.

- ***Barb and edges*** The original barb has been preserved on the left, top and right edges. On these sides, parts of the ungrounded and unpainted edges remain as well, although they are rather narrow, being only 3–4 mm wide. The barbs establish that the panel was originally housed in an engaged frame, now lost. The panel was somewhat cropped at the bottom edge (see below, *Altered dimensions*).

11.3 IRR

- ***Application*** The ground appears to have been applied rather thickly and evenly, and was worked into a smooth finish. Brushmarks from what appears to be the ground application can be seen in the bottom centre of the panel (see also below, *Intermediate layers*).

PREPARATORY LAYERS

- ***Underdrawing*** In several areas the underdrawing is visible in VIS, since it locally shimmers through the paint surface. It can also be seen in craquelure and damages (49MICGBM004/005). It is much better revealed with IRR/IRP, which shows that elaborate underdrawing is present throughout the painting, with the exception of the townscape that replaced an underdrawn composition with a wall (see below, *Revisions*). The donors and their children at lower left and right are also underdrawn and are thus part of the original composition. The functions of the underdrawing were to determine the composition and also to aid in modelling via parallel hatching to indicate shadowed areas. Even shaded areas in the main architecture in the left half of the painting were prepared in this way. It appears that such hatched zones in clothing indicated areas where little to no lead-white-based underpainting was to be applied.

left, which were executed in roughly laid-in dashes (as in the tormentor with the white tunic to Christ's left) and in broad wash-like areas (as in the red cloak of the man to the right of Christ; fig. 11.3). The modelling of shadows in the hecklers at lower right was mainly prepared with a finer brush producing more precisely placed fine, long, parallel lines. (See, e.g., the back of the man at lower right, wearing the light grey cloak with the green shoulderpiece.) In several smaller areas, though, the use of the medium-size brush can also be seen in these figures – for instance, in the deep sleeve folds of the man in the red robe and green headgear, in the lower part of the grey sleeve of the man to his right, and in the green tunic of the man to the left of the shield at the right edge of the panel. It is unclear whether the underdrawing in those areas formed part of the first stage or constituted a separate stage. Finally, some areas of hatching were locally corrected or reinforced with a more concentrated underdrawing material, as in the brocade sleeve of the man in the lower centre and in the light grey sleeve of the man to his right with the green shoulderpiece. In places some cross-hatching was used, as seen in the dark right part of the red garment worn by the man pulling Christ's cloak.

11.4–5 IRR and VIS

- ***Medium and application*** The elaborate underdrawing was applied directly onto the ground, in multiple stages and with brushes of different size. The detectable underdrawing material seems to be ink or a finely ground carbon black (not analysed) in a watery medium. Distinguishing different stages in this highly varied underdrawing is not straightforward. It appears that the main contours of the figures (including the donors and their children), the main folds, and the long horizontal and curved lines in the background were first underdrawn with a medium-size brush. The same brush was apparently used to model the figures at top

- ***Style*** The underdrawing is very extensive and detailed, applied in a variety of ways, using different size brushes. Some lines are long and thin and precisely placed, while others show a much more sketchlike manner, with relatively broad lines that are not straight. The thick, long, horizontal lines that probably prepared the top edge of a wall blocking off the composition in the upper right background actually waver, especially the top one (fig. 11.4). Small changes and reinforcements were made, followed by modelling, using mostly short hatched or parallel lines. Parallel hatching was done in long vertical strokes, but also in short diagonals. The diagonal hatching

11.6 XR

was sometimes done in both directions, which has been interpreted as being executed by two different draughtsmen, one being right-handed, the other left-handed.[7] These lines were drawn freely and more closely together or overlapping where a darker area with more shadow was intended. Line ends can be fairly irregular, but are generally straight (often tipped), although sometimes with hooks. The lines themselves can also be irregular and are often slightly curved.

- ***Revisions in underdrawing and differences from painting stage(s)*** With the noticeable exceptions of the figures in the right middleground and the river and townscape in the background, the underdrawing was fairly closely followed in the paint application phase, although numerous adjustments become evident in the outer contours and the positioning of folds. Such alterations are discernible, for example, in the central raised hands (which were painted smaller) and in Christ's loincloth (which was prepared with a lower bottom contour on his right leg). Christ's right shoulder was cropped and

the arch in the building was modified at the top. The man in the light grey cloak with the green shoulderpiece at lower right was prepared with a belt or rope above his hips, which was not painted, and his green shoulderpiece was to be much smaller. Numerous smaller folds were also shifted. A more important change, which might have iconographical significance, was in the position of the crossed arms of Christ: the proper right arm was initially drawn behind the left one instead of as they are painted, which is the other way around.

The underdrawing was much less closely followed in the group of hecklers behind the main figures on the lower right. Some men at the very back of the group were perhaps not prepared in the underdrawing, or were in different positions, as were several spears and scythes. The thick, long, horizontal lines in the upper right background (figs. 11.4–5), which must have been executed in the first stage of the underdrawing, most likely indicated the top edge of a wall that blocked off the composition. The thick double lines curving to the right edge of the panel might have indicated an opening in that wall.[8] Both the former and the latter lines were ignored in the paint stage. Furthermore, the buildings in the background townscape were not prepared in the underdrawing, although it appears that in the second-stage underdrawing, a feature (possibly a well) was underdrawn immediately to the right of the small sculpture at the far end of the bridge.

- ***Intermediate layers*** No isolating layer, whether pigmented or not, has been observed in VIS, IRR/IRP or (partial) XR. The distribution of metal soap aggregates, however, appears to indicate the presence of a pigmented isolating layer that likely contains some lead white (see further below, *Stability*).

PAINT LAYERS

- ***Paint application and painting technique*** The oil paint (not analysed) was applied using a brush and extends onto the barbs. The underlying ground is sometimes visible, shimmering through at some contours and in light areas and flesh tones. Paint was applied in several stages, mostly wet-on-dry but also wet-in-wet. Incisions were used in the foreground: in the platform and building to indicate stonework (see below), and in the round disc on the hilt of the foremost man's sword.

  Paint is generally applied rather thinly, especially in areas of skin tone. Medium-rich, wet and glossy paints were laid on in opaque as well as semi-transparent layers. Glazes were used frequently in red, green and purple (e.g., in the acanthus-leaf decorations on the green mantle of the foreground figure and in the lead-tin yellow boot and hem of the figure to the left of Christ; fig. 11.7). The red lake paint often has a fine speckled appearance, which may reflect the use of cloth for dabbed paint application. Hatching with red lake paint was used in red robes, where several folds were reinforced with numerous short, parallel, hatched lines suggesting shadows. Drier paints were employed for the impastoed modelling in lead white and/or lead-tin yellow that underlie areas of green and red lakes, and also for impastoed highlights. In general, the paint build-up consists of only a few layers, followed by highlights, shadows and additional detailing. The coarser azurite paint (e.g., in the mantle of Christ) was applied more thickly, and its higher medium content has resulted in slightly wider drying cracks. Notably, drying cracks are also evident in the vermilion red hat of the figure at the centre right edge. The artist painted fairly precisely, with more controlled than dynamic brushstrokes. The strokes were applied in multiple directions, but generally in a rather linear fashion. Brushstrokes were used to render contour and volume throughout the painting.

  The incised lines in the foreground building were made after the figures and the base paint of the building had been applied, since the lines were cut through those paint layers (figs. 11.2, 11.6 and 11.7). The incisions were then roughly followed by painted grey lines, ranging from brownish to nearly black. Single-point perspective was not employed, since the incised lines converge at different vanishing points.

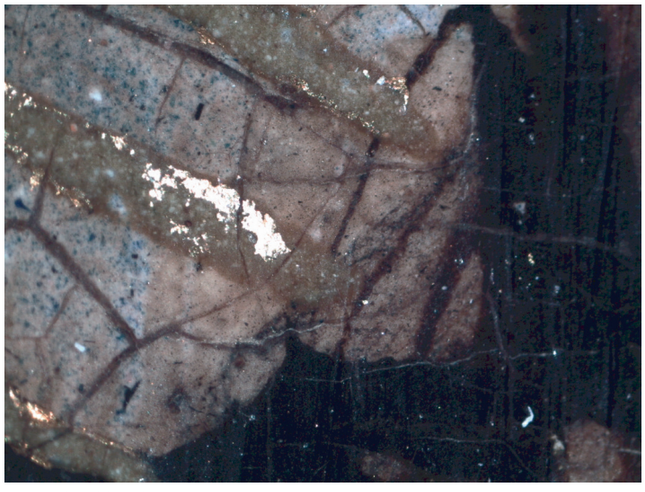
- ***Texture*** Several passages have a relatively smooth finish, although textured brushstrokes are often visible. Besides impastoed highlights, texture is used for modelling.

- ***Build-up and palette*** The paint was applied mostly from light to dark. Dark-to-light application is visible as well, though, where a darker base paint precedes lighter touches or detailing and highlights. In the raised, brocaded arm of the figure in the foreground, a light brown hue served as a base for red lake motifs, purple-grey accents and lead-tin yellow highlights.

  The paint application was largely planned. It seems to have been executed gradually, mainly 'back-to-front', leaving many areas in reserve. For example, the foreground architecture seems to have a brownish base paint for the darker areas, and the background sky was also painted at this stage. Then the reserved areas (mainly for the figures, including the donors and family members) received their initial paint layer, with subsequent painting of the foreground architecture. This sequence is visible in the overlaps at the raised hands. Afterwards the figures were further detailed; edges were reinforced (sometimes overlapping previously painted areas); and detailing, highlights and shadows were applied.

  The paint was built up skilfully. Generally the work is highly colourful, with bright, contrasting hues in the figures' clothes. The fire in the torch is built up as follows: brown background, lead-tin yellow, bright vermilion and red lake. The roofs of the buildings were mainly painted with a blue mixture, with added dabs of pink, red, yellow and white. The bricks of the structure at left were also painted in a similarly wide range of hues. The statue at the far end of the bridge has a grey base tone, followed by lead-tin yellow for the lighter parts, and finally the lead-white highlights and some red lake to accentuate the shadowed area, mainly in the helmet. It is likely

11.7 VIS



11.8 49MICGBM011

11.9 49MICGBM012

that the purplish paints have some red lake base. Besides the purple in the acanthus-leaf decorations of the foreground figure's mantle, the paints containing red lake were generally employed in smaller detailing, in some cases with lead-tin yellow. The copper-green glazes were applied over a modelled layer locally consisting of lead-tin yellow (as XR shows that it was not used throughout), which in a few areas was mixed with lead white. A lead-white-based undermodelling was used for most of the lighter red lake areas.

Most elements in the right background, such as the buildings, were at least partly painted wet-in-wet. This is also the case with the trees, which were energetically painted in dark green dabs and then with light green. Several reflective highlights in the weaponry were created using a bright blue with ensuing lines and dabs or dots of lead white (49MICGBM002). The rivets in the helmet were rendered using a blue-white paint, followed by adjacent cast shadows in black.

The fingers of the raised hands of the central figures were indicated with brown contours. Dark strokes locally reinforced these outlines, and brown hatching denoted shadow areas. Similar brown lines are also evident in some of the faces. The flesh tones are generally pinkish, ranging from slightly brownish to a pale, cool pink. The head of the figure in the upper left, which was largely painted wet-in-wet, appears almost like a grisaille, and the donors and their family members have similar skin tones. The build-up at the eye of the donor's child is still visible, although obscured by dark retouching (49MICGBM007). For the brown hair of several of the figures, dark brown and black lines were applied over a brown base colour. Lighter-coloured brushstrokes were used as well, also in other hair colours. These lines are beige, grey, yellowish and blue-white or even blue.

Most of the gold-like materials were painted using lead-tin yellow. Gold leaf was applied on an adhesive mordant for the rays emanating from Christ's head and the round clasp of his mantle, for the staff of Pilate and in the lettering. The mordant is a slightly impastoed and oily, pigmented mixture, which was applied directly on the finished background; an intermediate varnish layer was not observed. A micrograph shows this yellow-brown mixture over the blue of the architecture, the exposed ground and the black lines of Christ's hair (see fig. 11.8). Finally, and only on the first letter of *crucifige*, the contours were enhanced with a blend of lead-tin yellow and possibly lead white. Christ's cape buckle has a lead-tin yellow outline and a mordant-gilded centre with a red lake glaze (see fig. 11.9).

- ***Changes*** The red mantle of Pilate was extended and overlaps the masonry. The red mantle of the figure to the right of Christ was extended at its lower right edge and now partially overlaps the green robe. The shape of the red hat of the figure holding the torch was also altered during the paint stage. The figures at the very back of the group at the right edge of the panel were not left in reserve and painted over the background, although some of their hats appear to have been underdrawn, and were perhaps underdrawn larger than painted. The weapon to the right of the fire was made broader in a paint stage.

FRAME

The original, engaged frame has been lost. The modern gilded wooden frame (80.5 × 70.3 × 4.3 cm) is profiled and has a black outer edge.

CONDITION

Support

- ***Altered dimensions*** The panel was considerably thinned, since the dowel holes were left exposed. This was presumably done to enable the flattening of the warped panel and the application of the cradle. The bottom edge of the painting was somewhat cropped, probably only by a few centimetres at most. At the top of the panel, where the ungrounded edge is at its widest, an incised line is present. It seems to have indicated how far the original unpainted top edge was to be cropped, as was done elsewhere at the top edge. The other panel edges are locally damaged to some extent, mainly at the bottom left and right corners.
- ***Additions*** A wooden cradle was attached to the reverse of the panel. This might have been done in or shortly after 1932, since an XR from that year seems to show empty dowel holes, but no cradle. The horizontal cradle members are jammed.
- ***Cracks*** There is an old crack in the bottom right of the painting (seen from the front). It extends about 2.6 cm from the bottom edge and is possibly the result of woodworm damage.
- ***Deformations*** The panel has a very slight convex warp and minor deformations induced by the vertical cradle members.
- ***Joins*** The joins are closed, although there are some differences in levels. It seems that the left plank (front) had separated and was rejoined in the past. The right join remains closed and has not been separated.
- ***Coated reverse*** The thinned and cradled panel reverse is not coated, but there are some remains of what appears to be glue.

- ***Biological damage*** Old woodworm damage is mainly observable in the left plank (seen from the reverse), and to a minor extent in the other planks.

Ground and paint layers

- ***Stability*** The cradle has produced very slight deformations of the paint surface. In general, the adhesion of both paint and ground is very good. Most craquelure is caused by natural dimensional changes in the panels. Where thick azurite paint was used (with more binding medium), slightly broader drying cracks have formed. Youth or drying cracks are also evident in the red hat of the figure at the centre right edge. The 2001 condition report mentions 'pronounced craquelure with slight cupping', but this has only been noted at the shoulder of the man with the green cape in the foreground. A more open craquelure is visible in other areas, which is due to solvent damage. There are some small indentations in the paint; for example, to the left of Christ's legs.

  Metal soap aggregate formation, which can appear as small opaque points in XR, has been observed in several areas but to a minimal extent and the paint surface is not affected noticeably. Expansion of the aggregates may cause them to protrude from the paint surface, resulting in minuscule raised spots and a more granular surface texture. Loss of these metal soap aggregates results in tiny, crater-like holes that appear dark in XR. Over time, accumulation of dirt and varnish residues in these holes causes them to appear dark in VIS and IRR/IRP.

- ***Losses*** There are predominantly smaller losses to the paint, which are concentrated along the joins, mainly the left. The areas of the donors and family members are severely damaged because they were intentionally removed. From the remaining faces and the light part of a robe, it seems that a solvent was employed rather than the paint being scraped. The paints containing lead white proved more resistant to the solvent and were thus partially preserved. These damaged areas, as well as most of the losses, were filled and inpainted, although several old damages remain unretouched.

- ***Abrasion*** The paint surface is only slightly abraded and there are old damages at the edges of the panel, likely from previous framing.

- ***Discoloration and increased transparency*** The green, red and purplish glazes seem to have held up fairly well, although Christ's mantle was originally purplish (fig. 11.10). Where the paints containing copper green – and especially the glazes – have been applied more thinly on a generally lighter underlayer, brown discoloration is more apparent. Some of the lighter paints (e.g., those containing lead white) appear to have increased in transparency, mainly where applied thinly. This has caused the increased visibility of the underlying layers and an unintended change of appearance, which is apparent, for instance, in the right background.

- ***Filling, retouching and overpainting*** The damages at the left join were filled, and most others have been filled and inpainted. There are, however, many smaller losses that remain unretouched or were only partially treated, for example at the upper part of the right join. The retouchings are restricted to the losses, but are generally slightly warmer in tone. There are also many old, smaller retouchings that reinforce remaining original paint; for example, just below Christ's feet (49MICGBM008/009). The severely damaged parts of the donors have been inpainted in such a way that there is a continuity in the foreground, while allowing what remains of these figures to shimmer through.

Surface finish

- ***Varnish*** The thinly and evenly applied modern varnish has an even appearance. It has hardly yellowed, but there are several spots with more discoloured varnish residues of an underlying older layer. The varnish is damaged slightly in places (e.g., at the toad on the shield) and it has turned slightly matte overall.

- ***Surface dirt*** There is hardly any surface dirt present on the painting, although several brush hairs have been observed.

- ***Visibility of the original surface*** The saturation of the paint surface is good, but darker areas are somewhat more difficult to read because of an overall slightly matte finish and local loss of saturation. Despite this and the yellowed older varnish residues, the legibility of the original paint surface remains good.

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[1] For more information on the Rijksmuseum version (inv. SK-A-4252), see also Unverfehrt 1980, 90 and 262–63, no. 50.

[2] Sander 1993, 28–45.

[3] Sander 1993, 39.

[4] The museum holds a brief restoration report by Peter Waldeis and colour Ektachromes from before treatment (showing an old frame) and during treatment. The latter images show better what remains of the donors and family.

[5] Two dowels were applied 11.5 cm from the top and two about 8.5 cm from the bottom. They are circa 7.5 cm long and 0.7 cm thick. The dowel holes are visible from the reverse of the panel.

[6] Klein 2001, 125. The youngest or last-preserved ring on two of the three boards dates from, respectively, 1459 (board II) and 1451 (board III). Board I, on the left (seen from the front), only measures eighty rings and could not be dated.

[7] See Sander 1993, 40, and Sybesma Ironside 1974, 113–17.

[8] Compare the *Ecce Homo* on the *Altarpiece of Saint George* by the Cologne Master of the Legend of Saint George (Sander 1993, 42 fig. 12), and the engraving by Martin Schongauer.

12 *Christ Carrying the Cross / Christ Child*

RESEARCH REPORT 9–10[1]

Hieronymus Bosch
c. 1490–1510

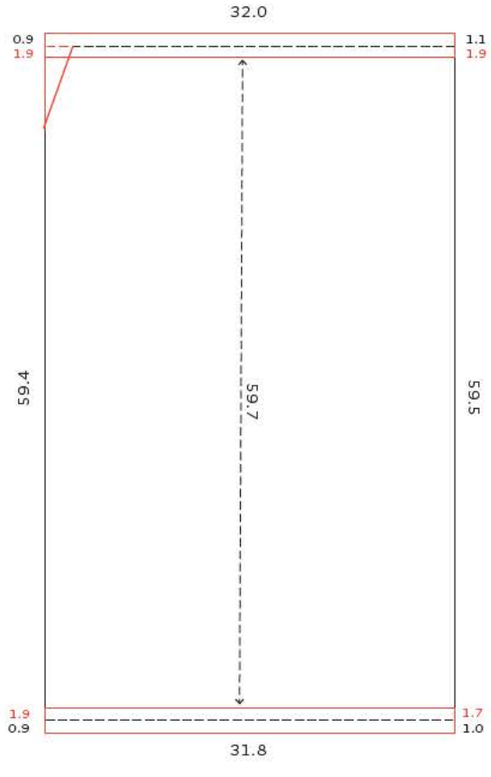
Oil (not analysed) on oak (not analysed) panel, painted on both sides, 59.7 × 32.0 cm. At some point, the rounded top of the panel was cropped and a wooden insert was added to the top right corner of no. 10 (being the top left corner of RR 9), as well as strips on the top and bottom edges.

Kunsthistorisches Museum, Vienna, GG-6429

The painting was restored in 2014–15, thus after the 2011 BRCP examination of the painting on which this text is largely based. BRCP, *Catalogue Raisonné*, cat. 12; www.boschproject.org no. 12.

SUMMARY OF CONCLUSIONS

This double-sided panel can be placed within Bosch's oeuvre. The phased underdrawing in the Carrying of the Cross *fits with that found in other works, and traces of a creative process in different stages of its production can also be observed. The slightly less refined finish here may point to some workshop involvement. Very little underdrawing was revealed in the* Christ Child, *but the quality of the paint application is high. For the* Carrying of the Cross, *in which ample underdrawing was revealed, more opaque paint was used.*
The panel originally functioned as the left wing of a triptych. The Christ Child *was visible when the triptych was closed, and the* Carrying of the Cross *was displayed when the ensemble was opened. The triptych's central panel and right wing are presumed lost. The panel was originally housed in an engaged frame. The barb at the top right edge of the* Carrying of the Cross *curves inward, implying that the wing initially had a rounded top that closed over the arched top of the lost centre section. The uppermost part of the left wing was at some point cropped, and the panel was made into a rectangle with a small insert at the top right corner. This intervention apparently triggered extensive overpainting of the landscape in the background. The image of the Christ Child was completely overpainted with a dark brown, presumably around the same time, perhaps to make the fragmented nature of the panel less evident. The overpaintings were largely removed in the course of subsequent restoration treatments.*
Dendrochronology has not yet been possible because strips of wood were added to the panel's top and bottom edges after it was cropped, obstructing access to the end grain. As further explained in BRCP, Catalogue Raisonné, *cat. 12, we date this work to around 1490–1510.*



12.1 Construction diagram (seen from RR 9, *Christ Child*). Non-original additions are in red; the dotted lines represent the edges of the remaining original panel on RR 10, the *Carrying of the Cross*.

12.2 Reconstruction of the triptych

RR 10

RR 9

RELATED WORK

This panel must have originally formed the left wing of a small triptych, the central panel of which was arched at the top (see fig. 12.2). The other panels of this ensemble are presumably lost.

EXAMINATION DATA

16–17 June 2011 (Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Ron Spronk).[2]

The painting was examined in the conservation studio of the Gemäldegalerie, out of its frame, both upright on an easel and flat on a table, under strong illumination. Both front and reverse were easily accessible.

- ***Previous research and additional documentation available*** The Gemäldegalerie's conservation department holds a file with information on the painting, including previous treatments and condition reports for loans.
- ***Previous treatments*** The conservation files hold information on three documented restorations, in 1923–25, 1929 and 1935. Discussing RR 9, in 1925: 'Restorer: Ms. Sykora and Bruder. Condition of the picture: The back completely overpainted with thick, brown colour. Work carried out: This uncovered, exposed the original picture, losses restored.'[3] Additionally, in 1929: 'Restorer: Karl Kolar. Condition of the picture: Blisters left and right at bottom edge, top centre. Work carried out: Laid down.'[4] Discussing RR 10, in 1935: 'Restorer:

Sebastian Isepp. Condition of the picture: Background overpainted (sky and terrain). Work carried out: Stripping the overpainting, losses restored.'[5] This treatment is reported in the annual report of 1935: 'Restorer Mr. Isepp has … removed the overpainting on the *Crucifixion* by Hieronymus Bosch, …'[6] The files concerning the purchase in 1923 do not contain information on condition or treatment.[7] An image of the *Carrying of the Cross* with the previously overpainted top section is at the Netherlands Institute for Art History (RKD) in The Hague (Archief Frederik Muller & Co).[8]

SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 12.1). Thickness (top) 5–9.2 mm. The dimensions include the added wooden strips at the top and bottom of the painting. The currently remaining dimensions of the original painting are 1.8–2.1 cm smaller for RR 10, and 3.6–3.8 cm smaller for RR 9. The thickness of the top half of the panel has been measured very precisely.[9] It varies between 5 and 9.2 mm, the thickness decreasing towards the edges but less towards the top left. Since the painting was reduced in size in the past, the thickness of the original edges would have been even less (see below, *Altered dimensions*).

  The panel, made of Baltic oak (not analysed), consists of one quarter-sawn plank, vertical in grain, laid vertically, with added wooden strips at top and bottom. RR 9 was damaged at the edges by bevelling (see below, *Altered dimensions*).

- ***Bevelled or half-lap edges*** Bevelling can be seen on all sides of RR 9. The bevels are incomplete and not original.

- ***Dendrochronology*** A dendrochronological dating is not available. The end grain is inaccessible because of the added strips. Peter Klein tried to analyse the panel from the XR, but that did not result in a measurement.

GROUND

- ***Visibility*** The off-white ground, which seems to consist of chalk (calcium carbonate – $CaCO_3$) bound in animal glue (not analysed), is present overall. The ground present on the bevelled edges on RR 9 is not original. The ground is evident in VIS and XR. On RR 10, the ground is almost completely covered by the paint layers but visible at the outer edges. On RR 9, the ground is mostly covered by paint layers but is discernible at contours (in the circle), in losses, and shimmering through paint layers. Visibility of the ground was perhaps intended as part of the composition (for example, in the face of the Christ Child), but was further increased by ageing effects of the paint layers.

- ***Barb and edges*** On RR 9, the original barb has not been preserved and the ungrounded edges are not original. On RR 10, remains of the barb are detectable at the left and right sides, with ungrounded edges roughly 2 mm wide. (These edges were reduced in size in the past.) At the top right of RR 10, the original barb arches to the left but has been severely abraded in this location. At top left, a small amount of blue paint is visible over the barb (10MICGBM001), indicating that the applied ground shrank a bit before painting, thus creating a small gap between the panel and the engaged frame, into which paint dripped. As the presence of barbs and ungrounded edges indicates, the painting originally had an engaged frame.

- ***Application*** The ground seems to have been applied with a large brush and worked into a fairly smooth finish, with brush marks that are slightly visible (in VIS on side RR 9, at the top left of the circle and in red above). The surface texture of the wooden support is somewhat apparent.

PREPARATORY LAYERS

- ***Underdrawing*** In RR 9, underdrawing appears to have been used only sparsely. It is visible in a few locations in VIS (using a stereomicroscope) and in IRR/IRP, but not clearly (fig. 12.6). The drawing seems only to indicate contours (as in the roundel and the figure) and to pinpoint the placement of certain facial features (e.g., the eyes and upper lip).

  In RR 10, underdrawing was used throughout and is visible in VIS (shimmering through the paint) and in IRR/IRP (fig. 12.7). Its function was not only to determine the composition, but also to serve in modelling, mostly through parallel hatching to indicate shadowed areas. It was used noticeably more in certain areas – for example, in the red-glazed robe of the tormentor in the centre, where it indicated where no underpainting with lead white was to be applied (see figs. 12.3–4).

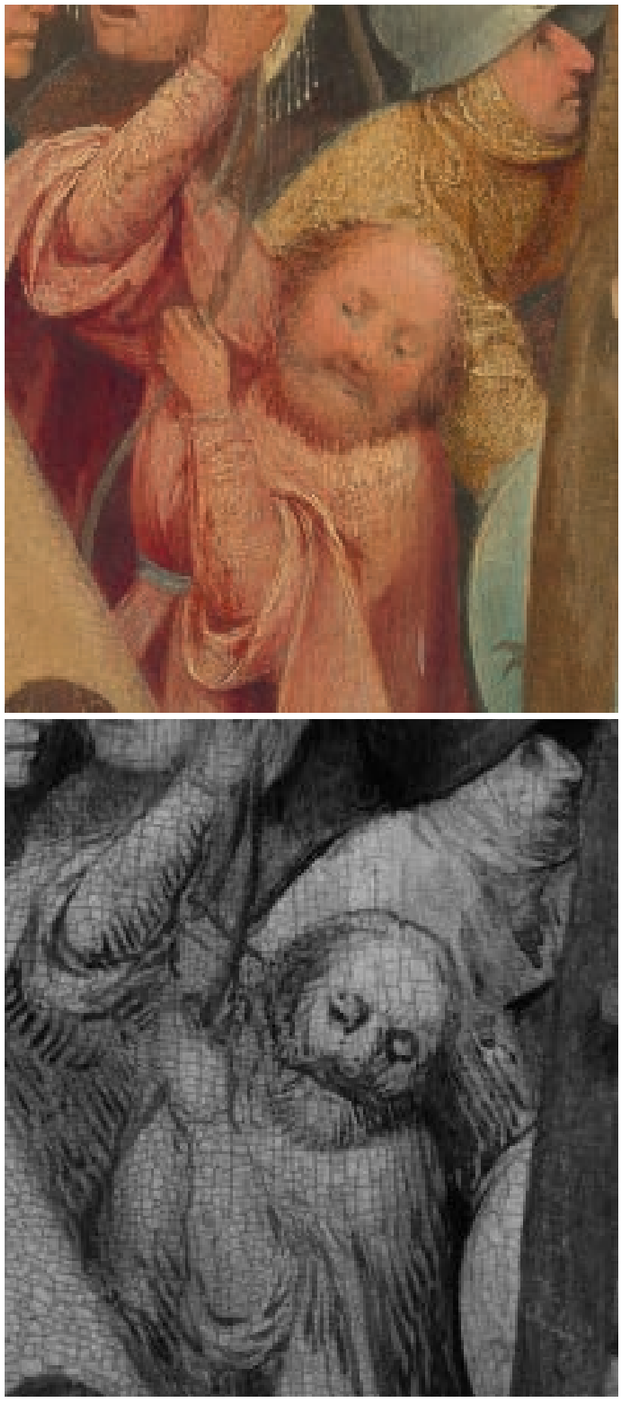
- ***Medium and application*** The detectable underdrawing in RR 9 was applied using a brush in a somewhat liquid medium, possibly a diluted, dark brown paint, which under the microscope appears to contain some red lake and carbon black, among other pigment particles, as was observed in the area of the forehead of the Christ Child (fig. 12.11). There seems to have been only one quick application stage. In the centre of the roundel, a compass mark is identifiable (09MICGBM004).

  The detectable underdrawing of RR 10 seems to have been applied using a brush in a more liquid medium, probably ink, that was used in two to three stages. Most contours were apparently drawn first, along with detailing and facial features, using what was probably a diluted ink. It appears that some of the underdrawing was subsequently altered or reinforced with a less diluted ink. In what seems to be a final stage, local modelling was then carried out using parallel hatching to indicate shadowed areas, which was more thickly applied in darker areas. Strong reinforcements and modelling are more apparent in the figures of Christ and others directly around him, especially the tormentor with the rope to his right, as well as in the cleric taking a confession from the repentant thief.

- ***Style*** The underdrawing in RR 9 was applied in a very rough and basic manner. This effect was also a result of the medium used, which gave the strokes a painterly feel. A few hatched lines are visible on the forehead of the Christ Child (09MICGBM003).

  Underdrawing on RR 10 was applied much more elaborately, and its medium allows for much finer detail. The initial drawing was done in a somewhat sketchlike manner, with long and short lines that are neither very straight (and sometimes even jittery, with the exception of some contour lines in the cross), nor always continuous. Small changes and reinforcements can locally be observed in an assumed second state, which was followed by a final modelling with mostly short, hatched lines. Hatching was typically done diagonally, predominantly (but not exclusively) from top left to bottom right. The lines run parallel, but were drawn freely and more closely together or overlapping in darker areas where more shadow was intended. In the figure with the yellowish robe and a helmet, the broad, underdrawn lines at his chest seem to converge in a wash resembling a watercolour technique (fig. 12.4). Line ends are usually straight (often tipped), without hooks or loops. The lines themselves can be curved, sometimes strongly (e.g., for facial features, and on the back of the figure carrying the shield at far right).

- ***Revisions in underdrawing and differences from painting stage(s)*** The underdrawing in RR 9 was only used as a general indication for placement and was only roughly followed in the paint application phase. The limited visibility in IRR of the underdrawing material and the carbon-containing paint mixtures makes it difficult to distinguish between underdrawing and paint layers. Nevertheless,



12.3–4 RR 10, VIS and IRR

it seems that the eyes, nose and mouth were positioned somewhat higher in the underdrawing. The current visibility of the underdrawing in the figure has been increased by changes in refractive index from ageing of the paint film. The drawing's partial visibility at the edge of the roundel (e.g., at upper left) did not seem to be of concern to the artist.

In RR 10, the underdrawing was generally but not precisely followed in the paint application phase, and numerous smaller changes are detectable. The weapon held by the figure with the green robe was positioned at a lower angle, for example, and the position of his hand was changed as well. The lower part of his white headpiece was initially longer, too, and his ear was positioned lower. The underdrawing of the cross at the left edge is slightly different from what we see now. At bottom right, the lower contour of the robe and the foot of the monk who is hearing the confession of the repentant thief were positioned a bit lower. The legs of that thief were also shifted: his proper right leg was initially placed lower and further to the left, and the left knee was also lower. At the centre of the panel, three long, diagonal lines that bring to mind a beam of the cross were underdrawn in the landscape, but the form was abandoned in the final composition. Instead, a small hill was painted there. The underdrawing's current level of visibility in several areas was probably not intended and was probably caused by changes in refractive index due to ageing of the paint film.

- ***Intermediate layers*** In RR 9, a cream-coloured layer is visible under the paint. It is exposed at paint contours, in damages, and it shimmers through all over the panel surface. This pigmented isolating layer was thinly applied over the entire surface. Visibility of this layer was undoubtedly meant by the painter as part of the composition. In the figure, however, it has become increasingly apparent, since the paint film that contains lead white has become more transparent with age. This has resulted in a somewhat different and unintended appearance, especially in the head of the Child. No such isolating layer was detected in RR 10.

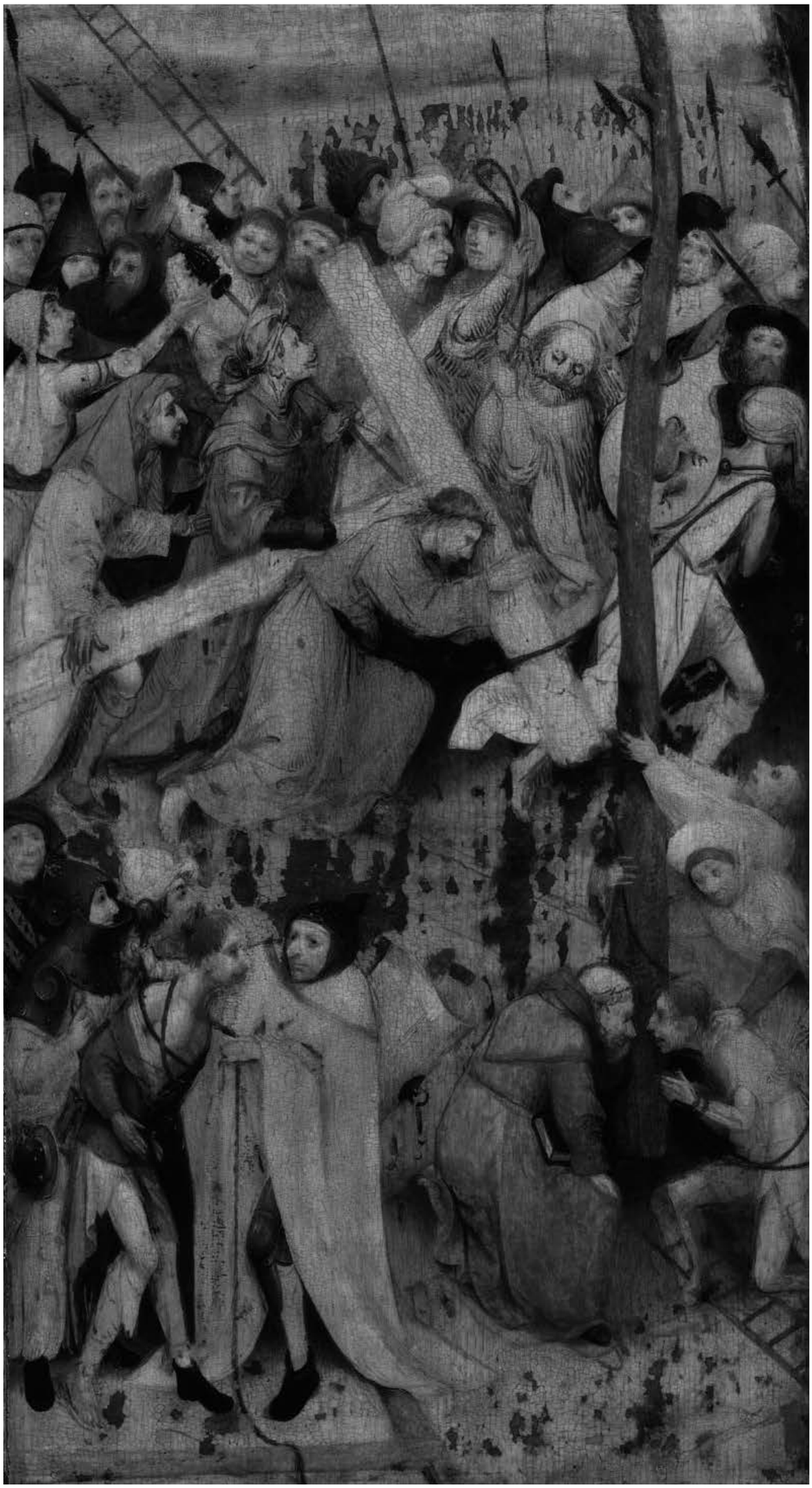
PAINT LAYERS

- ***Paint application and painting technique*** The oil paint (not analysed) was applied using a brush. In RR 9, where it covers the entire original panel surface, it was applied in two stages, mostly wet-in-wet (in the roundel), but also wet-on-dry (in the background). In RR 10, the paint extends onto the barb and was applied in several stages, mostly wet-on-dry, but also, to a lesser extent, wet-in-wet. Incisions were noted on both panel sides (see below).

  Paint application was both thick and thin, and the mostly fluid, glossy paints were applied in both opaque and semi-transparent layers. Lead white was applied with a stiff brush for the undermodelling of several red lake areas in RR 10, following the indications of the underdrawing. In general, RR 9 was painted in a more sketchlike fashion that was quick and suggestive, whereas RR 10 was worked out to a higher degree of finish, and in more opaque paint layers. The paint in RR 10 was generally built up in a maximum of two layers, except for highlights and shadows, and additions such as ropes and spears.

  In RR 9, some of the midtones in the Child were created by painting thinly, purposely allowing the underlying layer to shimmer through. On the opaque red background a few remnants of a red glaze are still identifiable. In the roundel, the entire composition was painted wet-in-wet (e.g., the face, fingers and hair of the Child; see fig. 12.10). The artist also used the backs of his brushes (or other pointed objects) and a ruler to incise the lines along the whirligig. It is possible to distinguish at least three differently sized incisions, the broadest one being the short groove immediately to the left of the hand holding

12.5–6 RR 9, VIS and IRR



12.7–9 RR 10, IRR, VIS and XR

the toy (see fig. 12.12). Another incised line seems to represent a string hanging between the left two legs of the child's walker, although this was partially filled with residues of the old brown overpaint. The red background was painted in the second phase, as it overlapped the roundel in certain areas.

In RR 10, paint was applied fairly precisely with vivid brushstrokes, covering almost everything, although the detailing is not very refined. Some thicker paints were used for impasto, but only locally (e.g., lead-tin yellow dots in the shield and hats, fig. 12.13). Glazes were added in red (for red and purple areas) and in green (as in the copper-green robe). For most red lake areas, a lead-white underpaint was laid on with a stiff brush, creating a sharp and impastoed texture that, after setting of the paint, was covered with the red lake. Abrasion has caused the textured underlayer to become more visible. The red hat at the top centre was painted wet-in-wet, with the red lake applied over the still-wet lead-white paint below, which also has a more fluid character. Brushstrokes render contour and volume with apparent ease throughout the painting. The ropes in front of the repentant thief's hips were partially incised.

- ***Texture*** Most passages do not have a smooth finish, as textured brushstrokes are often visible. Texture was used for modelling as well as impastoed highlights. In RR 10, for example, lead-white brushstrokes appear in the first layer of the shield below Christ. In RR 9, the ample textured strokes in the Christ Child are currently more apparent due to brown residues in the interstices of the paint (see below, *Filling …*). The paints on both sides frequently have a slight coarseness, and many lighter (abraded) particles can be observed as well, especially in the grey ground on which the Christ Child stands.[10]

- ***Build-up and palette*** The paint was applied mostly from light to dark. In RR 9, the figure was painted wet-in-wet, followed by the dark background, and then the red background, which was subsequently glazed over with a red lake (some of which remains; see below, *Abrasion*). RR 10, on the other hand, was largely executed wet-on-dry, using both pure and mixed paints, succeeded by highlights.

  In RR 9, all parts but the far left slat of the Child's walker were created by painting white and black lines with a narrow open strip in between. The grey background was used as a midtone, simultaneously suggesting a three-dimensional effect. This is an excellent example of the speed and facility with which this painting was conceived and made. The layering is visible in and around the Child's proper right leg, where the ground was followed by the pigmented isolating layer, the light paint layers of the figure, the black, and then the grey background.

  For the background of RR 10, the sky was underpainted with lead white and the landscape with a mixture containing lead-tin yellow. A blue paint layer was applied over both areas, very thinly in some parts of the landscape, after which a thin greenish paint covered the landscape area.

  The hair and hats of several figures were partially painted over the background, but most of the larger forms were left in reserve, roughly in accord with the underdrawing. While painting, however, the artist often expanded these areas over previously applied paint layers, as in the light cuff of the sleeve of the man behind the repentant thief. The cross was left in reserve, and although it looks enlarged, it was painted in a single application that was bigger than the underdrawing, hence covering other painted areas around it. The tall, thin tree trunk at right was also left in reserve, but the spears, ladder and noose were painted over the completed background.

  Glazes of copper green and two types of red (possibly kermes and madder – not analysed) were then applied, followed by final details and highlights. The bright copper-green glaze of the robe was painted over the undermodelling, which was done with a mixture containing lead-tin yellow. The grey-purple clothes of the hooded figure at top left were painted with a blue underlayer, and red lake was mixed with carbon-black pigments for the darkest shadows. Extraordinarily, a yellowish lake was used as well for the figure in the upper right.

  For the faces of several figures (e.g., the bearded figure top right), a flesh tone was applied, after which the eyes were executed. The paint was built up skilfully and only minor drying cracks have been observed (e.g., in the face and beard of the purple-robed figure at top left). The dotted helmet at centre left was painted by first applying a grey mixture, then lead-tin yellow dots, and finally a blue paint, partly muting these dots at the top of the helmet. Black was used both in blends (as for dark red or grey) and pure (for reinforcements, contours and pupils of the eyes). The hair of Christ was first painted in a reddish brown, then detailed with darker brown brushstrokes. This second layer seems to overlap the red lake of the blood. The crown of thorns has a copper-green glaze, lead-tin yellow highlights and some shadows in black.

  In the cross, the underlying layer shimmers through. This underlayer is also detectable in several faces, sometimes followed by pinkish highlights and semi-transparent brownish and red accents and shadows. Flesh tones range from a brownish pink (e.g., the figure at the lower left edge, looking at the beholder) to a cool greyish pink (as in the repentant thief), and can have a fairly monochrome appearance.

- ***Changes*** No alterations have been observed in RR 9. In RR 10, several small changes are visible with the naked eye, with IRR and in the XR (figs. 12.7–9). The top of the red hat at top centre was reduced in size, using background paint. The white headpiece of the man with the green robe was modified quite a bit. The underdrawing phase was not followed exactly, as the headpiece was much decreased in size at the neck. The top of the hat was also made smaller at the left, using a dark purple-red glaze. This section was then changed again with a bluish white paint and topped with a red glaze. The helmet at centre left first extended a bit further and was pointed (as seen in XR). The mouth of the unrepentant thief seems initially to have been closed. The arms and legs of the 'bad thief' were positioned lower (visible in IRR and XR). It is uncertain whether the trees in the background were planned or not.

FRAME

The original engaged frame has been lost. The current, rectangular wooden frame (max. 67.6 × 41 × 3.8 cm),[11] with wood finish on one side and black paint and gilding on the other, is modern.

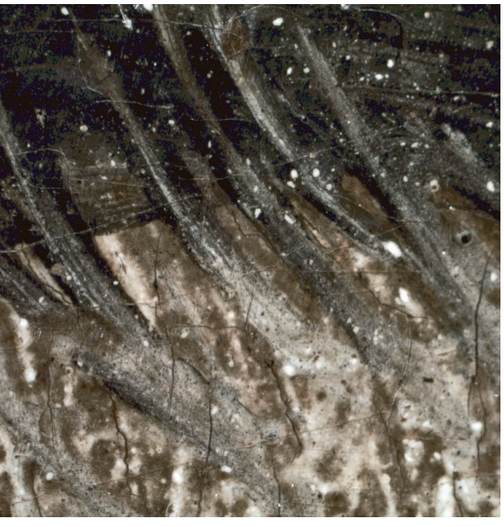
CONDITION

The painting was restored in 2014–15, thus after the 2011 BRCP examination of the painting on which this text is largely based.

Support

- ***Altered dimensions*** Originally the panel had a quarter-round arched top and formed the left wing of a triptych (see fig. 12.2). This is indicated by the remains of an original arched barb at the top right of RR 10. A reconstruction, based on the curvature of the original barb, yields a reduction in size of approximately 23–25 cm at the top.[12] The original panel was also cropped at the bottom and, to a lesser extent, on the left and right sides. Approximately 2 mm of the original ungrounded panel edges still remain on the sides of RR 10. The panel was made into a rectangle with a small wooden addition at the top right of RR 10, and the arched barb was locally abraded there (see below, *Abrasion*).

  RR 9 was bevelled, presumably to mimic original edges and reinforce the suggestion that this was the panel's initial format. Original wood, ground and paint were removed in the process, and the edges of the picture were partially repainted directly on the exposed wood and remaining ground. On the left and right sides, a vertical scratch mark



12.10 09MICGBM001

12.11 09MICGBM002

12.12 RR 9, VIS

was made about 1.1 cm from the panel edge, and that part was cleared of paint. The unpainted and ungrounded edges of RR 9, with the exception of some remains of ground, are therefore not original. In the edges of this side of the panel, nail marks from framing can also be found, clearly indicating that this side was made into the reverse. (Possibly at that time, this side was entirely overpainted with a brown paint.) Wooden strips (1.9 cm wide on RR 9 and about 1 cm wide on RR 10) were added to the top and bottom in half-lap joins, resulting in further losses on RR 9. These strips, however, allowed more of RR 10 to be visible when framed (see also below, *Filling …*).

- ***Additions*** A wooden insert was added to the top corner, and two wooden strips were added to the top and bottom sides. These strips were applied in half-lap joins, the widest sections of which are on side RR 9.
- ***Deformations*** Probably because the panel was painted on both sides, there are only minor deformations. RR 9 is generally very slightly convex, and RR 10 accordingly marginally concave. The panel is not entirely in plane, the bottom being slightly more concave. The stability of the wooden panel itself is reasonably good, again thanks at least in part to the panel's having been 'sealed' on both sides with paint.

Ground and paint layers

- ***Stability*** There are only a few spots with old and stable paint blisters on RR 9. There remain some areas of old, raised paint, which were consolidated in the past, spread over the surface of RR 10. No recent paint losses or issues with raised paint have been observed. Overall, the ground and paint layers seem relatively stable.
- ***Losses*** In RR 10 there are several larger losses, mostly contained in the landscape.
- ***Abrasion*** The paint surfaces on both sides are somewhat abraded overall, with frequent damage to the highest points of the paint. A few of the impastoed highlights have been abraded a bit (e.g., some nose tips in RR 10). There are only a few remains of red lake on the red background, so it is uncertain whether a red glaze covered the entire side of RR 9, although it is likely. The original arched barb in RR 10 has mostly been abraded or removed, presumably to conceal the insert (10MICGBM002).
- ***Discoloration and increased transparency*** In RR 9, noticeable changes have occurred at the surface of what would originally have been an entirely deep red background, which has now partially darkened (09MICGBM006). Since the red glaze was lost, the bright vermilion has darkened owing to natural, light-induced degradation. Also, the lead-white content of the paint in the figure of the Child has become more transparent over time, causing increased visibility of the darker underlayer, and thus an unintended change of appearance.

  In RR 10, the copper-green paints (lakes or glazes) were applied relatively thickly, so despite some discoloration they are still green. The red lakes have faded somewhat, both on light and dark underlayers (reds and purples, respectively). A general increase in transparency is evident in the lighter paints that contain lead white, causing the increased visibility of underdrawing.

- ***Filling, retouching and overpainting*** The artist seems to have covered the small compass hole in the centre of the roundel with paint, without filling it. The currently visible fill was apparently applied during a later restoration (09MICGBM004). There are many retouchings in the dark roundel background, and a vertical inpainting is visible at the cheek and chest of the Christ Child.[13]

  The entire surface of RR 9 was once covered by a thick, brownish overpaint, as mentioned in the 1923–25 conservation report. Although this was largely removed, there are still many remnants of that layer present on the surface. The residues are present in craquelure and can be seen most clearly (even with the naked eye) in the impastoed areas of the figure (fig. 12.12). They are also distinguishable in the red background, although less clearly so.

  In RR 10, the entire sky and landscape was once overpainted with a dull, bluish paint, which is darker at the top of the panel. The overpaint also covered the noose at the top edge of the panel and reduced the height of the tree, but the spears and ladder were left in reserve. This resulted in a much lower horizon which was likely the goal of this overpainting, since the sky was largely cropped off. During the 1935 restoration, much of this overpainting was removed again, but many of its residues are still apparent in the sky and elsewhere.

  An erroneous retouch is visible in the white wooden patten on the man's shoe at centre left, which currently has three 'heels' instead of two, the front one being a retouching. Damages to the original paint layer, especially in the landscape, have been filled and inpainted, but these retouchings have discoloured over time and are clearly discernible now.

12.13 RR 10, VIS

Surface finish

- ***Varnish*** The thick and glossy brush-applied modern varnish as well as older residues have yellowed considerably (e.g.10MICGBM003) and have an uneven appearance. RR 9 also has many horizontal drip lines in the varnish, most clearly near the bottom. The saturation of the paint surface is good, except for the retouches and the blanched varnish below the elbow of the man with the green robe.
- ***Surface dirt*** There is a small amount of surface dirt on the painting.
- ***Visibility of the original surface*** The highly yellowed varnish and many old varnish residues cause a reduced legibility of the original paint surface. This also makes the dark colours look brighter and less deep and the lighter parts appear darker, resulting in an imbalance when viewing the picture. The many not precisely colour-matching and/or discoloured retouches distract the viewer from the original paint surface. Furthermore, the large amounts of brown overpaint residue on RR 9 not only cover the original paint but result in an unintentionally different appearance, especially in the Child's figure.

[1] For this report, the exterior with the *Christ Child* is referred to as RR 9 and the interior with *Christ Carrying the Cross* as RR 10. This is in keeping with the BRCP numbering system for triptychs, which starts with the exterior surfaces.

[2] René Hoppenbrouwers of Stichting Restauratie Atelier Limburg (SRAL) also participated in the examinations.

[3] 'Post Nr. 342. Datum: 08.1923–10.1925. Restaurator: Frl. Sykora und Bruder. Zustand des Bildes: Die Rückseite ganz mit dicker brauner Farbe zugestrichen. Vorgenommene Arbeit: Diese abge(wisen?), dem Originalbild freigelegt, Fehlstellen ergänzt.'

[4] 'Post Nr. 497. Datum: 02.1929–25.03.1929. Restaurator: Karl Kolar. Zustand des Bildes: Blasen links und rechts unten am Rand, oben i. d. Mitte. Vorgenommene Arbeit: Niedergelegt.'

[5] 'Post Nr. 961. Datum: 13.05.1935–05.07.1935. Restaurator: Sebastian Isepp. Zustand des Bildes: Hintergrund zugestrichen (Himmel u. Terrain). Vorgenommene Arbeit: Abdeckung der Übermalungen, Fehlstellen ergänzt.'

[6] Report Zl 1 ex 1936, p. 5: 'Herr Restaurator Isepp hat ..., die Übermalungen an der *Kreuztragung* von Hieronymus Bosch abgedeckt,....'

[7] Email communication with Elke Oberthaler, chief paintings conservator, Kunsthistorisches Museum.

[8] A newspaper article from 1923. See https://rkd.nl/en/explore/archives/file/110057033, no. 8 (last visited 24 January 2016). The BRCP is grateful to Anna Koldeweij for sharing this information.

[9] A Hacklinger thickness gauge (version C, range 1–12 mm) was used by Ingrid Hopfner and Ute Tüchler of the Kunsthistorisches Museum to measure all points in a grid with a horizontal separation of 3 cm and a vertical separation of 4 cm.

[10] This might be partly related to metal soap aggregate formation, but typical aggregate losses have not been noted.

[11] Measurements by Monika Strolz, paintings conservator, Kunsthistorisches Museum, Vienna.

[12] In 1968, Baldass and Heinz estimated a 20 cm reduction in size.

[13] These retouchings are also revealed in the UV radiation-induced fluorescence images (see 09PUVFLU and 10PUVFLU).

12.14–15 **VIS, after treatment** (photos courtesy Kunsthistorisches Museum, Vienna)

Christ Carrying the Cross

Hieronymus Bosch
c. 1495–1505

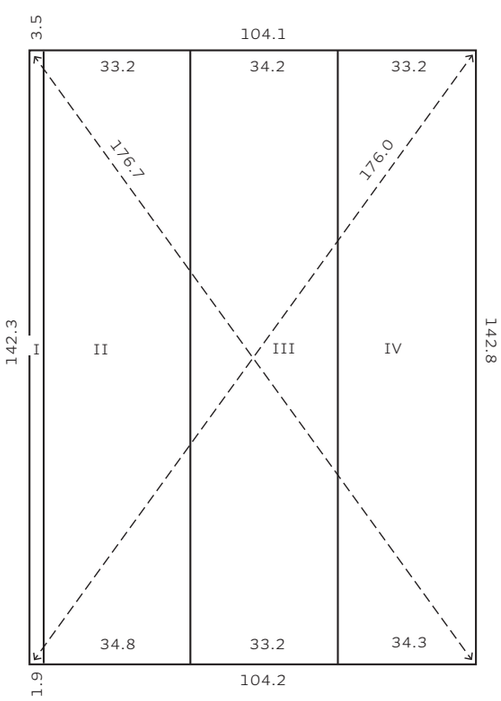
Oil (analysed) on oak (analysed) panel, 142.8 × 104.2 cm
Monasterio de San Lorenzo de El Escorial/Patrimonio Nacional,
San Lorenzo de El Escorial, 10014739

BRCP, *Catalogue Raisonné*, cat. 13; www.boschproject.org no. 13.

Inscriptions and labels
Bottom right-hand corner, in a fluid, white paint: 393.
Reverse, in the half-lap edge at top centre, a partially preserved paper label bears the incomplete inscription *Cuadros encontrados por elde* .... A white sticker in the upper right documents an earlier treatment: RESTAURADO EN EL AÑO 1979 *por Cecilia Juárez y José A. Menéndez-Morán*.
On the frame, a sticker with a Patrimonio Nacional bar code is attached to the bottom edge of the frame, and a large label on the bottom left of the vitrine lid warns about the vitrine's microclimate.

SUMMARY OF CONCLUSIONS

The technical evidence is in full agreement with the attribution of the Christ Carrying the Cross *in El Escorial to Hieronymus Bosch. The painting technique and the style and materials of the phased underdrawing place the panel in the core oeuvre. This is further supported by the presence of traces of the creative process in all phases of the painting's production.*
The green paint for the soldier at the far right is almost completely reconstructed, but much of the rest of the paint surface is in relatively good condition. The monumental panel was originally housed in an engaged frame, now lost. The reverse of the panel has always been unpainted, which refutes the suggestion that it might have served as the left wing of a folding triptych.[1] *Dendrochronology indicates that the work could have been painted from 1492 onwards, although a date after 1494 is statistically more probable. As further explained in* BRCP, Catalogue Raisonné, *cat. 13, we date this work to c. 1495–1505.*



13.1 Construction diagram (seen from the front)

EXAMINATION DATA

22–25 April 2013 (Robert Erdmann, Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Hanneke Nap, Ron Spronk).

The panel was examined in a separate room in the monastery. The painting was studied upright on an easel, under strong illumination.

- ***Previous research and additional documentation available*** The conservation file holds ample documents and photographs of the painting and its treatment, as well as an external report on extensive chemical analyses. Four rolls of XR film are also present.
- ***Previous treatments*** The painting was treated in 1979 (see above, *Inscriptions and labels*). More recently, in 2004, it was restored by Esperanza Rodríguez-Arana Muñoz and Lourdes Rico Martínez.[2]

SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 13.1). Maximum thickness c. 2 cm (about 0.7 cm along the four half-lap edges).

The wood species, Baltic oak, was identified through dendrochronology. The panel consists of four quarter-sawn planks, vertical in grain and laid vertically, one of which is very narrow.[3] The three wider planks all have some sapwood. Seen from the reverse, RR 90, the broad left-hand and centre planks have sapwood along their right edges. The broad right-hand plank has some sapwood along its left edge.

The four planks were butt-joined, dowelled and glued. The dowels are visible in XR. The dowels of the join of the narrow board I, on the left edge of the panel (the right edge of the reverse) are exposed. The support may therefore initially have been larger, and reduced in size before the painting started. Seen from the front, the dowels were consistently first inserted into the plank to the right of a join, where they fill the dowel holes completely, leaving a small void in the dowel holes in the adjoining planks. The intact dowels are between 8.5 and 9.5 cm long, and circa 0.6 cm thick.

The panel's original reverse has largely been preserved, with the exception of the half-lap edges and the areas that were cut to fit two crossbars, now lost (see below, *Altered dimensions*). The patches of oakum (tar-soaked rope; *estopa* in Spanish) are not original, but were applied in Spain (see further below, *Condition: Support*).

There are some tool marks visible, indicating that the panel reverse was gouged or planed. Traces of the splitting of the boards from the tree trunk can be seen on the edges of the two broad outer planks. These areas have darkened due to migration of tannin in the oak to the surface.

RR 89

RR 90

- ***Bevelled or half-lap edges*** No remains of original bevelling have been observed. The entire circumference of the panel has been worked to a half-lap edge.
- ***Dendrochronology*** The youngest growth ring (including three sapwood rings) dates from 1484, which, when corrected for the minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1490 for the tree that provided the wood.[4] An earliest felling date of 1492 is statistically more probable, however, since that would cover 93 per cent of the range of possibly missing sapwood rings. Assuming at least two more years for drying and transportation, the panel could have been produced from 1492 onwards, but a production date from 1494 onwards is statistically more probable.

GROUND

- ***Visibility*** The off-white ground is present overall and can be seen in VIS. The surface of the ground layer is not fully covered by the paint layers, and the ground is perceptible at contours, shimmering through paint layers, locally in craquelure, at the outer edges and in losses. Visibility of the ground seems to be an integral part of the artist's technique, although in some areas (e.g., in the face of Saint John; see fig. 13.10) it serves no distinct purpose and appears to be the result of swift execution. A sizeable section of the ground layer (and some underdrawing) is also exposed at the interface of the black hat and the sky in the top left. Ageing effects have increased the visibility of the ground in certain areas.
- ***Barb and edges*** The original barb and the ungrounded and unpainted edges have largely been preserved on all sides of the panel, establishing that it was initially housed in an engaged frame (now lost), and that it has survived in its original dimensions.
- ***Application*** The ground was applied rather thinly, apparently in a single coat. Brushmarks of what appears to be the ground application are visible in XR (fig. 13.15), most notably at the cross in the lower right. The surface texture of the panel and several traces of irregularities are still detectable and have not been fully evened out by the ground.
- ***Composition*** The ground consists of chalk (calcium carbonate – $CaCO_3$) bound in animal glue.[5]

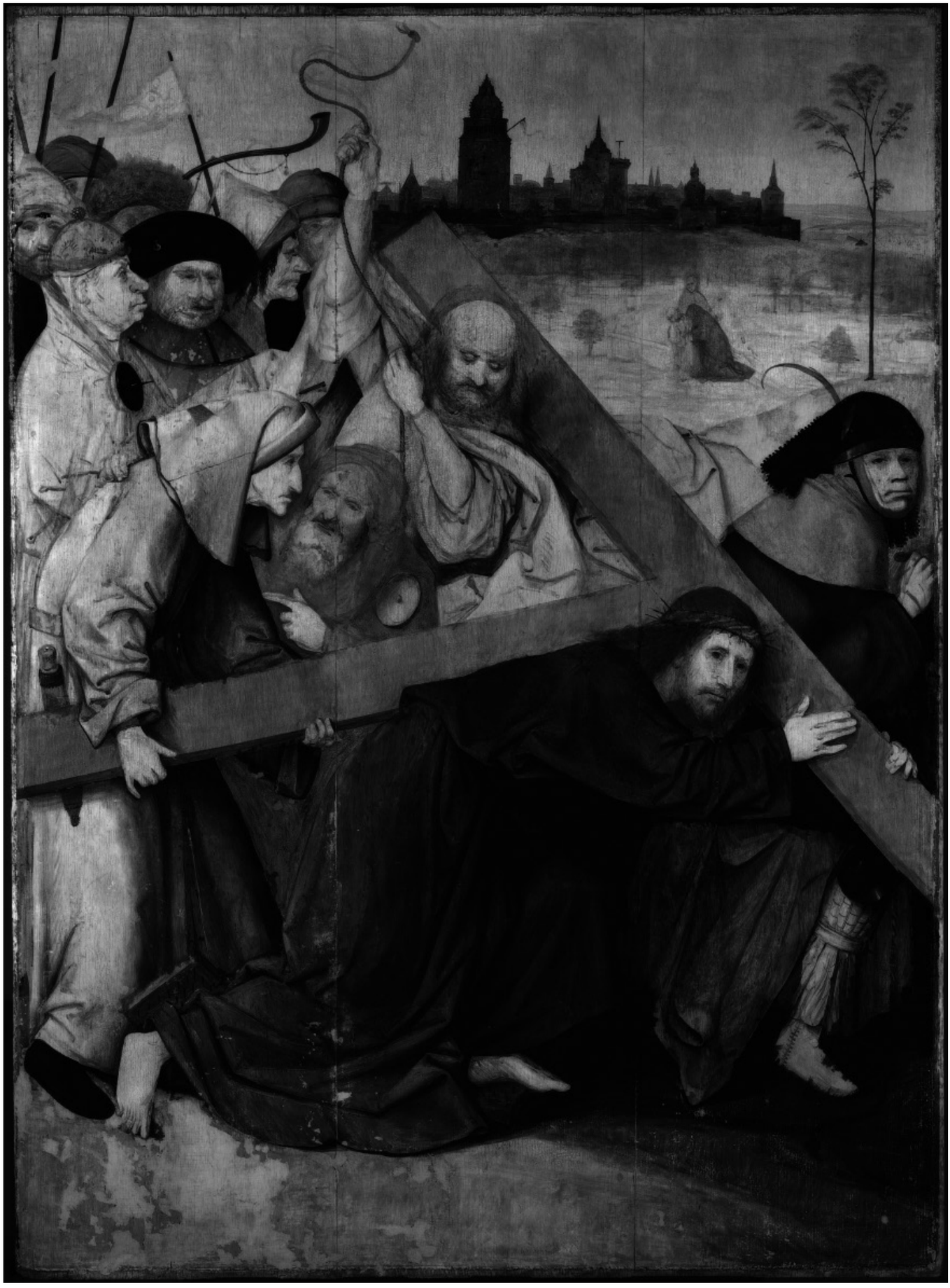
PREPARATORY LAYERS

- ***Underdrawing*** Underdrawing was observed in most areas of the painting. In some areas, where the paint is applied thinly, the underdrawing can be seen in VIS, shimmering through the paint surface. Ground and underdrawing are partly exposed, for example, at the tip of Simon of Cyrene's right-hand little finger (see fig. 13.11). IRP and especially IRR reveal the underdrawing beneath the paint, but to a much smaller extent in the grey cloak of Christ, which remains largely opaque to IRR (fig. 13.2). Surprisingly, the underdrawing in the whitish robe of Simon is almost better visible in VIS than in IRR. Some underdrawing is exposed at the interface between the black hat and the sky at the top left.

  A first-stage underdrawing was executed in what appears to be a dry medium to indicate general placement of the main features. In a second stage, the composition was worked out further with an underdrawing in brushwork to guide the painting process. The contour of the hand of the tormentor with the rope was underdrawn, for example, which facilitated this feature's being left in reserve from the underpainting of the sky. Two sizes of brush appear to have been used, one significantly smaller than the other. (Compare, e.g., the short parallel lines in the tormentor's red cloak just to the left of the joining crossbeams with the broader folds immediately below.) Thus it is quite possible that there were, in fact, three distinct drawing stages. The folds in this tormentor's red cloak were underdrawn, but these lines are often hard to distinguish from their later reinforcements in the paint surface. It appears that more densely underdrawn areas in the red lake indicated where a lead-white underpainting was not to be applied.

  The drawing is fairly elaborate but sketchlike, with most elements being indicated in at least two, but probably three stages of preparation. Underdrawing was used to work out the composition and to indicate contours, folds, areas of shading and smaller details. Several smaller changes are observable between the different underdrawing stages. The current visibility of the underdrawing in the lighter areas has probably been caused by the increased transparency of the paint in those locations because of changes in refractive index due to ageing. It seems that the underdrawing's current degree of visibility in VIS was probably not intended in several areas, as in the face of the heavy man to the rear with the black hat. His face was underdrawn in a more frontal position, but since much of the underdrawing visible through the thin paint on his jowls might be read as stubble, it does not interfere with the composition.

  Incisions seem to have been made only into the ground around the cross, with paint subsequently running into the incised lines, as is visible in IRR and XR.
- ***Medium and application*** A first-stage underdrawing was executed in a dry medium; for example, in the plane running through the trees in the background. Other such lines are visible in the red cloak of the tormentor with the rope (e.g., to the right of his lower elbow and in his shoulder; see figs. 13.7–8). In the following stage or stages,



13.2 IRR

13.3–4 VIS and IRR

apparently a watery solution with finely ground carbon black was applied with a brush.[6] The lines were quickly and freely executed, in wide but relatively short brushstrokes. In the background, only a few broader indication lines seem to have been used, as is evident to the right of the buildings on the far right in the lighter blue plane. Since the two tallest structures in the town on the horizon were left in reserve from the underpainting for the sky, though, these might also have been underdrawn.

- ***Style*** The faint initial dry placement lines are thin and fairly crisp. The finer brushed lines are relatively thin, but are executed in sketchlike fashion. The final-stage underdrawn lines are done with a broader brush, in thicker, more opaque lines that remain fairly short and somewhat irregular. Unlike the more finely brushed lines, which typically end in hooks, the broader brushed lines can also end in loops. It is especially in the final-stage drawing that shadow is prepared by closely spaced lines, creating the impression of areas of wash. (See, e.g., the red cloak of the figure at the far left edge, immediately above the horizontal crossbeam, or Christ's foot on the spike-block.) Particularly in the last stage of the underdrawing, material puddles or pools at the end of a line. Underdrawn lines are sometimes hard to distinguish from their later reinforcements in the paint surface.

  Parallel hatching can be found in both presumed brushed stages. The fine hatching in the red cloak of the tormentor with the rope, close to the angle of crossbeams, is part of this first brushed stage, while the hatching in Simon's sleeve nearest to the viewer was probably done in the last phase.

- ***Revisions in underdrawing and differences from painting stage(s)*** Generally, the underdrawing was followed relatively closely in the paint application phase, but several larger and smaller changes are discernible. In the middleground, Saint John was initially also kneeling while comforting the Virgin beside him. IRR revealed faint traces of two additional kneeling figures to the left and the right of John and Mary, which might have been their earlier planned positions (figs. 13.3–4). The tormentor with the rope was initially not bald, but had hair comparable to that of the figure of Saint John in

13.5–6 VIS and IRR

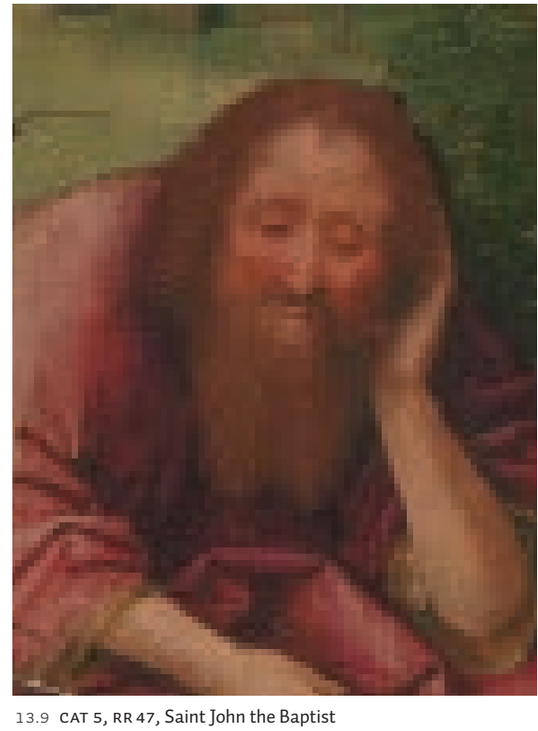
cat. 5, RR 47 (figs. 13.7–9). In the underdrawing, the tormentor's rope ended in a loop (fig. 13.2), just as in cat. 12, RR 10. The heavy-set man with the black hat and green cloak was prepared more frontally and with a beard (figs.13.5–6). His cloak was first planned to continue downwards to the light headwear of Simon, instead of the billowing fold of the tormentor's red cloak that was painted in that position. The banner, its pole and the spear shafts were not underdrawn. The red headgear of two soldiers was smaller in the underdrawing, and it appears that the green headpieces were designed differently as well. Several other contours were merely shifted; for example, those of Christ's fingers and toes, the thorns in his crown, and the fingers of the tormentor's hand holding the rope.

- ***Intermediate layers*** Analyses of cross-sections indicate that an isolating layer of linseed oil was applied over the underdrawing. It was also reported that the ground was impregnated with animal glue, but it is possible that the glue was actually the binding medium of the ground layer.[7]

application, with layers frequently blending into one another. Slightly thicker paints were used for impasto (e.g., in areas of lead-white undermodelling and in highlights of lead white and lead-tin yellow) and for the background trees and blue areas, which contain coarser azurite pigment. The forms were laid in fairly precisely, with lively brushstrokes in multiple directions that also render volume and texture throughout the painting, as in the sky. The underpainting in the lighter part of the sky was applied in predominantly vertical strokes, brushed on quickly and roughly. The ends of these strokes are visible in the XR in distinct horizontal bands (fig. 13.15).

Many elements were not worked out to a high degree of detail and finish, although several smaller details were applied, including the highlights on eyes and the tears on Christ's cheeks, creating the illusion of fine detail. In the lighter areas of the red robes there is an undermodelling containing lead white, applied with a stiff brush. Most of the lead-white undermodelling in these areas, however, was mixed with red lake into a single layer, which was later detailed with thicker red glazes for folds and areas of shading (see fig. 13.12). The densest underdrawing here apparently indicated where this light

13.7–8 VIS and IRR



13.9 CAT 5, RR 47, Saint John the Baptist

PAINT LAYERS

- ***Binding medium*** Both linseed oil and walnut oil have been detected in paint layers, although the walnut oil was only detected in certain cross-sections.[8]

- ***Paint application and painting technique*** The brush-applied paint covers almost the entire surface of the panel. It leaves ground locally exposed (see above, *Visibility*), but only rarely at the interfaces between different colours. Paint was applied in several stages, mostly wet-on-dry but also wet-in-wet, and it extends onto the barb, as the panels were originally painted in an engaged frame.

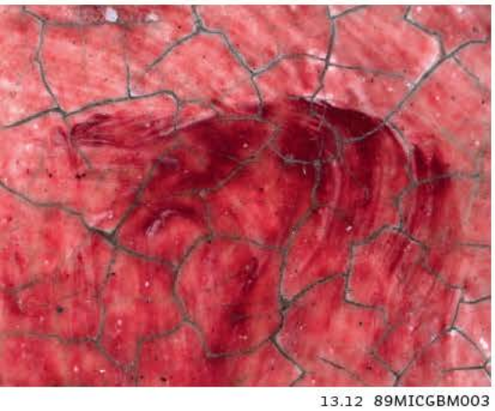
  The mostly fluid, glossy paints were laid on in both opaque and semi-transparent layers. Glazes were done in both green and red. The artist painted alternately in fairly fine and rough styles, mostly in one or two thin layers. There is ample wet-in-wet paint

underpainting was not to be applied. In areas of red lake, regular and very closely spaced dots of lake can be observed, which seems to indicate that the glazes were blotted with cloth. Hatching with red lake paint was used in a fold of the red-robed man at left, indicating shadow.

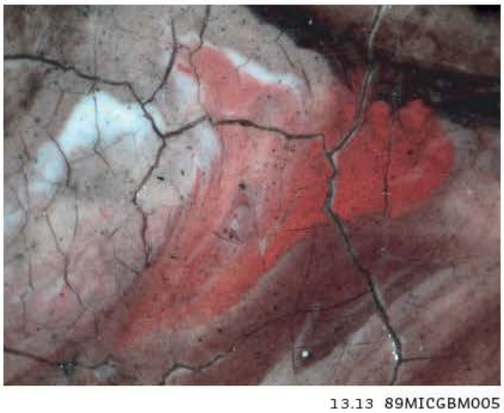
The metal discs on the shoulder of the man in the blue cloak in the centre and on the soldier's leg on the right were painted quite differently, but both of them efficiently and convincingly create the illusion of surface texture and shape. Over the golden disc's base colour, short, parallel lines were roughly hatched using lead-tin yellow and pink, organized in bands radiating from the centre. These hatch marks are shorter at the centre of the disc. In the lower right band of hatch marks (the lightest area of the disc), the wet, pink paint was dragged over the base colour, creating the illusion of a smooth, concave surface. The highlights on the grey disc on the soldier's leg,

13.10 89MICGBM012

13.11 89MICGBM006



13.12 89MICGBM003



13.13 89MICGBM005

13.14 Mapping of micrographs reproduced here (13.10–13)

however, result from adjacent lead-white brushstrokes gradually mixing with the still-wet grey paint underneath. This disc has a more complex shape, since it combines a slightly convex centre with a somewhat concave outer band, and its texture is less smooth.

The soldier's heavy leather greave was first painted with a light-hued base that must have had some lead white, followed by long, diagonal strokes in lighter and darker grey. Dark brown and black lines were then applied wet-in-wet, pushing the underlying paint and highlights aside. These lines were applied from left to right, gradually blending with the underlayer. Similarly, the veins on the top of Simon's right hand were applied over the still-wet underlayer, blending with the paint and pushing it aside (as seen in VIS and XR).

- ***Texture*** Most passages do not have a smooth finish, as slightly textured brushstrokes are often visible. These strokes often follow the forms and were used in part for modelling.

  In the painting, two fingerprints have been noted that are possibly the artist's. Just above the left corner of the spike-block, an imprint is visible in the white paint of the robe, especially in raking light (89MICGBM011). Similarly, a print is present in the cross just above the head of Christ, slightly to the left. The originality of a third fingerprint is less certain (89MICGBM001), as it appears to be more superficial and there are also remnants of retouching in that area.

- ***Build-up and palette*** The paint was mainly applied from light to dark, often making use of the light ground colour. Dark-to-light paint application is evident in many of the brownish areas, such as the hair, the rope and the furry hat, as well as in detailing. The IRR reveals that a relatively large amount of black was mixed in with the colours; for example, in the grey-brown robe of Christ and the light grey robe of Simon, and in the grey path in the foreground and the townscape in the background (fig. 13.2).

  The composition was generally built up from background to foreground, leaving many areas in reserve during the painting process, with the faces as a possible exception. It seems that the faces of the figures were painted before the rest of their bodies, since in several areas, parts of the clothing overlap both the base tones and pinkish flesh tones of the skin. (Some of these overlaps, however, are actually reinforcements of contours.) The modelling of the faces primarily took place in the surface layers, atop a more transparent base layer. This is illustrated by the man in blue who is pointing to Simon, whose eyes are dark circles in the XR, while the pinkish flesh tones of his forehead and cheekbones remain opaque to XR. At the lower left edge, pale green landscape paint was also applied in a later phase, as it partially overlaps the white and red lake paints used in two robes (89MICGBM010).

  The sky was applied in a single layer consisting of azurite paint, gradually mixed with more lead white towards the horizon.[9] In the upper part of the sky, where the smallest amount of lead white was used, the ground layer seems to shimmer through the paint. When the sky was laid on, a small, triangular shape was left in reserve for the banner (fig. 13.15). The hand of the tormentor and the two towers were also left in reserve, the latter as triangular forms. The green headpieces overlap the sky significantly, so these were probably planned much smaller. The pointy tips of the red headpieces, which were underdrawn lower, also overlap the sky. After the sky and the figures were completed, the rest of the banner and its pole were painted, followed by the spear shafts and the *lituus*, the curved trumpet.

  The background landscape and the city were painted after the sky was completed. The landscape was painted roughly, leaving the smaller figures of Saint John and the Virgin in reserve. The tree at right was painted over the finished background and sky. The trees were depicted in a bluish-green colour, mixed with white and applied in short, quick, horizontal strokes, followed in places by blue-green to lead-tin yellow highlights. For the foliage of the tall tree in the right foreground, light green dappling was followed by similar brushwork in lead-tin yellow, both partially overlapping darker green

13.15 XR

dabs of paint. This foliage was applied onto the still-wet branches of the tree.

Red lake was used extensively. Aside from the robes and hats, it was also used both pure and mixed with other pigments, often black, for many details. Red lake is present as a component in the deeply shadowed area to the right of Simon's waist, appearing somewhat purplish, and in the shadowed area around the gold-coloured disc. In detailing, dots of red lake even appear in the tower behind the gate. For the physiognomic detailing of Christ's left hand, red lake mixed with black was applied onto the still-wet skin tone, partially blending with it. It was also used in some of the noses and eyes – for example in the corner of Christ's eye, blending with what is possibly red earth (89MICGBM008).[10] This is different from the brownish contour lines in the details of the hands. The drops of blood on the ground beneath Christ consist of mixtures of red earth and red lake or lead white (89MICGBM009). The mixture of red earth with lead white seems to be present on the lips of Christ and on the eye of the soldier to the right, as well (fig. 13.13). Strikingly, there is also some greenish paint in the eye (89MICGBM004). Additionally, a slightly brownish red lake is visible at the bottom tip of the blue robe and just below that, at the edge of Christ's robe, which was later covered by grey paint.

Both Christ's grey robe and Simon's light grey one were painted after the initial azurite layer of the blue robe. It appears that over a blue base, a medium-rich dark blue was locally applied, followed by light blue modelling consisting of lead white and azurite pigments. Cross-section analyses of the blue *chaperon* headdress at the right edge show a two-layer build-up of lighter blue followed by dark blue paint, without light blue highlights.[11]

The stubble of the figure with the red robe to the left is depicted with blue pigments. The white cord extending from his headpiece is painted over the finished red robe, but wet-in-wet red lake detailing can be found on the lead-white knots. For highlights, lead white was primarily used, but there are also other pigments, such as lead-tin yellow. Christ's tears are indicated in lead white, with one accentuated by a dark line for shading. The greyish highlights on the tip of the dagger's scabbard, however, consist of a mixture of blue and white paints. Infrared examinations confirm the absence of black pigments in this detail.

- ***Changes*** Several small changes can be detected, all seeming to crop or extend elements in the composition. For example, the lowest tip of the green robe and the cuff of Simon's sleeve below his left hand were extended downward over the blue. The feet of both Christ and the soldier to the right were made smaller. The blue sleeve of the man pointing at Simon was extended over the flesh tone. Here the initial blue layer was covered by grey paint instead of a second layer of azurite paint. A similar adjustment is visible in the lower tip of the man's cap, revealing that the first layer of the blue robe was painted before Simon's robe was.

FRAME

The original, engaged frame has been lost. The panel is currently displayed in a microclimate vitrine fitted in a non-original wooden frame. The profiled and gilded frame (155.2 × 117.6 × 5.6 cm; 9.9 cm thick, including the sealing lid of the vitrine) has a black-painted central section.

CONDITION

Support

- ***Altered dimensions*** The panel has largely retained its original dimensions. There are some slight damages along the outer edges, and on the panel reverse. About 47 cm from the top and bottom of the panel, two sections were cut to fit two crossbars, now lost.
- ***Additions*** The narrow plank or strip at the left side of the painting is not an addition, but original.
- ***Deformations*** The panel has a slight concave deformation (seen from the front).
- ***Joins*** The joins are mostly closed, with the exception of the bottom part of the rightmost join (seen from the front), where a difference in levels is also discernible. Along the middle join there are several indentations, possibly a result of locally weakened support due to woodworm tunnelling.
- ***Coated reverse*** Patches of oakum were applied to the panel reverse at regular intervals along the joins. These ten patches of fibres were applied across the join with glue or tar. Wax is also present on the reverse, and there are traces of red paint (e.g., below the label).
- ***Biological damage*** Old woodworm damage apparent on the reverse of the panel is mostly present in the areas of sapwood along the joins.

Ground and paint layers

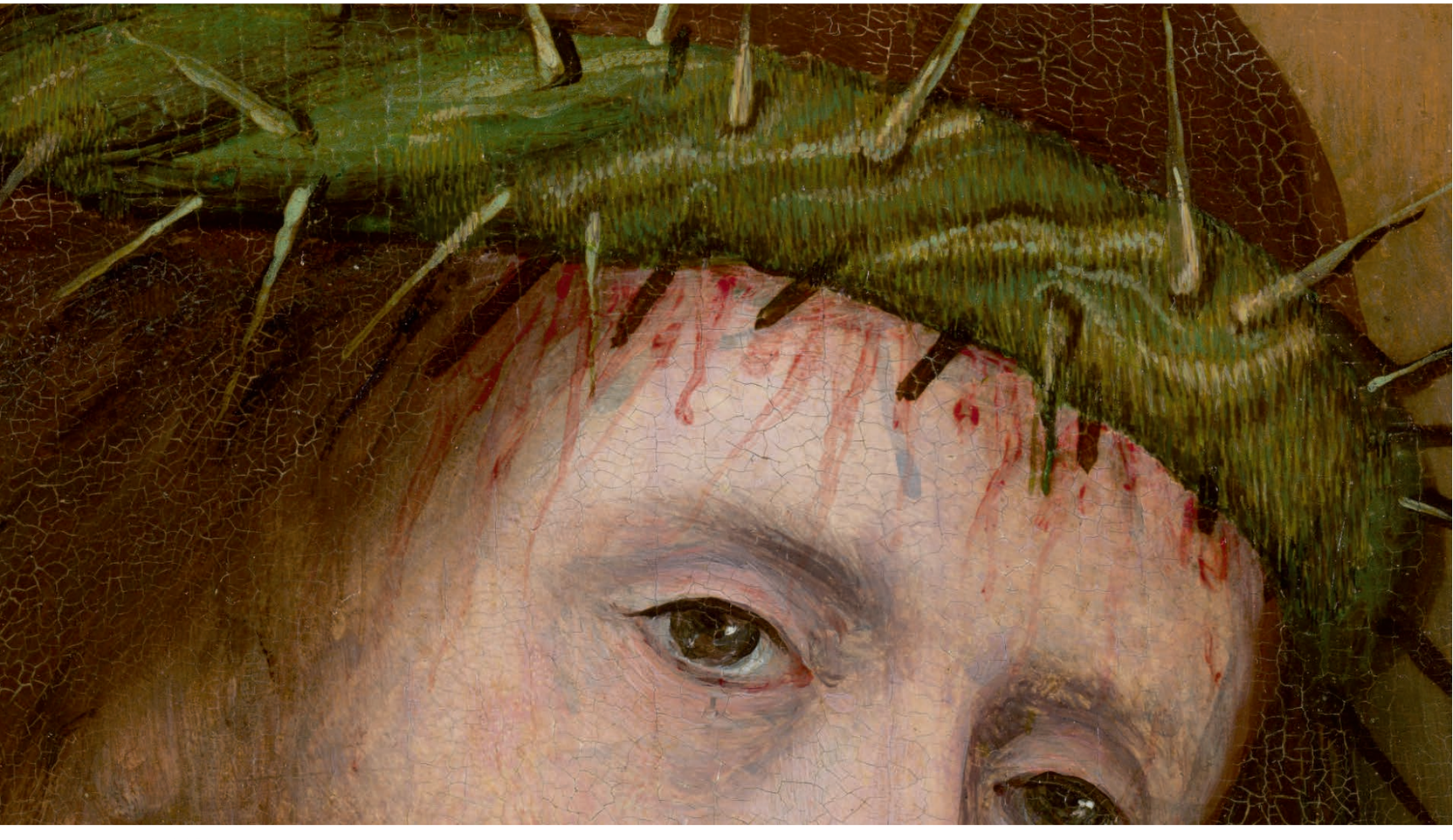
- ***Stability*** In general, the current adhesion of both paint and ground is very good. Most craquelure is caused by natural dimensional changes of the wooden panel. Broader drying cracks can be found in several areas, mainly where coarse azurite paint was applied thickly with ample medium.

  Metal soap aggregates appear to be forming between the oil binding medium and lead-white pigments, for instance in Simon's robe and in the face and robe of both Christ and his tormentor. The affected areas are opaque in the XR, and mostly follow the wood grain.
- ***Losses*** The green clothing of the soldier at right is almost completely lost. Other areas of severe loss are in the foreground landscape at the lower left and in the brown-yellow hill behind the soldier at right. These probably result from severe abrasion (see below). There are a number of smaller losses spread over the paint surface and along the joins.
- ***Abrasion*** The paint surface is somewhat abraded overall and a few scratches are detectable. The craquelure has become much more pronounced, possibly from a combination of abrasion of raised edges and solvent interaction. There are some older damages along the edges, with slightly more scuffing from previous framing. Green areas, however, have been severely abraded, to the point where large sections of the paint layers have been lost. Probably in an earlier treatment, the natural discoloration of the copper-green glazes (becoming brownish) was not understood and was mistaken as being non-original. Subsequent removal of this brownish-green material heavily damaged the original paint.
- ***Discoloration and increased transparency*** The red glazes have faded somewhat. This is particularly visible where they were applied thinly. The few remains of original glazes containing copper green have partially discoloured and appear rather brownish. Many paints (including skin tones) that contain lead white appear to have increased in transparency, causing the heightened discernibility of the ground and underdrawing, with an unintended change of appearance. Where purer, coarser azurite paint was used and more binding medium was necessary, the binder has discoloured slightly, giving the blue a slightly greenish tinge in places.
- ***Filling, retouching and overpainting*** The majority of the losses have been filled and inpainted, although a few smaller damages remain. The green areas were almost completely repainted. The retouchings

were generally applied in vertical strokes, using a *rigatino* technique, as in the crown of thorns (fig. 13.16) and in the green robe of the man at right.

Surface finish

- ***Varnish*** Three distinct layers of varnish can be distinguished. These are not original and appear glossy and very even, although in some darker areas, a reduced saturation is evident. The isolating varnish and the first coat of a finishing varnish were thinly and evenly applied to the entire painting with a brush. The second coat of finishing varnish was sprayed.
- ***Surface dirt*** There is only a minor amount of surface dirt on the painting itself. At its edges (e.g., top left), foam from framing is stuck on the surface.
- ***Visibility of the original surface*** The saturation of the paint surface is very good, but in places the varnish has sunk in, resulting in matte areas. Locally the abrasion and the more pronounced craquelure can be disturbing, and with the large repainted areas in *rigatino*, they distract slightly from the original paint surface.



13.16 VIS

[1] Marijnissen 1987, 280.

[2] The conservation report states that after its cleaning, the work's losses were filled using gypsum (calcium sulphate) with *aguacola*, a thinned animal (fish?) glue. After the filling, a Lefranc & Bourgeois retouching varnish was applied as an isolating layer. Retouching was done with Kremer dry pigments in a Gustav Berger polyvinyl alcohol (PVA)/ethanol medium, using a *rigatino* system. Glazes were applied using the Lefranc & Bourgeois retouching varnish. The final varnish consisted of an initial brush-applied layer of dammar (100 gr. resin, 500 cc white spirit, 3 cc Tinuvin®) in a 60:40 mixture with Lefranc & Bourgeois matte varnish, followed by a spray varnish of dammar (as above).

[3] Existing documentation and literature up to now only mention three planks instead of four.

[4] Klein 2001, 126. The youngest rings on the three wider boards are very close in date: 1483, 1484 and 1483, respectively. These three boards come from the same tree.

[5] Analyses have indicated that the thickness of the ground varies from 50 to 120 microns (µm). In addition to chalk, traces of gypsum, quartz and clay were also found. See Parra Crego 2004.

[6] See Parra Crego 2004.

[7] See Parra Crego 2004.

[8] Walnut oil was detected in paint samples of blue clothing and sky, in the whitish robe of Simon of Cyrene and also in the cool grey paints of the landscape and the robe of Christ. See Parra Crego 2004.

[9] Calcite was detected in this mixture as well. See Parra Crego 2004.

[10] Red earth was detected in the flesh tones and robe of Christ. Vermilion was not detected in the paint samples. See Parra Crego 2004.

[11] See Parra Crego 2004.

14 *The Crowning with Thorns*

RESEARCH REPORT 142–143

Hieronymus Bosch
c. 1490–1500

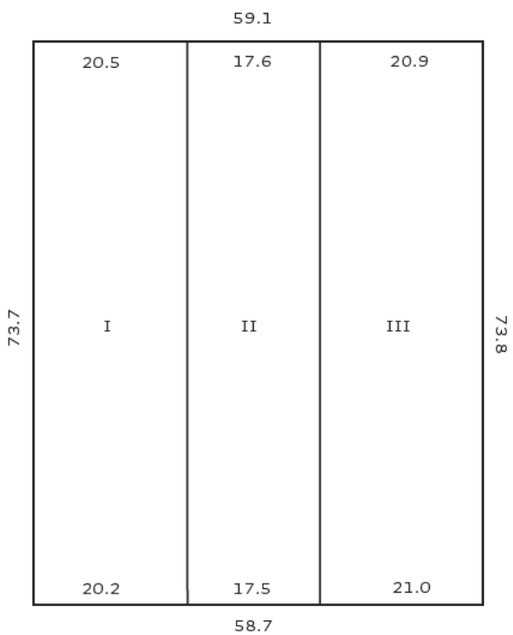
Oil (analysed) on oak (analysed) panel, 73.8 × 59.0 cm
London, The National Gallery, NG4744

BRCP, *Catalogue Raisonné*, cat. 14; www.boschproject.org no. 14.
The National Gallery did not give the BRCP permission to document this work.

Inscriptions and labels
There are multiple markings on both the cradle and the thinned panel, including circles and lines in blue crayon. In addition to seven round stamps,[1] there are a small, diagonal text stamp and a large, vertical inventory number stamp. A pencil mark is present at bottom centre, and at the centre right, a pen text and a printed label indicate in which direction the sliding cradle members should be extracted. On the reverse of the frame: TOP NG4744 F20714

SUMMARY OF CONCLUSIONS

The Crowning with Thorns *in London was painted by Hieronymus Bosch. The painting technique and the style and material of the phased underdrawing of the final composition can easily be linked with other works in the core of the group. The composition was significantly changed during the subsequent stages of production, further pointing to extensive personal involvement of Hieronymus in that process. Remnants of an earlier, abandoned composition (a Saint Christopher with the Christ Child) are present as well. This image was also started within the workshop but appears underdrawn by a different hand. The panel was originally housed in an engaged frame, now lost. Dendrochronology indicates that it could have been painted from 1481 onwards, although a date after 1483 is statistically more probable. As further explained in* BRCP, Catalogue Raisonné, *cat. 14, we date this work to around 1490–1500.*
The National Gallery did not give the BRCP *permission to document this work.*



14.1 Construction diagram (seen from the front)

RELATED WORKS

Elements of the composition were copied in several later versions of the *Crowning with Thorns*; see Van Schoute, Verougstraete and Garrido 2001, 113–15.

EXAMINATION DATA

24–25 November 2014 (Robert Erdmann, Luuk Hoogstede, Matthijs Ilsink, Jos Koldeweij, Ron Spronk).

The panel was examined by members of the BRCP team with Rachel Billinge at the National Gallery on 25 November 2014. The work was studied in limited time and without a strong light source. The painting was studied upright on an easel and flat on a table, using overhead daylight and fluorescent lighting. The available stereomicroscope and its cold light source were used, but no form of photographic documentation was allowed.

- ***Previous research and additional documentation available*** The conservation file on the painting holds two sets of XR prints. For one set, the gaps in the cradle had been filled with sugar before XR to create a more even and easier legible image. The file also includes IRP and IRR, as well as VIS images. Among the digital files are a visible light scan, OSIRIS IRR and many micrographs. No photograph of the panel reverse exists. Five paint samples had been made into cross-sections and two additional samples had been used for binding medium analyses. The cross-sections were not accessible for our research. Much of this data was published in Campbell 2014b; see also Spring 2012, 4–26.

- ***Previous treatments*** The painting was fully treated when it came into the collection in 1934. A private conservator removed the old varnish, then retouched and revarnished the painting. In 1950 the 'Surface [was] polished with mastic–wax mixture.' The conservation sheet further mentions 'Raised paint [in the] centre' in 1954, which may have resulted in consolidation. In 1967 the paint was consolidated and the surface was cleaned (meaning only surface dirt removal) and revarnished. In 2000, the pine cradle bars were extracted, thinned and refitted, and a 'Crack secured at the top edge (through the arrow) with dilute PVA.'

SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 14.1). Maximum thickness: c. 0.4 cm (excluding cradle).[2] The wood species, Baltic oak, was identified through dendrochronology.

  The panel consists of three quarter-sawn planks, vertical in grain, laid vertically. The three planks were butt-joined, dowelled and glued.

RR 143 (photo courtesy The National Gallery, London)

Only one dowel is partly visible on the thinned and cradled reverse of the panel. Less than half the thickness of the dowel remains (see further below, *Altered dimensions*).

- ***Dendrochronology*** The youngest heartwood ring dates from 1468, which, with the added minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1477 for the tree that produced that plank.[3] An earliest felling date of 1479 is statistically more probable, however, since that would cover 93 per cent of the range of possibly missing sapwood rings. Assuming at least two more years for drying and transportation, the panel could have been produced from 1479 onwards, but a production date from 1481 onwards is statistically more probable.

GROUND

- ***Visibility*** The off-white ground is present overall. The surface of the ground layer is fully covered by subsequent layers. The ground can be seen in VIS shimmering through paint layers, at the outer edges and in losses. Ageing effects have resulted in an unintended increase in visibility of the ground in certain areas.
- ***Barb and edges*** The panel has been trimmed up to the barb, removing the ungrounded and unpainted edges. Many traces of the original barb have been preserved on all sides of the panel, establishing that the panel was initially housed in an engaged frame (now lost), and that the painted surface has retained its original dimensions.
- ***Application*** The ground was applied fairly thinly, apparently in a single coat. The surface texture of the ground is not obvious in the painting.
- ***Composition*** The ground was analysed. It consists of chalk (calcium carbonate – $CaCO_3$) bound in glue.

PREPARATORY LAYERS

- ***Underdrawing*** The detectable underdrawing consists of two distinct types, with the first underdrawing relating to an abandoned initial composition of a Saint Christopher (see below, *Revisions …*).

  Underdrawing of the final composition can be seen in VIS, shimmering through the paint surface in multiple areas. The current visibility of the underdrawing, mainly in lighter areas, is caused by increased transparency of the paint in those locations, arising from changes in refractive index due to ageing. The greater transparency is especially notable in the garment of Christ, where both the lead white and the brownish glaze have altered. The extent of the preparatory drawing's clarity in VIS was not intended. IRP, and especially IRR, reveal its presence under the entire paint surface. The drawing is fairly elaborate but sketchlike, with most elements being indicated in what appear to be two stages of preparation. Underdrawing was used to work out the composition and to indicate contours, folds, areas of shading and some smaller details.
- ***Medium and application*** The underdrawing of the final composition was executed in a liquid medium. It appears to consist of relatively large, black particles sparingly dispersed in a medium that was applied with the brush atop the pigmented isolating layer.[4] Given the changes in the underdrawing stage and the hatching, the drawing appears to have been applied in two or possibly three stages.
- ***Style*** The underdrawing of the final composition is generally executed freely, with sketchlike and apparently quick, assured strokes. The lines are broad and range from fairly opaque to diluted black, applied more thinly and carefully in the faces – for example on the noses. Both long and short lines appear, and both types seem fairly regular. Depending on the feature drawn, they range from straight to highly curved, as at the underdrawn hair at Christ's shoulder. Most lines have slight curvature, and they frequently end in hooks or sometimes even loops. Line ends can be blunt or tipped, and occasionally underdrawing material puddles or pools at the end of a stroke. There is no evident bleeding of the liquid underdrawing. Where the artist made changes to the drawing, the lines are rather messy; for example, in the hand at the centre right. Presumably in the final-stage drawing, a few dark areas were prepared by sections of closely spaced lines. Strong parallel hatching can be found under the dark blue of the figure in the upper right. Fewer and softer hatched lines are present in some of the faces. The initial position of the black sleeve in the centre is also hatched, although these lines are positioned irregularly.
- ***Revisions in underdrawing and differences from painting stage(s)*** Two independent compositions can be found in the painting. The first, abandoned, composition represents Saint Christopher with the naked Christ Child on his shoulder. They are set in a landscape in which there appear to be an area of water and a rocky plateau. This drawing is revealed by IRR, although in VIS, too, a few elements can be seen shimmering through the paint. The initial drawing appears quite different in style and technique, although the reduced scale of the features drawn must be considered. The lines, finely done with a small brush, are seldom continuous. The contours, especially of the Christ Child, consist of very short and often curved black lines, applied in an energetic manner, that, unlike the broad underdrawn lines of the final composition, have not been encountered elsewhere in the core group.[5] Although only a limited amount of the initial drawing is detectable, the painted sky suggests that the underdrawing was completed, but perhaps partly rubbed off.

  It seems that the second composition was drawn directly over the first, as no intermediate layer was observed that could have covered up the initial composition.[6] The underdrawing of the final composition was revised in several areas before paint was applied. The figure in the lower left was underdrawn with his left arm raised, pointing at his mouth, and with a headdress covering his forehead. Both elements were changed in the preparation stages. The hand holding the spiked staff in the centre right initially clasped Christ's left arm. This hand, when altered, must have been underdrawn too, as the spikes on the staff were also underdrawn. These spikes, however, were not executed in paint.

  Other major deviations between the underdrawing and paint stages can be found in Christ's hair, which in its preparatory state was more profuse, and his garment, which was drawn as a mantle held together by a brooch. Christ was originally less slanting, standing more upright. His hands and the one on his right shoulder were both drawn in lower positions. The hand on his shoulder was not left in reserve but painted atop both robes. Just above the metal gauntlet and Christ's head, several underdrawn lines could have indicated a different position of the crown of thorns or perhaps a foreshortened hand holding it.[7] The nose of the man at the bottom right was painted slightly wider, and his eyes and arms a bit higher. His hands were adjusted as well, as they initially grasped the edge of Christ's mantle. The underdrawn staff of the man at the lower left was narrower and longer, resting against his shoulder. The nose and mouth of the tormentor at the top left were underdrawn a bit higher.

  The crossbow bolt was painted on top of the headdress (probably a wrapped *chaperon*) and the background. It is neither underdrawn nor reserved, but several incised lines roughly indicate its contour. Stereomicroscopic examination reveals that at the top, the incision also runs through the sky paint of the abandoned composition. The cut was not clean and dry, as evinced by the light blue paint raised along the incision. With the incision, the paint of the sky was pulled

up, indicating that it was not yet fully dry at the time. Since the bolt was painted in a final stage, the currently visible composition must have been executed shortly after the initial one was abandoned.[8]

- ***Intermediate layers*** A very thin, pigmented isolating layer, consisting of lead white and a very small amount of black pigment, was applied overall onto the ground. Stereomicroscopic examination indicates that the underdrawing of the final composition was applied atop this layer. This was supported by the inspection of cross-sections.[9]

PAINT LAYERS

- ***Binding medium*** Linseed oil was detected in the paint layers, with the addition of some pine resin for the red lake glaze of the man's headdress in the lower left.[10]

- ***Paint application and painting technique*** The paint was applied using a brush and covers almost the entire surface of the panel. The pigmented isolating layer is seldom visible at the interfaces between different colours. Paint was applied in several stages, both wet-in-wet and wet-on-dry. The paint extends onto the barb, as the panels were originally executed in an engaged frame. Incisions were made only around the crossbow bolt (visible in VIS and XR).

  The mostly fluid, glossy paints were applied in both opaque and semi-transparent layers. Glazes were done in green, red and a warm brownish colour. Depending on the scale of the feature, the artist painted in both fairly fine and rougher styles, mostly in two or three layers, covering nearly everything. Paints were applied quickly and skilfully, in both thick and thin layers. Thin paints can be found, for example, in some of the flesh areas. By comparison, those used in areas of lead-white undermodelling and highlights of lead white and lead-tin yellow, as well as in blue areas that contain coarser azurite pigments, are slightly thicker. The lead-white paint dots on the two small spheres are especially impastoed.

  The forms were laid in fairly precisely, and a sharp contour line of raised paint is often visible. Brushstrokes were applied in multiple directions, following the forms of the composition and rendering volume and texture throughout the painting. For example, at the chest area of the green robe, the brushstrokes follow and reinforce the fold pattern. The painting was evidently done at great speed, since the artist did not wait until all the layers were fully dry, which resulted locally in youth cracks (drying cracks caused by the application of medium-poor over medium-rich paint). In the crown of thorns paint was applied extensively wet-in-wet, too. Occasionally, the red lake paint, when applied thus, pushed aside the grey and white paint underneath, exposing the pigmented isolating layer.[11] In the hand at centre right, brown contour lines containing some black pigment were put on, pushing aside the still-wet, semi-transparent paint. The lower contour of the hand is blacker, and the red lake applied afterwards dragged some of the black paint along. At the wrist, the light skin tone was followed by the black of the sleeve, then brownish skin-tone paint was applied, and finally a black stroke adjusting the sleeve's contour. In addition to the wet-in-wet painting, the artist also appears to have employed some feathering. This can be seen in the light grey detailing on the black woollen hat.[12] The metal disc on the blue cape has a grey base colour, subsequently detailed by lead-white brushstrokes and then thinner, finely painted lead-white lines, both radiating from the centre knob of the roundel. The white strokes were laid into the still-wet grey, partly blending with it to result in the apparent play of light.

  Many elements were not worked out to a high degree of detail and finish, although highlights on eyes and several other small details were applied. The detailing of the star, crescent and cross were done in a fairly fluid lead-white paint on the still-wet red lake of the headdress. In both red and green lake paints, regular and very closely spaced dots of lake are discernible in areas, which seems to indicate that the glazes were blotted with cloth.[13] The discoloured copper-green glaze seems to have been applied evenly onto the darker and lighter areas of the green robe.

  At the top left, around the green headdress, part of the blue sky from the abandoned first composition was left exposed by the grey background paint. This resulted in a light contour that Campbell interpreted as a deliberate highlight.[14]

- ***Texture*** Many passages do not have a smooth finish, as slightly textured brushstrokes are often visible. These strokes often follow the forms and were probably used for some modelling. Several colour passages have fairly sharp paint ridges at their contours.

- ***Build-up and palette*** The paint was mainly applied from light to dark, followed by highlights. Dark-to-light paint application is evident in the hair of Christ, the black woollen hat, the gauntlet, and detailing. The composition was roughly built up by first painting the larger sections and leaving in reserve the smaller compositional elements, with the faces as a possible exception. It seems that the figures' visages were painted before the rest of their bodies, as in some areas, parts of the clothing overlap the skin tones. The faces appear to be modelled in two to three layers. A thin, light layer was laid down first, containing mostly lead white, but seemingly also black and/or earth pigments in differing quantities for each face, resulting in midtones. This layer's current level of transparency seems to be largely the result of ageing. It is slightly warm-toned for the face of the tormentor at the top left, whiter for the face of Christ, and slightly greyish for the figure at the top right. The second layer generally consists of more pinkish paint, again of varying colour, and is applied primarily in lighter areas of the faces. Although the pinkish areas bear considerable lead white, they appear less transparent due to the thickening effect of this second paint layer, and have resulted in the higher contrasts seen now. Finally, a brownish glaze paint, some vermilion, and possibly red lake detailing were applied locally. Some green pigment was observed in the shadow under the lower lip of the top left tormentor.[15] The light skin-tone paint in Christ's neck was applied after his beard was painted.

  Red lake was used extensively. Aside from the two red robes and the headdress, it was also used both pure and mixed with other pigments for many details and as a component in the brownish glaze. Red lake is present as a glaze on the purplish-blue robe at the bottom, applied thinly for the lighter areas and more thickly for shadows, where it is preserved better. Red lake was also used in a cast shadow for the metal disc.[16] Mixed with black, this colourant is the main component of the reddish cap extending below the green and black *chaperons*. In multiple areas, tiny red fibres of wool shavings were detected, revealing the source of the red lake.[17] The red sleeves, including the lead-white-bearing undermodelling, were painted after Christ's robe and were followed by the black undergarment (of which the long sleeves and standing collar are visible) and the black of the buttonholes. The difference in appearance of the two red robes is caused by the underlayer. For the sleeves, a lead-white undermodelling was applied that contained some blue pigment and red lake, whereas in the other robe, an unadulterated azurite blue undermodelling was applied. The red lake here seems to have been added after the hand was painted. The veins in the hand were painted in blue. Blue pigment can be found in all of the skin tones, especially where shadow areas are depicted, as in the stubble of the man in the lower right. The metal tip of the crossbow bolt was painted in lead white and blue, with only a little black added to the mixture.

  The green clothes were done in two stages. It appears that a verdigris glaze was applied on top of a base modelled from verdigris

and lead-tin yellow, with black and lead white, respectively, added for the shadows and lighter areas.[18] The white teeth of the man in the lower left have a grey base. The green lake of the robe overlapped this white and the skin tone, but the changes to the chin (see below, *Changes*) and the white paint of the beard were painted after the green. The eye of this figure has a grey base at the right and is bluish at the left, followed by pinkish grey, black and then white paints. The red hue of the initial *chaperon* was applied before the azurite blue of the robe and consists of a mixture of red lead and vermilion, with colourless powdered glass added.[19] The two small pendant spheres on the red headdress have a grey base that was detailed by highly impastoed lead-white dots. The spheres were painted in a final stage, as were the markings on the *chaperon*. For highlights, primarily lead white was used, and in a few instances, lead-tin yellow. In the crown of thorns, several highlights were applied after the red lake. The initial hand at the bottom centre was completely finished, with dark brown shadows painted around the lower fingers, the latter also overlapping the base colour of Christ's robe. These paints were overlapped by the changes made to the hand, then a warm brownish glaze was applied as a new shadow. After that a more opaque, slightly purplish grey-brown paint was applied below the hand.

The grey background, consisting of lead white mixed with a fine black pigment, seems to have been painted after the main sections were laid in, but before detailing was applied. For instance, it covers the green glaze at the edge of the headdress in the top left, but the grey and black fibres of the black woollen hat overlap the grey. In a few areas, contours were slightly adjusted by grey reinforcements. Before the grey background paint was dry, the thorns of Christ's crown were painted, pushing grey paint aside and pulling it along onto his hair. Next, several loose hairs were painted, partly intersecting the thorns. This further connected the crown to the head. The oak twig pinned through the hat was painted atop the black. The darkest black paint on the woollen hat was applied in a final stage, as it was worked around the thorns and the spiked collar.

- ***Changes*** The light blue sky of the abandoned and overpainted first composition consists of a mixture of lead-white and azurite pigments and stands out in the XR. The sky was applied in vertical brushstrokes, leaving in reserve an area to the right, possibly for a tower. No other paints have been found, and the initial composition was given up in this unfinished state.

  Multiple changes can be detected in the visible composition, some of them cropping or extending elements in the composition, but also larger changes. The gauntlet was painted wider at the hand, overlapping the green robe on both sides. The chin of the figure at the lower left protruded less, and there were also changes to his neck. His entire headdress was initially executed in opaque red and had the form of a *chaperon*. This was altered, largely by covering it with a pinkish base containing lead white (as well as some blue pigment), followed by red lake. Around the hand holding the staff, blue paint was observed in an underlying layer, probably relating to the sleeve of his left arm. The spiked collar in the top right was added later, covering the skin tone of the neck and the black of the hat. The man's nose was cropped slightly with warm brown paint. The black *chaperon* of the figure in the bottom right was extended, covering his arm and the garment of Christ, making the face stand out more. The XR reveals that also at his shoulder the black of the *chaperon* was initially planned to be narrower. The red lake of the completed arm currently shimmers through the black paint. Other visible pentimenti include this man's lower hand in the centre, the changes to the bluish sleeve and the hand in the bottom, the red paint visible under the extended staff, and the white hair and green robe visible at the top of the altered red headdress.

FRAME

The original, engaged frame has been lost. The panel is mounted in a modern wooden frame (86.7 × 72 × c. 8 cm). The profiled and gilded frame has a black-painted central section.

CONDITION

Support

- ***Altered dimensions*** The panel was cropped on all four sides, removing the original unpainted and ungrounded edges. The barb and the entire painted surface were preserved. The panel reverse was thinned by more than half (as indicated by the dowel remains) in order to apply the cradle.
- ***Additions*** After the panel was thinned a cradle of soft wood was applied, consisting of seven vertical and eight horizontal members. The vertical cradle members seem to have been attached using an animal glue. In the 2000 treatment, the blocked horizontal bars were adjusted to slide again, and screws with washers were attached at both long ends to prevent the thinned bars from unintentionally sliding out.
- ***Cracks*** A very small crack in the top centre was stabilized in the 2000 treatment.
- ***Deformations*** The panel is almost completely flat. This is likely the result of the cradling and flattening treatment that took place before the painting was acquired in 1934.
- ***Joins*** The two vertical joins are covered by cradle members on the reverse. The joins are closed, but a slight difference in level is discernible on the front.

Ground and paint layers

- ***Stability*** In general, the current adhesion of both paint and ground is very good. Most craquelure is caused by natural dimensional changes of the wooden panel. Broader drying cracks were observed mainly in the hair of Christ, where they stand out because of the dark brown residues in these cracks. Drying cracks are also present in the red lake paint covering Christ's robe, just right of the bottom centre. Youth cracks are present in the left centre, where lead-white and red lake paints were applied onto a slow-drying vermilion initially used for the headpiece. Original adhesion problems were noted at the buckle of the spiked collar, where the brown paint overlaps the dark grey or black of the cap. Similar issues are visible at the altered chin of the man in the lower left and at the eye of the man in the lower right, where paint did not originally adhere properly. At present these do not form stability issues.

  Metal soap aggregate formation, which can appear as small, opaque points in XR, has been observed in many areas, especially in areas of the crown of thorns that are rich in lead white and lead-tin yellow. Expansion of the aggregates may cause them to protrude from the paint surface, resulting in minuscule raised spots and a more granular surface texture. Loss of these metal soap aggregates results in tiny, craterlike holes that appear dark in XR. Over time, accumulation of dirt and varnish residues in these holes causes them to appear dark in VIS and IRR/IRP.
- ***Losses*** The paint layers are largely intact. There are losses at the joins and scattered pinpoint losses. In the lower part of the painting there are several deep scratches. The paint was also damaged by something that dripped down just left of the top centre, extending from the top edge and continuing onto the gauntlet. Here, a transparent, brownish material is present in the interstices of the paint.

- ***Abrasion*** The paint surface is slightly abraded overall.
- ***Discoloration and increased transparency*** The red glazes have faded somewhat. This is especially visible where they were applied thinly, as on the blue sleeve, which would originally have appeared more purplish. Abrasion may play a role as well. The copper-green glazes have partially discoloured and appear somewhat brownish. Many paints (including skin tones) that contain lead white and earth pigments have increased in transparency, causing the heightened visibility of the ground and underdrawing and with it, an unintended change of appearance. This is more evident where the paint is thin, as in the garment of Christ. The lead-white base layer contains some earth pigments, a little red lake, a tiny amount of blue pigment and some black. The glaze, more thickly applied in areas of shadow, contains warm brown earth pigments, and some black and red lake. Since most of these paints have increased in transparency or perhaps faded, it does seem possible that the white of Christ's robe initially had a very slight pinkish tone, but it was never scarlet or purple in colour.[20]
- ***Filling, retouching and overpainting*** The majority of the losses have been filled and inpainted, although a few smaller damages remain. Most of the retouches stand out now because of their discoloration.

Surface finish

- ***Varnish*** The documented previous treatments indicate that at least three distinct layers of varnish must be present, one of a mastic-wax mixture (see above, *Previous treatments*). These are not original and appear glossy and reasonably even.

  The mastic-wax mixture was probably rubbed (polished) onto the surface. The application method of the other varnish layers is uncertain, but appears brushed.

  The appearance of the varnish is reasonable. Despite some matte areas from sunken-in varnish, the paint is largely saturated. The varnish has, however, discoloured, turning more yellowish.
- ***Surface dirt*** There is hardly any surface dirt on the painting itself, since it is displayed behind glass.
- ***Visibility of the original surface*** The saturation of the paint surface is reasonable, but in places the varnish has sunk in, resulting in matte areas. Additionally, there are multiple glossy areas from retouchings. Many of the old retouchings have discoloured. Furthermore, the discoloration of paints and their increased transparency can be disturbing. The aged, discoloured varnish has caused a reduced contrast, as the dark paints appear lighter and less deep (e.g., the black hat), and the light paints appear darker, more yellowish.

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[1] Campbell 2014b, 148: 'Two of the stamps were applied by the Italian Customs authorities at Chiasso, the frontier post on the railway between Milan and Lucerne, and are dated 4 December [1933] and 15 January [193]4; another bears the date 18 January.'

[2] Because of restrictions on time that researchers were allowed with the painting, measurements were copied from Campbell 2014b, 148.

[3] Analysis was done by Peter Klein in 1995. The youngest rings on each of the three boards date from 1468 (I), 1460 (II) and 1439 (III), respectively. Boards I and II came from the same tree. See Klein 2001, 124.

[4] Campbell 2014b, 148.

[5] Compare Campbell 2014b, 157, who states, 'It is probably also by Bosch, who, when he decided to reuse the panel, may have made a deliberate choice of broader brushes and a more dilute paint for the second underdrawing. He was working directly on top of the underdrawn Saint Christopher – there is no trace in the paint samples of any layer between the two underdrawing stages – and would have wished to make as clear as possible the distinction between the two superimposed underdrawings.'

[6] Campbell 2014b, 148 and 157.

[7] Campbell 2014b, 149.

[8] This observation and conclusion were further supported by the absence of dirt between the two compositions, as noted by Billinge in examining paint cross-sections. Rachel Billinge, oral communication, 25 November 2014.

[9] Campbell 2014b, 148. No mention was made of the position of the initial drawing.

[10] Campbell 2014b, 150, further states that 'No evidence has been found that heat-bodied linseed oil was anywhere employed.'

[11] Campbell 2014b, 151 fig. 15.

[12] Campbell 2014b, 151 fig. 14.

[13] Campbell 2014b, 150 figs. 9–10.

[14] Campbell 2014b, 150 and 151 fig. 11. This highlight does not accurately match the light direction depicted and might have been unintentional.

[15] Campbell 2014b, 149. The author further states that '... the inclusion of green in flesh paint is uncommon in Netherlandish paintings of the period'.

[16] Campbell 2014b, 150 and 151 fig. 12.

[17] Rachel Billinge, oral communication, 25 November 2014. For more information and literature on the production of red lakes, see Wallert 1991, 74–83; Hofenk de Graaff, Roelofs and Van Bommel 2004, 344–52. Although the red lake paint appears to have been blotted locally, a red cloth is not the source of the fibres, as they have also been detected in areas without traces of blotting.

[18] Campbell 2014b, 150.

[19] Colourless powdered glass was added to the mixture of red lead and vermilion in the red headdress and to the red lake glaze on top. The glass has an estimated particle size of 5–10 µm and is of a wood ash-lime (high lime–low potash) type. Spring 2012, 23.

[20] Campbell 2014b, 155.

15 *Calvary with Donor*

RESEARCH REPORT 19–20

Hieronymus Bosch
c. 1490–1500

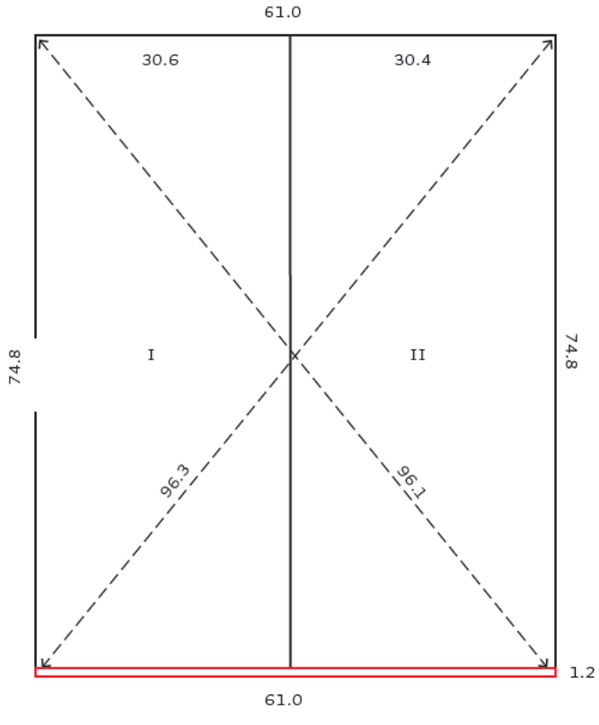
Oil (not analysed) on oak (analysed) panel, 74.8 × 61.0 cm (including added strip on the bottom).
Musées royaux des Beaux-Arts de Belgique/Koninklijke Musea voor Schone Kunsten van België, Brussels, 6639

BRCP, *Catalogue Raisonné*, cat. 15; www.boschproject.org no. 15.

Inscriptions and labels
Top centre, *inri* as part of the iconography inscribed in black on the white plaque above the cross.
Reverse, top centre: a museum identification label.

SUMMARY OF CONCLUSIONS

The technical evidence is in full agreement with the attribution of the Calvary with Donor *to Hieronymus Bosch. There are relatively few differences between the phased underdrawing and the paint layers, but the painting technique as well as the style and material of the underdrawing place the panel in the core oeuvre.*
At some point in time, the donor was at least partly painted over with another figure at the foot of the cross, probably a Mary Magdalene, but that figure was later removed. A strip at the bottom of the panel was cropped off and reconstructed. The panel was originally housed in an engaged frame, now lost. Dendrochronology indicates that it could have been painted from 1477 onwards, although a date after 1479 is statistically more probable. As further explained in BRCP, Catalogue Raisonné, *cat. 15, we date this work to around 1490–1500.*



15.1 Construction diagram (seen from the front).
Red lines indicate non-original section.

EXAMINATION DATA

5–6 October 2011 (Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Ron Spronk).

The painting was examined in a photo studio. The panel was studied upright on an easel and flat on a table under strong visible light and UV radiation.

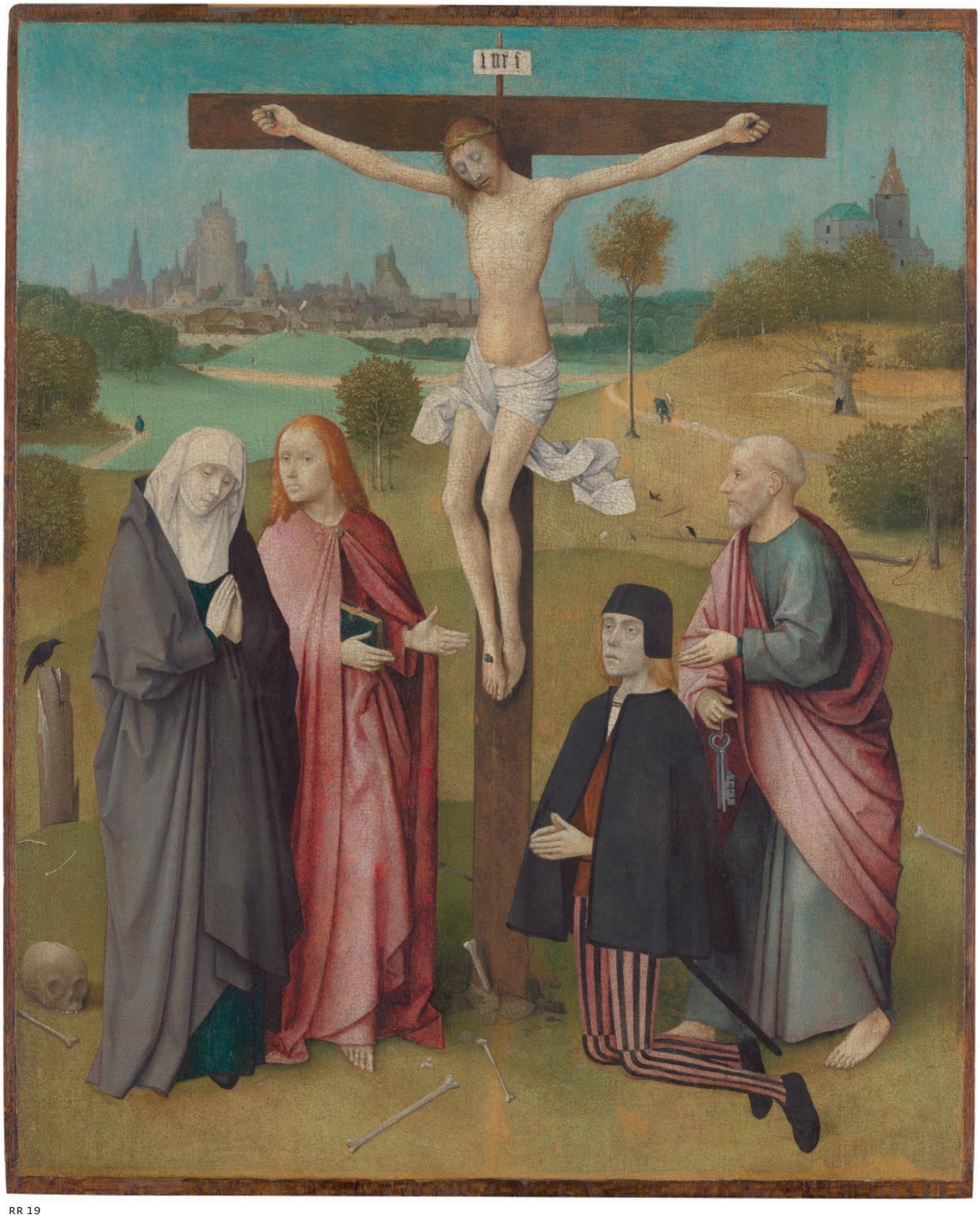
- ***Previous research and additional documentation available***
  Stroo et al. 2001, 70–83.
  Five complete XRS of the painting were studied and photographed.[1]

- ***Previous treatments*** The painting was extensively treated at least once before it entered the collection of the Brussels museum in 1952. The two boards must have come apart at some point before 1952, and, according to Stroo et al. 2001, two extra dowels were inserted into the thickness of the wood to reinforce the join.[2] Also before 1952, presumably during the same treatment, nine buttons were adhered onto the reverse on the join, and a larger, rectangular piece of wood was inserted into the upper left (as seen from the reverse) corner of the panel. The reverse was sealed with glue. A figure that had been painted on top and just left of the donor at the foot of the cross (probably a Mary Magdalene; a hand is still visible on the vertical crossbeam in the X-radiograph) was largely removed before 1952 and the painting was retouched (see below, *Filling* ...).[3]
  During the 1966–67 treatment by A. Philippot and his team (which included Nicole Goetghebeur and Regine Wittermann) at the Royal Institute for Cultural Heritage (KIK-IRPA), a strip of wood was used to replace the severely worm-eaten lower edge; the glue layer on the reverse was scratched off and the reverse was impregnated with wax; the paint layer was consolidated; varnish, overpaint, early retouchings and fills were removed; and new fills and retouchings were applied.[4] There may be a report from the 1984 treatment, but it could not be located.

SUPPORT

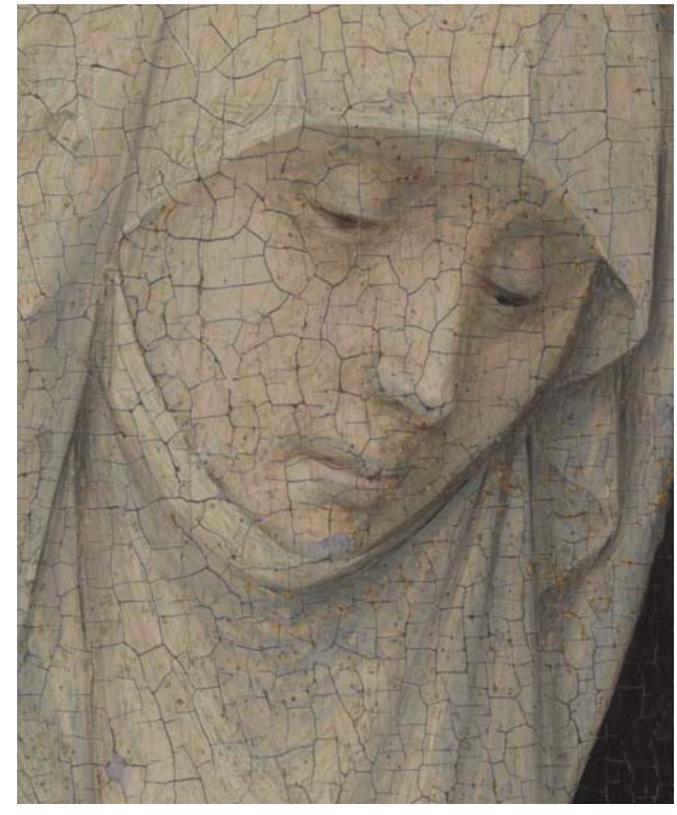
- ***Panel*** Dimensions: see construction diagram (fig. 15.1). The thickness of the original panel is irregular, but measures around 1.6 cm.
  The wood species, Baltic oak, was identified through dendrochronology. The painting consists of two quarter-sawn planks, vertical in grain, laid vertically. The two planks were butt-joined, dowelled and glued. The position of the dowel holes is visible in XR, although only one dowel shows clearly.[5]
  Traces of possible scrub-work and planing can be observed on the reverse.

- ***Bevelled or half-lap edges*** Half-lap edges are present on the left, top and right of the panel reverse. The half-lap section at the bottom edge is a later addition (see below, *Altered dimensions*).



RR 19

RR 20



15.2 VIS

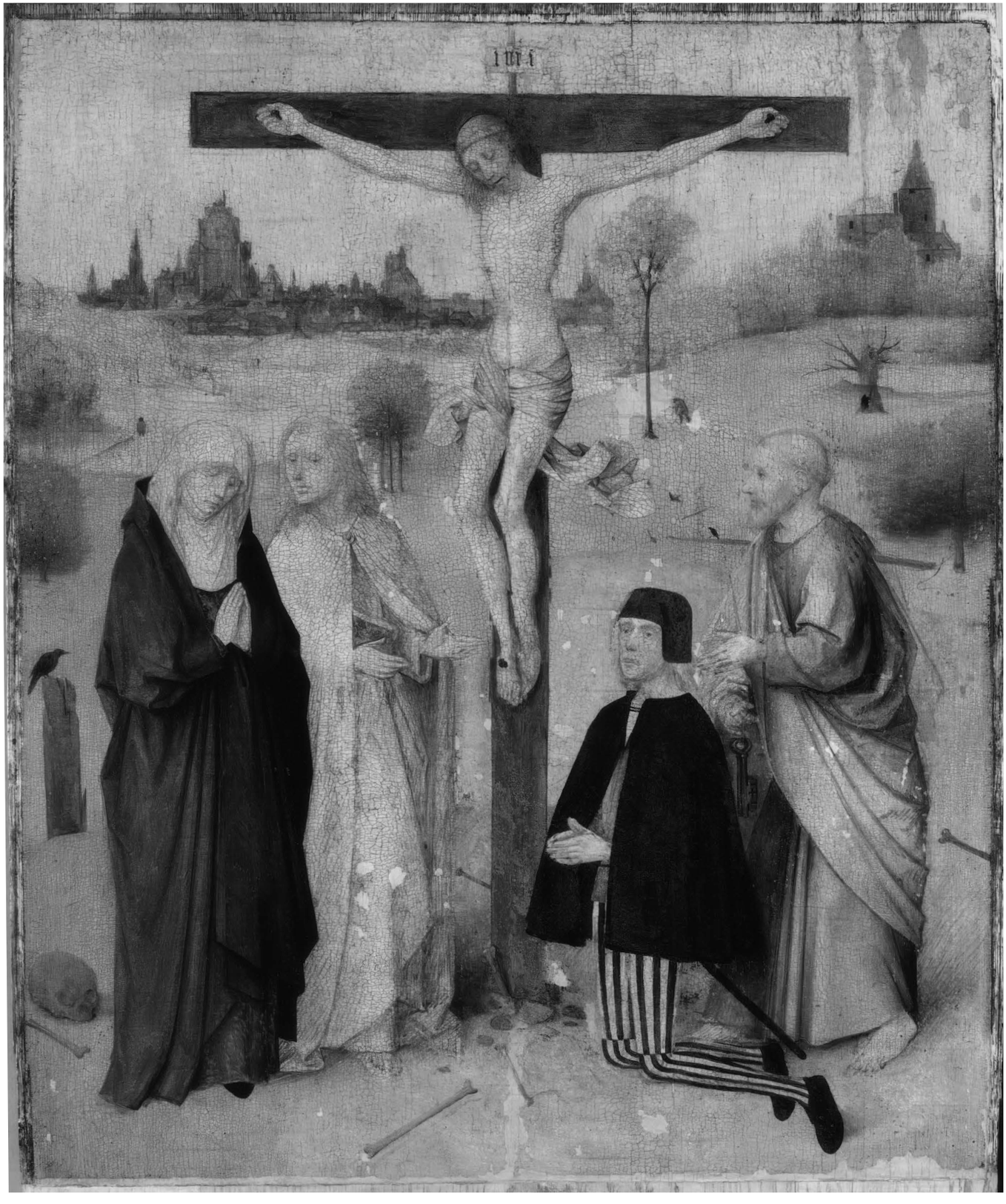
- ***Dendrochronology*** The youngest heartwood ring dates from 1466, which, with the minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1475 for the tree that produced the wood for that plank.[6] A felling date after 1477 is statistically more probable, however, since 93 per cent of the possibly missing sapwood rings would be covered by that range. Assuming an additional minimum of two years for drying and transportation, the painting could have been produced from 1477 onwards, although a production date from 1479 onwards is statistically more probable.

GROUND

- ***Visibility*** The cream-coloured ground (not analysed) is present overall. In VIS the ground can be seen in damages and at craquelure.
- ***Barb and edges*** The original barb and ungrounded and unpainted edges have been preserved on the left and right sides and at the top of the panel, establishing that it was originally housed in an engaged frame, now lost. These original ungrounded and unpainted edges vary in width between 0.8 and 1.2 cm. The bottom edge is a modern reconstruction of the ungrounded and unpainted edge and barb (see below, *Altered dimensions*).
- ***Application*** The ground seems to have been applied fairly evenly. Brushmarks in the ground application were not noted.[7]

PREPARATORY LAYERS

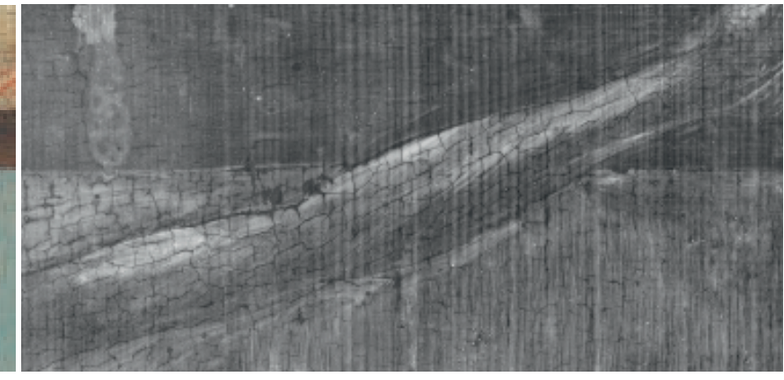
- ***Underdrawing*** Extensive underdrawing is discernible in most of the painting, both in VIS (shimmering through paint layers; fig. 15.2) and in IRR/IRP, but the dense craquelure and the ample use of dark and green paints reduces its visibility (fig. 15.3). Underdrawing was used to indicate most pictorial elements and thus to determine the overall composition. The background landscape was quite elaborately prepared, especially in the left middleground and in the lower right corner, where Saint Peter's shadow is indicated. Locally, underdrawing was noted at the top edge of the cross, left of Christ's head. The underdrawing also aided in modelling, with large zones of parallel hatching. Areas of deep shadow were prepared with denser hatching, using broader, more opaque lines that were placed closer together. It appears that the underdrawing in the red robe and mantles indicated those areas where lead-white-based underpainting was not to be applied. It seems unlikely that the underdrawing was meant to be evident in the final composition. Its current visibility in several areas has probably been caused by changes in refractive index due to the ageing of the paint film and fading of the red lake.
- ***Medium and application*** The underdrawing was applied using a brush in a liquid medium in what appear to be two or three stages. The possible first-stage underdrawing indicated the contours of the main elements and facial features, with a medium-size brush. Most of the large zones with the finer parallel hatching were also done with a medium-size brush, in a presumed second stage. It is possible that the areas of deepest shadow were laid in last, in a third stage, with a larger brush – for example, in the dark right section of Saint John's robe, in the lower right part of his cloak and in the dark area on Saint John's chest above the book. The density of the lines varies somewhat, but diluted pigments were not noted in the IRR macro.
- ***Style*** The relatively detailed underdrawing seems to have been applied quite fluently (especially in the robe and face of Saint John). Some longer, continuous lines are present at folds and contours, but most tend to be short and discontinuous (e.g., the contour of the Virgin's headdress). Hatching is done almost exclusively with



15.3 IRR

parallel lines that follow the direction of the feature. Lines tend to run from top right to bottom left, but also vertically, and from top left to bottom right. Cross-hatching was only rarely used, for example in some of the folds of Saint Peter's robe. Shadow was indicated with thicker lines and denser parallel hatching. Shadows on the ground were also prepared with hatching. Line ends are mostly straight and often tipped, but the lines themselves often have some curves.

- ***Revisions in underdrawing and differences from painting stage(s)***
  There are only very few revisions within the underdrawing, which itself was largely followed in the paint application phase. The contours of the heads of Mary, John and Peter were reduced and the hands of John and Peter were altered. The back of Peter's mantle was shifted to the left, and two short, more horizontal folds in the lowest part of his red cloak were not painted. The foot of John was shifted



15.4–5 VIS and XR

slightly to the left. The larger bone in front of him was planned somewhat lower, but the smaller bones, ribs and skull were not underdrawn. Also, an earlier contour appears to have been drawn above the head of Christ.

- ***Intermediate layers*** A pigmented off-white isolating layer was applied overall and is visible in VIS (glimmering through the paint layers) and in XR. The thinly painted layer contains some lead white that makes it distinguishable in XR, revealing broad brushstrokes that do not relate to the composition. The underdrawing probably lies below this layer, since the underdrawn lines do not 'skip' anywhere over the roughly brushed strokes.

PAINT LAYERS

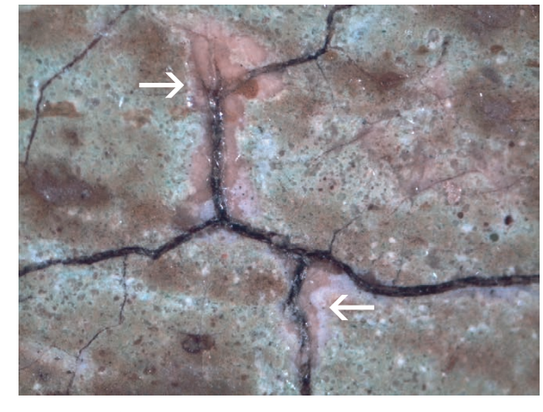
- ***Paint application and painting technique*** The oil paint (not analysed) was applied with the brush over the entire original panel surface and onto the edges of the barbs (see below, *Altered dimensions*). It was applied in several stages atop the pigmented isolating layer (as can be seen, e.g., at the opened craquelure in the foreground; fig. 15.6), mostly in one to two layers, followed by additional modelling and detailing. Paint application was mostly wet-on-dry, but locally some wet-in-wet was observed; for example, in the tree trunk with the bird at the left and in the black lines on the white undergarment on the donor's chest. Here and elsewhere, paint does not seem to have been manipulated with the back of a brush but moved aside by brushstrokes (19MICGBM005).

  The thin dark lines that are visible in XR at the contours of the horizontal beam of the cross and around Christ's body are probably not the result of incisions, but seem to be related to the linking of craquelure along the edge of the sky. The craquelure has widened due to paint loss, possibly as a result of solvent interaction (figs. 15.4–5). A similar effect is visible at the interface of Christ's chest and the sky to his left.

  The generally wet and glossy paints were applied in both opaque and semi-transparent layers. Both thick and thin paint layers were used, some allowing the underlying pigmented isolating layer to shimmer through. This is more apparent in lighter areas or where there are red glazes. But no extensive use was made of the underlying layer shimmering through, and in several deep red lake zones a dark or black paint was applied afterwards to enhance the shadow. Also, the current visibility of the underlayer is largely due to ageing of the paint (see also below, *Discoloration …*).

  In general, the panel was painted to a high degree of finish, using fine brushstrokes. Rougher strokes were frequently used in the underlayer (e.g., in the white of the sky and in the background). Brushstrokes were utilized to some extent to render contour and volume throughout the painting, but more so for impastoed paints, which often contain a lead-white component. In Mary's cloak, final red lake touches were locally applied atop the lighter grey paint, using short, parallel lines perpendicular to the direction of the long folds, giving the cloak a purplish sheen. The dark and light shades of grey in the face of the donor seem to have been painted adjacent to one another, only slightly overlapping and blended. The lighter colour of the cheekbones was possibly applied after the darker grey, but this area is in a generally poor condition (see below, *Abrasion*).

- ***Texture*** Several passages do not have a smooth finish but a light impasto with slightly textured brushstrokes. This is the case in Christ's chest, the landscape, the sky and areas where thick azurite paint was employed. Many of these brushstrokes have become more apparent because of darkened varnish and dirt residues in the interstices. Aside from some impastoed highlights, texture was also used for some modelling, as in the robe of Saint Peter. A very fine,



15.6 19MICGBM006

15.7 VIS

regular textural pattern is discernible in a few areas of Mary's robe. It may have been pressed into an underlying layer, but does not appear to serve a specific purpose in the pictorial layer.

- ***Build-up and palette*** The paint was applied from light to dark (as in the sky, areas of red and green glazes and shadows) and from dark to light (as in the foliage of the trees, Mary's robe and highlights). The painting was largely built up from back to front and was almost completely planned. Larger features were left in reserve, but smaller objects like the rocks and bones in the foreground were executed atop the background layer. For the entire sky, first a light blue layer containing primarily lead white and azurite pigments was applied atop the lead-white-based isolating layer. This was followed by a second, darker blue layer, seemingly only applied closer to the top of the panel. When the sky was painted, the cross, Christ, the landscape and most of the architecture were roughly left in reserve. Subsequently these elements were painted in, slightly overlapping the sky, which is also the case with trees extending into the sky area. The farthest and darkest row of buildings in the left background was painted atop the sky, as were the buildings on the far right.

15.8 XR

For the trees, first a darker green base colour was applied, followed by light green dabs, then adjacent touches of a still lighter hue in a fairly fluid impasto. The *titulus* on the top of the cross was left in reserve from the blue. The figures that had been left in reserve were painted roughly at first and received their detailing only after the landscape was completed. This is illustrated, for example, in Saint John's hair, where greenish landscape paint covered part of the base colour (reducing the size of his head), but was followed by the fine lines of his locks. His hair was also painted after his mantle, beginning with a brownish base. Then, from the top of his head some lighter, blended brushstrokes were applied, gradually becoming the thinner, more defined, hatched highlights towards his shoulders.

Red lake was used extensively in the garments of the saints and in the striped breeches and stockings of the donor. The lighter sections of Peter's mantle and John's robe seem to have been thinly and locally modelled with white to greyish paint before the application of red lake. Also, Peter's purplish-blue robe was modelled before the red lake was applied, apparently over the entire robe. The cloak of Mary received initial modelling in red lake, followed by lighter grey paint and final red lake touches to create local purplish effects (see above, *Paint application* …). Some red lake pigment was also found in Christ's crown of thorns, his side wound, and on his hands (19MICGBM001), but an orange to red paint was generally used to indicate blood.

Mary's headdress is composed of a thinly applied, wet-in-wet, greyish white (fig. 15.2). Her dark blue robe under her cloak appears to have been painted with azurite pigment, which was also used for John's book. The azurite paint was applied after John's hand was painted. The brownish outlines visible in the hands and feet were essential to convey physiognomic detailing; without them, the hands and fingernails would hardly be legible as such. The black stripes on the donor's hosiery were painted atop a still-wet paint layer, as evident from the displacement of paint. The closing cords of his lower garment were also painted wet-in-wet with the white layer underneath. In a similar way, black strokes were pushed into the still-wet grey base paint of Saint Peter's keys. Subsequently, highlights were applied. A green lake is present in the crown of thorns, in which light green highlights appear as well.

- ***Changes*** There are few changes in the paint layer, as the painter closely followed the underdrawn composition and the areas left in reserve. The heads of Mary, John and Peter were reduced in size slightly at the tops; Mary's blue robe was extended downwards slightly over her footwear; and Peter's robe was shortened at the bottom while the paint was still wet.

FRAME

The original, engaged frame has been lost. The panel is exhibited in a modern, reddish-brown wooden frame with black exterior (85.8 × 73.0 cm).

CONDITION

Support

- ***Altered dimensions*** The panel's original dimensions and thickness have largely been maintained, except on the bottom edge, where new strips of wood were added during the 1966–67 treatment. Considering the woodworm-damaged state of the panel, it seems plausible that it was reduced in size before coming into the museum's collection in 1952. During the 1966–67 treatment, the damaged lower edge was scraped clean, presumably to create a better gluing face. At that time, the lower barb had already been lost.[8] The edge of the painted surface, therefore, originally continued slightly further down, to an extent that can be roughly judged from the brushstrokes at the bottom of the panel. Currently, these stop rather abruptly, which would not have been possible when the picture was painted in the engaged frame. In the corners, the start of curved brushstrokes are visible in XR, indicating that perhaps 1 cm of original paint may be missing. This would place the original barb about 0.5 cm lower than the current false barb. Assuming an unpainted edge of about 1 cm (the average of the surviving unpainted edges), the panel could originally have been 0.5 cm longer at the bottom. In total, the bottom edge would have been reduced in size by about 1.8 cm. Scraping off about 2 mm of original paint at the bottom edge then created a new unpainted edge, so the panel would appear as a complete painting. Possibly at that time, the sky was extended a bit further upwards as well, to create a narrower unpainted edge matching the new one at the bottom, but that paint was later largely removed again. The incised line still visible at the top probably indicated the edge of the extended paint area (fig. 15.7).
- ***Additions*** Sections of wood with a vertical grain to match that of the original panel were added at the panel's bottom to form a longer strip (see above). On the reverse of the panel, nine small, wooden blocks were glued along the entire length of the join. A larger rectangular wooden block was glued onto the largest crack at the top left of the reverse, and an insert was added to the damaged top left corner.
- ***Cracks*** There are three cracks in the top right of the painting, as seen from the front. They run parallel to the wood grain, and two extend from the top edge. These fissures are open to some extent, but are old and stable. The longest crack was stabilized on the reverse by a wooden block and is still stable. The two smaller cracks, one below the other, are adjacent to it. There is still activity in the upper crack, as filling material is lifting slightly and a few more recent losses are discernible. At the bottom edge of the panel, just to the right of the donor's feet, another recent crack is also detectable in the wooden addition and filling.
- ***Deformations*** The panel has a convex curve overall (seen from the front), and the right plank also shows some undulation.
- ***Joins*** The join in the centre of the panel is closed, but there is a slight difference of levels in the middle. The boards must have come apart at some point.
- ***Coated reverse*** The reverse of the panel was impregnated with strong glue. Also, residues of wax and possibly resin are present.
- ***Biological damage*** Woodworm tunnelling severely damaged the panel in the past. The weakened wood (consolidated with glue and wax during previous treatments) led to losses, fractures, and local panel collapses that are visible on the reverse. There are several sections where the wood is raised slightly.

Ground and paint layers

- ***Stability*** In general, the adhesion of the paints and that of the ground are both good. Most craquelure is caused by natural dimensional changes in the panel. Drying cracks were not noted. There are many areas with more open craquelure, but these are related to abrasion and solvent damage (see below, *Abrasion*).

  Metal soap aggregate formation, which can appear as small opaque points in XR, has been observed throughout and has severely affected the painting's appearance (fig. 15.2). Expansion of the aggregates may cause them to protrude from the paint surface, resulting in minuscule raised spots and a more granular surface texture. Loss of these metal soap aggregates results in tiny, craterlike holes that appear dark in XR. Over time, accumulation of dirt and varnish residues in these holes causes them to appear dark in VIS and IRR/

IRP. Since these paint defects are also visible in the brown crossbeam that was left in reserve from the sky, it is likely that the saponification takes place in the lead-white pigmented isolating layer applied overall and not just in local paint layers.

- ***Losses*** Most of the larger, old losses of paint and ground have been filled and retouched. These are mainly present around the panel join in the centre and around the cracks at top right, where some recent losses are present as well (see above, *Cracks*). Losses appear, too, in the cross and the tall, isolated tree in the background, in the robes of Saints John and Peter, around the donor and in the landscape. Many smaller losses spread over the paint surface remain untreated, and among them are also several woodworm holes and numerous tiny craters from metal soap aggregate formation (see above, *Stability*).
- ***Abrasion*** The paint surface is quite abraded overall. This is clearly visible in sections of the sky; for example, the building at right has been scuffed to such an extent that the blue paint underneath has become visible. The central foreground was damaged as well, especially in the area of the donor, when the overpainting was removed there to reveal that figure (see further below, *Filling …*). In several other areas, the edges of paint craquelure have become more abraded, making them more noticeable, as in the mantle of Saint John.
- ***Discoloration and increased transparency*** It is possible that the glazes have discoloured somewhat, although this is not apparent. There is an increase in transparency in the red lake, but in many areas its reduced presence is mainly the result of abrasion. The lighter paints, which often contain lead white, have become more transparent in ageing. This has resulted in a localized increase in visibility of the underdrawing and underlying layers.
- ***Filling, retouching and overpainting*** After the addition of the wooden strips at the bottom, losses were filled and an extended, unpainted edge was reconstructed. Using pencil lines, some craquelure was imitated there, as well as in the smaller bone in the foreground. Many of the old losses have been filled and inpainted, most extensively in the sky and cross, around the donor, and in the landscape. These retouchings seem to have discoloured slightly, but are often also not precisely colour-matching. There remain numerous smaller losses and areas of abrasion (especially around craquelure and more impastoed paint) that have not been retouched.

  During the 1966–67 treatment, the remains of an overpainted figure were found just to the left of the donor.[9] This figure may have represented Mary Magdalene.[10] She was painted atop the background, indicating a later addition. Several small pinkish, brown, bluish and greyish residues still remain. The XR reveals that this figure at least partly overlapped the donor, and a hand and arm are still discernible in front of the cross (fig. 15.8). It seems quite possible that this figure was painted in order to cover up the donor. The letters *inri* were originally done in black over an already-dry white underlayer. Largely due to abrasion, these letters were retouched and the white area surrounding them was in part overpainted with white. The small rod supporting the *titulus* has been completely retouched, leaving no trace of the original rod visible (fig. 15.7).

Surface finish

- ***Varnish*** There seem to be multiple varnish layers present. These are modern and glossy, and show very little discoloration. The varnish layers seem to have been thinly and evenly applied by brush over the entire surface.

  Although the varnish application is even and glossy, there are many small matte spots from retouchings. These are insufficiently saturated, but the original paint surface has adequate saturation from the varnish.
- ***Surface dirt*** There is some surface dirt on the painting. This greyish matte dirt layer does, however, even out the matte spots of retouching. The numerous tiny spots present on the surface are the result of metal soap aggregate losses (see above, *Stability*). Over time, dirt, varnish and retouching material have accumulated in these 'craters', resulting in the darker spots we see now.
- ***Visibility of the original surface*** The saturation of the original paint surface is adequate. The matte spots from inpainting, however, cause a reduced visibility of the original paint surface. Furthermore, the countless darker spots and the numerous partial, not precisely colour-matching and/or discoloured retouches strongly distract from the original surface.

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1 The XRs date from before the 1966–67 treatment of the painting, since the added wooden strip at the bottom edge is not discernible.

2 Stroo et al. 2001, 71.

3 Stroo et al. 2001, 71–72.

4 Stroo et al. 2001, 72.

5 The three dowel holes that taper at both ends are original, but the two larger, round-ended dowels are later additions. The original dowel holes measure 5.5 × 0.5 cm. The non-original dowels measure 6.5 × 0.8 cm and 7.0 × 0.7 cm. Stroo et al. 2001, 82 nn. 1 and 7.

6 Analysis done by Pascale Fraiture (November 2000). See also Stroo et al. 2001, 72, 78.

7 The brushmarks that visibly underlie the paint, as seen in XR, are from the pigmented isolating layer.

8 The XRs that were taken before that treatment do not show a barb, but reveal a previously carved, unpainted edge and damages. Marijnissen mentions that this unpainted edge needed to be reinforced and completed. Marijnissen 1987, 346.

9 Where this figure was removed, there is more damage to the original paint. Additionally, old black-and-white photographs from KIK-IRPA show the donor with a moustache and other small alterations. These, however, were clearly later additions, as the paint continued over the craquelure; they have been removed since, reportedly during the 1966–67 treatment.

10 Marijnissen 1987, 346.

The Last Judgement

Hieronymus Bosch
c. 1495–1505

Oil (not analysed) on oak (analysed) panel, left wing (RR 71): 99.5 × 28.8 cm; central panel (RR 72): 99.2 × 60.5 cm; right wing (RR 73): 99.5 × 28.6 cm[1]
Stad Brugge, Groeningemuseum, Bruges, 0000GRO.0208.I

The triptych was restored in 2014–16, thus after the 2012 BRCP technical examination of the painting on which this report is largely based.
BRCP, *Catalogue Raisonné*, cat. 16; www.boschproject.org no. 16.

Inscriptions and labels
Central panel, bottom right: *Jheronimus bosch*. On the blade of the knife the letter *M* is applied.
Reverse RR 74, top centre: labels of the *Exposition de la Toison d'Or Bruges* and *VIIème EXPOSITION BIENNALE INTERNATIONALE DES BEAUX ARTS – VENISE* 1954; related label, 552; an Italian customs label.
Reverse of frame, RR 74 (top centre): a white label, 61.

RR 69

RR 70

RR 71

SUMMARY OF CONCLUSIONS

The Bruges triptych of the Last Judgement, *with* Paradise *on the left wing and* Hell *on the right, can be easily linked to other works in the core of the Bosch group in regard to painting technique, style and material of the phased underdrawings, and provenance. Traces of the creative process can be observed in all stages of the production, further pointing to the extensive personal involvement of Hieronymus.*
At some point before 1845, the wings were separated from the central panel and joined together as a second arched panel, with Hell *on the left and* Paradise *on the right.*
The connecting bars applied to the exteriors of the wings severely damaged the Christ Crowned with Thorns *painted in grisaille on a black base layer. The triptych format was reconstructed at the beginning of the twentieth century, although the frames provided then did not allow the wings to close over the central panel. This was corrected in the 2014–15 treatment.*
The three panels were originally housed in engaged frames, now lost, although the exteriors of the wings, as in other triptychs by Bosch, formed a continuous pictorial plane when closed, uninterrupted by vertical frame members. That implies that the opened wings must have had integrated frame members applied on their long edges. Dendrochronology has established that the central panel could have been painted from 1480 onwards, although a date after 1482 is statistically more probable. As further explained in BRCP, Catalogue Raisonné, *cat.16, we date this work to around 1495–1505.*

RR 72

RR 73

Hieronymus Bosch

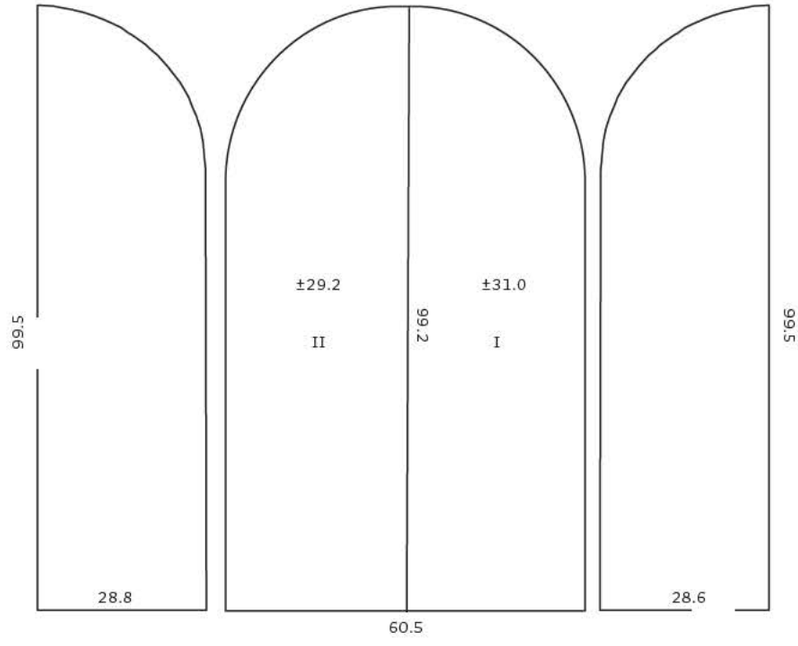
EXAMINATION DATA

2–6 June 2012 (Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Ron Spronk).

The triptych was examined in its frame in the gallery and in a storage space, both upright on an easel and flat on a table under strong illumination. The wings were temporarily separated from the central panel. Both front and reverse were easily accessible, with the exception of the edges, which were blocked from view by the frame.

- ***Previous research and additional documentation available*** The Groeningemuseum holds files with information on the painting. The files also contain IRP and VIS photo documentation by Adri Verburg and prints of XR negatives; the XR films themselves are stored at the Royal Institute for Cultural Heritage (KIK-IRPA) in Brussels. See also the technical information on the painting in Janssens de Bisthoven 1981, 68–84, and plates LVI–LXXIX.

- ***Previous treatments*** The *Paradise* and *Hell* wings were joined together before 1845. During that procedure, the grisailles on the reverses were severely damaged. Between 1900 and 1906 the triptych form was reconstructed, although the current frames do not allow the wings to close over the central panel. Jef Van der Veken restored the triptych in Brussels in 1936, but the reverses do not seem to have been treated on that occasion. There is no documentation of this treatment. Cornelis Leegenhoek removed the overpainting from the damaged grisailles in 1959.[2]



16.2 Construction diagram (seen from the inside of the triptych)

SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 16.2). Thickness: 0.4 cm along the edges and 0.9–1.0 in the centre;[3] RR 73 (right wing): 0.6–1.1 cm.[4]

  The wood species, Baltic oak, was identified through dendrochronology. The central panel consists of two quarter-sawn planks, the wings of one plank each. The planks are vertical in grain and laid vertically.

  The two planks of the central panel were butt-joined, dowelled (presumably with four dowels)[5] and glued.

  The wings were painted on both sides. The central panel is comparatively thin and smooth, but the dowels are still covered by the panel. The join was possibly adjusted locally in order to apply the non-original reinforcing blocks. Traces of planing can be found on the central panel reverse.

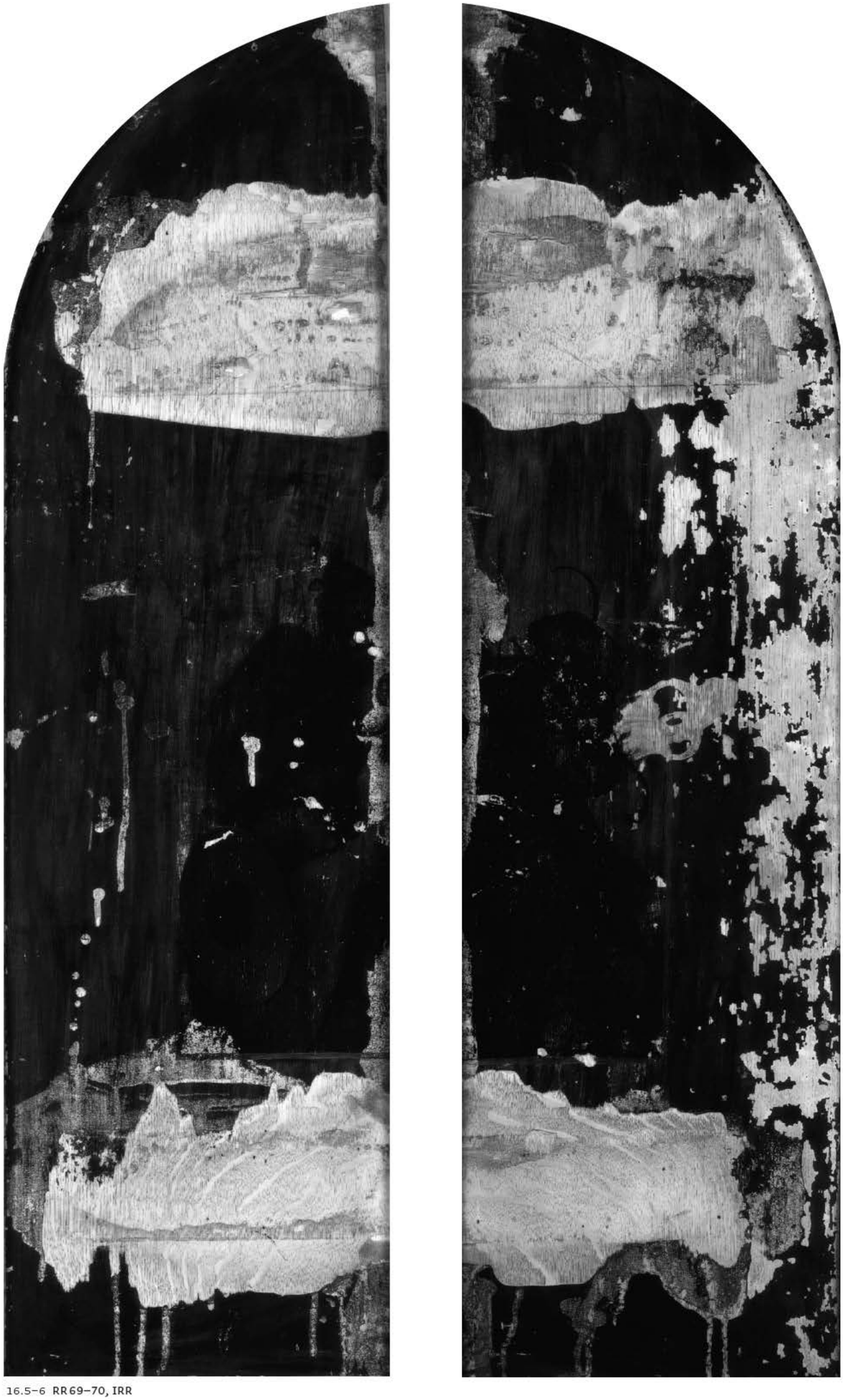
- ***Bevelled or half-lap edges*** The central panel has bevelling on all sides. Nail marks from a previous framing can be observed around the edges.

- ***Dendrochronology*** The youngest heartwood ring in the central panel dates from 1469, which, with the added minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1478 for the tree that supplied the wood for that plank.[6] An earliest felling date of 1480 is statistically more probable, however, since that would cover 93 per cent of the range of possibly missing sapwood rings. Assuming at least two more years for drying and transportation, the triptych could have been produced from 1480 onwards, but a production date from 1482 onwards is statistically more probable. The wings were not measured.

RR 74

16.1 RR 72, VIS

16.3–4 RR 69–70, VIS



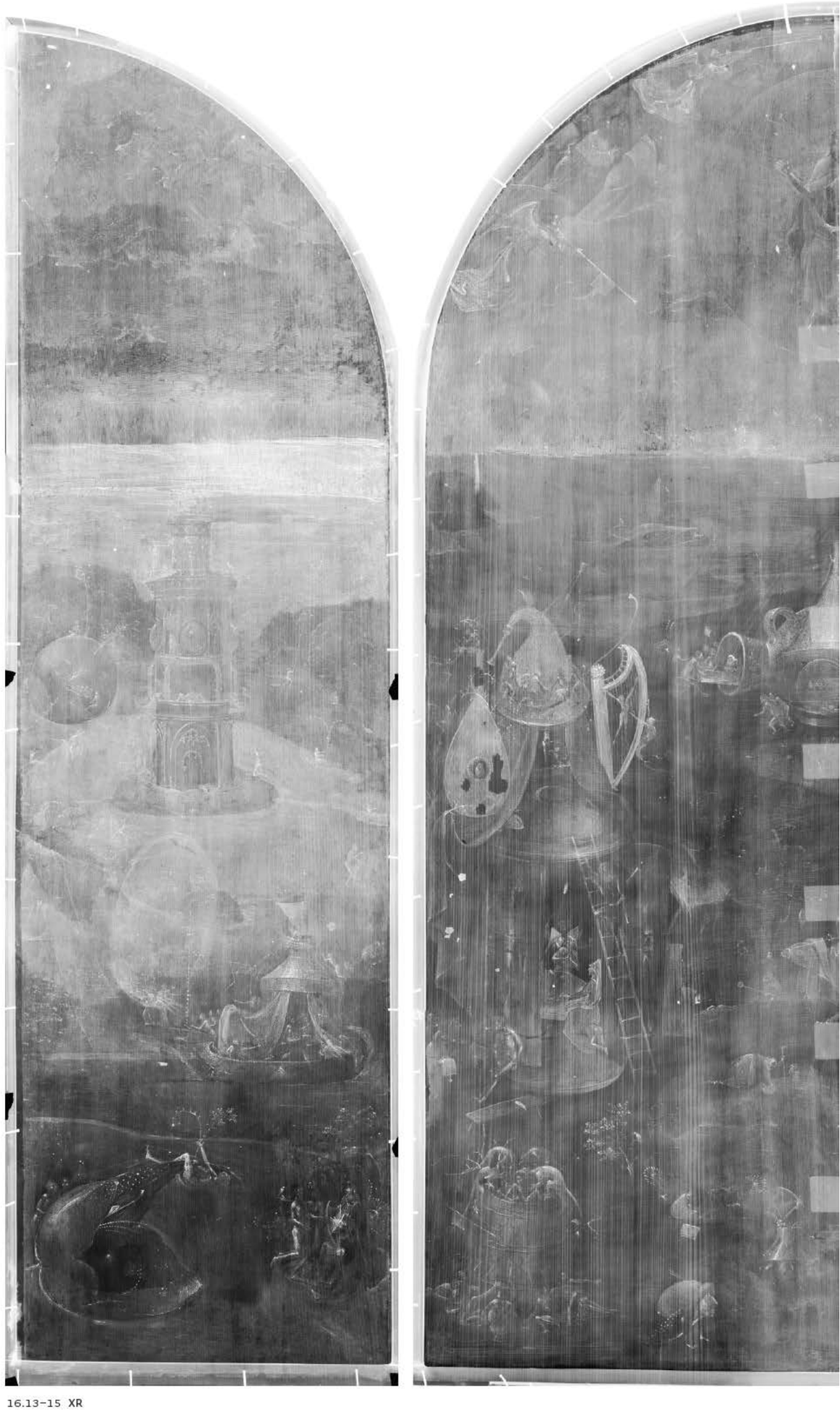
16.5–6 RR69–70, IRR

16.7–8 RR 71, VIS and IRR

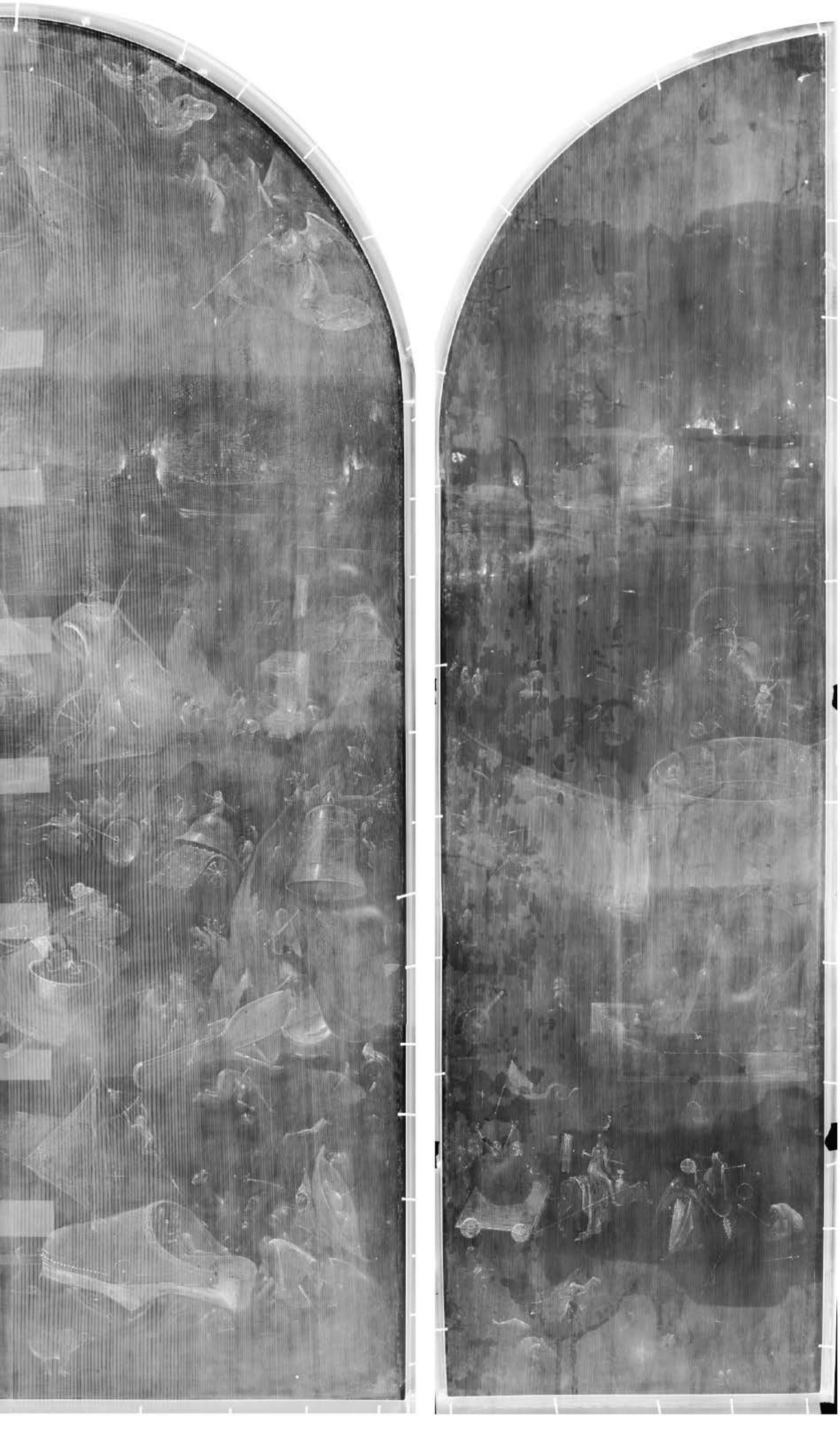
16.9–10 RR 73, VIS and IRR

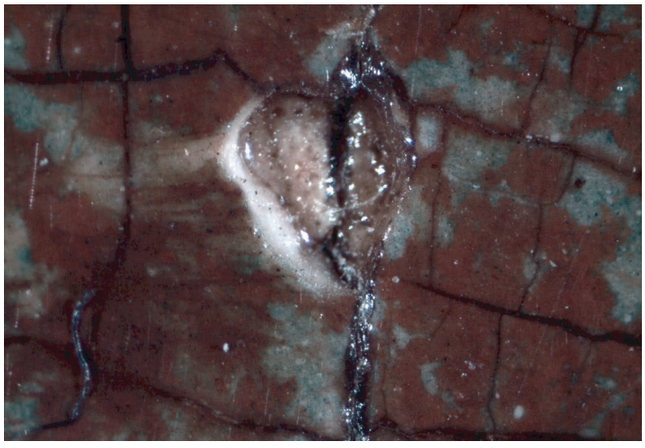
16.11–12 RR 72, VIS and IRR

Last Judgement, Bruges 239



16.13–15 XR





16.16 72MICGBM001

16.17 RR 72, IRR

GROUND

- ***Visibility*** The off-white to cream-coloured ground seems to consist of a thin layer of chalk (calcium carbonate – $CaCO_3$) bound in animal glue[7] and is present overall.

  The ground layer is evident under VIS. The ground is not fully covered by the paint layers, but is visible at contours and in losses. (The outer edges of the panels were not accessible because of the presence of the frame.) The ground also shimmers through the paint surface in several areas – for example in skin tones and in the tree trunk in the central panel. This appears to have been an intended effect, despite the fact that the transparency of the paint layers will have increased with age, especially in the lighter areas. In other areas with objects that are more solid, and at several contours, the visibility of the ground does not seem to be intentional.

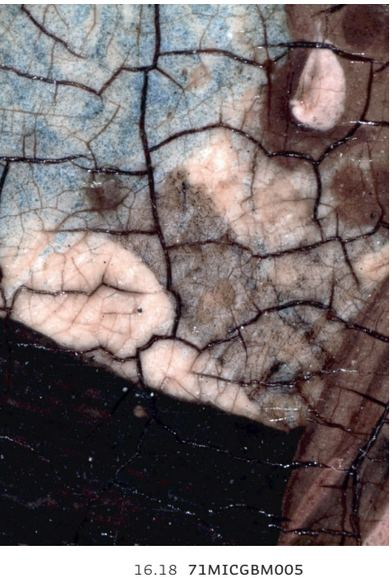
- ***Barb and edges*** The panels were studied in their frame, but several barbs could still be observed. The grisaille on the exteriors of the wings of the closed triptych has a barb on the outer left and right sides. Barbs have also been noted at the left and right edges of the interior of the left wing, at the top and right of the central panel, and at the left edge of the interior of the right wing. The latter wing has four ungrounded and unpainted edges (although the longest side is overpainted). The painted surfaces of the closed wings are about one centimetre wider than those of the open wings.[8] This and the apparent absence of barbs on the inside of the closed triptych wings indicate that probably the grisaille did not have an interrupting central framing element, so that the composition continued over the two panels.

- ***Application*** The ground seems to have been applied fairly thinly in a single layer and worked into a smooth finish. The panel surface itself has not been evenly finished, and in raking light, planing marks and the grain of the wood can be seen clearly. A micrograph of a crack in the central panel (fig. 16.16) reveals the lower off-white to cream-coloured ground layer, which is more porous than the dense upper white-coloured intermediate layer (see below, *Intermediate layers*).

PREPARATORY LAYERS

- ***Underdrawing*** Underdrawing could not be identified with certainty in the grisailles on the wings (see figs. 16.5–6). The black paint layer applied overall absorbs IR radiation. At the top edge of the shield and in the robe to its right in the left wing grisaille, a darker line of a possible drawing is distinguishable in IRR. However, underdrawing could not be detected in VIS on top of areas with exposed ground.

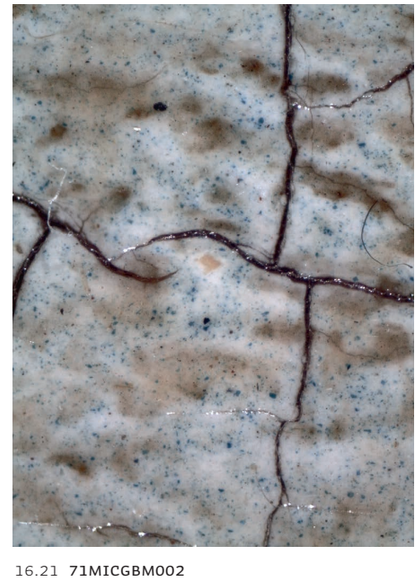
  On the inside of the triptych, the underdrawing shimmers through the paint surface in several areas and is visible in VIS. At some contours the ground is not covered by paint, and underdrawing is exposed (fig. 16.18). With IRR, the drawing was also revealed from beneath the paint in many locations. The current visibility (in VIS)



16.18 71MICGBM005

16.19 71MICGBM001

16.20 73MICGBM001

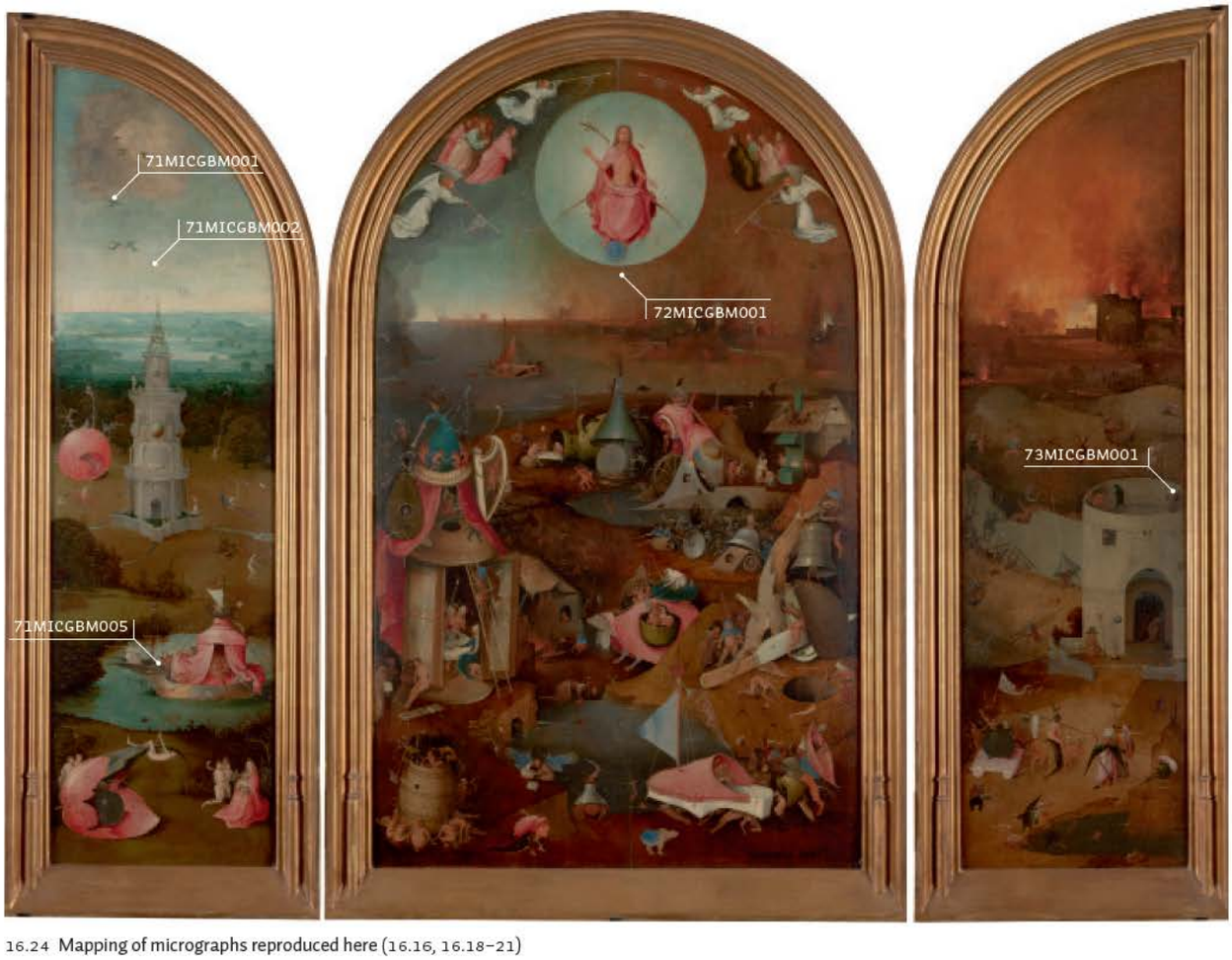


16.21 71MICGBM002

16.22–23 RR 71, VIS and IRR

of the underdrawing in light areas is likely caused by changes in refractive index due to ageing of the paint film, resulting in an increased transparency. Underdrawing was used to indicate the contours of elements and some detailing, to indicate landscape, and for local modelling, using hatched lines to render areas of shadow. Most modelling occurred in the central panel; in the wings relatively little modelling was observed. Some areas of shadow were prepared with near-horizontal parallel hatching, for example to the right of the large red fruit in the lower left corner in the Paradise wing. In the central panel a smaller, circular incision (probably in the ground) is discernible inside the round form, with a compass mark in the belly of Christ.

- ***Medium and application*** The detectable underdrawing was applied in different stages and differs slightly for the interiors of the left and right wings and the central panel. For the underdrawing of the initial stage, a slightly larger brush and a more even underdrawing material that shows darker under infrared appears to have been used. It is visible in the Paradise wing (RR 71), for example in the lower left and in the landscape. The medium is less dense and more fluid in the central panel and for the right wing, where it was used, for example, for the underdrawn but not painted elements in the foreground. The final-stage underdrawing was applied with a medium-size brush and executed in a liquid medium of an aqueous



16.24 Mapping of micrographs reproduced here (16.16, 16.18–21)

nature.[9] In the lower zone of the central panel, the modelling and shading was worked out notably more elaborately with areas of parallel hatching. The hatching, presumably applied in a different stage, follows the direction of the forms, for example in the *trip* boat lower right (see fig. 16.17). It was also applied locally for shadows in landscape.

- ***Style*** The underdrawing of the opened wings appears more sketchlike than that in the central panel. Contour lines are seldom continuous; they are drawn in short, irregular strokes, especially those of the initial stage, and can look 'stitched' (see fig. 16.23). Here, the relatively broad lines are even in appearance. In other areas, and more so in the right wing, the lines are less even and show pooling of underdrawing material, apparently from a more fluid application. Some closely placed underdrawn lines that were executed with a relatively large brush resemble a wash, such as those in the hollow of the dead tree in the central panel. The hatched lines, presumably applied in a later stage, are generally finer, and drawn with a smaller brush. Line ends are usually straight, with those of the initial stage being often blunt and those of the final composition often tipped, both without hooks or loops. The lines themselves can be curved, depending on the feature drawn.

- ***Revisions in underdrawing and differences from painting stage(s)*** Numerous changes between the underdrawing and the painted composition were noted in the wings. For example, the figure of God was originally drawn at the top of the left wing (fig. 16.8). To his right there appears to be a large angel, and just behind are smaller figures. The fountain was drawn with two flags extending from below the top, and to the right of the current opening, a larger one with a much larger figure was drawn. The fountain itself used to be positioned on a small island.[10] Figures are placed in the water around the island, and to the left a figure is crossing a bridge or plank towards the spherical, red object. In the middleground, more figures in and around the water can be seen, indicating that the water initially extended forwards to the water that is currently visible in the paint surface. The red tent on the boat was underdrawn with a pointed top and a cross instead of a small boat, and the cable was drawn higher and at a different angle. The mast at left was not underdrawn. To the right of the boat, two relatively large figures can be detected, with a diagonal feature behind them, perhaps an angel's wing. In the water to the lower left of the boat, another swimming person is discernible (figs. 16.8 and 16.23). The man hanging from the plant was repositioned, as were his legs. Just below him, a figure extends an arm towards him, and in the flower, the crossed legs of another figure are visible.

  The two jousting figures riding naked men instead of horses at the centre of the inner right wing were not underdrawn, but between them other figures were prepared with mostly vertical strokes (fig. 16.10). Below the wall, at centre left, several smaller revisions are apparent. The round tower was underdrawn differently, especially its gate. In front of it, two larger changes can also be found: at right, a bending man is drawn with a long feature coming out of his behind, and to the left of that, a sizeable cow with a rider and a female figure behind him were underdrawn. The initially planned rider and beast are drawn more in profile but very similar to the smaller cow and rider positioned just below them in the painted composition. Around the kettle, more heads can be distinguished. The dark pool of water in the foreground extended farther to the left, and a creature was drinking at its left edge.

  The changes in the central panel are fewer and smaller. At left on the horizon, the drawing of a tower can be seen in both VIS and IRR/IRP. The shoe-boat once had a different drawing on its sail, as well as diagonal lines in the red section (figs. 16.12 and 16.17).

- ***Intermediate layers*** Previous cross-section examination seems to indicate that the ground was sanded and then isolated, impregnated with oil.[11] This layer has not been distinguished with stereomicroscopic examination. However, on the interior panels, a brush-applied layer with strokes in mainly diagonal and horizontal directions can be observed in XR in a layer underlying the paint surface. The brushmarks that are visible to the right of the harp and in the lower left of the circle around Christ in the central panel seem to be from this upper layer (fig. 16.16). In the sky area of the Paradise wing a dense light layer, probably consisting of lead white (perhaps partially mixed with blue), was also observed on top of the ground.

PAINT LAYERS

- ***Paint application and painting technique*** The brush-applied oil paint (not analysed) covers almost the entire surfaces of the panels.[12] The underlying ground is sometimes visible at contours, as well as in lighter-hued objects and in the flesh tones, where it shimmers through. Paint was applied in several stages, mostly wet-on-dry, but also wet-in-wet.

  Medium-rich, wet and glossy paints were applied in opaque as well as semi-transparent layers. Paint was mostly applied rather thinly, especially for larger surface areas such as the brownish landscapes.[13] The downward-tilted head in the grisaille of the left wing was modelled thinly, with very subtle transitions. Thicker, drier paints were used for the lead-white undermodelling of most red lake areas, as well as for impasto (e.g., lead-white and lead-tin yellow highlights). The bluish background landscape in the left wing was also more thickly applied. Areas with azurite consist of thick but medium-rich paint, as the coarseness of the pigment dictates. The paint was typically built up to a maximum of two layers, with the exception of highlights, shadows and additional detailing. Although the painting appears to have a high degree of finish, many elements were actually painted in a rather sketchlike manner, especially the faces of the figures. Brushstrokes were used to render contour and volume throughout the painting.

- ***Texture*** Most passages have a smooth finish, although slightly textured brushstrokes are often visible. Areas where lead-white or azurite pigments were used generally have more texture as well. Texture was often used not only for impastoed highlights but also for modelling.

- ***Build-up and palette*** The paint was applied mostly from light to dark, with a final application of highlights. The paint application was largely planned and was executed 'back-to-front', with the background being painted before the figures, for which areas were left in reserve.

  The grisaille paintings on the outer wings of the closed triptych have a monochrome black underpainting. This layer covers the entire painted surface of the panels and is applied atop the ground. The grisailles are painted directly onto the black underlayer, using lighter paints (containing more lead white) for detailing and highlights. The figures were partly painted wet-in-wet. The heads in the grisaille of the right wing seem to have a black outline, but this is from the underlying black layer that was not covered by paint. The grisailles are visible through a 'window', with an outline that currently appears brown-green. Atop the black underpaint a grey line was applied, also containing red lake pigment, followed by a green (earth?) pigment and green glaze paint (69MICGBM001). Outside of this line, too, copper-green glaze paint was applied directly on the black underpaint. Although the green glaze has discoloured to a browner hue, and many highly discoloured varnish residues obscure the legibility of the grisaille, it seems that the outline was applied somewhat lighter on the bottom and the right side, representing a directional light source.

In the interior left wing, the lower section of the sky and the top part of the landscape were painted with lead white. Azurite paint seems to have been applied afterwards in the upper regions of the sky and in the blue landscape, the top section of which covers the lead-white paint. In the uppermost area, a section was left in reserve where the grey clouds were then painted. More detailing was applied there with impastoed lead-white and pinkish paints, which were used for accents in the sky as well (see also the central panel). Most of the angels are supporting small pinkish or bluish souls that are better visible under higher magnification (see fig. 16.19). Some of these are also discernible in IRR/IRP or XR. Many areas were left in reserve during the painting of the landscape, including the solid upper segment of the fountain. The tent on the boat was first modelled in lead white, followed by application of red lake paint, lead-white and light blue highlights, and red lake mixed with black pigment for the final detailing (e.g., in the folds at the lower right). The grey-black lines of the boat's rigging were painted using adjacently applied partial lines of lead white with spaces in between. At the lower left, the blue in the flower could be smalt, which can turn greyish in oil paint.

In the central panel, many figures and objects were left in reserve, but the layer build-up can be more difficult to discern in some areas. In addition to blue paint inside the circle behind Christ, consisting of lead-white and lazurite (natural ultramarine),[14] blue is also visible outside of it, and partially applied underneath the red-brown smoke. Rather than using blue for the whole section, the artist painted the circle separately, as evident from the brushstrokes following its contour. A black outline delineated the round form, after which the darker blue and red-brown paints were applied. A lead-white outline was applied to the lower and left parts of the circle, indicating a directional light source from the opposite side of that indicated in the grisaille.

The figure of Christ was left in reserve from the blue, but parts of his hair, hands and feet cover it. His red robe was painted first, as sections of the white loincloth overlap the red, as do his feet and the small, blue sphere. Brown lines provide detailing of hands and feet. The figures around Christ were also built up using a flesh tone followed by brown detailing, although certain angels and Christ himself do have some added pinkish highlights. The angels' hair is of an orange-brown hue with lead-tin yellow highlights. Their white robes are very freely painted, blending black and blue into white, and using blue and then black contour and fold lines pushed into the still-wet paint underneath. Locally, some red lake is also mixed in for contour lines.

The smaller figures on the whaleboat are painted atop the background, in either monochrome black or brown. Two of the figures have pink highlights. The large insect at the tip of the funnel seems to be painted using the background as a midtone, although remnants of a thin, red-purple lake appear to be present. The purple lake was also used for the wings, together with a pinkish highlight and a lead-tin yellow outline (72MICGBM002). For the group of figures behind the large helmet, the background was also used as a midtone, and the figures were indicated by dark outlines and highlights. The fire in the background was built up using lead-tin yellow, vermilion, bright pink/orange and red lake detailing. IRR/IRP shows that the buildings in that section were underpainted in black, although those forms were not followed exactly in the brownish paint. It seems that fine black pigment was mixed in for the water in the background as well, as it also appears dark in the IRR/IRP images.

The red drapery covering the lantern is reported to consist of a thin layer of vermilion, followed by a layer of white with madder lake, with a final madder lake glaze.[15] The figures dancing around the blue bagpipe were roughly left in reserve and now partially cover the blue. The figure in the harp was painted before the strings were, but is not intertwined in them. On top of the barrel at the lower left, four dragon-like creatures were painted. The top two have a dark, discoloured glaze and are currently difficult to distinguish from the red-brown background, although they are highly distinct in IRR/IRP. At the bottom centre, very small elements were also left in reserve (e.g., the arm above the helmet). The feet of the creature with the red hat seem painted only with a red glaze. The creature with the blue behind has a cream-white flesh tone, with white highlights followed by a black dab below the front foot to cover the remaining area that was left in reserve.

The right wing has a slightly different appearance due to lower colour contrast and less use of bright lead-white and lead-tin yellow highlights. The tempered colours relate directly to the subject of this panel, although other small differences can be discerned. The lines and windows in the tower are painted on top of the greyish layer in a rather fluid and sketchlike manner, rather less precise and less crisply than in the other panels. Several figures stand in the dark gate, one painted with a purple glaze. In general, both red and purple glazes were used in all three panels. In several areas, these have also been mixed in and used as shading. In the right wing, however, purplish lake was used more frequently for glazing, and red lake was used for fires. The bird seated on a branch at the lower right edge has a purplish body, a grey tail and head, and some white highlights (partially mixed into the purple), but it now appears rather flat. In the hat of the man fishing below, more red lake was used. His leg to the rear was painted in grey but his forward leg and his clothes in green. The face of this figure has pinkish highlights and black detailing. His fishing pole was formed of adjacent dark- and light-coloured lines. Black detailing or outlines can also be found in other figures; for example, the seated one in front of the tower, and above that, the one under the funnel helmet. The facial modelling of the hooded figure on top of the tower was very skilfully achieved by applying just a few pink and reddish dabs on the underlying greyish colour of the tower (fig. 16.20).

The signature in the lower right corner of the central panel was applied in black over the already dry brown background. It is better legible in IRR/IRP than in VIS, but possibly the brown paint mixture has darkened over time. No guidelines or incisions were noted here. The black dot above the J does not seem intended to belong to the signature. The signature's appearance, craquelure, state of degradation and adhesion correspond to those in the rest of the painting.

- ***Changes*** The largest changes have occurred in the inner left wing, where the island of the fountain was not only underdrawn but also painted, including the water area around it. The artist subsequently covered the water with green landscape paint, but the change is visible in XR and in losses (71MICGBM004). Below the fountain, at the left edge, a red colour is visible shimmering through the green of the landscape and the trees. This is a red lake used for the robe of a relatively large seated figure, with possibly a smaller angel to his right, whose outlines can also be seen in IRR/IRP.

  Small alterations in the central panel include the slightly reduced red robe of Christ, in which blue paint covers the red at both sides of his waist. The robes of some of the figures around him, too, have been taken in slightly. Beneath the whaleboat, an area can be seen that was initially left in reserve but later covered by water. At the centre right, a larger hill shimmers through the paint of the house. Above that, the burning city was changed somewhat in a few areas.

  In the XR of the right wing, the wall at left centre seems to be continuous, which could indicate that the breach was a later addition (figs. 16.15 and 16.25).

FRAME

The neo-Gothic gilded wooden frame is not original. The wings can only close to some extent because the frames overlap each other. As the presence of barbs and unpainted edges indicates, the triptych originally had an engaged frame. It seems likely that the composition would have continued across the two outer wings of the closed triptych, uninterrupted by central framing elements. These elements may have been planed (as in the Prado *Haywain*, cat. 20, RR 97–102), although traces of connection of a painted central framing element were not found. Also, a traditional engaged framing element in this location seems unlikely, as more of the painted composition of the grisaille would have been preserved in that case.

CONDITION

The triptych was restored in 2014–16, thus after the 2012 BRCP examination on which this report is largely based.

Support

- ***Altered dimensions*** At the lower left of the central panel's reverse, the corner tip broke off and was glued back on at some point in time. Apparently the height of the wings was gradually reduced in the curved part, up to the barb at the top. They were cropped by about two to three centimetres at the top and the wings of the closed triptych seem to be missing about 6 to 7 cm of the painted composition in the centre,[16] much more than the 2 cm-wide strip hitherto suggested.[17]
- ***Additions*** On the reverse of the central panel, the join is covered by seven horizontally grained oak reinforcing blocks. (Three others are missing.) At some point, the inner wings were joined together and two horizontal bars were applied on the grisailles, severely damaging them. The bars have since been removed, but traces of wood and glue from this operation remain.[18]
- ***Cracks*** In the left plank of the central panel, a small crack runs a few centimetres from the centre bottom edge, parallel to the wood grain. A larger, partially open crack is visible at the right edge of the central panel reverse, just below the curve.
- ***Deformations*** The three panels on the inside of the triptych all have slightly convex surfaces. The other sides seem relatively flat, although the wings and their frames are generally somewhat torqued.
- ***Joins*** Although the join in the central panel is slightly open, the paint film is continuous in the central section. This indicates that the two planks of the central panel have never been separated. There are no differences in level.
- ***Biological damage*** Old woodworm damage is discernible at the top right of the right wing's grisaille.

Ground and paint layers

- ***Stability*** In general, the adhesion of paint and ground itself is very good, with the exception of some minor local blisters in the central panel and right wing, and raised paint along the join (72MICGBM003). At the right edge of the closed right wing, however, there is extensive flaking paint loss. The remains of ground here indicate an adhesion problem at the interface of ground and paint, but the causes of this problem and its confinement to this area are not known.

  Most craquelure is caused by natural dimensional changes of the panels. Where thick azurite paint was used (with more binding medium), slightly broader natural drying cracks have formed. These are also present in the brown sky at the upper right of the central panel. In the areas immediately around the fires there are also wide cracks revealing the light ground. These so-called youth cracks (drying cracks caused by medium-poor over medium-rich paint application) have often occurred where slow-drying red lake was used in an underlying paint layer. In that area and towards the left, paint also appears wrinkled, presumably indicating that too much oil binding medium was used there. In the area directly below the sphere, the blue of the sky may have become exposed as a result of poorer adhesion of the brown to the underlying layer.[19]

  Lead soap aggregate formation, which can appear as small, opaque points in XR, has been observed spread over the surface of the central panel and the inner right wing, but not in the left wing. Expansion of the aggregates may cause them to protrude from the paint surface, resulting in minuscule raised spots and a more granular surface texture. Loss of such metal soap aggregates results in tiny, crater-like holes that appear dark in XR. Over time, accumulation of dirt and varnish residues in these holes causes them to appear dark in VIS and IRR/IRP.
- ***Losses*** Small losses can be found along the join in the central panel. Larger filled and retouched losses are present near the left edge of the central panel (in the lute, the red drapery, the figure below it and the dragons at left on the barrel). In the grey section of land at the upper left of the central panel a (filled and retouched) dent in the original paint, with only few losses, is present.[20]

  Large sections of paint, ground and wood were removed from the top and bottom of the grisailles by planing in order to attach the wooden bars. Other losses were caused by a very harsh cleaning or paint-stripping agent used in the past, as indicated by drip marks revealing the support of the grisailles, as well as flaking paint issues.
- ***Abrasion*** The paint surfaces are only slightly abraded overall. Locally, more severe abrasion is present – for example, in the sky area below Christ. Also, the painted edges of the panels have been damaged by abrasion caused by lack of protection between the paintings and the framing elements. In many areas, scratches are visible where in the past old residues were removed with a scalpel, damaging the paint and locally resulting in losses. Spread over the paint surfaces there are also a few smaller scratches and indentations.
- ***Discoloration and increased transparency*** The glazes containing red madder lake have held up fairly well. Greenish glazes have discoloured, as seen at the centre of the right wing in the jousting figure, whose armour currently appears brown. In the glass-like spheres on the fountain in the left wing, both discoloration and abrasion seem to have resulted in their present appearance (71MICGBM003). On the barrel in the central panel at bottom left, a presumably green glaze on the dragons has completely discoloured to brown. The two centre dragons, which do not seem to have a light green underpainting, are now hard to distinguish from the background, but they are clearly visible in IRP/IRR. An increase in transparency is most evident in paints containing white, causing the greater visibility of the underlayers and/or ground layer and an unintended change of appearance.
- ***Filling, retouching and overpainting*** In the central panel some retouching can be discerned along the join, mostly at the bottom. The left edge was also given some inpainting, the losses in the lute were filled with a material that appears black in IRR/IRP and were inpainted, and losses in the red drapery below the lute were restored. Several of the wings' edges were retouched as well.

Surface finish

- ***Varnish*** There seem to be multiple (discoloured) natural resin varnish layers present. These are not original and appear heavy and glossy. On the grisailles, the varnish layer has only been applied locally.

The appearance of the varnish is relatively even, though very glossy. The surface has a somewhat greasy look. The fairly thick varnish has yellowed, but the severely discoloured residues of an underlying older varnish layer are more primarily disturbing; see, for example, the many brown residues on the shield in the grisaille and the greenish spots in the blue sky (fig. 16.21). There are some matte spots, and the saturation is uneven and insufficient in several areas.

- ***Surface dirt*** There is only a small amount of surface dirt on the painting, and there are some remnants of brush hairs.
- ***Visibility of the original surface*** The paint surface of the triptych is insufficiently saturated in areas. The yellowed, degraded varnish layers, and especially the highly yellowed older varnish residues, reduce the legibility of the original paint surface. The unequal retouching and discoloration distract from the original surfaces. In the grisailles, the matte areas, paint damage and exposed wood also result in a poorly legible paint surface that is not presentable.

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[1] The edges of the panels were not accessible. Measurements are taken from Janssens de Bisthoven 1981, 68.

[2] Janssens de Bisthoven 1981, 77.

[3] Simon Egan measured the panel thickness in the centre.

[4] See note 1 above.

[5] Simon Egan and Griet Steyaert observed three dowels in the XRS, and their placement suggests that a fourth dowel must be present. Email communication with Griet Steyaert, 13 May 2015.

[6] Klein 2001, 124. The youngest or last-preserved ring in each of the two planks of the central panel dates from 1469 (I) and 1465 (II), respectively.

[7] Examination of cross-sections indicates a ground layer of 160–240 µm thick. Janssens de Bisthoven 1981, 70. Its chemical compound might have been analysed at the time, but that is uncertain.

[8] The painted surfaces of the panels measure, respectively: (inner left wing) 98.7 × 27.3 cm; (left wing reverse) 99.5 × 28.5 cm; (central panel) 98.7 × 55.9 cm; (inner right wing) 98.7 × 27.5 cm; (right wing reverse) 99.5 × 28.6 cm. This information is taken from Janssens de Bisthoven 1981, 68.

[9] Ivory-black and an aqueous binder in a layer of about 8 µm was detected in cross-sections. Janssens de Bisthoven 1981, 70.

[10] The island was erroneously interpreted as a wider base of the fountain with a path around it in Janssens de Bisthoven 1981, 70.

[11] Janssens de Bisthoven 1981, 70.

[12] The paint edges were not accessible for examination.

[13] The oil paint layers are only 24–32 µm thick. Janssens de Bisthoven 1981, 70.

[14] Janssens de Bisthoven 1981, 70.

[15] Janssens de Bisthoven 1981, 70. This thin layer of vermilion was not visible using stereomicroscopic examination.

[16] With thanks to Griet Steyaert; oral communication, 28 August 2015.

[17] Janssens de Bisthoven 1981, 70.

[18] Apparently two dowel holes related to the applied bars match on both sides of the wings. Janssens de Bisthoven 1981, 71.

[19] With thanks to Griet Steyaert; oral communication, 18 February 2015.

[20] With thanks to Griet Steyaert; oral communication, 18 February 2015.

16.25 RR 73, VIS

16.26–27 VIS, after treatment (photos courtesy Stad Brugge, Groeningemuseum, Bruges)

16.28–30 VIS, after treatment (photos courtesy Stad Brugge, Groeningemuseum, Bruges)

17 *The Last Judgement*

NO RESEARCH REPORT

Hieronymus Bosch and Workshop
c. 1500–05

Oil on oak panel, left wing 163 x 60 cm, central panel 163 x 127 cm, right wing 163 x 60 cm
Akademie der bildenden Künste, Vienna, GG-579–GG-581

The BRCP was not granted permission to examine and document the painting; www.boschproject.org no. 17.
For notes on technique, see BRCP, *Catalogue Raisonné*, cat. 17.

Condition
Since the BRCP was not allowed to study the work, we have to rely on earlier statements by colleagues. Margarethe Poch-Kalous: 'The altarpiece is undoubtedly not well preserved and has already been reworked in the sixteenth century and again in the seventeenth, to the extent that the original artist's hand is not easily recognized in places.'[1] Roger H. Marijnissen: 'The central panel lost about four centimetres. … We know of several restorations, the last of which took place in 1954. The areas with thick, severely cracked impasto – particularly in the left wing – are totally out of character with Bosch's painting technique and must be viewed as overpainting from a later period. The present frame dates from 1877.'

Photos courtesy Akademie der bildenden Künste, Vienna

SUMMARY OF CONCLUSIONS

from BRCP, *Catalogue Raisonné*, cat. 17

The attribution to Bosch of the grisailles on the exteriors of the Last Judgement *in Vienna is indisputable. Not only the painting technique but also the style and method of the underdrawing of the large, standing figures (done with a relatively large brush in a watery medium) can be readily linked to other paintings in the core of the Bosch group. On the other hand, the underdrawings of the open triptych, as published in Trnek 2014, were worked out in a free, vigorous and sketchy style in a dry material, and to an unusually high level of detail. A donor figure was drawn in the lower left corner of the central panel, but not completed in paint. The underdrawings show repeated outlines and careful hatching that follows the modelling of the figures. Deeper shadows were indicated with closely placed hatching in long, straight lines as well as with zigzags. This style of underdrawing has so far not been encountered in any other work within the larger Bosch group. The painting technique of the interior panels also differs considerably from the rest of Bosch's oeuvre in several respects. Therefore, substantial workshop involvement must be assumed for the interior panels. Dendrochronological dating of the three panels by Peter Klein results in an earliest possible creation date of 1476, with execution after 1478 more likely. As explained in* BRCP, Catalogue Raisonné, *cat. 17, we date the work to about 1500–05.*

Visions of the Hereafter

Hieronymus Bosch
1505–15

The Ascent of the Blessed (RR 38); *The Garden of Eden* (RR 36); *The Fall of the Damned* (RR 32); *The River to Hell* (RR 34).
The original format of the ensemble to which they belonged is unknown.
Oil (not analysed) on oak (analysed) panel, RR 32: 88.8 × 39.6 cm; RR 34: 88.8 × 39.6 cm; RR 36: 88.5 × 39.8 cm; RR 38: 88.8 × 39.9 cm
Museo di Palazzo Grimani, Venice

A full conservation treatment of the reverses with imitation stone (RR 33, 35, 37, 39) began in 2015, thus after the 2011 BRCP technical examination of the painting on which this report is largely based.
BRCP, *Catalogue Raisonné*, cat. 18; www.boschproject.org no. 18.

Inscriptions and labels
Reverse: RR 33 has a wooden backing, but no documentation was observed on a photograph made during its recent treatment (see below). After temporary removal of two sections of the inlay in December 2012 by paintings conservator Giulio Bono, an altered, cleaner reverse was observed, as was the marking *42* in blue crayon in the top centre.
RR 37, top right: a large label marked *103 / / ARTE A VENEZIA / / 1971*, with the addition in black pen of *CLIMA N° 1*, plus an illegible symbol. Just above that, in the centre of the panel, written in blue crayon: *184*.
RR 35: top left, written in blue crayon: *189* (?)
Under UV, non-original markings can be observed at the top left or right corner of each panel except for RR 36. These inventory numbers from Napoleonic times were painted in but later removed, damaging the original paint underneath.
At the top left of RR 34, *DPV N° 489* can be discerned.

RR 38

RR 36

SUMMARY OF CONCLUSIONS

The four panels depicting the Visions of the Hereafter, *with imitation stone in red or green on their reverses, are linked with other works in the core of the group by their painting technique. No underdrawing was revealed, as the images were painted atop a black base layer.*
The four panels were cropped at the top and bottom, and their reverses damaged by crude bevelling. They must have functioned as folding members of a larger ensemble, the original format and function of which are unknown. Remnants of barbs on the lateral edges suggest that the panels were originally housed in engaged frames, now lost. Dendrochronology indicates that the panels could have been painted from 1484 onwards, although a date after 1486 is statistically more probable. The panels are strongly cross-linked by wood from the same trees, further confirming their close connection to each other. As further explained in BRCP, Catalogue Raisonné, *cat. 18, we date these panels to around 1505–15.*

EXAMINATION DATA

14–25 November 2011 (Luuk Hoogstede, Matthijs Ilsink, Jos Koldeweij, Rik Klein Gotink, Ron Spronk).

The paintings were examined in an empty gallery space upright on an easel and also flat on a table. The fronts and sides were easily accessible. The reverses were in part blocked from view by the flexible, attached auxiliary supports, one of which has a wooden inlay.

- ***Previous research and additional documentation available*** See the illustrated articles and reports published by Nepi Scirè, Nonfarmale and Rossi-Manaresi and Tucci in Limentani Virdis et al. 1992.

Twelve IRR details (although none from *Fall of the Damned*) and a set of twelve nearly complete XR images are kept at the offices of the Soprintendenza. The relatively low-resolution

RR 32

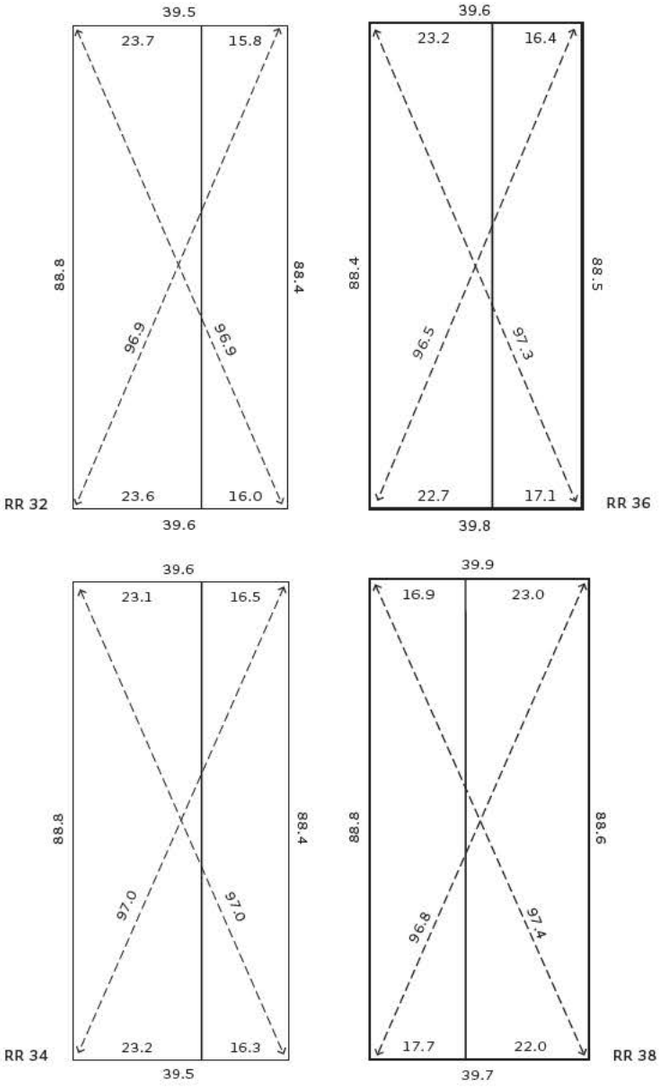
RR 34

RR 39

RR 37

RR 33

RR 35



XR scans were used for this report. The results of the analyses of a cross-section by the Centro Cesare Gnudi in Bologna were published in 1992.[1]

- ***Previous treatments*** The paintings were most likely restored during their stay in Vienna (1838–1919). Mauro Pellicioli and aides restored the four panels in Venice in 1951.[2] They were treated again from 1990 to 1992 in a specially created studio in the Palazzo Ducale.[3] Lifting paint was consolidated, old glue residues were dissolved and fills were integrated using *rigatino* retouching, followed by a final matte varnish application on both fronts and reverses of the paintings.[4] The auxiliary perimeter wooden frameworks, attached using bolts and springs, were applied in 2007 by Pierpaolo Monfardini.[5] Between 2007 and 2008 the paintings were treated by Alfeo Micheletto; the varnishes were thinned or removed and the paintings extensively retouched.[6] At that time, cleaning tests were performed on the imitation-stone reverses. In 2008 the painting was moved to the Palazzo Grimani, where the panels were placed in a large vitrine around 2009–10.

SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 18.1). Thickness at edges (approx.), RR 32: 0.3–0.5 cm; RR 34: 0.3–0.4 cm; RR 36: 0.3–0.4 cm; RR 38: 0.3–0.4 cm. The panels' widths are original, but all four were cropped at the bottom and top edges (see below, *Barb and edges*). The wood species, Baltic oak, was identified through dendrochronology.[7]

  Each panel consists of two false-quarter to quarter-sawn planks, vertical in grain, laid vertically. In the lower left of RR 38, curved growth rings of the beginning of a knot can be seen. The planks were butt-joined, dowelled with three dowels and glued (see also below, *Joins*).

18.1 Construction diagram (seen from the front)

The presumably original panel reverses are painted with imitations of stone with reddish (RR 33 and 37) and greenish (RR 35 and 39) hues, the latter on a black base colour.[8]

On RR 33, the imitation stone is almost completely lost, and only remnants of that layer remain.

- ***Bevelled or half-lap edges*** Non-original bevels are present on the reverses.
- ***Dendrochronology*** The youngest heartwood ring in the four panels dates from 1473, which, with the added minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1482 for the tree that produced the wood for that plank.[9] An earliest felling date of 1484 is statistically more probable, however, since that would cover 93 per cent of the range of possibly missing sapwood rings. Assuming at least two more years for drying and transportation, the panels could have been produced from 1484 onwards, but a production date from 1486 onwards is statistically more probable. Klein also concluded that the four panels are strongly cross-linked by the use of planks produced from the same trees, which further confirms their close relationship.

GROUND

- ***Visibility*** The off-white ground is present overall. The ground can be seen in VIS and XR. It is almost completely covered by the paint layers but is detectable at the outer edges and in losses. Although it was not intended to appear as part of the composition, it has become perceptible through damage.
- ***Barb and edges*** On the fronts of the four panels (RR 32, 34, 36 and 38), ungrounded and unpainted edges have been preserved on the sides, but not on the tops and bottoms. Sections of the original barbs have been retained on the left and right sides of the *Fall of the Damned* (RR 32), the upper left and lower right sides of the *River to Hell* (RR 34), and the centre left and upper right side of the *Garden of Eden* (RR 36). This establishes that the panels were originally housed in an engaged frame, now lost. It also implies that the panels still have their original widths, but that they were all cropped at the bottom and top edges.

  No traces of original edges have survived on the reverses (RR 33, 35, 37 and 39), which were all heavily damaged in those areas (see below, *Losses*).
- ***Application*** The ground seems to have been worked into a fairly smooth finish.
- ***Composition*** Chalk (calcium carbonate – $CaCO_3$) was identified in two samples from RR 35 and 37, the reverses of *The River to Hell* and *Garden of Eden*, respectively.[10]

PREPARATORY LAYERS

- ***Underdrawing*** Not observed in VIS or IRR/IRP. The presence of a black underlayer would have necessitated the use of a lighter-coloured underdrawing material, not detectable by IRR/IRP, if one was indeed applied (see also *Paint application …*).
- ***Intermediate layers*** A bone-black underlayer was applied on the ground, covering the entire painted surfaces of the panel fronts (RR 32, 34, 36 and 38).[11]

PAINT LAYERS

- ***Paint application and painting technique*** The brush-applied oil paint (not analysed) covers the entire surface of the original painting and extends onto the remains of the barb (see below, *Altered dimensions*).[12] The paint was applied in multiple stages, both wet-in-wet and wet-on-dry.

  On all four panels, a bone-black underlayer was applied on the ground in broad brushstrokes. IRR indicates that this layer was applied overall, but not evenly (figs. 18.16–19).

  The fact that certain areas were left in reserve from another background colour does indicate some form of composition planning. As mentioned, underdrawing could not be discerned, but it is possible that parts of the preliminary composition were indicated in a light underdrawing material or paint. Perhaps the blue-grey paint observable at the contours of the figures (and also shimmering through in areas) in *Fall of the Damned* (RR 32) and especially in the *River to Hell* (RR 34) played a preparatory role. A thin line of that paint is visible bordering the upper leg of the man in the central foreground in the *River to Hell*. A similar paint below his lower leg seems to have been used in a later stage to adjust the contour of the leg. It is discernible in other areas as well, such as below the leg of the falling figure in the upper centre of *Fall of the Damned*. In the *Garden of Eden* (RR 36) and *Ascent of the Blessed* (RR 38), both a greyish paint (e.g., the thumb of the raised hand just below the centre in RR 36, fig. 18.14) and a brownish one (e.g., exposed in the lower left corner of RR 36, where the legs of the seated men were altered) might have played a preparatory role.

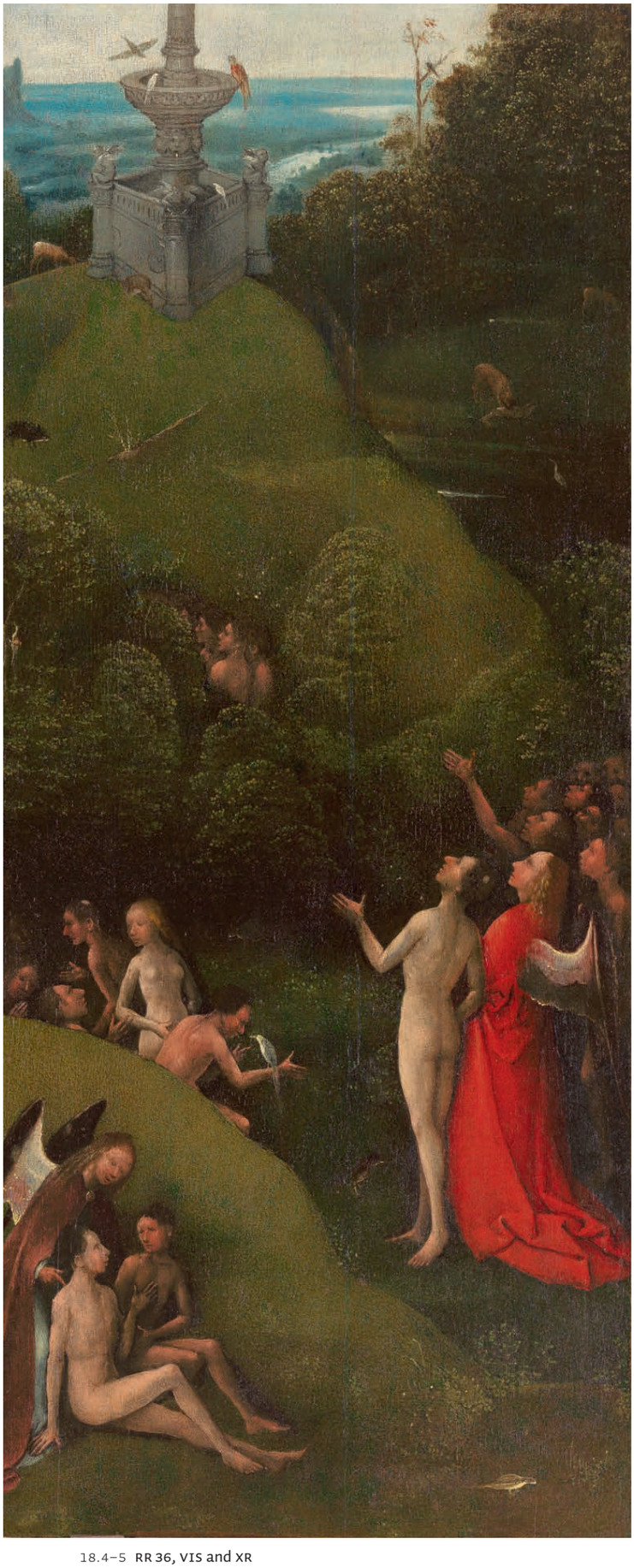
  In general, both the fluid and the dry, glossy paints were applied in opaque as well as semi-transparent layers. Paint was mostly laid on thickly, usually in lighter-coloured areas that needed to cover the dark underpaint, but it was also used thinly for the darker paints, where the underlayer was allowed to shimmer through. Glazes were primarily used for larger areas of clothing and fires rather than for detailing. The drier, more opaque paint and its method of application have resulted in a rather hatched appearance. For instance, in areas of flesh tones, the more impastoed paint was applied in long lines (for contour or base lines of arms and legs), in short strokes (for modelling) and in small dabs (for highlights of faces). Brushstrokes in general are fairly elongated and narrow – a technique that worked well with the slender figures and their often long hands. The panels were painted in a sketchlike manner, with only a few short dabs or strokes indicating facial features.

  For the imitation stone on the reverses, whitish paint was splattered, blown and/or dripped onto the black or reddish underlayer. A brush-applied coat of green and red glaze, respectively, was then applied thickly onto the entire surface.
- ***Texture*** Most passages do not have a smooth finish, and textured brushstrokes are often visible. Besides impastoed highlights, texture was frequently used for modelling, for example in figures such as the seated man at the lower left of the *Garden of Eden*, where a fish-bone pattern is visible in his leg (in VIS, IRR/IRP and XR).

  On the reverses with the imitation stone, the highlights are quite impastoed.
- ***Build-up and palette*** The paint was mainly applied from dark to light. A black underpaint was applied overall to the surface of the four panels, and that layer was used effectively in the build-up. Only shadows and detailing such as facial features were applied dark-on-light. The artist painted from background to foreground without the use of lead-white undermodelling, while leaving areas in reserve for the foreground features.

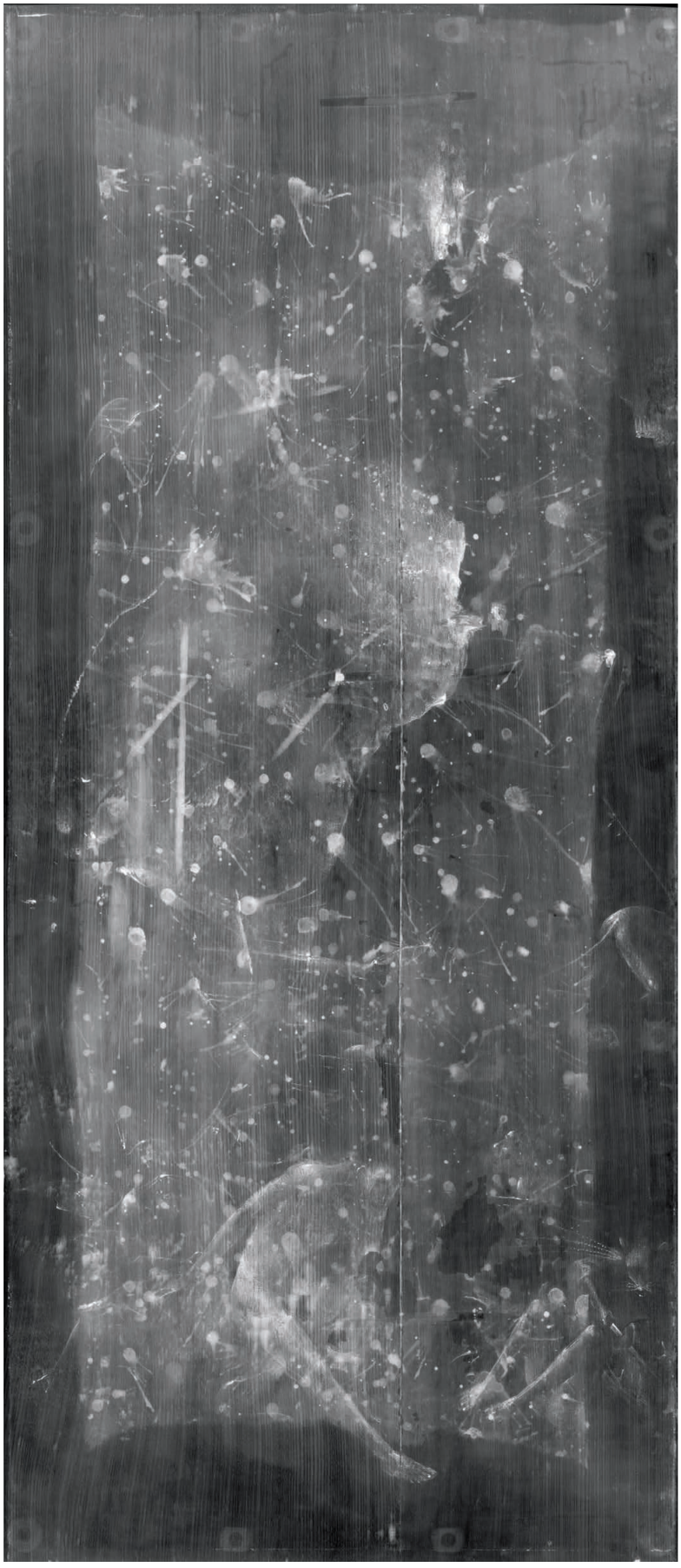
  Glaze-like paints were applied in green (for landscape, demons and angels' wings and robes), purplish (for wings, angels' robes and some lips) and red areas (for fires and an angel's robe). Lead-white and lead-tin yellow highlights were used. The hair-like features extending from the demon at top centre in the *Fall of the Damned* (RR 32) were painted in lead-tin yellow. For the demon at the centre left, a green glaze was followed by lead-tin yellow, but the bright teeth

18.2–3 RR 38, VIS and XR



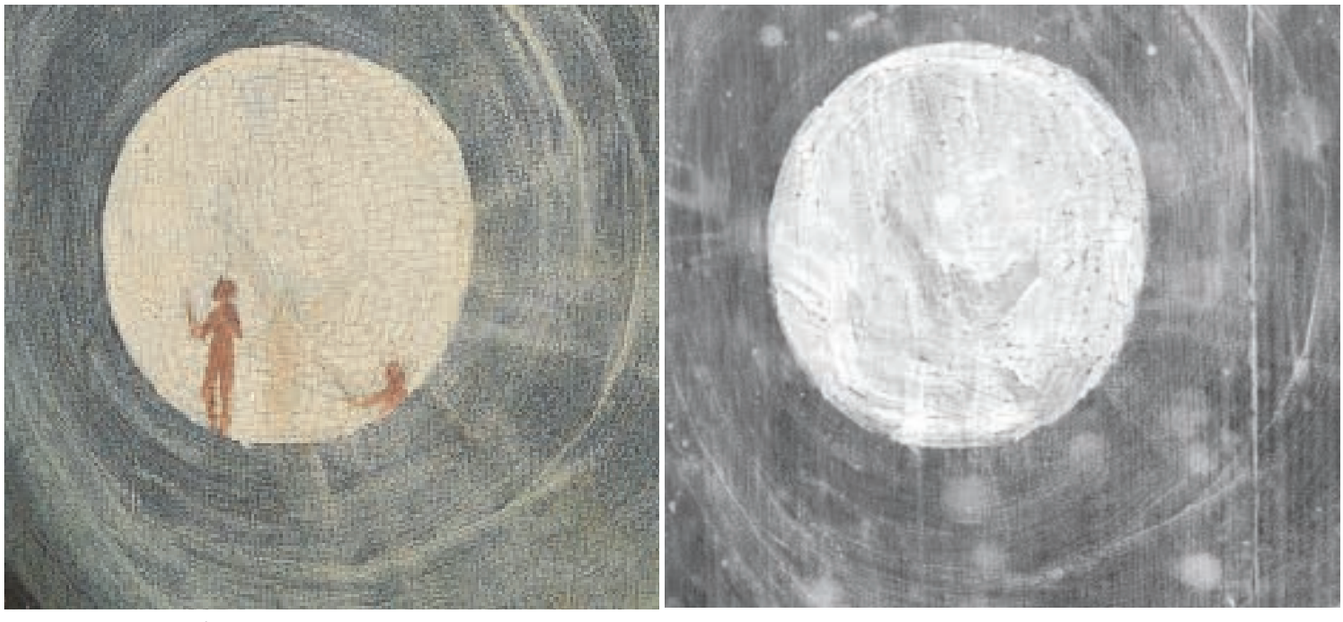
18.4–5 RR 36, VIS and XR

18.6–7 RR 32, VIS and XR



18.8–9 RR 34, VIS and XR

18.10–11 RR 36, VIS and XR



18.12–13 RR 38, VIS and XR

were painted in lead white. In the lower left corner of the *River to Hell* (RR 34), the demon was painted wet-in-wet, using light and dark green paints along with some ochre, followed by highlights. The fires in both panels primarily consist of vermilion red, bright orange, lead-tin yellow, lead white and a red or brownish purple lake (not analysed). A few orange strokes (e.g., at the right edge of the *River to Hell*, just below the hind leg of a monster, were covered by a greyish layer (fig.18.15). It is possible this fractured layer was the substrate material of a degraded (red?) lake.

In the foreground landscape of the *River to Hell* (RR 34), a greenish colour can be seen shimmering through. The green landscape in the *Garden of Eden* consists of a mixture of lead-tin yellow, malachite (copper sulphate), green earth and lead-white pigments.[13] On top of the black underpaint, the sky was first painted white with vertical brushstrokes. Then a light blue paint was applied in broad, horizontal brushstrokes, also covering the landscape and extending beneath the fountain, foliage and part of the hill. The grey fountain with wet-in-wet detailing and the foliage were painted next, followed by the darker blue of the landscape. It seems the hill was made less steep on the left to fit the fountain, the lowest section of which was painted over the hill. In the foliage at upper right, curved strokes are visible in XR (figs. 18.10–11); these were applied in the still-wet underlayer, possibly to indicate the position of the foliage. The foliage itself consists of a greenish layer followed by light green paint dots, and (locally) more whitish green dots.

The figures in the centre and the background figures at centre right were painted atop a green layer, while the foreground figures were painted directly on the black underlayer. The raised arm and hand of the man in the bottom left corner of the *Garden of Eden* (RR 36) were left in reserve from the man behind. The hair of the angel to the right was first painted in brown, with some darker brown brushstrokes for shadow areas. The lighter hairs were done with light brown, yellow (ochre?), lead-tin yellow and lead white (not analysed). The angel's gown was executed in vermilion with a red glaze for shadow areas, while black paint was used for folds, with a few touches of white for highlights. All flesh tones have a whitish to brownish pink colour, the lighter areas often being applied on top of a slightly darker and thinner pink-brown. In the *Ascent of the Blessed* (RR 38), the dark blue of the angel's robe at lower right was painted around the hand of the figure, dragging along some of the still-wet pink (38MICGBM003). The highlights on the skin tone of the angel and the figure in the tunnel were applied with heavy impasto. The greyish-blue tunnel was painted directly on the black underlayer. The dark to light grey sky colour was applied afterwards, followed by the angels, and then the figures that had been left in reserve. The artist made use of the greyish background colour shimmering through in multiple areas. The centre of the tunnel was painted first with a lead-white layer, followed by two brown figures, and a very faint suggestion of a figure, perhaps an angel. XR shows that a second layer of lead white was applied around these figures (figs. 18.12–13).

The reverses of the panels have the following build-up: on top of the chalk ground an opaque layer was applied. For the greenish imitation stone, this consists of a black layer, while the reddish stone imitation has an orangeish underlayer followed by a coating of red lake (figs. 18.22–23). White paint, which seems to be composed of lead white and chalk (ceruse) with traces of other pigments, was then

splattered, blown, and/or dripped on all panels. Finally, a copper-green lake was applied on the entire surface of the two imitation green-stone paintings, while a thick red lake layer was applied on the two imitation red-stone paintings (one of which, RR 33, is heavily damaged; see below, *Stability*).

- ***Changes*** Changes are visible in VIS and IRR/IRP. In the *River to Hell* (RR 34), a tail section was painted out at the upper leg of the human figure in the central foreground. In the *Garden of Eden* (RR 36), the hill of the fountain had a different shape. The vermilion red gown of the angel was reduced in size at the shoulder and runs under the figure to the left. That figure's arm was left in reserve from the gown but was shifted a bit. The red section between the arm and back is now covered by original red lake paint mixed with black. The right leg of the figure was originally planned slightly more forward (in a greyish-brown colour) but was moved backward, partially covering green paint.

FRAME

At the time of our research, the panels were unframed.[14] The original, engaged frames have been lost and the original format of the ensemble is unknown. The modern perimeter frameworks attached to the imitation-stone sides with bolts and springs provide additional support for the panels to cope with temperature and humidity fluctuations. Each framework consists of a rectangular wooden profile with round slots for springs and holes for bolts. The bolts are attached to small, round pieces of wood, which are glued to the panel's reverse. The wider bolt holes and the spring attachments allow for movement of the panel. Tightening the bolts increases the tension on the springs and reduces the flexibility between the panel and the perimeter framework. One panel has a wooden backing consisting of three thin planks inserted into the slots of the wooden profile.

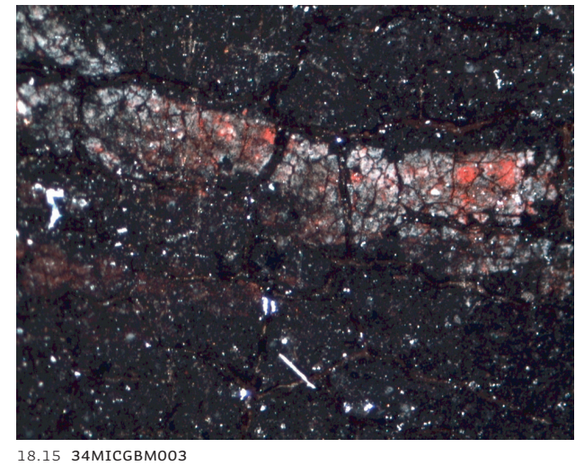
CONDITION

A full conservation treatment of the reverses with imitation stone (RR 33, 35, 37, 39) began in 2015, thus after the 2011 BRCP technical examination of the painting on which this report is largely based.

Support

- ***Altered dimensions*** All four panels have been cropped at the top and bottom. On the reverses, non-original bevelling on the edges has heavily damaged the picture support as well as the layer build-up.
- ***Additions*** On each of the four reverses, a thin, wooden inlay consisting of several sections was observed between the planks.[15]
- ***Cracks*** At the top left and bottom right corners of both the *Fall of the Damned* (RR 32) and the *River to Hell* (RR 34), cracks are present. In the *Ascent of the Blessed* (RR 38), cracks running along the wood grain are discernible at the top right and along the bottom edge.
- ***Deformations*** Probably because the panels are painted on both sides, there are only minor deformations and their stability is reasonably good. The support of the *Ascent of the Blessed* is slightly concave. At the bottom right of the *Fall of the Damned*, there is a small indentation.
- ***Joins*** The joins in the panels remain closed, but slight differences in level are observable on the reverses. XR indicates that in all four panels, each pair of planks has separated at some point, as all dowels are broken along the join.
- ***Coated reverse*** The reverses are painted, although the reverse of the *Fall of the Damned* is heavily damaged.

18.14 36MICGBM005



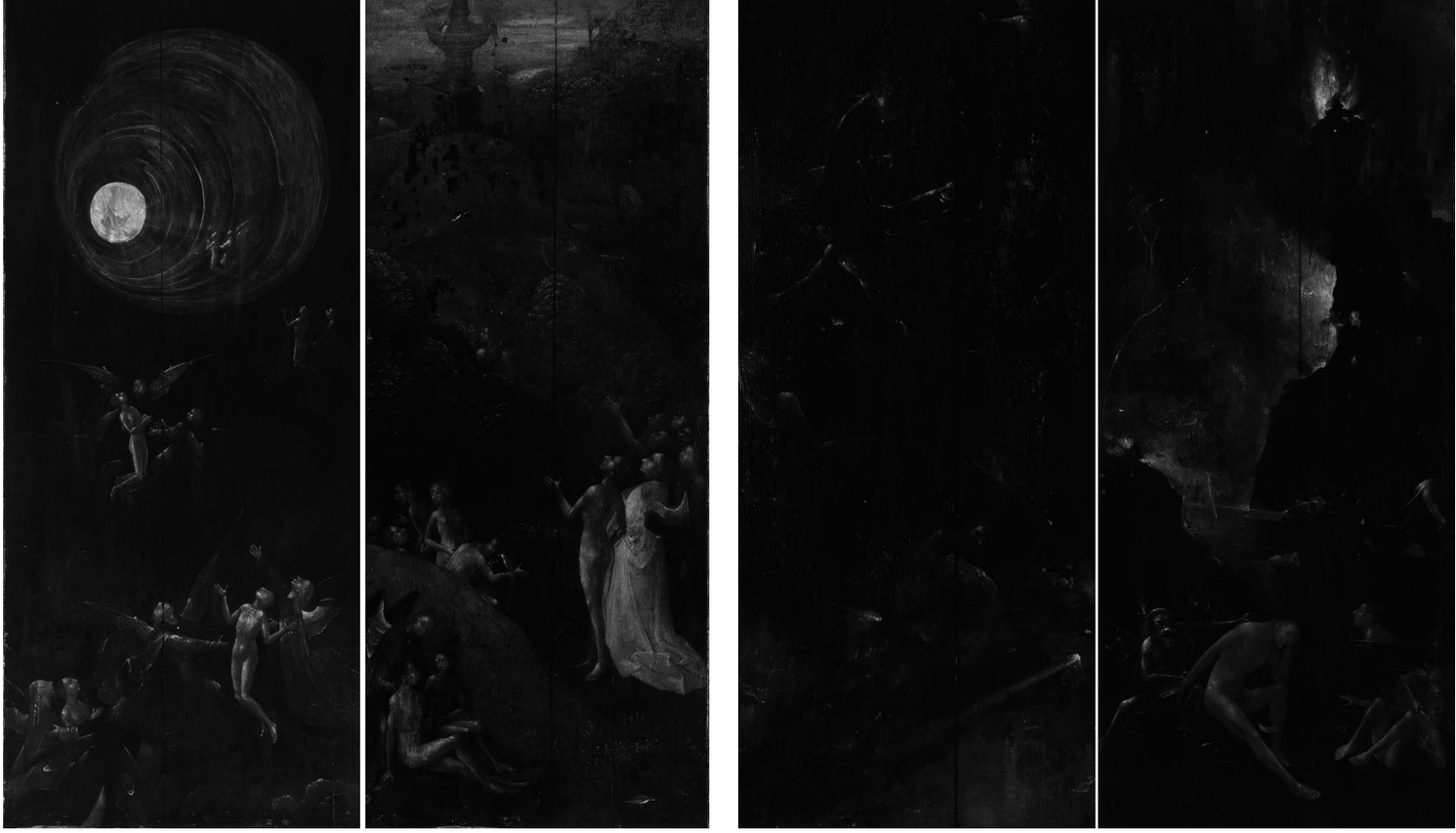
18.15 34MICGBM003

- ***Biological damage*** Minor old woodworm damage was observed in all panels. Additionally, on the reverse of *Fall of the Damned* (RR 33), brown-rot fungi have severely damaged the panel.

Ground and paint layers

- ***Stability*** The paintings are generally stable and there are no issues of recent cracks or raised paint. The reverses, however, are in poor condition, with facings holding locally raised paint in place. Also, there are only remains of original paint on the reverse of the *Fall of the Damned*, and the other panels (mainly the lower left of the reverse of the *River to Hell*, RR 35) show losses that have not been filled and retouched. The inlays at the joins are not continuous, and the remaining holes are unfilled.
- ***Losses*** In the *Fall of the Damned* (RR 32), there are several small losses spread over the surface. *The River to Hell* (RR 34) has a few losses evident just to the right of centre and in the water. Besides small losses, the *Garden of Eden* (RR 36) has larger losses in the hill area below the fountain and a scratch along the top edge. In the *Ascent of the Blessed* (RR 38), there are only pinpoint losses and a scratch in the lower left.

  Non-original bevelling has heavily damaged the preparatory and paint layers on the reverses. The reverse of *Fall of the Damned* (RR 33) has suffered the most, and only traces of reddish stone-imitation paint remain there. There are multiple losses on the other reverses.
- ***Abrasion*** The paint surface has been greatly damaged where the old inventory numbers used to be (see above, *Inscriptions and labels*). Overall the paint is quite abraded, with severely damaged paint surfaces in places.
- ***Discoloration and increased transparency*** The greens have darkened; see, for example, the foliage in the *Garden of Eden* (RR 36) and the green glazes on the imitation-stone reverses (RR 35 and 39). Some fading may have occurred in the purplish paint in the *Ascent of*



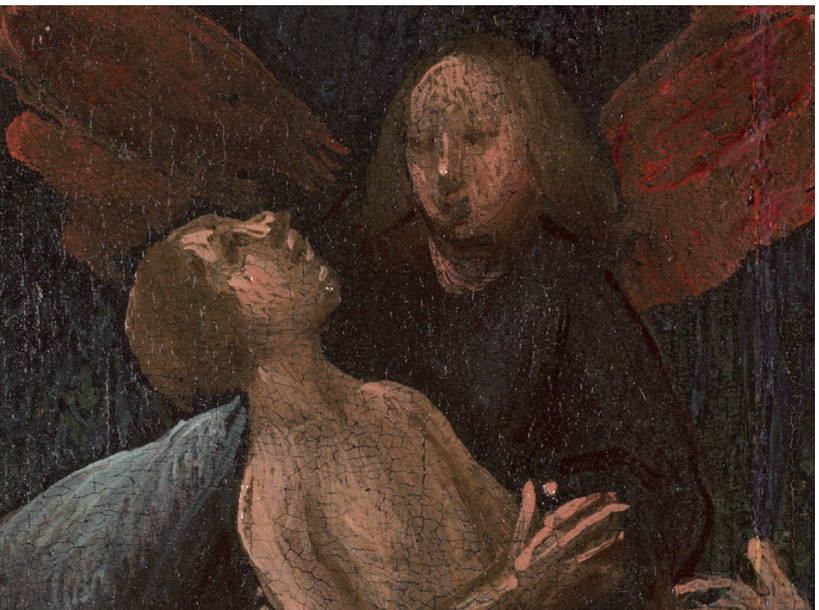
18.16–19 IRR

the Blessed (RR 38). The lead-white-bearing paint in the figures has increased somewhat in transparency, causing greater visibility of the dark underlayer and a natural but unintended change of appearance (see, e.g., fig. 18.20). This effect has been reinforced by the abrasion of the paint layers.

- ***Filling, retouching and overpainting*** The joins and most losses have been filled and inpainted. Additional retouching can be seen spread over the surface, generally more concentrated in the background. Some of these retouchings have discoloured over time and are now more apparent. The unpainted edges have been toned to reduce their presence. A bird on the join in the lower centre of the *Garden of Eden* is partially painted out. There are many retouchings just below the fountain, where a large part of the deer is still missing. A diagonal scratch at the lower right of the fountain has been retouched, and the same goes for a horizontal scratch at the bottom left of the *Ascent of the Blessed*. At the top right of *Fall of the Damned*, the grey-brown, horizontal 'beam' continues over the figure and does not seem to be original.

The top right of *Fall of the Damned* seems to have been thinly overpainted in grey-brown, covering the craquelure of the black underlayer. Large sections at the bottom of the panel have also been thinly overpainted, with greyish strokes covering the orange-brown paint. The bottom edge of the *River to Hell* is thinly overpainted as well, covering the more greenish landscape. In the entire background sky and part of the water, similarly thin, semi-transparent, dark strokes are present on the brighter original paint. At the hip of the man at the bottom centre, three larger spots where this non-original layer has been damaged reveal the original skin tone (fig. 18.21). A similar feature can be seen in *Fall of the Damned*, where at the lower left edge, the layer continues over both original paint and retouches (32MICGBM004) and locally appears more brownish (32MICGBM005), covering original red glaze-like paints. In other areas the layer is darker and thicker, covering orange and red paints (32MICGBM001–002) as well as the cracks in the paint layers underneath. Possibly this layer is glue-based and was applied during the 1951 treatment of the painting by Mauro Pellicioli, who often used glue as patina and retouching medium (see *Varnish*). This would

18.20 RR 38, VIS



18.21 RR 34, VIS

also explain the difference in thickness and colour. This material was not removed during the 2007–08 treatment, which was considered 'maintenance' (see above, *Previous treatments*).

Residues of old filling material are present on the severely damaged reverse of *Fall of the Damned* (RR 33). No filling and retouching have been discerned on the other reverses.

Surface finish

- ***Varnish*** The appearance of the varnish is uneven due to a spray application of a somewhat matte surface coating. Numerous underlying older, severely discoloured varnish residues are especially disturbing (see, e.g., the dark brown colour in the foliage at the top right of the *Garden of Eden*). There is local loss of saturation, resulting in matte areas.

  Dirt and grime were not removed from the surfaces of the reverses prior to the application of a glue layer,[16] and later, a spray coat of slightly matte varnish.[17] This has resulted in a lack of saturation and in a much darker appearance of the imitation stone.

- ***Surface dirt*** There is only a small amount of surface dirt on the paintings, since they are displayed in a vitrine. However, the extensive dirt and grime on the panel reverses has bonded with the later-applied glue (see *Varnish*).

- ***Visibility of the original surface*** The sprayed varnish has resulted in slightly matte and generally dull-looking surfaces. There are several unsaturated matte spots on the fronts of the panels. These and the highly yellowed old varnish residues cause a reduced legibility of the original paint surfaces. The many partial, not precisely colour-matched and/or discoloured retouchings distract from the original paint surfaces.

Surface dirt and lack of saturation severely obscure the depth in the reverses with the stone imitations. Local losses, damages at the joins, cleaning test areas, facing tissues, an exhibition label and non-original markings further reduce the legibility of the reverses.

18.22 RR 37 and 39, after treatment

[1] See Rossi-Manaresi and Tucci in Limentani Virdis et al. 1992, 201.

[2] Nepi Scirè in Limentani Virdis et al. 1992, 176.

[3] See Nonfarmale (in Limentani Virdis et al. 1992, 187), who mentions that the old, non-original cradles, which partly covered the marbled reverses of the *Visions of the Hereafter* panels, were maintained during the 1990–92 treatment. However, currently there are neither cradles on the reverses of these panels nor any traces of such. Also, no cradles are present in the XRS of the 1990–92 treatment.

[4] Nonfarmale in Limentani Virdis et al. 1992, 187. This brief text only discusses the general treatment of the three ensembles attributed to Bosch in Venice, and does not refer to specific works.

[5] Giulio Manieri Elia, oral communication. Pre-treatment photographs show that the panels had a simple wooden perimeter framework and that they were connected by an auxiliary metal mounting frame, similar to those on the *Saint Wilgefortis Triptych* (cat. 8; RR 21–25) and the *Hermit Saints Triptych* (cat. 2; RR 26–31).

[6] Reports were apparently not created for this treatment. Paintings conservator Alfeo Micheletto and head of conservation Maria Chiara Maida, oral communication.

[7] Klein 2001, 124.

[8] Nepi Scirè in Limentani Virdis et al. 1992, 176; also compare Baldass 1959, 231, who stated that this paint could be original ('Diese Färbelung dürfte der Entstehungszeit der Bilder entstammen.').

[9] The youngest or last-preserved ring on each plank dates from, respectively: *Fall of the Damned* – 1459 (I), 1456 (II); *The River to Hell* – 1473 (I), 1456 (II); *Garden of Eden* – 1461 (I), 1461 (II); *Ascent of the Blessed* – 1468 (I), 1472 (II). See Klein 2001, 124.

[10] A scanning electron microscope equipped for energy-dispersive X-ray spectroscopy (SEM-EDS) was used by Enrico Fiorin to analyse the samples at the Misericordia laboratory, Venice, on 11 October 2007.

[11] See Rossi-Manaresi and Tucci in Limentani Virdis et al. 1992, 201 fig. 44.

[12] This could not be confirmed for the reverses, which are all heavily damaged on the edges.

[13] The silicon detected in the *Garden of Eden* is present in both green earth and lead-tin yellow type 2. Based on comparison with the *Wilgefortis Triptych* (cat. 8, RR 29–31), where only type 1 lead-tin yellow was present, the authors conclude that Bosch used only type 1 (and thus that the silicon in the other painting must be from green earth pigment). Rossi-Manaresi and Tucci in Limentani Virdis et al. 1992, 184.

[14] Previous XRS show the non-original, mitre-joined frame of the panels.

[15] The lighter areas around the joins are caused by residues of polyvinyl acetate (PVA) glue that was used for the adhesion of the thin wooden strips.

[16] The glue was most likely applied during the 1951 treatment of the painting by Mauro Pellicioli, who often used glue as a patina and as medium for retouching. Paintings conservator Giulio Bono and head of conservation Maria Chiara Maida, oral communication. Flaking remains of this thick glue coating were also observed in places.

[17] A spray coat of slightly matte varnish was evidently applied to the reverses of the panels during the 1992 treatment. Nonfarmale in Limentani Virdis et al. 1992, 187.

19 *Wayfarer Triptych*

A *The Wayfarer*

RESEARCH REPORT 8

Hieronymus Bosch
c. 1500–10

Oil (not analysed) on oak (analysed) panel, 71.3 × 70.7 cm.
Two exteriors of a now-disassembled triptych were joined and cropped, resulting in this panel.
Museum Boijmans Van Beuningen, Rotterdam, 1079

BRCP, *Catalogue Raisonné*, cat. 19A; www.boschproject.org no. 19A.

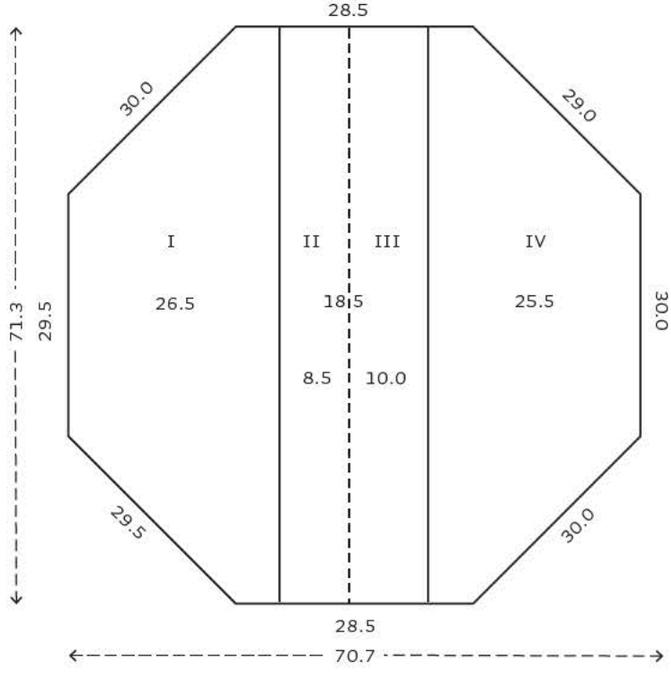
Inscriptions and labels
Reverse: a museum identification label on the cradle.

SUMMARY OF CONCLUSIONS

The Rotterdam Wayfarer *originally functioned as the two exterior wings of a now-disassembled triptych; these were later joined into a single painting that was cropped into its current octagonal format. The wings were also split lengthwise. The Paris* Ship of Fools, *with its fragment in New Haven,* Gluttony and Lust, *below it, once comprised the left wing, while* Death and the Miser *in Washington, DC, formed the interior of the right shutter. The central panel is presumed lost.*

While the paintings can be attributed to Hieronymus Bosch, their underdrawings were probably executed by an assistant. The modelling in these underdrawings is unusually elaborate, with dense webs of hatching and cross-hatching preparing areas of shadow to highly atypical levels of detail. This style of underdrawing is fully consistent in these four panels, but stands notably apart from that of other works in the group. The depicted compositions were probably not developed in the underdrawings, which appear to follow earlier models.

Each of the wings was originally housed in an engaged frame on three sides: at the top, bottom and lateral edges (in the closed position). The inner edges of the wings were never framed on the exterior, but closed side by side instead to form a continuous paint surface. On their interiors, these edges were outfitted with integrated (or applied) frame members.[1] *When the wings were dismembered, the engaged frames were discarded. The panel sections with the applied frame members were cropped off from the left edge of the* Ship of Fools *and the fragment at Yale (cat. 19B; RR 17–18 and RR 75–76), and from the right edge of* Death and the Miser *(cat. 19C, RR 53–54), explaining the current discrepancy in widths. Dendrochronology indicates that the panels, which share wood from the same tree, could have been painted from 1488 onwards, although a date after 1490 is statistically more probable. As further explained in* BRCP, Catalogue Raisonné, *cat. 19, we date these works to about 1500–10.*



19.1 Construction diagram (seen from the front;[2] dotted centre line represents the non-original join)

RR 8, reverse

RELATED WORKS

Ship of Fools, Paris (cat. 19B, RR 17–18); *Gluttony and Lust*, New Haven, CT (cat. 19B, RR 75–76); and *Death and the Miser*, Washington, DC (cat. 19C, RR 53–54). These works and the Rotterdam *Wayfarer* all belonged to the same, now-disassembled triptych (see further below, *Altered dimensions*).

EXAMINATION DATA

23–26 May 2011 (Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Ron Spronk).[3]

The painting was examined in the gallery, out of its frame, both upright on an easel and flat on a table, under strong illumination. Both front and reverse were easily accessible.

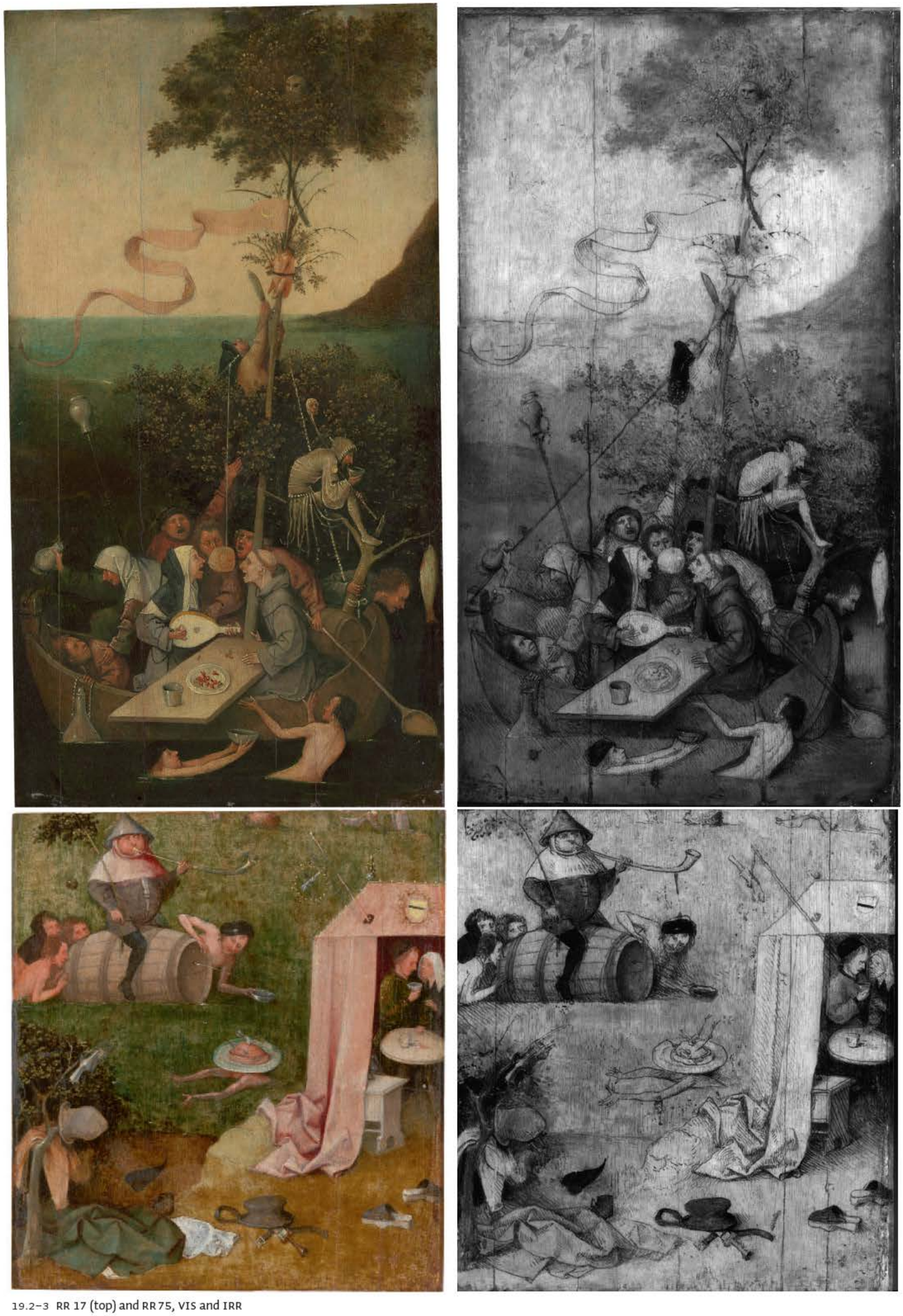
RR 8

- ***Previous research and additional documentation available*** The museum holds several files with photographs and information on the painting, including previous treatments. These documents have mostly been studied; they contain IRRS (AB 1079/2–AB 1082) that were made in 1988–89 by J.R.J. van Asperen de Boer and U.I. Nürnberger. Earlier IRR, conducted by Van Asperen de Boer and J.P. Filedt Kok in 1971–72, was published by Filedt Kok in 1972–73. These IRRS, together with IRRS from 2001 by Van Asperen de Boer and Jaap van der Weerd, are also on file at the RKD, The Hague. There are four detail XRS. Annetje Boersma took photographs and some paint samples during the last treatment in 2000–01.[4] A detailed report on the cross-section analyses was made at the Netherlands Institute for Cultural Heritage (ICN) by Karin Groen. See also Groen 2001, Lammertse 1994, Lammertse en Boersma 2003, and Van Bommel 2001.

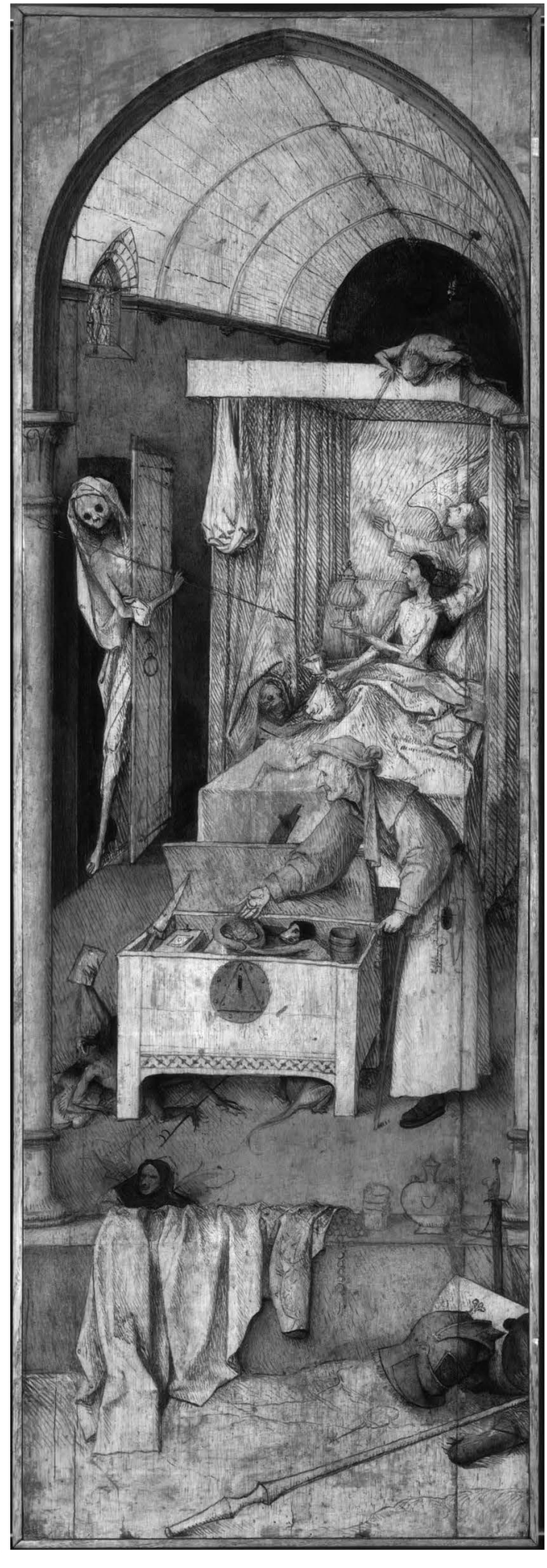
- ***Previous treatments*** The first documented treatment occurred in 1931, soon after the museum acquired the work. Restorer Hendrik G. Luitwieler replaced the old cradle with the help of carpenter Broomans and subsequently cleaned, retouched and varnished the painting. He probably also consolidated the paint layers[5] and may have reinforced the non-original join between the two wings of the painting.[6] In 2000–01 the painting was restored in Rotterdam by Annetje Boersma, who cleaned, retouched and varnished it.

SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 19.1). The thickness of the panel varies between about 2 and 8 mm.

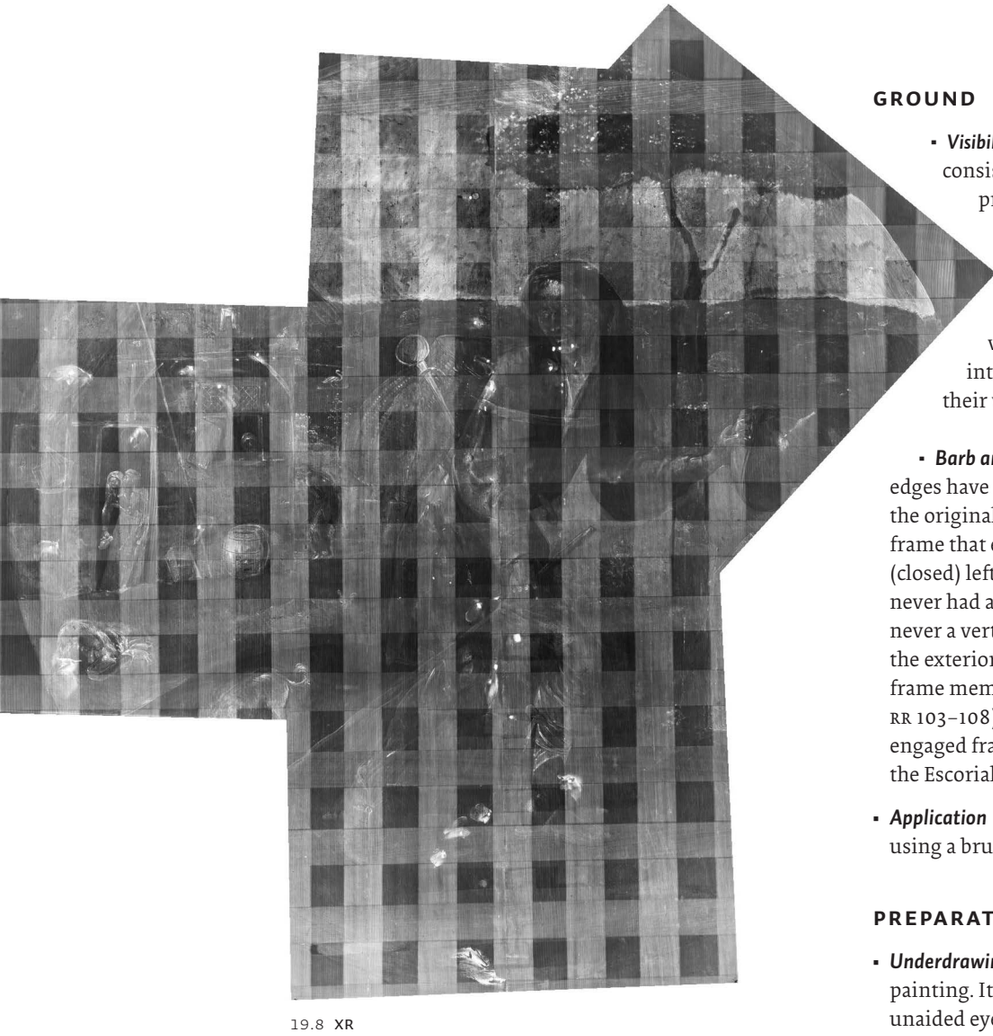


19.2–3 RR 17 (top) and RR 75, VIS and IRR



19.4–5 RR 53, VIS and IRR

19.6–7 RR 8, VIS and IRR



19.8 XR

The wood species, Baltic oak, was identified through dendrochronology. The current panel consists of four quarter-sawn planks, vertical in grain, and laid vertically. The two narrow central boards most probably were initially a single plank that was cut lengthwise by the panelmaker and possibly planed or smoothed afterward.[7]

The connection of boards I and II and that of boards III and IV were butt-joined, dowelled and glued. Remains of the dowels are visible on the thinned reverse at both joins,[8] and one dowel is visible in an XR.[9]

The reverse is not in its original condition, since the original triptych wings were sawn lengthwise before its exteriors were joined into a single panel, reshaped into an octagon and cradled (see below, *Altered dimensions*). Some traces of non-original sawmarks are visible.

- ***Dendrochronology*** All boards come from the same tree. The youngest heartwood growth ring dates from 1476, which, with the minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1485 for the tree that produced the wood for that plank.[10] However, the slightly later earliest possible felling date of 1486 can be applied, since the panel was made from wood of the same tree as *Death and the Miser* (cat. 19C), and that panel's youngest ring dates from 1477. A felling date after 1488 is statistically more probable, since 93 per cent of the possibly missing sapwood rings would be covered by this range. Assuming an additional minimum of two years for drying and transportation, the panel could have been produced from 1488 onwards, although a production date from 1490 onwards is statistically more probable. This outcome is applicable as well to the panels for the *Ship of Fools* in Paris and the Yale fragment (cat. 19B), which were also produced from wood of the same tree.

GROUND

- ***Visibility*** The off-white ground, which has been reported to consist of chalk (calcium carbonate – $CaCO_3$) and glue,[11] is present overall. It is discernible in VIS and to some extent in XR in the interstices of the wood grain. The ground is not fully covered by the relatively thin paint layers, being visible at paint contours, in losses and generally shimmering through the paint in several areas. The visibility of the ground and underdrawing may have been intended, but ageing effects of the paint film have increased their visibility.

- ***Barb and edges*** Barbs and original ungrounded and unpainted edges have not been preserved. It should be noted, though, that in the original situation, the shutters did not have a traditional engaged frame that enclosed the panel on all four sides. The right edge of the (closed) left shutter and the left edge of the (closed) right shutter never had a barb and unpainted or ungrounded edges, since there was never a vertical member of an engaged frame in those locations on the exteriors. Here, on the interior only, there were vertical applied frame members, as in the wings of the *Haywain* in the Escorial (cat. S1, RR 103–108).[12] It is highly likely that the shutters originally did have engaged frame members at the three other edges, as in the triptych in the Escorial.

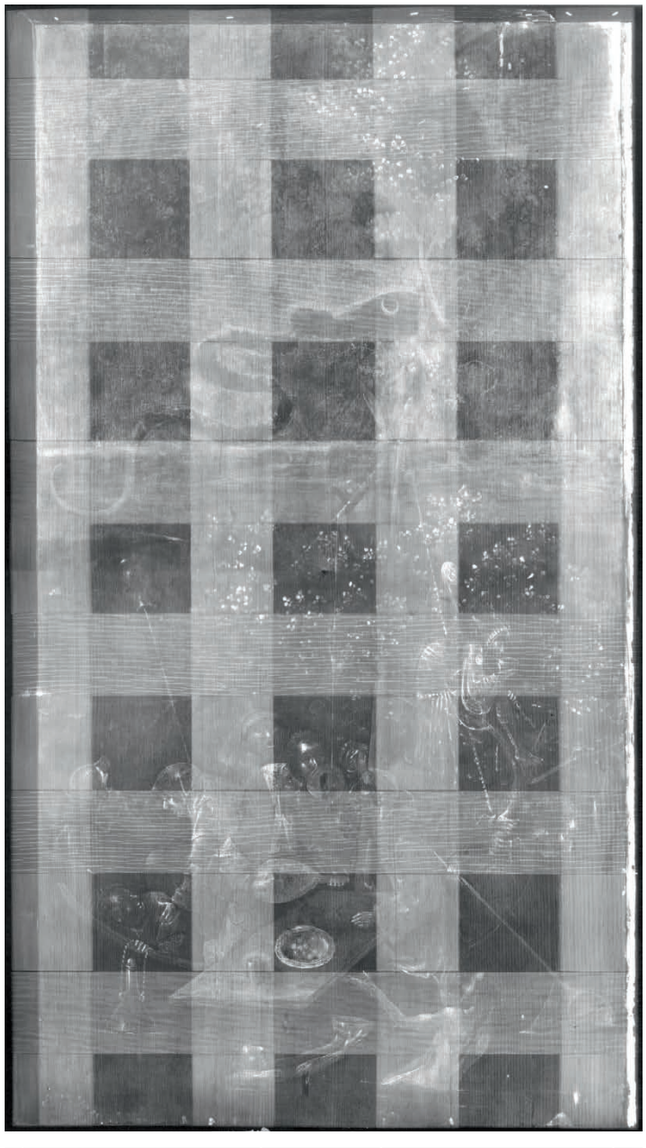
- ***Application*** The ground seems to have been thinly applied (possibly using a brush) and worked into a fairly smooth finish.

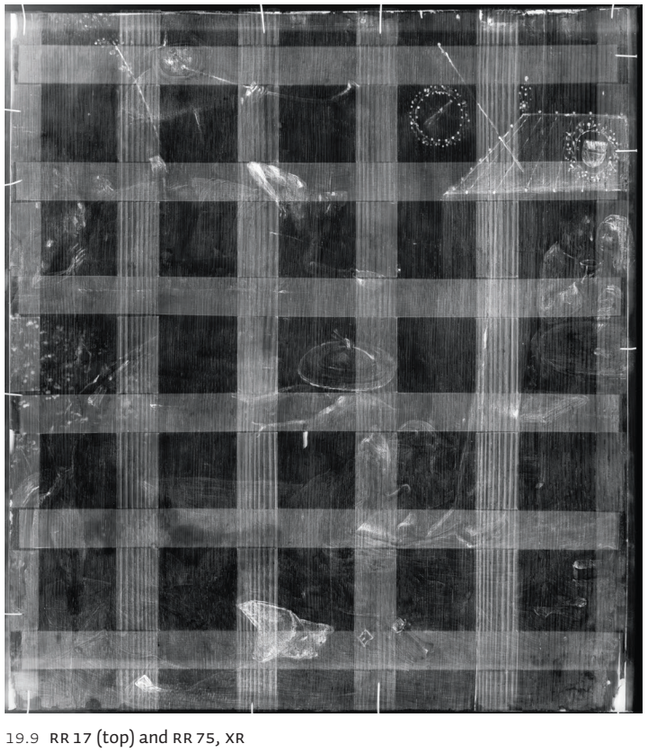
PREPARATORY LAYERS

- ***Underdrawing*** Underdrawing is observed throughout the entire painting. It is visible in IRR/IRP and, to an unusual degree, with the unaided eye in VIS. The drawing is unusually extensive and detailed, depicting almost every single element. Its function was to determine the outlines of the forms in the composition and to prepare modelling. Distinct zones of parallel hatching and cross-hatching indicate shadowed areas, in which denser webs of hatching are used to indicate the deeper shadows. It seems likely that the underdrawing played an intentional role in the final composition, functioning as a darker undertone slightly shimmering through the thin paint layers, but changes in refractive index due to ageing of the paint film will also have increased its transparency.[13]

- ***Medium and application*** The detectable underdrawing was applied using a brush in a liquid medium in at least two stages. The underdrawing material shows variations in opacity and tends to pool locally. The contours were perhaps drawn first, in mostly thin, long, fluent lines, some of which were restruck, while others apparently wavered. The circular outline at the inner edge of the tondo appears to have been underdrawn using some type of compass, the centre point of which was placed in the current centre join, against the edge of the panel. The two outlines atop the reddish layer were not underdrawn.

- ***Style*** The unusually extensive and detailed underdrawing was applied skilfully and fluently. Long, continuous lines are evident as well as many that are short and hatched. The hatching in preparation of modelling is highly elaborate. Most hatched lines are relatively short, and were applied in what seem to be at least two stages. The spaces between the parallel lines vary to indicate the depths of the shadows, but are relatively consistent within a distinct shape. Several fold lines are indicated with parallel hatching only, without a contour line. Line ends are both straight (often tipped) and hooked (e.g., in the lower right leg of the wayfarer). The lines themselves often have some curves, and the strokes frequently follow the modelling in the composition.[14]





19.9 RR 17 (top) and RR 75, XR

19.10 RR 53, XR

The short, parallel hatching is predominantly, but by no means exclusively, diagonal, running from top left to lower right (or vice versa) and curving to the lower left. Several authors have concluded that this style of hatching is an indication of its having been executed by a left-handed draughtsman.[15] In other areas, however, similarly oriented diagonal parallel hatching curves to the upper right; for example, in the proper right sleeve of the wayfarer. Moreover, many other lines run in other directions, such as horizontal (to the right of the piglets), vertical (in the lower leg of the wayfarer and in the rim of his hat), and diagonal from bottom left to top right, with a slight curve to the lower right (or vice versa, as seen on and behind the fence and in the spoon in his wicker backpack).

Cross-hatching is used for the darkest areas of shadow. The lines that were used for cross-hatching are generally longer and were applied to indicate darker shadowed areas. In some areas that seem to have been cross-hatched, the effect was achieved by overlapping subsequent webs of parallel hatching rather than by actually cross-hatching (as on the proper left leg of the wayfarer).

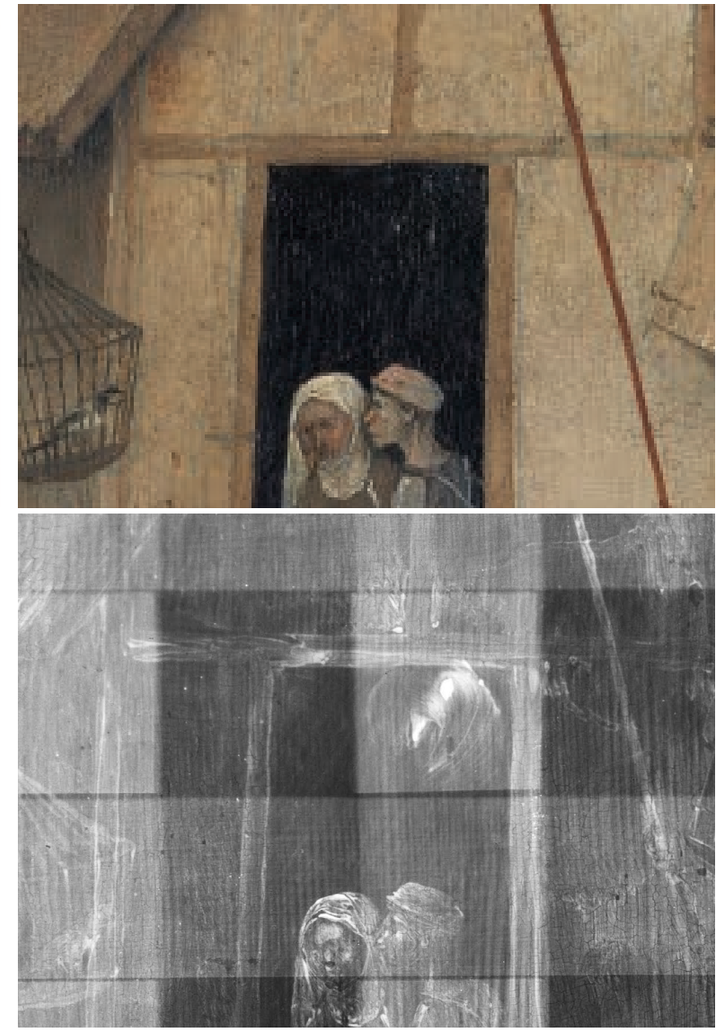
- ***Revisions in underdrawing and differences from painting stage(s)*** The underdrawing was followed quite closely in the paint application phase, although numerous minor contour shifts as well as some larger changes can be observed, which are often visible in VIS. The dog (figs. 19.11–12) and the sow at left and the wayfarer's dagger were painted considerably smaller than prepared, for example, and the position of the birds in the sky, the tree, and the legs of the cow were altered. Additional alterations to the wayfarer include the omitted hair at his right shoulder, the size of his hat, the tips of his sleeves, the length of his fingers, and the positions of his left thigh and knee, as well as both feet. His face was initially also turned slightly more to the left, and the upper contour of his headgear was lowered.
- ***Intermediate layers*** A warm, cream-coloured layer is visible under the paint layers, shimmering through them overall and exposed where the paint layers are damaged and also at paint contours (e.g., between the sky and the red and in the jug, 08MICGBM006). This layer seems to have been thinly applied over the ground on the entire panel surface and could be a pigmented isolating layer. Cross-section research indicates the presence of an oily isolating layer, with black pigment detected in one sample and yellow-brown ochre in another.[16] Discoloration of the binding medium may play a role in the appearance of this layer.

  Several impastoed and highly radio-opaque lead-white dabs were noted on both panel sections (figs. 19.13–14). These dabs correlate to small, local damages in the ground layer and underdrawing, and probably served to quickly fill the lacunae before painting (08MICGBM009).

PAINT LAYERS

- ***Paint application and painting technique*** The oil paint (not analysed) was applied using a brush and covers the entire original panel

19.11–12 RR 8, VIS and IRR



19.13–14 RR 8, VIS and XR

surface. It was applied in several stages – usually a single base layer for larger surface areas, often followed by one or sometimes two additional stages (some with several wet-in-wet applied paints) for areas with more modelling and detail. After that, highlights and shadows were applied, locally directly onto the base layer. Paint was applied both wet-on-dry and wet-in-wet. It does not seem to have been scratched away with the back of a brush, but still-wet paint was sometimes moved aside by brushstrokes (see, e.g., the barrel rings, fig. 19.15).[17] It also does not seem necessary that the painter worked separately on each wing, since the paint composition and colour are highly comparable on both sides of the central join.[18] Since the underdrawn composition is not continuous (see below, *Altered dimensions*), and vertical brushstrokes are present in the sky just left of the central join, the panels were indeed not placed directly against each other while being worked on, but there would have been a very slight separation between the two.

Paint was applied very thinly overall, with the exception of impastoed paints that contain lead white, including the sky. The generally fluid paints of opaque pigment (such as lead white, black and ochres) were applied so thinly that in these areas the underlying layer now often shimmers through. With the exception of the red lake at the outer edge, glazes were not used. The paint has a slightly matte appearance from extensive use of duller earth pigments. On the whole, the panel was brought to a reasonably high degree of finish, using both fairly rough and finer brushstrokes. Although areas were left in reserve, it seems that the tone of the underlying layer was utilized in the paint application to some extent. In addition, sometimes highlights were applied directly onto the first paint layer, indicating a quick working method. Brushstrokes were used to render contour and volume throughout the painting (and more so for impastoed paints). On the bars of the gate at the right, highlights were usually applied from right to left, whereas in the wayfarer and the house (e.g., the exposed roof struts and the swan sign), lines applied predominantly from left to right are discernible.

- ***Texture*** Most passages have a smooth finish, but locally, more impastoed areas with textured brushstrokes are visible. Aside from impastoed highlights, texture is also used for modelling (e.g., in the wayfarer's spoon and in his sleeve). The impasto is fairly fluid, mostly where lead white has been used.

- ***Build-up and palette*** The paint was applied from light to dark (e.g., glazes, the damaged roof, several reinforcements of contours and shadows) and from dark to light (e.g., figures, foliage and highlights). The painting appears to have been built up back-to-front in mostly thin layers and was almost completely planned. The sky area was painted first (lead white to greyish, with some blue pigment particles), leaving areas in reserve. It was followed by the base ochre, umber and grey hues of the house and the wayfarer, as both forms slightly overlap the sky. The foreground and background landscape seem to have been painted afterwards, indicating that large colour sections were painted first, leaving other compositional elements in reserve. The other elements were then executed, followed by details, highlights and shadows. The red contour was painted after the sky and, in some areas, over the landscape as well. In other parts, however, landscape paint continues over the red. A possible explanation for this could be a layered build-up of the red, with the second red layer being applied after the landscape was painted. For the red contour, a dense black base layer was covered by a layer of red madder lake mixed with some lead white, followed by a red madder glaze with a few orange-red inorganic pigments.[19] This first red layer (appearing slightly greyish) is visible at the outer section of the painting, but brushstrokes applied in multiple directions indicate that it covers the entire red section. The second red glaze only covers the inner section and was laid on after the two black circular lines were painted atop the first reddish layer. The foliage of the large tree consists of a brown base layer containing some bone-black, red (ochre?) and white pigments as well.[20] Dark grey dabs of paint with ensuing smaller, light grey touches indicate the foliage. The wings of the bird hanging from a dark brown branch were painted with blue pigment added to some grey; its belly consists of lead-tin yellow and its head of pure black with a dab of lead-white paint. The small space left in reserve between the black and white makes for a convincing eye. Blue pigment can also be found in the black paint below the hand of the woman holding a jug (08MICGBM005).

- ***Changes*** Very little was changed during the later paint stages. It seems that only the skin on the wayfarer's basket and the dog at the lower left were reduced in size (figs. 19.11–12).

FRAME

The gilded octagonal wooden frame (max. 85 × 85 cm) is modern. The original frames of the two wings have been lost, but most likely these wings would have had engaged frames on three sides. The non-original central join would not have been covered by a framing element on the exteriors, so as to allow the composition to continue over both wing sections. Instead, the interiors (i.e. cat. 19B and 19C) would have had an applied frame member in this location. Indeed, on both sides of the later central join, round holes with filling material are distinguishable.[21] The holes originally contained the pins that enabled the attachment of the vertical applied frame member on the interiors.

CONDITION

Support

- ***Altered dimensions*** As known from previous technical investigations,[22] the *Wayfarer* originally functioned as the two exterior wings of a now-disassembled triptych, which were later joined into a single painting and cropped into the current octagonal format. The composition, which continued over these two exteriors, was originally visible only when the triptych was closed. The *Ship of Fools* with the fragment at Yale (the so-called *Gluttony and Lust*) below it comprised the interior of the left wing, and *Death and the Miser* in Washington, DC, formed the interior of the right shutter. The interiors were separated from the exteriors by sawing the panels lengthwise through the middle. The central panel is presumed lost.

  Sawmarks can be found at all edges of the *Wayfarer* and there are no traces of original barbs. The panel was cropped at the left and right sides, roughly removing the engaged framing elements there, including the barb. Much more was removed from the top and bottom, and also the corners, to arrive at the octagonal shape. The current panel of the *Wayfarer* is thin and highly irregular on the reverse, perhaps indicating that it was hand-sawn. Its original thickness seems to have been at least 1 cm (see above, *Panel*, and note 9).

  The composition of the *Wayfarer* does not continue perfectly over its new central join, where about 0.5 cm seems to be missing between the two halves. The original exteriors of the wings did not have an engaged frame here, but only an applied frame member on the interiors, which allowed the composition on the exterior to continue in the same plane when the wings were closed. Although some original materials might indeed have been scraped away from the edges of the wings here when these were joined, there must originally have been a small gap to allow for the opening and closing of the triptych wings.

- ***Additions*** A wooden cradle is present on the thinned panel reverse. The cradling is very extensive for such a thin panel and although only

some horizontal cradle members are blocked, it seems the cradle hardly allows for natural dimensional changes of the panel. The gap between the slightly deformed panel centre and the flat cradle has been filled up with wooden strips.

- ***Cracks*** Old, stable cracks have been noted at the lower left and right edges and at the top centre. These cracks do not seem to relate to the current cradle.
- ***Deformations*** The panel has a slight wave-like deformation. The cradle and wooden fills probably have kept the panel in this configuration and restrict any further movement.
- ***Joins*** The two original joins are closed, as is the later central join.
- ***Biological damage*** A few small, old woodworm holes can be observed in the panel.

Ground and paint layers

- ***Stability*** No recent paint losses or issues with raised paint have been observed.[23] Most craquelure is caused by ageing of the paint and natural dimensional changes of the panels, but in the darkest area between the wayfarer's legs broader drying cracks are present. Overall, the ground and paint layers adhere well and seem relatively stable.

  Metal soap aggregate formation, which can appear as small opaque points in XR, has been observed in several areas of the painting, albeit to a limited extent. Expansion of the aggregates may cause them to protrude from the paint surface, resulting in minuscule raised spots and a more granular surface texture. Loss of these metal soap aggregates results in tiny, craterlike holes that appear dark in XR. Over time, accumulation of dirt and varnish residues in these holes causes them to appear dark in VIS and IRR/IRP.
- ***Losses*** There are several tiny losses spread over the painting surface. At top centre, a diagonal paint indentation line is detectable in the sky.

19.15 VIS

- ***Abrasion*** In general the paint is well preserved, although there is some slight overall abrasion, especially in the sky area and on the tree.
- ***Discoloration and increased transparency*** The paints that contain lead white (mainly in sky and skin tones) and earth pigments are likely to have become more transparent over time, an effect that is further enhanced by the use of thin paint layers. This has resulted in a significantly increased visibility of the ground, underdrawing and lower paint layers. The red lake paint on the outer edges seems to have held up well, although the discoloured (oil?) varnish on top makes a possible fading difficult to ascertain.
- ***Filling, retouching and overpainting*** Many of the smallest losses have not been retouched. Small losses and the area at the central join have been inpainted. Several areas of the paint surface appear greyish. This is more clearly visible in the sky, where a thin, dark overpaint remains on the surface and in many of the interstices of the paint, on top of old varnish residues.

Surface finish

- ***Varnish*** The varnish, which appears to be of a natural resin, is modern and has a glossy, even appearance, with the exception of the older, dirty (oil?) varnish on the outer red layer.[24] The saturation of the paint surface is relatively good, although the varnish is blanched a bit locally (e.g., in the lower part of the doorway). Discoloured old varnish residues can still be seen in the interstices of the paint (08MICGBM007).
- ***Surface dirt*** There is hardly any surface dirt on the painting, as it is displayed in a vitrine.
- ***Visibility of the original surface*** Residues of mainly discoloured old varnish in the interstices of the paint result in an uneven appearance, especially in the sky area. This area looks greyish due to remains of a thin, dark overpaint present on the older (oil?) varnish. Furthermore, the local blanching of varnish causes a reduced legibility of an otherwise excellently visible original paint surface.

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1 The same framing method was used for the *Haywain Triptych* in the Escorial (cat. S1, RR 103–108) and (presumably) the *Last Judgement Triptych* in Bruges (cat. 16, RR 69–74). The construction of the frame of the *Haywain Triptych* in the Prado (cat. 20, RR 97–102) is similar but not fully identical.

2 Dimensions (except overall) are as noted in Peter Klein's 1983 dendrochronological report.

3 René Hoppenbrouwers of Stichting Restauratie Atelier Limburg (SRAL) also participated in the examination and documentation.

4 Treatment photographs and samples (?) are kept in the conservation studio of Annetje Boersma.

5 Lammertse and Boersma 2003, 103 and 114.

6 A handwritten note in the museum's file about Luitwieler's treatment of the painting indicates that the central join had a tendency to separate. ('De naad in het midden van het paneel had neiging om los te gaan.') Furthermore, it mentions that the painting was cleaned ('uitgewasschen') with turpentine. In another handwriting, it was added that the painting had previously been cradled around 1870.

7 Peter Klein's dendrochronological report from 23 December 1983 (kept in the archives of the Museum Boijmans Van Beuningen). The last-preserved ring on plank II dates from 1367 and the first on plank III from 1386.

8 The slightly tapering dowels measure about 0.5 × 5.5 cm. Lammertse and Boersma 2001, 104.

9 The maximum thickness of this dowel is almost 8 mm, indicating that the original panel at this section was at least 1 cm thick. Caspers 2010, 69 n. 12.

10 The youngest or last-preserved ring on each of the two planks of the central panel of the *Wayfarer* dates from, respectively, 1473 (I), 1367 (II), 1476 (III) and 1476 (IV). Klein 2001, 125; Lammertse 1994, 91. It should be noted that there is a discrepancy between Klein's 1983 report and his 2001 publication. In his 1983 report, all the last-preserved growth rings are dated six years earlier: e.g., 1467 (I), 1361 (II), 1470 (III) and 1470 (IV). As a result of improvements to the reference chronology for Baltic oak in 1985, these dates were revised by Klein. A copy of Klein's report is housed at the RKD, The Hague.

11 Unpublished cross-section report: Groen 2001, 1–24. The composition of the ground does not seem to have been analysed.

12 The frame of the *Haywain* in the Prado was constructed slightly differently; see cat. 20, RR 97–102.

13 In the historically informed reconstruction made by Caspers, the underdrawing is hardly visible through the recent paint layers. Caspers 2010, 57–70. It would be interesting to establish whether the transparency of the paint layers of this copy will alter with ageing.

14 Caspers 2010, 64.

15 See Nicole Verhagen, 'Un nouvel aspect du problème Juste de Gand' (MA thesis, New York University, 1962), 47; Lugt 1968, 22–26; Micheline Sonkes, 'Le dessin sous-jacent chez les primitifs flamands', *Bulletin de l'Institut Royal du Patrimoine Artistique* 12 (1970), 195–225; Reuterswärd 1970, 163–64; Filedt Kok 1972–73, 133–62; Sybesma-Ironside 1973; Reuterswärd 1993, 1–10; Koreny 2002–03, 47–75; Koreny 2012. See also BRCP, *Catalogue Raisonné*, 37.

16 Groen 2001, 1–24.

17 Contra Caspers 2010, 66.

18 Contra Lammertse and Boersma (2003, 117), who mention that possibility, based on slight colour differences.

19 Groen 2001, 11–14 and 21–24. A sample of madder lake was analysed by the ICN (now the Netherlands Cultural Heritage Agency, or RCE), using high-pressure liquid chromatography (HPLC) and a fluorescence detector. Unpublished analytical report, Van Bommel 2001, 1–7.

20 Groen 2001, 5–10.

21 Lammertse and Boersma 2003, 107.

22 Mainly Klein 2001, 120–22; Lammertse and Boersma 2003, 102–18.

23 A condition report dated November 2007 by Annetje Boersma, Camille Marchand and Luuk Hoogstede notes that several months before, the painting was checked by Boersma and showed signs of instability.

24 This old varnish could not be removed without risk and was left on the red area as a protective layer during the last treatment of the painting, by Annetje Boersma in Rotterdam in 2000–2001. Lammertse and Boersma 2003,116.

19 *Wayfarer Triptych*

B *The Ship of Fools*

Hieronymus Bosch
c. 1500–10

Oil (not analysed) on oak (analysed) panel, 58.1 × 32.8 cm (with added strips and backing; the cropped panel formed the top section of the interior left wing of a now-disassembled triptych).
Musée du Louvre, Paris, RF 2218

The painting was restored in 2015, thus after the 2011 BRCP technical examination of the painting on which this text is largely based.
BRCP, *Catalogue Raisonné*, cat. 19B; www.boschproject.org no. 19B.

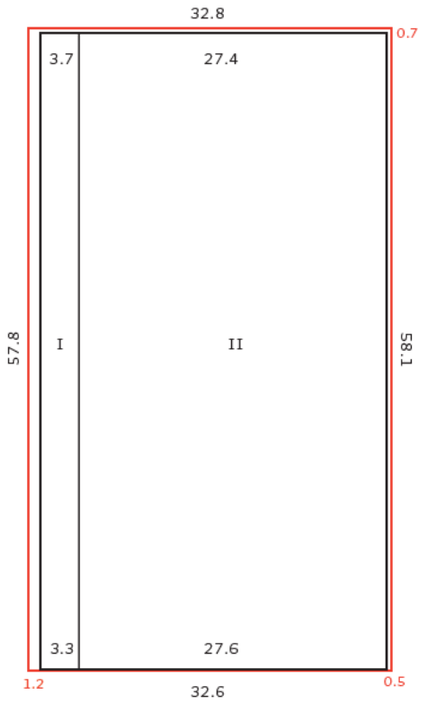
Inscriptions and labels
Reverse: There are several markings on the backing and the cradle. On the central two vertical cradle members are the marks MUSEE DU LOUVRE and RF 2218. On the horizontal cradle members in the lower centre, RF 2218 is written in pencil, and in the lower left is a label, 1186. On the backing, a number in pencil is visible in the top left; a vague, round stamp is present in the top centre; and in the lower centre in ink is RF 2218.

SUMMARY OF CONCLUSIONS

See cat. 19A.

RELATED WORKS

Gluttony and Lust, New Haven, CT (cat. 19B; RR 75–76); *Death and the Miser*, Washington, DC (cat. 19C; RR 53–54); *The Wayfarer*, Rotterdam (cat. 19A; RR 8). These works, and the *Ship of Fools*, all belonged to the same, now-disassembled triptych. The *Ship of Fools* originally functioned as the top section of the interior left wing (see further below, *Altered dimensions*).



19.16 Construction diagram (seen from the front). Red lines indicate non-original current dimensions, with the attached backing and cradle.

EXAMINATION DATA

3–4 October 2011 (Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Ron Spronk).

The painting was examined under good conditions in storage. The panel was studied upright on an easel and flat on a table, under strong illumination.

- ***Previous research and additional documentation available*** The technical information in Marijnissen 1987, 310–15, and in Morganstern 1984, 295–302. Two complete XR photos of the painting were studied and photographed. Additional conservation and technical documentation is preserved at the Versailles palace.[1] Marijnissen (1987, 310) briefly describes the condition of the painting and mentions the existence of a technical report from 1951. The BRCP has not yet been able to study these documents.

SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 19.16). Thickness c. 0.3–0.4 cm (including the backing, but excluding the cradle). The remaining original panel measures 57.4 × 31.1 cm.

  The wood species, Baltic oak, was identified through dendrochronology. The painting consists of two quarter-sawn planks (a broader plank and a very narrow one), vertical in grain, laid vertically. The two planks were butt-joined, dowelled and glued. Only one trace of a dowel seems to be visible in the XR (at the tip of the pennant).

  The reverse is not in original condition. After being thinned, a plywood backing was applied to the panel and later cradled (see also below, *Altered dimensions*).

- ***Dendrochronology*** The youngest heartwood ring dates from 1474, which, with a minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1483 for the tree that produced the wood for that plank.[2] However, the slightly later earliest possible felling date of 1486 can be applied, since the panel was made from wood of the same tree as *Death and the Miser* (cat. 19C) in Washington, DC, and that panel's youngest ring dates from 1477. A felling date after 1488 is statistically more probable, since 93 per cent of the possibly missing sapwood rings would be covered by this range. Assuming an additional minimum of two years for drying and transportation, the panel could have been produced from 1488 onwards, although a production date from 1490 onwards is statistically more probable. This outcome is also applicable to the

RR 17

panels for the *Wayfarer* in Rotterdam (cat. 19A) and *Gluttony and Lust* in New Haven, CT (cat. 19B, RR 75–76), which were produced from wood from the same tree.

GROUND

- ***Visibility*** In a recent loss (perhaps a previous sample location) at the bottom right of the panel, it appeared that a sizing layer between the panel and the ground may be present.

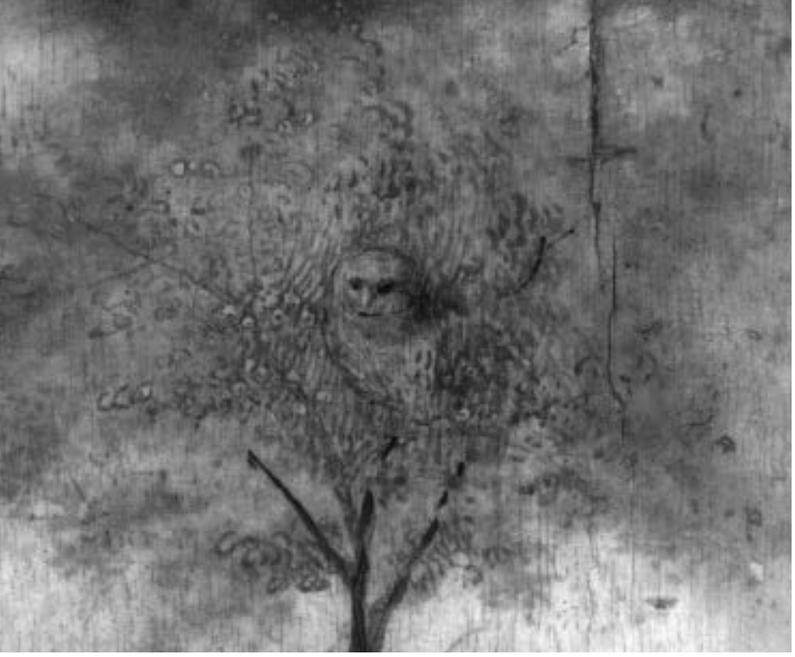
  The off-white ground (not analysed), which seems to consist of chalk (calcium carbonate – $CaCO_3$) bound in animal glue, is present overall.

  The ground is apparent in VIS and to some extent in XR, in the interstices of the wood grain. The surface of the ground layer was almost fully covered by the paint layers. The ground is now only evident at the damaged outer edges, in losses and areas of abrasion. The layer shimmers through the paint surface in several areas in the figures. This appears to have been an intentional effect, despite the increasing transparency of the paint layers on account of their ageing, especially in the lighter areas. The ground also appears at some contours (e.g., below the figure in the tree), but that was probably unintended.

19.17–18 RR 17, VIS and IRR

19.19 RR 17, IRR

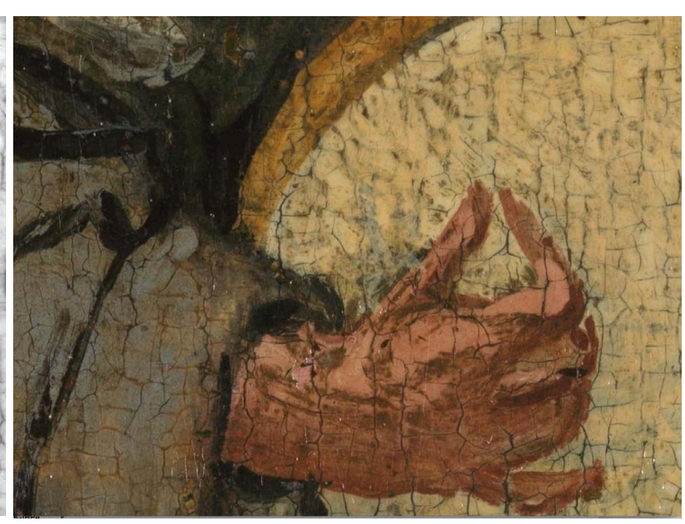
RR 18



- ***Barb and edges*** The original ungrounded and unpainted edges have not been preserved. Minor traces of what could be the onset of a barb were noted at the top and upper left edges, although this remains uncertain.
- ***Application*** The ground was evenly applied and has a smooth finish.

PREPARATORY LAYERS

- ***Underdrawing*** Underdrawing is observable throughout the entire painting. It can be seen in VIS, shimmering through, and in IRP and IRR. The drawing is unusually extensive and detailed, depicting almost every single element (e.g., the background landscape). Its function was to determine the outlines of the forms in the composition and to prepare modelling. Distinct zones of parallel hatching and cross-hatching indicate shadowed areas, in which denser webs of hatching are used to indicate the deeper shadows. It is likely that the underdrawing played some intentional role in the final composition, functioning as a darker undertone slightly shimmering through the thin paint layers, but changes in refractive index due to ageing of the paint film in conjunction with the fading of red lake paint will also have increased its transparency.
- ***Medium and application*** The detectable underdrawing was applied with the brush in a liquid medium. Broad, fluent compositional lines can be distinguished from slightly thinner, shorter lines for detailing, although most of the underdrawing was executed with about the same size brush. Some of the thinner lines were used in hatching and in the section of land at centre left (fig. 19.19). There seem to be at least two application stages, the sequence of which is not evident. Modelling was done using parallel hatching and cross-hatching to indicate darker shadow areas.
- ***Style*** The unusually extensive and detailed underdrawing was applied skilfully and fluently. Long, continuous lines are observable as well as many short, hatched lines. The elaborateness of the hatching in preparation of modelling brings to mind the graphic arts. Most hatched lines are relatively short, and were applied in what seem to be at least two stages. The spaces between the parallel lines vary to indicate the depth of the shadow, but are relatively consistent within a distinct shape. Several fold lines are indicated with parallel hatching only, without a contour line. Line ends are both straight (often tipped) and with hooks (e.g., in the arms of the figures below the boat). The lines themselves often have some curves and the strokes frequently follow the modelling in the composition. The short parallel hatching is predominantly, but by no means exclusively, placed diagonally, running from top left to lower right (or vice versa).[3]
- ***Revisions in underdrawing and differences from painting stage(s)*** The underdrawing is followed relatively closely in the paint application phase, although numerous minor contour shifts as well as some larger changes can be observed, which are often visible in VIS. The owl was underdrawn in its entirety; a bird was underdrawn at the top right edge but not painted; the upper body of the drinking figure on the branch was reduced in size; the hand of the lute player was positioned differently (see figs. 19.20–21), as was the hand of the opposite figure; and the white plate, the fruits and the bowl beneath were altered, as well as the angle of the spoon that serves as oar. At the bottom edge, some small underdrawn elements relate to the composition of *Gluttony and Lust* in New Haven (fig 19.22).
- ***Intermediate layers*** A possible isolating layer, slightly yellowish in tone, is perceptible atop the ground (17MICGBM006).



19.20–21 RR 17, IRR macro and VIS

19.22 RR 17, IRR

PAINT LAYERS

- ***Paint application and painting technique*** The brush-applied oil paint (not analysed) covers the entire original panel surface (see below, *Altered dimensions*). The original paint layers (see below) were applied in a few stages – a single base layer was typically followed by a second stage with more modelling and detailing. This modelling was also applied to larger surface areas, such as the sky, albeit conforming to the larger scale. Last, highlights and shadows were painted, with multiple black lines in the folds of the robes being applied on a still-wet underlayer. Paint application was mostly wet-on-dry, but also wet-in-wet. Paint does not seem to have been scratched away with the back of a brush; instead, still-wet paint was moved aside by brushstrokes.

  The generally wet and glossy paints were laid on in both opaque and semi-transparent applications. Thick and thin paint layers are discernible, some allowing the underlying layer to shimmer through. This is especially apparent in the lighter areas and areas of red glazes. This use of a slightly visible underlying tone is not extensive, and many areas were left in reserve. The current degree of visibility of the underlying layer is in large part due to ageing effects of the paint (see also below, *Discoloration …*). In general, the panel was painted to a reasonably high degree of finish, using both fairly rough and fine brushstrokes. Such strokes were utilized to render contour and volume throughout the painting – more so for impastoed paints, which often contain a lead-white component. At the end of the spoon used as oar a line of paint seems to have been pushed away, revealing the underlying layer, but this might have been unintended.

- ***Texture*** Several passages do not have a smooth finish but slightly textured brushstrokes instead. These strokes, however, are less apparent because of the thick varnish layer. In addition to impastoed highlights, texture is used for some modelling as well (e.g., in folds and dabs of pinkish paint on skin tones). The impasto is fairly fluid, mostly where lead white has been used.

- ***Build-up and palette*** The paint was applied from light to dark (e.g., glazes, the sky, several reinforcements of contours and shadows) and from dark to light (e.g., foliage, figures and highlights). The painting seems to have been built up back to front, and was almost completely planned. The sky area, containing lead white, was painted first, leaving areas in reserve. The pennant and the area around the owl were largely left in reserve from the sky (as seen in XR). The figure of the climbing man with the knife was roughly left in reserve from the blue of the water, but not so the pennant, the last section of which was painted atop the blue. The blue paint also continues somewhat over the white layer at the horizon.

  The owl and the human figures were roughly left in reserve from the brown base colour of the foliage. Those areas were then painted, followed by detailing, highlights and shadows. The original foliage (see below, *Filling …*) was executed with dabs of green paint and smaller, light green touches placed adjacent to them on the brown underlayer. These later paints extend somewhat over the blue background paint. Before the foliage in the centre of the composition was painted, a dark green base layer was applied on top of the brown underlayer. The figure sitting on the large branch was partly painted wet-in-wet, with black lines pushed into the still-wet lighter paint underneath. Although he has a greyish appearance, several colours were used. A reddish hue was used in some of the shadows, while a pinkish colour was mixed in with several of the highlights. Along with pure lead white, blue pigment was mixed in for some cooler highlights. The man's belt was initially painted in a pinkish colour, with a red lake. This was covered by a black layer, followed by lead-tin yellow highlights. The lead-tin yellow object on his upper arm was further modelled with red lake to indicate areas of shadow. Red lake paint was also applied on the bluish sleeve of the figure with the jug, creating a purplish shot colour (*changeant*) effect. The lower left part of the grey robe on the figure with the lute continues over red lake paint used in the adjacent figure. For the red fruits on the plate, an inorganic bright red paint – probably vermilion or minium (red lead) – was followed by highlighting and a red lake glaze to indicate the shadows. The underdrawn elements at the bottom edge that continue on *Gluttony and Lust* were executed in paint as well, again fully confirming the relationship with the fragment in New Haven.

- ***Changes*** Very little was changed during the later paint stages. The figure with the raised hand was initially painted (and underdrawn) with a different headpiece that had a cup on top (17MICGBM003). Although the branch with the owl was left in reserve from the sky (as evident in XR), the non-original extended foliage was painted after the sky was finished, and the same seems to be the case with the hill to the right. (See also below, *Filling …*).

FRAME

The modern wooden frame (66.8 × 42.0 cm) is painted reddish brown, with sides that are a darker (bronze) brown. Although only possible remnants of the barb seem to be present, it is likely that the original painting had an engaged frame on three sides, and an applied vertical frame member on the left side. This would allow the original composition on its reverse (the *Wayfarer* in Rotterdam, cat. 19A; RR 8) to continue over the two exterior wings.

CONDITION

The painting was restored in 2015, thus after the 2011 BRCP technical examination of the painting on which this text is largely based.

Support

- ***Altered dimensions*** The *Ship of Fools* was reduced in size at all edges and there are only traces of a possible barb at the top and upper left edges. At bottom right, the panel is damaged slightly further. At least, the original engaged framing elements, including the barb, were sawn off at the outer sides, and the additions (see below) were probably then attached.

As known from previous technical investigations,[4] the current format of the panel is not original. The painting originally formed a single composition with *Gluttony and Lust* in New Haven, with that panel as the bottom section and the *Ship of Fools* as the top. Together they originally constituted the left interior wing of a triptych. The *Death and the Miser* in Washington formed the interior right wing and the *Wayfarer*, Rotterdam (cat. 19A), currently joined into a single, octagonal panel, was located on the wings' exteriors. The interiors were separated from the exteriors by sawing the panels lengthwise through the middle. The central panel of this triptych is presumed lost.

- ***Additions*** Strips of wood were added at the top, left and right sides. Only the right strip was painted, covering some original paint surface. Considering the damage to the strips at top left, it seems likely that the plywood backing and the cradle were applied after the strips. Both the backing and the cradle cover the entire reverse, including the added strips.
- ***Cracks*** No recent damages were observed. Just left of the centre, a crack runs the entire length of the original panel, although not continuously but with a few steps. Both at the top and bottom right, three cracks are visible running parallel along the wood grain and extending several centimetres. These cracks are open to some extent, but are old. The cracks in the panel were not caused by the current cradle, as they are in part covered by the vertical cradle members.
- ***Deformations*** The surface of the panel undulates slightly between the cracks, but is fairly even overall.
- ***Joins*** The join at the left of the panel is only slightly open and has not separated. No differences in level were observed.

Ground and paint layers

- ***Stability*** In general, the adhesion of paint and ground is good. Most craquelure is caused by natural dimensional changes of the panel. Slightly broader drying cracks are visible only in areas of later paint (e.g., the non-original foliage at top right).

  Metal soap aggregate formation, which can appear as small opaque points in XR, has been observed in several areas of the painting, but to a limited extent. Expansion of the aggregates may cause them to protrude from the paint surface, resulting in minuscule raised spots and a more granular surface texture. Loss of these metal soap aggregates results in tiny, craterlike holes that appear dark in XR. Over time, accumulation of dirt and varnish residues in these holes causes them to appear dark in VIS and IRR/IRP.
- ***Losses*** Besides the damaged edges, there are losses to paint and ground in the bottom right of the panel, as well as several smaller old (filled and inpainted) losses spread over the paint surface.
- ***Abrasion*** The paint surface is severely abraded overall. This is especially visible in sections of the sky, where large parts of the blue layer have been lost. In addition to a few scratches and small dents (e.g., at the back of the head of the figure with the lute), locally the paint (and varnish) is somewhat damaged at the edges, probably due to framing.
- ***Discoloration and increased transparency*** Some of the red glazes appear to have faded to a large extent, which is especially visible in the dull pinkish pennant. Also, the garb of the figure climbing the pole must have been redder once; the tone is observable between his arms, where the glaze was applied thicker. It is possible that green glazes have discoloured to a darker and browner colour. The lighter paints (which often contain lead white) have become more transparent from ageing. This has resulted in a localized increase in visibility of the ground and underdrawing.
- ***Filling, retouching and overpainting*** Most of the old losses have been filled and inpainted. The mostly smaller retouchings are spread over the surface, but the majority of retouchings and overpaintings were done on the cracks and abraded areas. These retouchings have discoloured somewhat, but are often also not precisely colour-matching. The pennant, for example, has been almost completely retouched in a pinkish colour.

  The sky area was overpainted entirely, covering craquelure and remains of original paint. Extensive overpainting is also present in non-original foliage around the originally much smaller branch with the owl (fig. 19.17–18), in the hill in the right background and in the dark blue-green at the lower left of the panel.[5] It is quite possible that these overpaintings were executed when the painting's dimensions were altered.

Surface finish

- ***Varnish*** The appearance of the varnish is uneven, and drip marks and varnish wrinkles are evident. A fairly thick underlying layer of varnish has yellowed a great deal and is damaged (17MICGBM002), with a later (not visibly discoloured) varnish layer covering these damages. In areas, the saturation of the paint is insufficient and the gloss is uneven. There are also scratches and losses in the varnish (and paint), in part from the framing.
- ***Surface dirt*** There is only a small amount of surface dirt on the painting.[6]
- ***Visibility of the original surface*** The saturation of the original paint surface is locally inadequate. The highly yellowed, degraded varnish layers cause a reduced visibility of the original paint surface. The thick and uneven varnish has resulted in a poor legibility of the impasto of the different brushstrokes. Furthermore, the numerous partial, not precisely colour-matching and/or discoloured retouchings, as well as the extensive overpainting, strongly distract from the original surface.

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1 Cécile Scailliérez, curator of sixteenth-century French and Netherlandish painting, Musée du Louvre, Paris, oral communication, 3 October 2011.

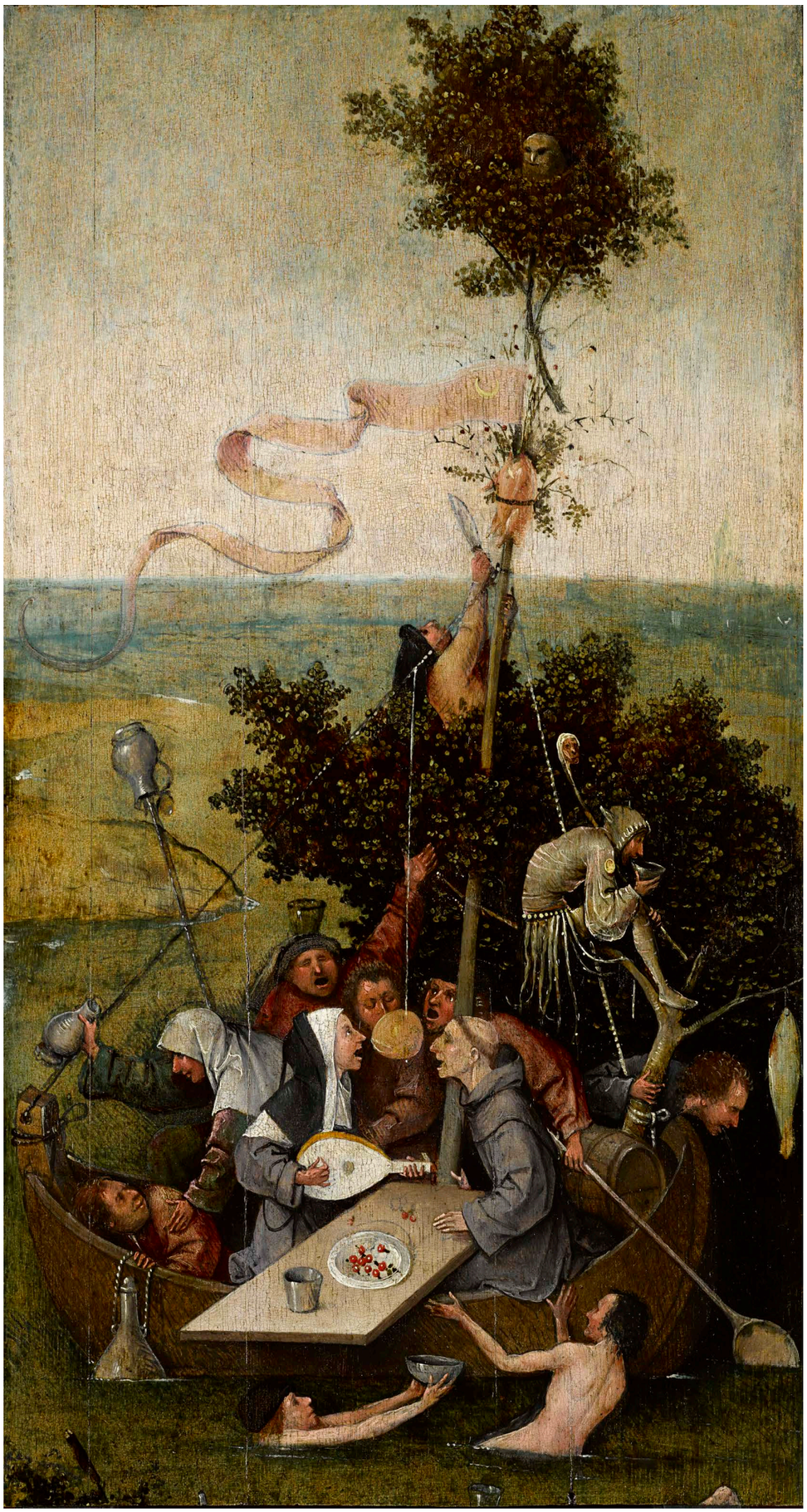
2 Klein 2001, 125.

3 Several authors concluded that this style of hatching is an indication of it having been executed by a left-handed draughtsman. See cat. 19A, RR 8; see also BRCP, *Catalogue Raisonné*, 37.

4 Klein 2001, 131; Lammertse and Boersma 2003, 102–18.

5 A drawing of the *Ship of Fools* in the collection of the Musée du Louvre (inv. RF 3714; our cat. 56) is generally regarded to be a close copy of the painting before it was extensively overpainted. If this is indeed the case, the drawing thus provides an accurate impression of the appearance of the painting without the additional foliage painted in the top of the ship's mast and without the hill closing the composition on the right. Originally there seems to have been a painted cityscape on the horizon on the right.

6 There are several dark, round spots present on the surface; their number and small size appear to preclude insect droppings. It is possible that they relate to tiny air bubbles formed during the ground application. The holes on the ground surface were covered by paint, but could have resulted in tiny indentations where dirt and varnish accumulated.



19.23–24 **VIS, after treatment** (photo courtesy Musée du Louvre, Paris/Franck Raux)

Wayfarer Triptych

B *Gluttony and Lust*

Hieronymus Bosch
c. 1500–10

Oil (not analysed) on oak (analysed) panel, 34.9 × 31.4 cm (with added strips; the cropped panel formed the bottom section of the interior left wing of a now-disassembled triptych).
Yale University Art Gallery, New Haven, CT, 1959.15.22

BRCP, *Catalogue Raisonné*, cat. 19B; www.boschproject.org no. 19B.

Inscriptions and labels
Reverse: The accession number 1959.15.22 is painted in red at top left of the backing. Top right: a paper label, partly covering a cradle member. On the poorly legible label, KÖLN can be made out, probably relating to its provenance. (In 1936 the painting was in the possession of Kunsthaus Malmedé, a former art and antique dealer in Cologne.)

SUMMARY OF CONCLUSIONS

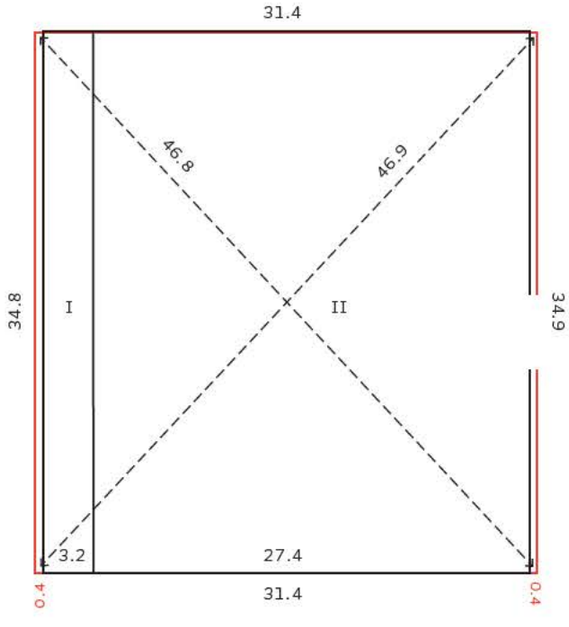
See cat. 19A.

RELATED WORKS

Ship of Fools, Paris (cat. 19B; RR 17–18); *Death and the Miser*, Washington, DC (cat. 19C; RR 53–54); *The Wayfarer*, Rotterdam (cat. 19A; RR 8). *Gluttony and Lust* originally functioned as the lower section of the interior left wing of a now-disassembled triptych (see further below, *Altered dimensions*).

EXAMINATION DATA

24 September 2012 (Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Ron Spronk).



19.25 Construction diagram (seen from the front). Red lines indicate non-original current dimensions, including the added strips of wood.

The painting was examined in the painting conservation studio. The panel was studied flat on a table, under strong illumination.

- ***Previous research and additional documentation available*** An XR image; the physical characteristics of the painting as described in Eisler 1961, 44–49; the technical information in Morganstern 1984, 295–302.
  Several complete XRS and XR details of the painting were studied and photographed. A condition report and a conservation report were studied as well.
- ***Previous treatments*** A condition report sheet in the Yale University Art Gallery states that in May 1972, 'Cradle is warping panel, therefore causing paint to lift, all over' and that in November 1972, the painting was 'Cleaned and restored by Elizabeth Jones, Fogg Art Museum'. Additionally, on 30 November 1981, 'When the painting was unframed for x-ray exam ...', an old scratch was recorded, as well as two possibly new losses, and it was noted that 'The painting appears to be in stable condition overall ...'.

RR 76

RR 75

A transcript of the October 1972 conservation report describes the next treatment: 'Painting washed with soap and water, rinsed with naphtha. Sprayed with PVA AYAF [a polyvinyl acetate resin] in ethanol. Lifting paint set down with 1:30 size. Painting rinsed with ethanol to remove old discoloured varnish. Dimethylformamide used in areas of repaint. Painting sprayed with PVA AYAF in ethanol several times and inpainted with designer's gouache. Back of painting waxed with Butcher's Bowling Alley Wax. Plexiglass box ordered for painting and frame.'

SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 19.25). The thickness of the original panel is about 2.5 mm (from 2 to 3.5 mm max.), and the backing measures about 3 mm in thickness.

  Wood species: Baltic oak (identified indirectly, through cat. 19B, RR 17–18). The original painting consists of two quarter-sawn planks (one broader plank and a narrow one), vertical in grain, laid vertically.

  The two planks were butt-joined and glued. No likely traces of dowels were observed.[1]

  The reverse is not in original condition. After being thinned, a backing and a cradle were applied (see below, *Altered dimensions*).

- ***Dendrochronology*** The panel was not examined with dendrochronology, but since there cannot be any doubt that this fragment was sawn off the *Ship of Fools*, we can use the outcome of the analyses of that panel. And since the wings of this disassembled triptych were all produced from wood from the same tree, we can use the youngest growth ring that is known for these combined panels (from *Death and the Miser*, cat. 19C, in Washington, DC), which dates from 1477. With a minimum of nine sapwood rings, this results in an earliest possible felling date of 1486 for the tree that provided the wood, although a felling date after 1488 is statistically more probable, since 93 per cent of the possibly missing sapwood rings would be covered by this range. Assuming an additional minimum of two years for drying and transportation, the panel could have been produced from 1488 onwards, although a production date from 1490 onwards is statistically more probable. This outcome is also applicable to the third surviving painting from this triptych, the *Wayfarer* in Rotterdam (cat. 19A).

GROUND

- ***Visibility*** The off-white ground (not analysed), which seems to consist of chalk (calcium carbonate – $CaCO_3$) bound in animal glue, is present overall.

  The ground is observable in VIS and to some extent in XR in the interstices of the wood grain. The surface of the ground layer was almost fully covered by the paint layers, but the ground is now visible at the damaged edges and in losses and abrasions. The ground layer shimmers through the paint surface in several areas – for example, in the figures. This could have been an intentional effect, despite the transparency of the paint layers having increased with their ageing, especially in the lighter areas.

- ***Barb and edges*** The original ungrounded and unpainted edges have not been preserved. No traces of a barb have been observed, either.

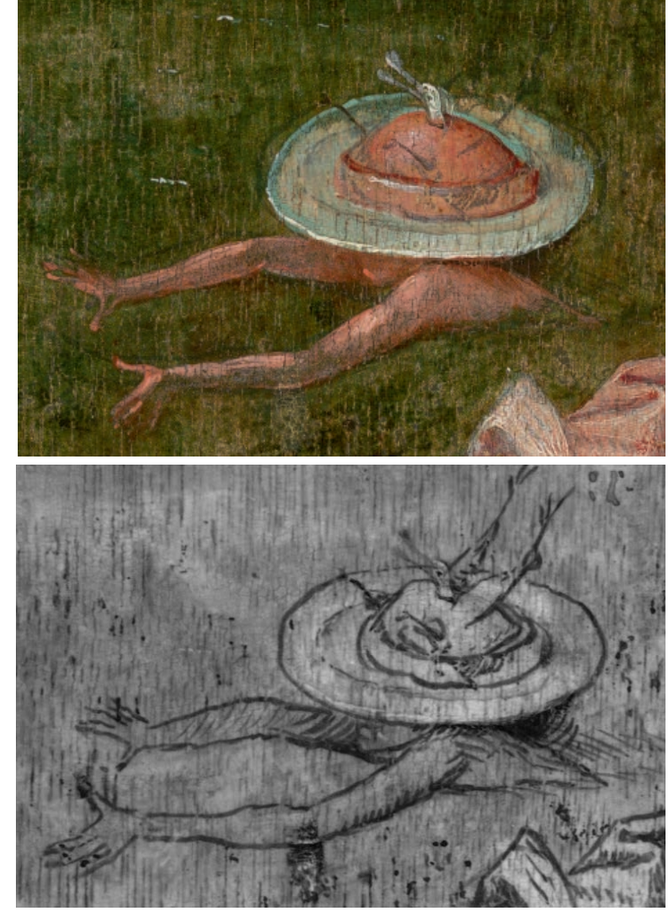
- ***Application*** The ground was evenly applied and has a smooth finish. No brushmarks of the ground application were noted.

PREPARATORY LAYERS

- ***Underdrawing*** Underdrawing appears throughout the painting, and is visible in VIS (shimmering through paint layers) and in IRR/IRP. The drawing is unusually extensive and detailed, with almost every element being underdrawn or indicated; its function was not only to determine the composition, it was also used for modelling, with zones of parallel and cross-hatching indicating shadowed areas. In some areas, lines that appear to be part of the underdrawing are in fact painted (e.g., the lower part of the garland around the coat of arms). It seems possible that the underdrawing was meant to play a role in the final composition, acting as a darker undertone shimmering through the paint layers. However, its current level of visibility was probably not intended and is caused by the increase in transparency due to the ageing of the paint film, as well as fading of the red lake.

- ***Medium and application*** The detectable underdrawing was applied with the brush in a liquid medium (figs. 19.3 and 19.27). Broad, fluent compositional lines can be distinguished from slightly thinner, shorter lines for detailing, although the greater part of the underdrawing was executed with about the same brush size. Some of the thinner lines were used for hatching. In the dark red opening of the tent, rather broad lines are apparent. There seem to be at least two application stages, the sequence of which is not evident. Modelling was done with parallel hatching and cross-hatching to indicate darker shadow areas.

- ***Style*** The extensive and detailed underdrawing seems to have been applied quite fluently. Long, fairly continuous (but not straight) lines are discernible, as well as many short, hatched lines. On the right, the long, slightly jittery horizontal line of the tent is not continuous, however. Changes in underdrawing are fairly small, and there are no substantial alterations in the underdrawn composition. Hatching is mostly parallel, with different spacing between the lines. Several fold lines are created or reinforced (also at contours) by many short, parallel hatches. Cross-hatching is only employed for a few darker areas of shadow. Hatching is typically diagonal, mostly in strokes from top left to bottom right. Line ends are generally straight (often tipped), but may also have slight hooks. The lines themselves often have some curves and the strokes frequently follow the modelling in the composition. Several authors have concluded that this style of hatching is an indication of its having been executed by a left-handed draughtsman.[2] In other areas, though, one can see parallel hatched lines in different directions, or curving differently; for example, in the folds of the tent and in the rock below those folds.



19.26–27 RR 75, VIS and IRR

- ***Revisions in underdrawing and differences from painting stage(s)*** The underdrawing is followed rather closely in the paint application phase, although several minor changes can be observed, which are often evident in VIS. The upper arm of the figure pushing the barrel was made thinner; the pole sticking out of a hole in the tent was underdrawn lower, extending from the tent opening, with the pig's leg underdrawn much larger and in a different direction; the cup on the table was only underdrawn and not painted; and the left arm of the swimming figure was shortened. Instead of the painted pie with the head of what appears to be a spoonbill on the swimmer's head, a type of large fowl (a swan?) was underdrawn, lying on its back, with a head, long neck and extended legs (figs. 19.26–27). At the top edge, a few underdrawn elements can be seen that continue onto the *Ship of Fools* in Paris (see also RR 17).

- ***Intermediate layers*** In a small loss (75MICGBM002), the build-up from panel to paint layer is visible, showing what appears to be a second light-coloured layer atop the ground and below the final paint layer.[3]

PAINT LAYERS

- ***Paint application and painting technique*** The brush-applied oil paint (not analysed) covers the entire original panel surface (see *Altered dimensions*). It was applied in a few stages; a base layer was followed by a stage with more modelling and detailing. This modelling was also applied to larger surface areas, such as the foreground and the water, albeit conforming to the larger scale. Last, highlights and shadows were painted, with multiple black lines in the folds of the robes being applied on a still-wet underlayer. Paint application was mostly wet-on-dry, but also wet-in-wet. Paint does not seem to have been scratched away with the back of a brush; instead, still-wet paint was moved aside by brushstrokes. Examples of this can be seen in the tree branch at the left and in the white cloth fold at the bottom left (75MICGBM001), where underlying wet paint was pushed away by the dark paint applied later, in places also revealing the underlying layer.

A similar case is discernible in the liquid spouting from the barrel, applied in lead white from left to right, dragging along some of the paint from the arm. The lead-tin yellow paint in the coat of arms was also pushed aside by black paint that was applied wet-in-wet.

The generally fluid, glossy paints were applied in both opaque and semi-transparent layers. Thick and thin paint layers are observable, some allowing the underlying layer to shimmer through. This is more apparent in lighter areas, or where red and green glazes were used. This use of the underlying tone showing through is not extensive, and many areas were left in reserve. (The current visibility of the underlying layer is largely due to ageing effects of the paint; see also below, *Discoloration* ....) In general, the panel was painted to a reasonably high degree of finish, with fairly rough as well as fine brushstrokes. These strokes render contour and volume throughout the painting. This is even more so for impastoed paints, which often contain a lead-white or a lead-tin yellow component.

- ***Texture*** Several passages exhibit slightly textured brushstrokes rather than a smooth finish. In addition to impastoed highlights, texture is used for some modelling as well (e.g., folds and dabs of pinkish paint on skin tones). The impasto is fairly fluid, mostly where lead white was utilized. For example, an impasto of this sort indicates a fold caused by a piece of furniture leaning against the tent curtain.

- ***Build-up and palette*** The paint was applied from light to dark (e.g., glazes, the water area, and several reinforcements of contours and shadows) and from dark to light (e.g., skin tones, foliage and highlights). Generally, the painting seems to have been built up from back to front, primarily in thin layers, and it was almost completely planned.

  The water area was painted first, leaving many elements in reserve. The red tent was put in next, followed by the foreground landscape. Other areas were then done, followed by detailing, highlights and shadows. Where filling in reserved areas, these later paints sometimes extend slightly over the layers applied earlier. In other places, compositional elements are applied atop previous paint layers.

  The tree was left in reserve and the green dabs of the foliage were painted over a dark green base layer applied on top of a brown underlayer. The branch held by the figure on the barrel was painted over the water, and here the foliage was executed with dabs of dark green (perhaps a glaze) and adjacent smaller yellow-green dabs. The greyish robe of this figure partly covers his red cap (fig. 19.28). Both the red cap and the tent were built up using a partly impastoed lead-white undermodelling, followed by a layer of red lake. Red lake paint was applied on the bluish cloth at bottom left to create a purplish shot colour (*changeant*) effect. It was also used in some of the brown contour lines, for example at the hands, but to a larger extent in the lips and noses of the figures. Green lake can be found in the water, as well as in the robe of the male figure in the tent. Several of the highlights, shadows, and lines of contours and detailing were applied in a still-wet underlying layer, as in the cloth and the tree to the left. In addition to pure lead white, for some cooler-toned highlights, blue pigment was intermixed (as in the water), and for other highlights a pinker colour was added. The lighter areas in the horn consist of lead-tin yellow, which was also used for many of the highlights in the tent. The pole extending from the tent was built up with two or three strokes of lead white followed by two strokes of pink, applied from top left to bottom right (as seen from the displacement of the underlying wet lead-tin yellow). The underdrawn hand and head at top centre and the legs at top right were adjacently executed in paint. The tip of the funnel helm and the branch are identifiable in the *Ship of Fools* in Paris (see also RR 17).

- ***Changes*** Very little was changed during the later paint stages. In the upper left, one figure's dark brown cap was painted over the skin tone and the water. At the bottom, a section of the purplish cloth was covered by lead-white paint.

FRAME

The current unpainted wooden frame (46.7 × 41.9 cm; 6 cm thick, including the build-up), with profiled sides and a slanting bottom section, is modern. Although no remnants of a barb have been noted, it is likely that the original painting had an engaged frame on three sides (top, bottom and right), and an applied vertical frame member on the left side. This would allow the original composition on its reverse (the *Wayfarer* in Rotterdam, cat. 19A, RR 8) to continue over the two exterior wings.

CONDITION

Support

- ***Altered dimensions*** The painting was reduced in size at all edges. At the top edge, above the figure on the barrel, a notch is present from sawing.[4] At the very least, the original engaged framing elements, including the barb, were sawn off at the outer sides; later additions followed. As previous technical investigations have shown,[5] the current painting is a fragment from a larger composition with the *Ship of Fools* in Paris as the top section. Together they constituted the interior of the left wing of a triptych. *Death and the Miser* in Washington, DC, formed the interior of the right wing, and the *Wayfarer* in Rotterdam (currently joined into a single, octagonal panel) functioned as the wings' exteriors. The interiors were separated from the exteriors by sawing the panels lengthwise through the middle. The central triptych panel is presumed lost.

- ***Additions*** Strips of wood were added at the left and right sides and then painted.[6] The backing and the cradle were applied after the wooden strips, as indicated by the closed sides of the outer cradle members. Furthermore, both the backing and the cradle cover the entire reverse, including the added strips. Since the paper label covers the cradle, this treatment presumably occurred before 1936 and likely before 1928, when the painting was auctioned.[7] The second horizontal cradle member from the top has retained some sliding capability, but movement is blocked for all other sliding cradle members.

- ***Cracks*** At the right edge, two continuous cracks run the entire length of the panel along the wood grain (with a small step). The rightmost crack is positioned at 4.5 cm from the edge. The other one starts at the top, 7.1 cm from the right edge, and ends at the bottom, 7.7 cm from the right edge. A partial crack runs circa 12 cm from the bottom centre, and in the left top edge, a small crack of about 2.5 cm is visible. Recent damages have not been noted. These old cracks in the panel do not seem to have been caused by the current cradle.

- ***Deformations*** The surface of the panel is somewhat convex. There are local deformations in the top left and right corners; at the left edge, just above the centre, both wood and paint are raised.

- ***Joins*** The join at the left of the panel is closed but may have separated before, since a very slight difference in levels is discernible.

- ***Coated reverse*** A backing and a cradle were applied to the reverse of the panel, followed by a wax coating.

Ground and paint layers

- ***Stability*** In general, the adhesion of both paint and ground is relatively good. Most craquelure is caused by natural dimensional changes of the panel (see also below, *Abrasion*). Previous issues with raised paint have resulted in many losses (see below). Currently there

seem to be a few spots with raised paint that may be old and stable, as in the bottom left corner and below the handle of the dagger.

Metal soap aggregate formation, which can appear as small opaque points in XR, has been observed in several areas of the painting, such as in the table, but to a limited extent. Expansion of the aggregates may cause them to protrude from the paint surface, resulting in minuscule raised spots and a more granular surface texture. Loss of these metal soap aggregates results in tiny, craterlike holes that appear dark in XR. Over time, accumulation of dirt and varnish residues in these holes causes them to appear dark in VIS and IRR/IRP.

- ***Losses*** Overall, there are many small, vertical losses in the paint that follow the wood grain. These were likely caused by previous compression(s) of the panel, resulting in tenting paint and subsequent losses. There are many other losses to paint and/or ground, mostly smaller, but locally some that are larger. Most damages are on the left side and the right edge, as well as at the bottom of the panel. At the top edge of the panel, just right of the centre, a larger loss that has not been filled and retouched reveals the support.
- ***Abrasion*** The paint surface is severely abraded overall. This is especially visible in most of the water and in the foreground landscape. Mainly, abrasion seems to have occurred where paint had previously tented, resulting in damage to the raised edges during cleaning treatment(s), or in areas of impastoed paint. For example, in the cloth depicted at bottom left, abrasion (possibly combined with fading red lake) has resulted in its appearing bluish rather than purplish. Red lake is still present where it was applied more thickly (e.g., at the folds); other remains are evident under high magnification. In certain areas, solvent-induced abrasion seems to play a role as well (e.g., at the lower section of the tent curtain), where abrasion extends outwards from the craquelure, causing an unnatural broadening of the craquelure effect. There are several old scratches: one between the horn and the hat of the figure below, two in the tent, another through the pattens in the tree, and a smaller one just above that.
- ***Discoloration and increased transparency*** Areas of red glaze seem to have faded, which is especially visible in the lighter areas of the tent. The green glaze on the robe of the male figure in the tent has discoloured to a darker and browner colour. The lighter (often lead-white-containing) paints have become more transparent on ageing. This has resulted in a local increase in visibility of the ground and underdrawing. Although the light ground has a brightening effect on, for example, the body of the figure holding a cup in front of the barrel (fig. 19.28), the shimmering through of the underdrawing seems mostly unintended by the artist. The lower arm was not left in reserve but painted over the background, resulting in a now-darker appearance. Also, the swimming figure (fig. 19.26) was painted over the water, whereas his headpiece (plate with pie) was left in reserve. It is unlikely that the underdrawing was intended to be visible to the current degree.
- ***Filling, retouching and overpainting*** There are some fillings and retouchings in the main body of the painting and more along the edges. Larger fills are present at the left and bottom edges. The area around the pointed black shoe is quite damaged, and vertical scratch marks were made in the filling to create a more coherent appearance with the rest of the painting. There are, however, many areas of abrasion and/or loss that have not been filled and/or inpainted. Also, several of the gouache retouches are somewhat off in colour. At the left, two pattens hanging from a tree branch were underdrawn and painted, though one of them is hardly recognizable due to damages and old inpainting.

Surface finish

- ***Varnish*** There seem to be multiple modern varnish layers present, which are only slightly discoloured. The varnish (PVA AYAF dissolved in ethanol) seems to have been sprayed fairly thinly and evenly over the entire surface.

  Though slightly yellowed, the appearance of the varnish is relatively even. In areas, however, the saturation of the paint is insufficient and the gloss is uneven (several matte spots, e.g., from sunken-in varnish). There are only some light matte areas along the edges, which were likely caused by (previous?) framing.
- ***Surface dirt*** There is hardly any surface dirt on the painting.[8]
- ***Visibility of the original surface*** The saturation of the original paint surface is relatively good overall, but with local loss of saturation as well as several matte spots. The varnish is slightly yellowed and some of the retouches are slightly off in colour. It is mainly the numerous losses and extensive abrasions (which were not inpainted) that have resulted in a patchy surface and strongly distract from the original painting.

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1 In the *Ship of Fools*, a trace of a dowel seems to be visible in the XR.

2 See RR 8; BRCP, *Catalogue Raisonné*, 37.

3 This should be confirmed by further technical investigation, since it was not observed with certainty in other areas of the painting.

4 The possibility remains that this damage occurred during the removal of the added strip and the cropping of the plywood backing and the cradle (see below, *Additions*).

5 Klein 2001, 120–22; Lammertse and Boersma 2003, 102–18.

6 In the past, also, added wooden strips were present at the top and bottom of the panel. These were likely removed in the 1972 treatment of the painting (as mentioned in a 2001 letter from former chief conservator Mark Aronson to Friso Lammertse), possibly because the nailed cross-grained elements were inhibiting the panel's movement. After the two strips had been removed, the protruding backing and cradle at the top and bottom were cropped. A 1981 XR detail shows that the strip on the bottom had been removed, whereas an older, complete XR image still shows all the nailed strips of wood.

7 Sale London (Christie's), Sir Felix Clay and Other Collections, 11 May 1928, lot 31 (£105, to Brace).

8 Chief conservator Ian McClure removed loose surface dirt on 24 September 2012, using a soft Japanese brush. There are several dark, round spots present on the surface, although not nearly as many as in the *Ship of Fools*; their number and small size appear to preclude insect droppings. It is possible that they relate to tiny air bubbles formed during the ground application. The holes on the ground surface were covered by paint, but could have resulted in tiny indentations where dirt and varnish accumulated.

19.28 **RR 75, VIS**

19 *Wayfarer Triptych*

C *Death and the Miser*

RESEARCH REPORT 53–54

Hieronymus Bosch
c. 1500–10

Oil (not analysed) on oak (analysed) panel, 94.3 × 32.4 cm (with added strips; the slightly cropped panel formed the interior right wing of a now-disassembled triptych).
National Gallery of Art, Washington, DC (Samuel H. Kress Collection), 1952.5.33

BRCP, *Catalogue Raisonné*, cat. 19C; www.boschproject.org no. 19C.

Inscriptions and labels
Reverse, bottom right of the cradle: an inventory label.

SUMMARY OF CONCLUSIONS

See cat. 19A.

RELATED WORKS

Ship of Fools, Paris (cat. 19B, RR 17–18); *Gluttony and Lust*, New Haven, CT (cat. 19B; RR 75–76); and *The Wayfarer*, Rotterdam (cat. 19A; RR 8). *Death and the Miser* originally functioned as the interior of the right wing of a now-disassembled triptych (see further below, *Altered dimensions*).

EXAMINATION DATA

12–13 April 2012 (Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Ron Spronk).

The painting was examined in a photo studio. The panel was studied upright on an easel under strong illumination.

- ***Previous research and additional documentation available*** Eisler 1977; Hand and Wolff 1986;[1] Metzger 2003.

  A 1983 examination report of the painting also lists the photographic documentation to that date, including IRR details by Faries and XR done in 1982. New IRR and XR documentation (with Elvacite® fill material between the cradle members), as well as analysis of two cross-sections, were done during the 1999–2000 treatment of the panel.

- ***Previous treatments*** Hand and Wolff quote Eisler 1977, who stated that the panel was thinned, laminated and cradled around 1900. Eisler, however, did not give a source, and he was not aware of the relationship between *Death and the Miser* and the other panels from this triptych. Hand and Wolff further report that the painting was restored by Albert Philippot in Belgium prior to 1951, possibly in 1937.[2] In 1999–2000 the painting was fully treated by Catherine Metzger; see Metzger 2003.

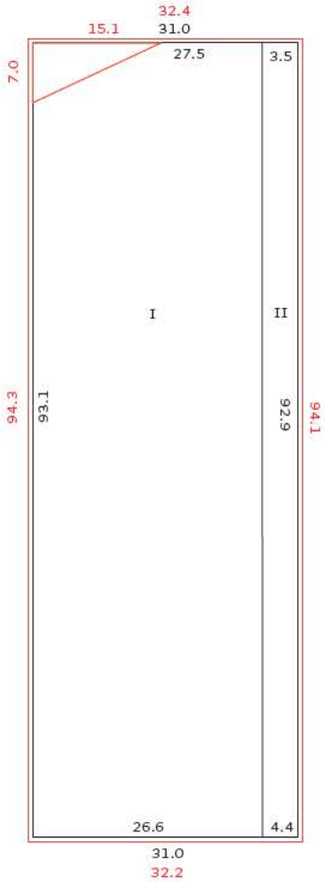
SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 19.29). The thickness of the original panel is c. 0.02 cm at the left edge and 0.2 cm at the right. The thickness including the circa 4 mm-thick, 3-ply plywood backing and the cradle is about 2.5 cm.

  The wood species, Baltic oak, was identified through dendrochronology. The painting consists of two quarter-sawn planks (a broader plank and a narrow one), vertical in grain, laid vertically.

The original panel was thinned to a veneer, but because it was originally the back of the right section of the *Wayfarer* in Rotterdam (cat. 19A), we can follow the information that is available for that painting. Those planks were butt-joined, dowelled and glued.

The reverse is not in original condition. After the panel was thinned, a plywood backing and a cradle were applied (see below, *Altered dimensions*).



19.29 Construction diagram (seen from the front). The red lines indicate the triangular insert and the non-original current dimensions with the attached wooden strips.

RR 54

RR 53

- ***Dendrochronology***. The boards come from the same tree. The youngest heartwood ring dates from 1477, which, with the minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1486 for the tree that produced the wood.[3] A felling date after 1488 is statistically more probable, however, since 93 per cent of the possibly missing sapwood rings would be covered by this range. Assuming an additional minimum of two years for drying and transportation, the panel could have been produced from 1488 onwards, although a production date from 1490 onwards is statistically more probable. This information can also be applied to the *Ship of Fools*, Paris (cat. 19B, RR 17–18); *Gluttony and Lust*, New Haven, CT (cat. 19B, RR 75–76); and *The Wayfarer*, Rotterdam (cat. 19A, RR 8), which all derive from the same tree.

GROUND

- ***Visibility*** The off-white ground (not analysed) is present overall. Stereomicroscopic examination and two cross-section images seem to indicate that the ground consists of chalk (calcium carbonate – $CaCO_3$) bound in animal glue.[4] The ground is apparent in both VIS and, to some extent, the interstices of the wood grain in XR. The surface of the ground layer was almost fully covered by the paint layers. The ground is now only evident locally at damaged outer edges, in losses and in areas of abrasion. Although it was probably unintended, minute sections of ground also appear at a few contours (e.g., at the back of the demon in the chest). The light ground layer shimmers through the paint surface in many areas. This could well have been an intentional effect but not to the current extent, since the ageing of the paint layers has further increased their transparency, especially in the lighter areas.
- ***Barb and edges*** The original ungrounded and unpainted edges have not been preserved. No traces of a barb have been observed, either (see below, *Altered dimensions*).
- ***Application*** The ground was evenly applied and has a fairly smooth finish. Some texture from the support is present, but that could have occurred over time.

PREPARATORY LAYERS

- ***Underdrawing*** Underdrawing is observable throughout the entire painting. It can be seen in VIS, clearly shimmering through, IRP and IRR. It is also visible in some losses (53MICGBM002). The drawing is unusually extensive and detailed, with almost every element being underdrawn or indicated. The function of the drawing was not only to determine the exact composition, but also to prepare modelling, with zones of parallel hatching and cross-hatching indicating shadowed areas. It seems quite possible that the underdrawing would have played some intended role in the modelling of the final composition, shimmering through the paint layers. However, the paint layers have also become more transparent over time, further exaggerating this effect. In the orange-brown wooden roofing, for example, of all the underdrawn lines, only the main construction lines were painted, the former now aiding in creating shadow and depth. However, in the painting phase the artist consciously deviated from the underdrawing, creating a steeper roof, and also simplified the foreground. The current level of visibility of the underdrawing in most parts was thus probably unplanned; rather, it was probably caused by changes in refractive index from ageing of the paint film, in conjunction with the

fading of red lake paint. In the dark areas of the green robe the underdrawing does not shimmer through, a further sign that it was mostly used to indicate placement of painted shadow areas and zones where the whitish underlayer for the lakes was not to be applied. At most, the underdrawing functioned as a darker undertone.

- ***Medium and application*** The detectable underdrawing was applied with the brush in a liquid medium that generally has a consistent opacity. Previous cross-section examination has concluded that an aqueous lampblack underdrawing was used.[5] Broad, fluent compositional lines can be distinguished from shorter, slightly thinner lines for detailing, although most of the underdrawing was executed with about the same size brush. There seem to have been at least two application stages: the initial drawing, which apparently indicated the main elements of the composition, and a later stage, reinforcing and elaborating on the first. Modelling was done using parallel hatching and cross-hatching to indicate darker shadow areas.

- ***Style*** The extensive and highly detailed underdrawing seems to have been applied quite fluently. There are long, fairly continuous (but slightly wobbly) lines, as well as many that are short and hatched. Underdrawing changes appear rarely, and there are no substantial alterations in the underdrawn composition. Hatching is mostly parallel, with different spacing between the lines that often becomes more compact for darker areas of shadow. Several fold lines are created or reinforced (also at contours) by many short, parallel hatchings, and numerous folds are indicated with hatched lines only, thus without contours. Cross-hatching is only used for a few darker areas of shadow, as in the bed's canopy. Hatching was typically done diagonally, mostly from top left to bottom right. A few large sections were hatched from top right to bottom left. Line ends are primarily straight (often tipped), but some also have slight hooks. The lines themselves often have some curves, and the strokes frequently follow the modelling in the composition. Several authors have concluded that diagonal hatching from top left to lower right, with the lines themselves curving towards the right, would indicate an execution by a left-handed draughtsman.[6] In other areas, though – for example, in the bed – one can see parallel hatched lines running in different directions or curving differently.

- ***Revisions in underdrawing and differences from painting stage(s)*** The underdrawing was not followed precisely in the paint application phase and multiple changes are evident, ranging from shifted contours and adjusted forms to underdrawn elements omitted in the painting phase. In the underdrawing the room was deeper, since the tunnel vault had an extra bay at the far end. The small, round window in the far wall was not initially planned. Many of these changes, some of which have iconographical significance, were already reported on by Hand and Wolff, as well as by Metzger. The underdrawing shows the dying miser grabbing the money bag with his right hand. In his left he held a decorated goblet, which was omitted in paint. His head was underdrawn larger, with his mouth open as if he was speaking, and a pillow was prepared but not painted. The length of Death's arrow was significantly decreased in the painting stage, and much of Death's leg was originally planned to be visible. The perspective of the door was changed at the top and the bottom, which also forced the shift in the hinges, and perhaps that of the handle. The pole of the fire-bearing demon on top of the bed was underdrawn much longer, with a rounded object at the end. The knee of this monster was initially planned to be depicted as well. The hook under the legs of the monster beneath the chest was painted farther to the right, and the paper that the creature holds was larger. The tail of the other monster under the chest curved to the left instead of the right. Several objects belonging to the man at the right of the chest were also changed: his rosary was painted higher, his key was flipped, his stick was longer, his purse larger, and he appears to have had a shaft for a dagger. In the foreground, on the parapet, the brocaded pattern on a jacket sleeve was only underdrawn, and a rosary, a cup (?) that resembles the one in the chest, and a large vessel in the shape of a heart were underdrawn but not painted. The wings of the devilish figure behind the parapet were larger. In front of the parapet, the plume on the helmet was underdrawn but not painted, as was the spur just below the helmet.[7] The closest foreground was also changed, and a small hillock in the lower right corner of the panel was not painted. Instead, a similar hillock that had not been underdrawn was painted against the parapet.

PAINT LAYERS

- ***Paint application and painting technique*** The brush-applied oil paint covers the entire original panel surface (see below, *Altered dimensions*). It was applied in a few stages – often a single base layer for larger surface areas was followed by a second and possibly a third stage with more modelling and detailing. Highlights and shadows were painted after that, sometimes wet-in-wet. Paint application was mostly wet-on-dry, but also wet-in-wet. Paint does not seem to have been scratched away with the back of a brush; instead, still-wet paint was moved aside by brushstrokes.

  The generally wet and glossy paints were applied in opaque and semi-transparent layers. Although impastoed highlights were also used throughout, paint is generally applied thinly, allowing the underlying layers to shimmer through, especially in the lighter areas or where red and green glazes were used (see also below, *Discoloration …*). A slightly visible underlayer tone was used, from which many underdrawn elements were left in reserve. The visibility of the underlying layer has increased with the ageing of the paint.

  In general, the panel was painted to a relatively high degree of finish, using both fairly rough and finer brushstrokes. Such strokes were utilized to render contour and volume throughout the painting – more so for impastoed paints, which often contained lead white. The lower part of the pole of the fire-bearing demon was painted in parallel black and white lines, with some underlying paint visible in between. The arched window with the crucifix was painted wet-in-wet, and the ray of light was done wet-on-dry, as a semi-transparent veil. Several highlighted contours suggest that the light source is at the left.

- ***Texture*** Several passages do not have a smooth finish, but textured brushstrokes instead. The arched window with the crucifixion is highly textured (fig. 19.30). In addition to impastoed highlights, texture is used for some modelling as well (e.g., in folds and in dabs of pinkish or greyish paint on skin tones, fig. 19.31). The impasto of the highlights is fairly fluid, especially where lead white was used.

- ***Build-up and palette*** The paint was applied from light to dark (e.g., glazes, reinforcements of contours and shadows) and from dark to light (e.g., figures and highlights). The painting seems to have been built up back to front, and was largely planned. First, a thin underpainting that contained lead white was applied, filling in certain areas but also leaving many underdrawn elements in reserve. In the cross-section image, the light underlayer appears to contain carbon black and some brown pigment particles as well.[8] This underpainting is also present underneath red lake paints (e.g., in the bed curtain), but it extends beyond those contours onto the head of Death (also visible in XR). The opaque layer was applied rather roughly and thickly with a brush, in relatively short, dynamic strokes with slightly impastoed brushmarks being visible. Its current visibility is largely caused by abrasion of the paint layer on top, revealing the impastoed ridges of the underpainting.

  For the brightest areas (e.g., in the bed canopy), more impastoed lead-white undermodelling was applied atop the already-dry,

horizontally brushed underpainting. Red lake paint was then applied onto the entire canopy. It appears that the red lake and lighter background areas were painted fairly early, since most elements were left in reserve from these layers and often slightly overlap the underlying paints at the edges. This is visible, for instance, in the wings of the angel and in the column to the right, which both overlap the red lake in several areas. The miser's green robe, which also overlaps the red lake, was painted with a mixture containing copper green and lead-tin yellow, which layer was followed by a deep copper-green glaze.

Dark or black paints used for shadow areas were applied after the general composition was completed. Physiognomic detailing was frequently done in brown. Red-brown and dark brown contour lines were used for the left hand of the angel, and brown contour lines in the left hand of the standing figure beside the chest were reinforced with black. The hair of the angel was painted with lead-tin yellow highlights.

As seen in VIS and XR, the arched window with the crucifix was painted entirely wet-in-wet, and from back to front. First lead-white paint was applied, roughly leaving the crucifix in reserve. Black lines and blue dabs were then painted to indicate the stained glass. Then the brown paint of the cross and the skin-tone paints of Christ were applied, pushing aside and pulling along the wet paints underneath. Locally, black reinforcing lines and white highlights were applied last. After the room was made more shallow (see also *Changes*), the round window in the far wall was added by painting it over the black background in a dark blue-green colour that possibly included lead-tin yellow pigment. Light blue paint was used at the upper edge of the round window. The black window mullion was painted wet-in-wet. The fire of the demon's lantern was done with pink paint that contains lead white, followed by what appears to be lead-tin yellow, vermilion and a purplish glaze. The coins were painted in a brown colour mixed with red, possibly a lake, followed wet-in-wet with lead-tin yellow. The left object above the paper in the chest, perhaps a writing utensil, is painted in lead-tin yellow, followed by reddish-brown and black paints. The smaller object to its right, which was not underdrawn, is painted in an opaque green, followed by a dark, copper-green glaze. The red lines of the key string were painted after the black.

- ***Changes*** The initial, deeper design of the room was not only underdrawn, but also taken up into a painting stage, since the far edge of the extra bay of the tunnel vault shows in XR. Hence, the dark back wall was initially much smaller, which also explains the later addition of the round window. The raised hands of both the miser and the angel were changed slightly. The miser's right hand was painted twice, the final version retracted farther from the money bag. In the underdrawing, the demon was supporting the bag with both hands from the bottom. The artist altered this directly in the paint phase, putting the demon's arm over the red bed curtain. The overturned white bed linen was painted over the red lake paint of the bed. The angle of the open door was changed at both the top and bottom. The goblet and the small objects on the parapet were left in reserve from the initial, lead-white-containing underlayer, but were never executed in paint (figs. 19.32–33).[9] Instead, they were covered by a monochrome paint used for the middleground.

FRAME

The gilded wooden frame (108 × 46.5 cm; thickness: 6.9 cm) is modern. It is profiled with black paint applied along both sides of a column-element. The bottom profile consists largely of a bevel (*Wasserschlag*). The four sides are painted in a dark brown colour. Although remnants of the barb are not present, it is likely that the painting originally had an engaged frame on three sides, and an applied vertical frame member on the right side. This would allow the original composition on its reverse (*The Wayfarer* in Rotterdam, cat. 19A, RR 8) to continue over the two exterior wings.

CONDITION

Support

- ***Altered dimensions*** As previous technical investigations have shown,[10] the current format of the panel is not original. The painting originally formed the right interior of a triptych wing. The *Ship of Fools* in Paris and *Gluttony and Lust* in New Haven together formed the interior of the left wing. On the exterior of the wings, visible when the triptych was closed, was *The Wayfarer* in Rotterdam, which

19.30 RR 53, VIS, raking light

19.31 53MICGBM004, raking light

19.32–33 RR 53, VIS and IRR

was later joined into a single panel and cropped into an octagonal format. The interiors were separated from the exteriors by sawing the panels lengthwise through the middle. The central panel of the triptych is presumed lost. *Death and the Miser* was reduced in size along all edges, and no traces of a possible barb remain. The panel is extremely thin and essentially a veneer, especially at the left edge. Splitting of the wing has probably resulted in severe damage to the top left corner, as it was replaced by a later insert. At the very least, the original engaged framing elements, including the barb, were sawn off at the outer sides.

- ***Additions*** After the panel was split and thinned to a veneer, a 3-ply plywood backing was glued to the reverse. A triangular wooden veneer insert replaces a section in the top left corner. At the reverse of the plywood backing a wooden cradle was attached. Strips of wood resembling unpainted edges were nailed to the edges of the panel, enabling the display of the entire painted surface.
- ***Cracks*** A crack runs over the entire length of the panel at about 3.2 cm from the left edge, not continuously, but in several steps. Around a dozen other short and medium-length cracks run parallel along the wood grain, spread over the panel surface. Some of these cracks are open to some extent, but they appear old. No recent damages have been observed. The thinness of the panel has also resulted in local differences of levels at cracks. Most cracks in the panel do not seem to have been caused by the current cradle, as they are in part covered by the vertical cradle members. At the bottom left, however, a crack runs through the original panel and the plywood backing.
- ***Deformations*** The surface of the panel undulates slightly, but appears rather flat overall.
- ***Joins*** The join at the right of the panel is slightly open for the most part. Only slight differences in level were observed locally at the join.

Ground and paint layers

- ***Stability*** In general, the adhesion of paint and ground itself is fairly good. Most craquelure is caused by natural dimensional changes of the panel. In raking light, however, slightly tenting paint following the grain of the wood is apparent throughout.

  Metal soap aggregate formation, which can appear as small opaque points in XR, has been observed in several areas of the painting, but to a limited extent. Expansion of the aggregates may cause them to protrude from the paint surface, resulting in minuscule raised spots and a more granular surface texture. Loss of these metal soap aggregates results in tiny, craterlike holes that appear dark in XR. Over time, accumulation of dirt and varnish residues in these holes causes them to appear dark in VIS and IRR/IRP.
- ***Losses*** There are several damages along the edges, especially in the corners. Multiple small losses to paint and ground are predominantly present in the bottom part of the panel. In the top left a triangular section was replaced and in the centre there is a large damage extending from the lid of the chest to the money bag. The lower part of the red bed curtain at the right side of the panel is also damaged. Most losses are filled and inpainted, except a number of old pinpoint losses and a few in the bottom right at the join.
- ***Abrasion*** The paint surface is somewhat abraded overall. This is visible in areas of thinly applied paint or glaze, especially where it covers an impastoed underlayer. Here, the highest points in the paint surface are often slightly abraded, something that has also occurred at the edges of tenting paint. Some scratches and small dents are present throughout the panel.
- ***Discoloration and increased transparency*** The thinly applied paints, especially those that are lighter (which often contain lead white), have become more transparent from ageing. This has resulted in an increase in visibility of the ground and underdrawing. Most of the red glaze paint has faded to a large extent, becoming duller and more pinkish in colour (53MICGBM001). This has increased the visibility of the underlying layer, which now creates a whitish hue over the entire composition. The copper-green glaze of the miser's costume has discoloured to a browner colour, but still appears dark green where the glaze was applied more thickly.
- ***Filling, retouching and overpainting*** Most of the old losses have been filled and inpainted. The mostly smaller retouchings are spread over the surface, but are mainly present in the bottom part of the panel. Extensive retouching was done on the large damages in the centre and at the insert at the top left, as well as on the locally damaged red bed curtain. Many of these retouchings can be seen with the naked eye. In the retouched area just above the chest, there appears to be a partial non-original fingerprint.

Surface finish

- ***Varnish*** The appearance of the varnish is a little uneven, with slight differences in gloss. This is in part due to the matte and uneven spots caused by the losses and retouchings. Generally the saturation of the paint is good, but in some areas, such as blacks, it is insufficient. In the top left, drip marks of varnish application are discernible.

- ***Surface dirt*** There is only a small amount of loose surface dirt on the painting, as the painting is displayed behind glass.
- ***Visibility of the original surface*** Overall the painting is properly legible, with a generally adequate saturation of the original paint surface. The varnish layers are fairly even, but there are some unsaturated spots, especially in the dark or black areas. Furthermore, local matte and not precisely colour-matching retouchings, as well as the old, still-exposed losses and damages, all slightly distract from the original surface.

[1] 'The panel has been thinned to a veneer (maximum thickness 0.15) and laminated to another wooden panel, which has been cradled in turn; according to Eisler this was done around 1900 [Eisler 1977, 66]. The painting was restored in Belgium sometime prior to 1951 [René Sneyers, Institut Royal du Patrimoine Artistique, Brussels, letter of 8 July 1968 to Eisler stating that the picture was restored by Albert Philippot without giving a date. Eisler 1977, 69, n. 2, cites De Tolnay 1966, 347, who says that the painting was cleaned and restored in 1937]. The top left corner has been replaced with a triangular piece of veneer. Two vertical splits run the length of the painting, one 3.7 cm from the left edge and the other 4.0 cm from the right edge. There are small scratches and indentations throughout the support. The paint layer has been damaged. There are large areas of loss and subsequent restoration in the head and upper body of the figure of Death; in the approximate centre of the painting, extending vertically through the lid of the chest, the left corner of the bed, and into the bed-curtain and arm of the demon; and at the right edge to the right of the corner of the bed and the standing figure in green. Moreover, extensive retouchings are scattered throughout the painting, including a narrow strip over the split at the right, extending downward from the bottom of the green robe into the low wall in the foreground. Some of the retouching has discoloured.' See Hand and Wolff 1986, 17.

[2] See note 1 above.

[3] Klein 2001, 122 and 125. The youngest or last-preserved ring on each of the planks dates from 1476 (I) and 1477 (II), respectively. Only 12 cm were measured from board II.

[4] For the cross-section images, see Metzger 2003, 41–42, figs. 5–6.

[5] This also seems valid for RR 17, 75 and 8.

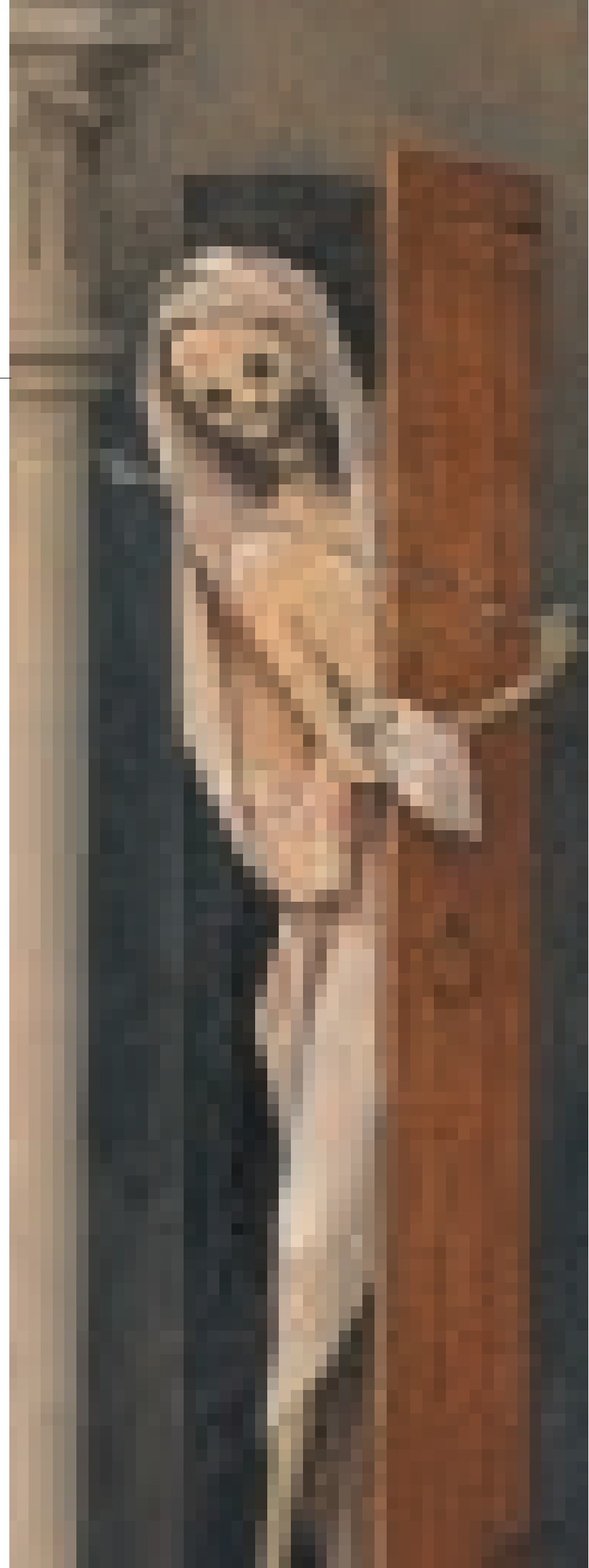
[6] See also cat 19A, RR 8; BRCP, *Catalogue Raisonné*, 37.

[7] Metzger interpreted the spur as a fish; see Metzger 2003, 40–41.

[8] Metzger 2003, 41 fig. 5.

[9] This was confirmed via cross-section examination published in Metzger 2003, 41–42.

[10] Klein 2001, 120–22; Lammertse and Boersma 2003, 102–18.



19.34 **RR 53, VIS**

20

The Haywain

RESEARCH REPORT 97–102

Hieronymus Bosch
1510–16

Oil and egg (both analysed) on oak (analysed) panel,
closed left wing (RR 97): 136.1 × c. 51 cm; closed right wing (RR 98):
136.1 × c. 51 cm; open left wing (RR 99): 136.1 × c. 47.7 cm; central panel (RR 100):
c. 133 × c. 100 cm; open right wing (RR 101): c. 136.1 × c. 47.6 cm. The frames of the
wings are original, that of the central panel is modern.
Museo Nacional del Prado, Madrid, P02052

BRCP, *Catalogue Raisonné*, cat. 20; www.boschproject.org no. 20.

Inscriptions and labels
Signed, central panel, bottom right: *Jheronimus bosch*.
Left wing, bottom left, in green: 460; right wing, bottom right, in white: 493.[1]
Reverse, central panel, upper left, in black on a vertical cradle member: N:2052.

RR 97 RR 98

RR 99

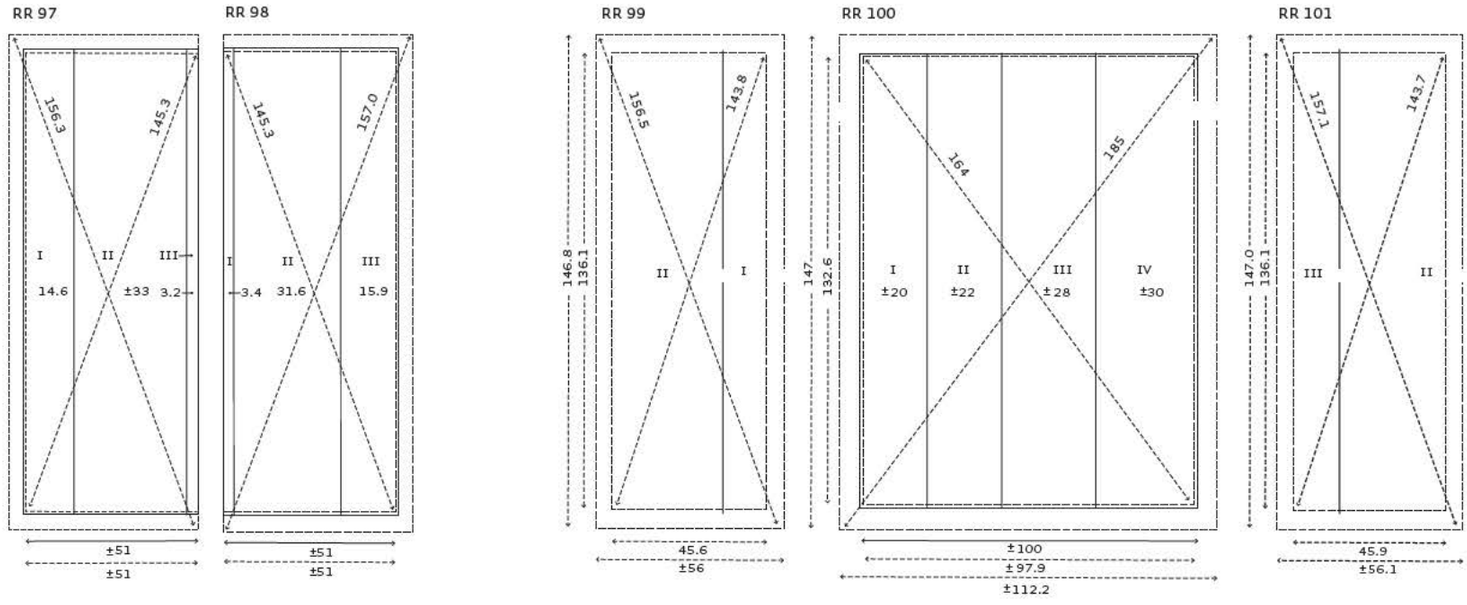
SUMMARY OF CONCLUSIONS

The Haywain Triptych *in the Prado, Madrid, can easily be linked to other works in the core of the Bosch group by its painting technique and the style and material of its phased underdrawings. Traces of the creative process are evident in all stages of the production of this autograph work.*[2] *The ample changes between underdrawing and paint layers in the Prado* Haywain, *as well as the pentimenti in paint, establish beyond any doubt that this work is the original composition, and that the Escorial version (cat. S1, RR 103–108), where no such changes are present, is a copy.*

The wings are still housed in their original, engaged frames. When the triptych is closed, the composition on the exterior continues over the two wings within a single plane, which was achieved by planing down the central vertical frame members. The central panel has a modern frame. Dendrochronology has established that this panel could have been painted from 1510 onwards, although a date after 1512 is statistically more probable. It therefore is one of the foremost examples of Bosch's late work: Hieronymus died in the summer of 1516.

RR 100

RR 101



20.1 Construction diagram

RELATED WORK

A close copy of this triptych, also called *The Haywain*, is in the Monasterio de San Lorenzo de El Escorial (cat. S1, RR 103–108).

EXAMINATION DATA

1–5 July 2013 (Robert Erdmann, Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Hanneke Nap, Ron Spronk).

The triptych was examined in its frame in an empty gallery space. The wings were separated and the paintings studied upright on an easel under strong illumination. Both front and reverse were accessible, with the exception of several panel edges that were blocked from view by the frame.

- ***Previous research and additional documentation available*** XR films, vidicon infrared reflectograms and paint cross-sections exist. Most of these data were published in Garrido and Van Schoute 1991, 177–79; Garrido and Van Schoute 2001; and Van Schoute, Verougstraete and Garrido 2001, 103–19. With the exception of the radiographs, the original documentation and the 2006–09 treatment report were not available for study.
- ***Previous treatments*** On 13 July 1897, the *Paradise* wing was restored by Francisco Fonseca. Between 2006 and 2009, the triptych was restored in two stages at the Museo Nacional del Prado by Rocío Dávila Álvarez. The frame for the central panel was created during this treatment.

SUPPORT

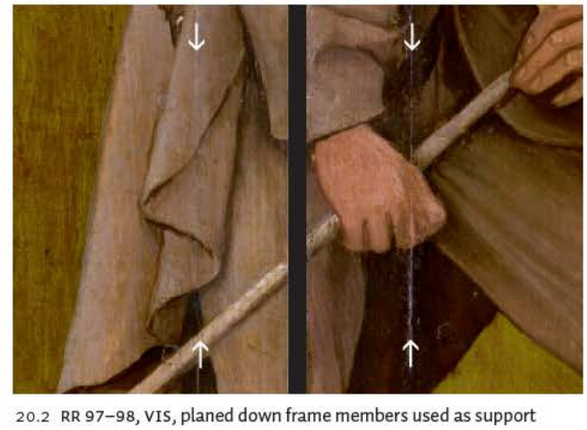
- ***Panel*** Dimensions: see construction diagram (fig. 20.1). Because of the framing, not all parts of the panel could be measured accurately.

  The wood species, Baltic oak, was identified through dendrochronology.

  The central panel consists of four planks, whereas the wings consist of two planks each. All planks are quarter-sawn, vertical in grain and laid vertically. The planks were butt-joined, dowelled and glued. In the XRS it appears that there are four dowels in the left wing, possibly four in the central panel, and four in the right wing. Just below the top dowel in the right wing, an additional half-dowel is present, with no dowel or dowel hole in the opposite plank.

  The panels were originally housed in engaged frames, which were lost from the central panel but are still intact at the wings. To enable

RR 102



20.2 RR 97–98, VIS, planed down frame members used as support

the composition to continue within the same plane over the two wings when these are closed, the central vertical framing elements were planed down before the painting process started (see below, FRAME). Therefore, it might appear that the exteriors have a third, narrow plank (fig. 20.2), but these elements (III in RR 97 and I in RR 98; see fig. 20.1) are actually part of the original frame construction.[3]

The wings are painted on both sides. The original central panel reverse was thinned to about 5–7 mm and then cradled. No exposed dowels were observed.

- ***Dendrochronology*** The youngest heartwood ring dates from 1499, which, with the added minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1508 for the tree that supplied that plank.[4] An earliest felling date of 1510 is statistically more probable, however, since that would cover 93 per cent of the range of possibly missing sapwood rings. Assuming at least two more years for drying and transportation, the panel could have been produced from 1510 onwards, but a production date from 1512 onwards is statistically more probable.

GROUND

- ***Visibility*** The off-white ground, which is present overall, is almost fully covered by the paint layers. Around the 'head' of the anthropomorphous rock in the upper background of the *Paradise* wing, a larger section of exposed ground can be seen, especially to the right. The ground is further detectable in VIS at some of the painted contours and in losses. It also shimmers through the paint surface in several areas, which must have been intended as part of the composition. However, the ageing of paint layers may have increased their transparency, and thus the discernibility of the ground, especially in lighter areas.

- ***Barb and edges*** Although damaged in many places, all the original barbs and unpainted edges have been preserved on the wings, since their engaged frames are original. As described above (see *Panel*) and below (see FRAME), the central vertical members in the engaged frames of the closed wings (RR 97 and 98) were planed down to allow the composition to continue in the same plane. Since those sections were painted without engaged frame members, barbs or unpainted edges never existed in those locations. At the bottom right of the *Paradise* wing (RR 99), the ungrounded edge is detectable, measuring about 11 mm.

  Although the central panel (RR 100) was studied in its frame, it was evident that its edges were damaged at some point in the past. These appear to have been cropped on all sides, but possible remains of a barb were observed at the top edge.

- ***Application*** The ground was worked to a generally smooth finish. Locally, brushmarks are visible within the pigmented isolating layer on top, rather than in the ground layer. With ageing, the surface texture of the wooden support has become more apparent, especially in the central panel.

- ***Composition*** The ground consists of chalk (calcium carbonate – $CaCO_3$) bound in animal glue.[5]

PREPARATORY LAYERS

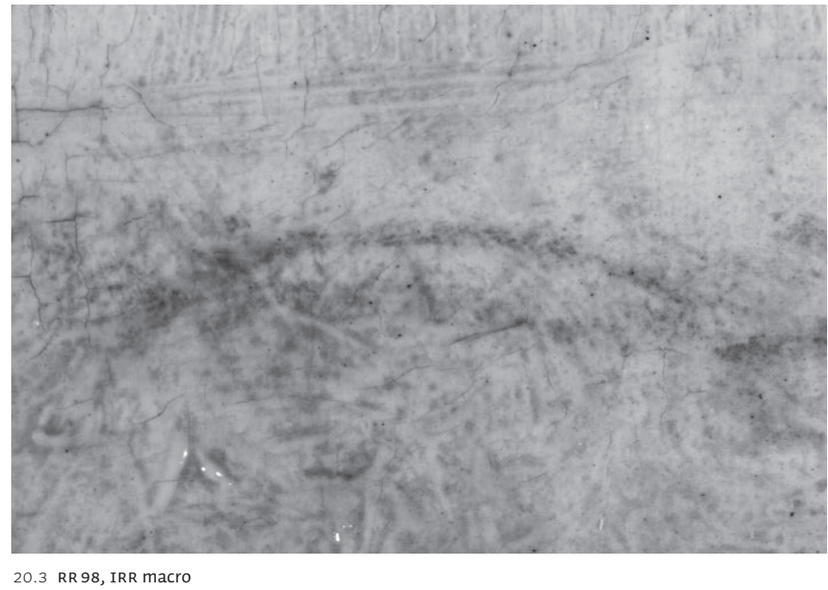
- ***Underdrawing*** The compositions are almost fully underdrawn, although the drawing is less elaborate on the exteriors (RR 97–98) than in the open triptych (RR 99–101).

  The underdrawing shimmers through the paint surface in several areas and can be seen in VIS in all panels, especially in lighter areas. It is evident, for example, on the path in the closed wings, in the sky in front of the 'head' of the anthropomorphous rock in the upper background of the open left wing (RR 99), in the ground in front of the haywain in the central panel (RR 100), and in the face of the wall with the vaulted opening in the foreground on the open right wing (RR 101). In these lighter areas, the underdrawing has become more apparent over time in VIS because of increased transparency caused by changes in the refractive index of the paint film due to ageing. With IRR/IRP, underdrawing was also revealed in many other locations.

  In the closed wings (RR 97–98), mostly contours and elements such as the main folds and facial features were indicated, although some smaller trees in the background were prepared with wash-like underdrawing. In the *Paradise* wing (RR 99) and the central panel the drawing is more extensive, and some hatching was locally used for modelling. The compositions were worked out in the underdrawing but the creative process did not stop there, since the final composition in paint deviates in many details from the underdrawn one.

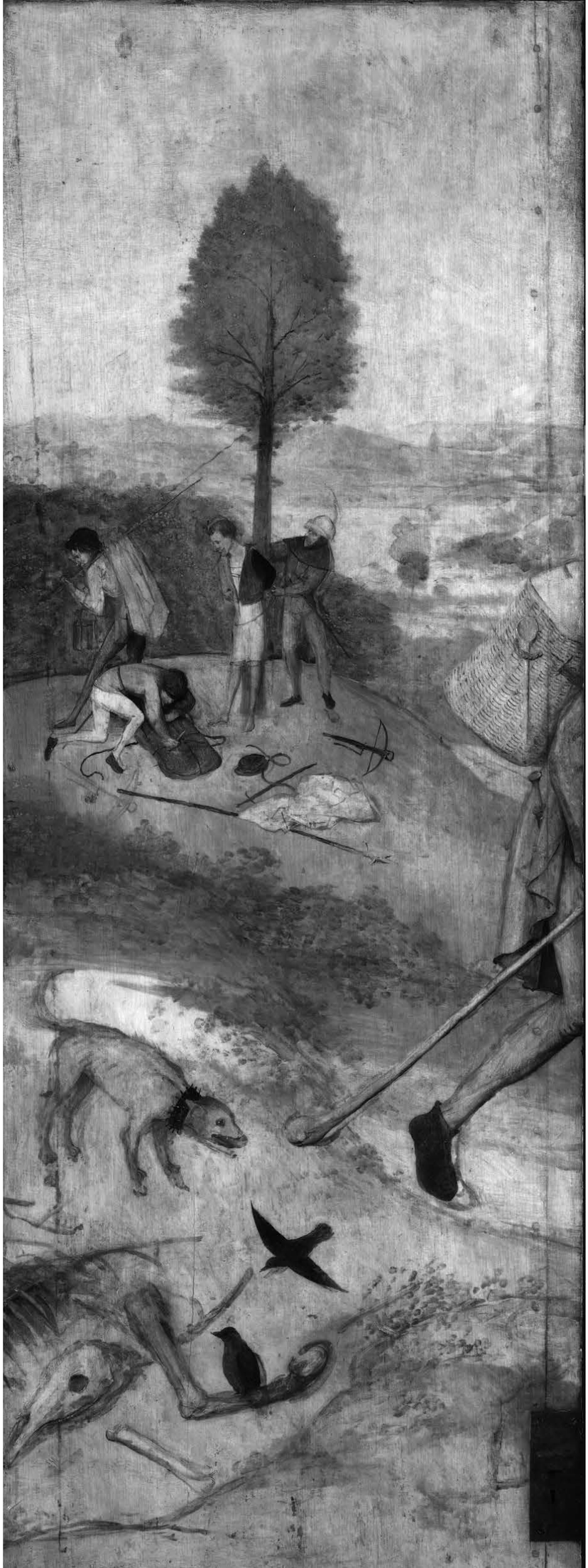
- ***Medium and application*** It is possible that an initial dry underdrawing was used to indicate some of the main contours and the planes in the landscapes. Some thin, very faint lines, possibly executed in a dry medium, were revealed in some locations; for example, at the hind contour of the dog in the closed left wing (RR 97); just below the horizon at the right edge of the closed right wing (RR 98; fig. 20.3); in the landscape under the feet of Eve in the scene of the Fall in the *Paradise* wing (RR 99); the horizon at the left edge of the central panel (RR 100); and sections of the vertical contour of the tower on the *Hell* panel (RR 101). By and large, the observed underdrawing was applied with the brush in different phases, and different brush sizes and liquid media seem to have been used. In many sections of the drawing, numerous very small particles are detectable, which may indicate the use of a finely ground carbon black dispersed in a watery medium. In other underdrawn lines, however, such particles were not noted, quite possibly indicating a different medium, such as ink, in those locations.

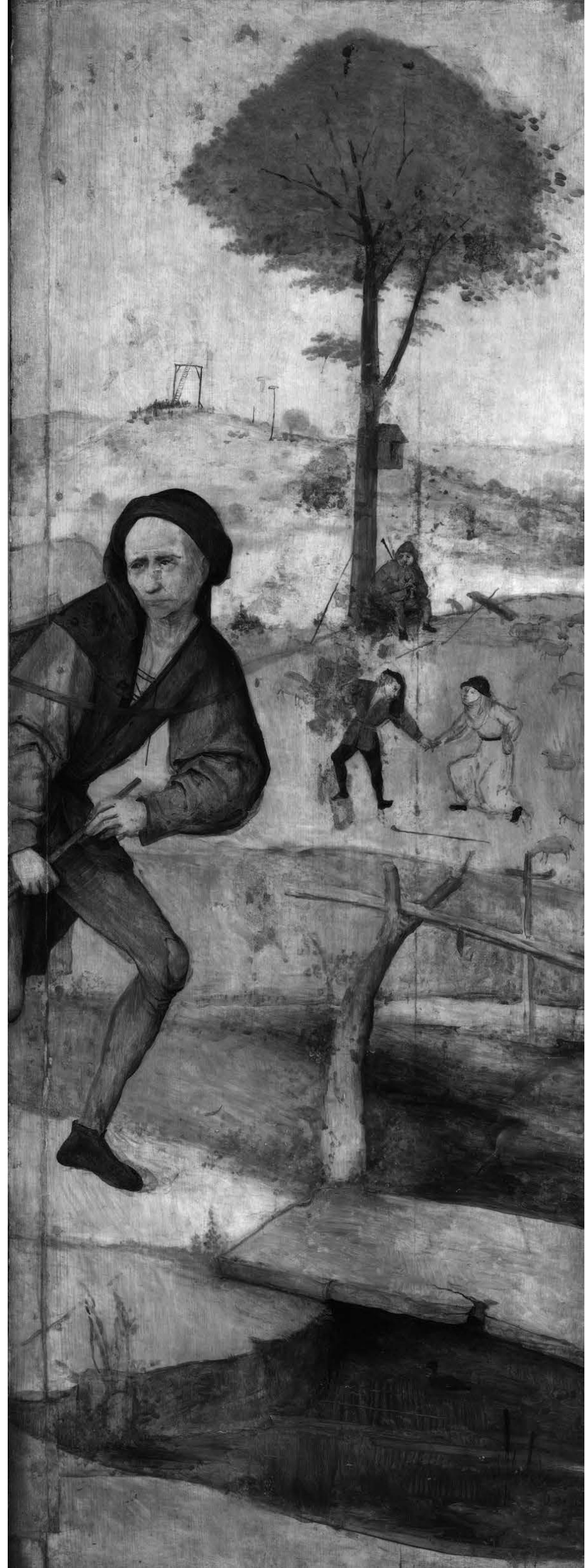
  In the closed wings (RR 97–98), for example, both types can be seen side by side, as in the hind part of the dog and at the proper left foot of the wayfarer. The relatively thin strokes show the minuscule particles; the much broader, wetter strokes do not. It appears that the phased underdrawing was applied not only with different media but also with different techniques. In the underdrawing of the bushes in the left middleground and of the sheep at centre right, these broader

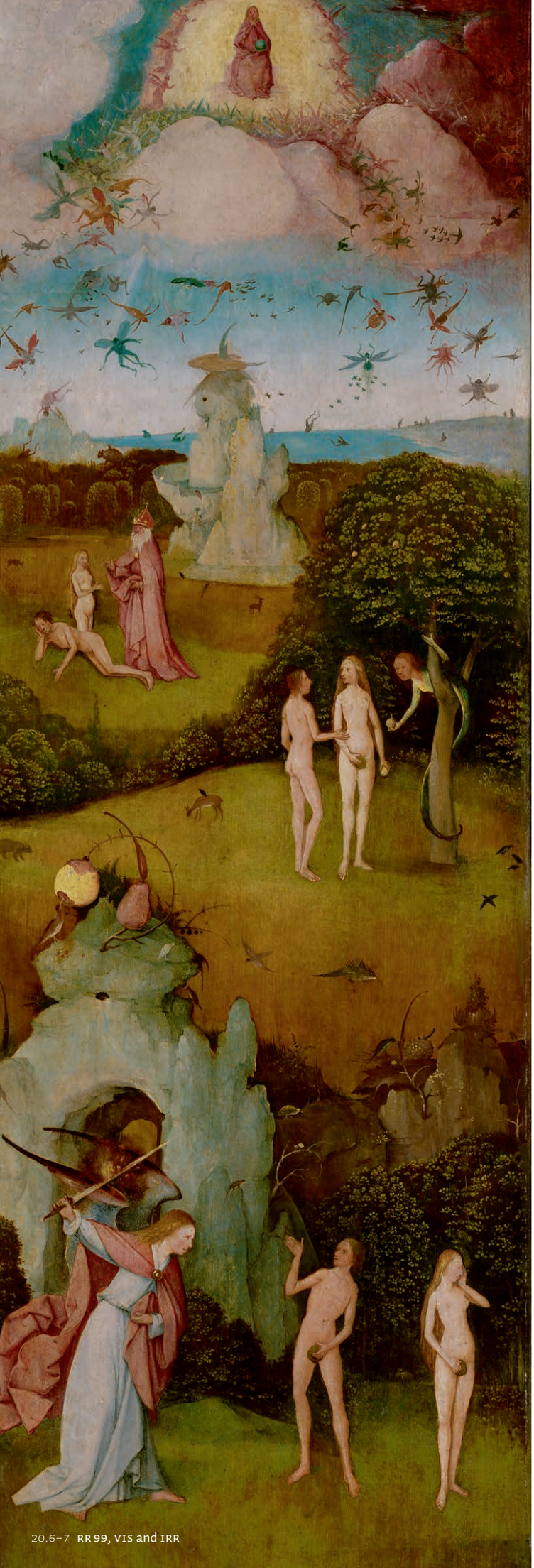


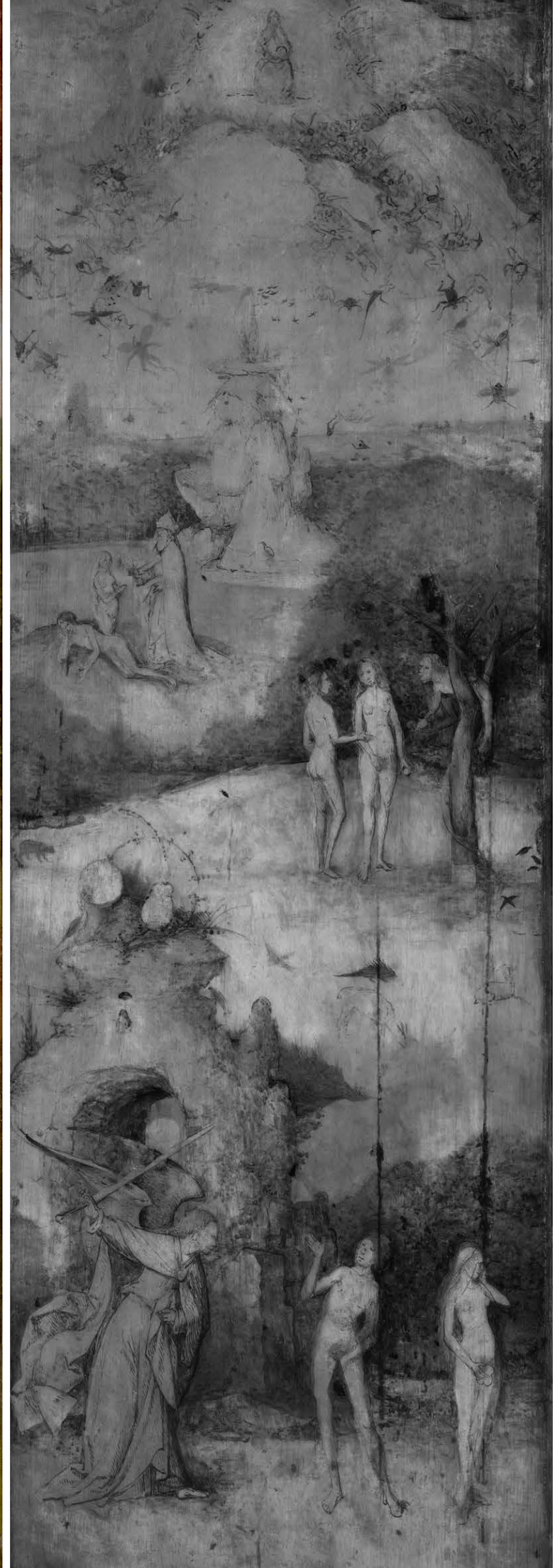
20.3 RR 98, IRR macro

20.4–5 RR 97–98, VIS and IRR

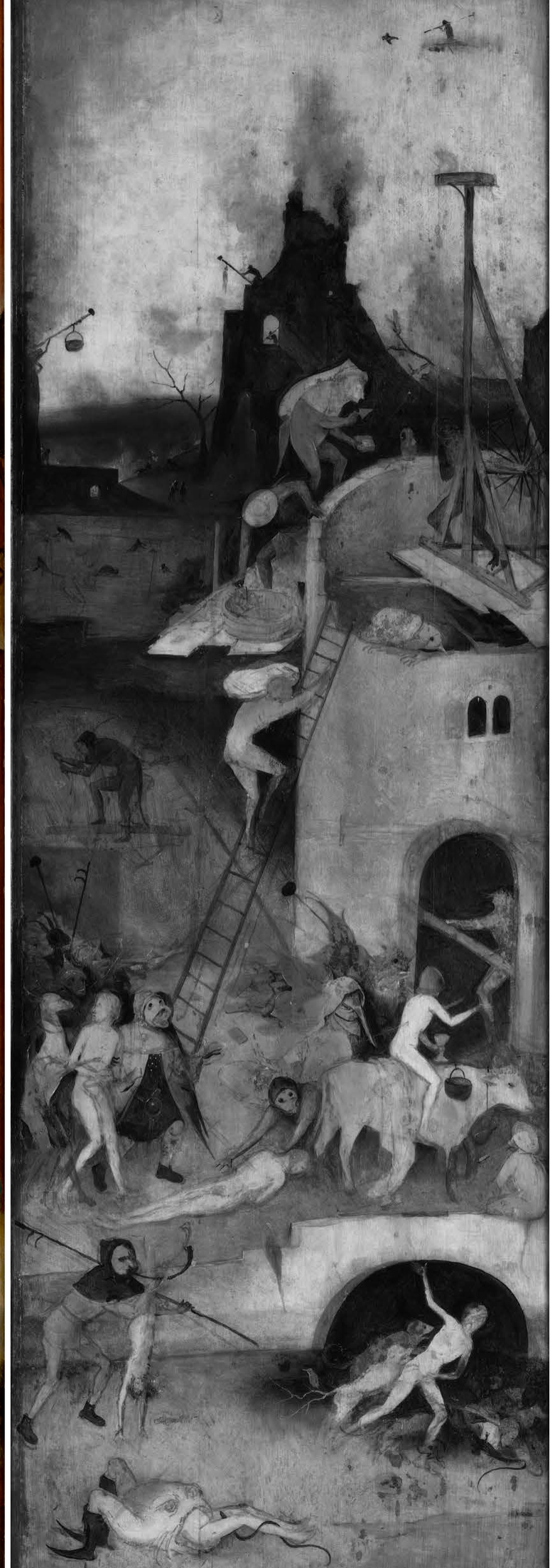








20.6–7 RR 99, VIS and IRR



20.8–9 RR 101, VIS and IRR

20.10–11 RR 100, VIS and IRR

Jheronimus bosch

strokes appear as washes, filling the rough shapes with an ink-like material. The very broad strokes that were used to prepare the darker area of the wayfarer's inner left thigh in RR 98 are so closely placed that they also begin to resemble a wash, and actual washes seem to have been used in the preparation of the small trees in the middle background, to the right of the figure with the red hat. Similar wash-like preparations can be observed in the open triptych; see, for example, the landscape of the *Paradise* wing (RR 99), the winged musician on top of the haywain and the lighter rock at the right edge of the central panel (RR 100).

Generally, contours appear to have been drawn first, followed by indications of finer forms, such as folds and facial features. Further detailing and modelling ensued, and some limited and relatively small zones of parallel hatching to indicate shadowed areas are detectable on all panels. Underdrawing lines appear to be uninterrupted, possibly indicating they were applied before the pigmented isolating layer.[6]

- ***Style*** The painting is almost fully underdrawn and shows a high degree of artistic invention. The style of the phased underdrawing is coherent throughout the triptych.[7] The lines were applied swiftly and generally appear sketched, although many elements were nevertheless accurately depicted. The longer lines, often found in contours, can be somewhat winding or even jittery. In certain cases, such as the female figure in the closed right wing, lines appear to be irregular and rather crude. Many elements were drawn with short, often disconnected strokes or dashes. It is possible that the thin, scarcely visible underdrawing lines, such as those at the foot of the wayfarer, were from the initial drawing. These were later reinforced by broader strokes, which also appear in the rest of the drawing, along with the parallel hatching indicating shadow areas.

  Hatching typically runs at a slight diagonal, from the upper left to the lower right. Locally, hatching in other directions is evident as well. Hatched lines are generally short and regularly spaced and are usually fairly straight or, in some instances, slightly curved. In several areas they appear darker in IRR/IRP and sometimes they are closer together, thus indicating darker shaded areas. Line ends are mostly straight (blunt or tipped), but often slightly curved and can have hooks as well.

  Several areas in the composition are filled with wide brushstrokes or even appear washed. Among these are the initial version of the rear wing of the angel on the haywain, many shadowy areas in the central plane of the panel below the figures, and an underdrawn window of the tower in the right wing. In a similar fashion, the bank of the altered path of the wayfarer was broadly underdrawn with rough brushstrokes that seem to indicate foliage.

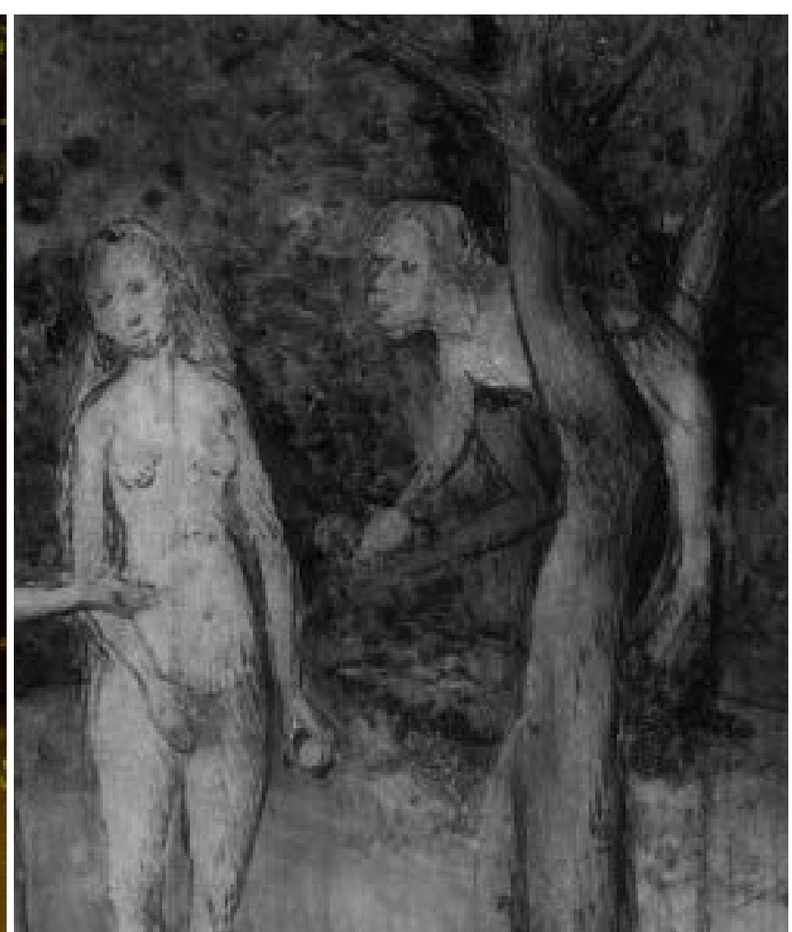
- ***Revisions in underdrawing and differences from painting stage(s)*** There are numerous smaller and larger corrections in the underdrawing, as well as changes in the painted surface. Most changes relate to shifted contours, yet many other features were underdrawn but omitted in the painting stage, repositioned or painted without being prepared.

  On the exterior (RR 97–98), for example, the feet of the wayfarer were repositioned. In the left middleground, the crossbow was drawn in a different location, and the right arm of the man being tied to the tree was not painted. The large tree on the right was underdrawn somewhat wider, with ink dots extending beyond the painted tree on the right side. At the centre right, three underdrawn sheep were not painted. The box with the small crucifixion scene hanging on the tree at right was not planned. The gallows in the background were prepared larger.

  More important changes concern a large underdrawn cross beside the path behind the bridge in RR 98 that was omitted from the painting stage. The path of the wayfarer was also altered significantly. Behind him, the path did not continue as far left in the underdrawing; behind the dog, a small hill was planned with underdrawn brushes above and to the right of the animal's head. The path then sharply turned to the right, towards the large underdrawn cross on the right edge of RR 98. The small hill was never painted, and the path's curve was shifted to the left. At the foot of the cross, under the railing of the bridge, the path was left in reserve from the initial landscape paint, but covered over in a later stage.

  The open triptych also shows several changes. In the Expulsion scene in the foreground of the *Paradise* wing (RR 99), for example,

20.12–13 RR 99, VIS and IRR



20.14–15 RR 99, VIS and IRR

Adam and Eve were initially taller and positioned lower, in the exact same plane as the angel. Right above them, two deer were underdrawn but not painted. In the scene of the Fall, the heads of Eve and the serpent were drawn at different angles, and the serpent's arm was changed (figs. 20.12–13). Many of the angels and demons throughout the sky were arranged differently, several underdrawn figures were not painted, and others were added in the painting phase (figs. 20.14–15). The shape of the feature on top of the 'head' of the anthropomorphous rock in the upper background was also changed.

In the central panel (RR 100), countless changes can also be found throughout. Although the basic composition was maintained, it is difficult to find figures and features that were not changed from the underdrawing stage. Just a few random examples are given here. Several contours of the riders and their horses to the left of the cart were shifted. The right hand of the Pope on the white horse was prepared higher, pointing at the haywain. Below this figure, the crippled man to the left of the rear cartwheel who is being attacked with a knife was underdrawn with a hurdy-gurdy that was never painted. The fish-shaped monster pulling the cart was prepared as a more anthropomorphous figure with large, hare-like ears, or was wearing a hat in that shape. Above this figure, in the side of the rock at the right edge of the panel, several features were underdrawn that were painted elsewhere, including the stake with the blindfolded, severed head. In the figural group atop the haywain, the shape of the angel's wings was altered, and the head of the winged creature to the right was more animal-like at first. The latter figure was carrying a large tree branch, and its proper left leg was brought inward.

Similar changes can be found in the *Hell* wing (RR 101), where in the left background a pit-saw was drawn, presumably with two figures. Just below that motif, the man with a side axe was underdrawn much larger, appearing rougher and working in the opposite direction. The gate in the tower was much bigger, and above that, as seen in the IR images, a third window is evident to the left of those that were painted. The bird-like creature resting on the tower wall was underdrawn as a figure with a large hat, looking over the edge.[8] The human figure lying on the ground was underdrawn with a sword sticking in his chest.

The examples listed here illustrate the myriad revisions implemented in the subsequent production stages of the Prado *Haywain*. These compositions were obviously developed here, and Campbell's suggestion that the triptych is a mere copy after an earlier example can thus be firmly rejected.[9]

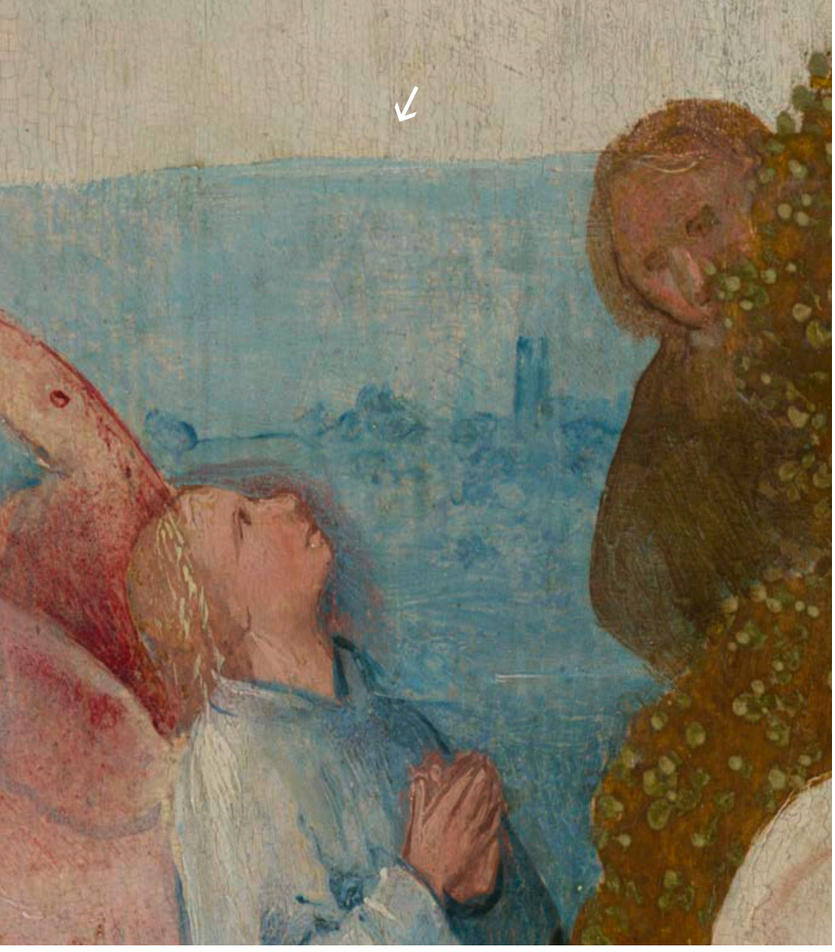
- ***Intermediate layers*** The underdrawing seems to have been applied directly on the ground. Parra Crego identified two intermediate layers: an initial isolating layer in oil and a whitish 'imprimatura of ceruse tempera'.[10] We observed a streaky whitish layer at several paint contours (97MICGBM002 and 98MICGBM003, both on top of the underdrawing). It also shimmers through the paint surface very slightly in multiple areas and was used in the final composition, in some areas not being fully covered by later paint (fig. 20.19). Visibility of this layer shimmering through was undoubtedly meant by the painter as part of the composition. In many areas, though, it is more apparent now because of the increased transparency of the paint strata upon ageing. The whitish layer was thinly applied with a brush and contains lead-white pigment. It is unclear whether this layer was applied evenly and over all panels of the triptych.[11]

PAINT LAYERS

- ***Binding medium*** Mixtures of linseed oil (analysed) and egg (white and/or yolk) were reportedly identified as binders.[12]
- ***Paint application and painting technique*** The brush-applied paint covers almost the entire surfaces of the panels. In the closed wings, paint was applied onto the centre vertical edges where the composition continues onto the adjacent panel. In a few locations, it slightly overlaps these edges. The underlying preparatory layer is sometimes visible at the interface between different colours. Paint was applied in several stages, mostly wet-on-dry, but also frequently wet-in-wet. An incision just above the face of the angel on the haywain points directly towards the face of Christ, and might have prepared a sightline (fig. 20.16).

While painting, the artist often deviated from the underdrawing and earlier painting stages. Areas left in reserve were not accurately followed and paints often overlapped slightly. The painting was typically worked out rapidly and to a high degree of finish. Primarily medium-rich, fluid and glossy paints were used, applied in opaque as well as semi-transparent layers. Glazes were done in red (for red and slightly purplish areas) and in green. The red lake paint often has a finely speckled appearance, which may reflect the use of cloth for dabbed paint application. Generally the composition was built up in only a few paint layers. In multiple areas, the preparatory layer plays a role as well, shimmering through the paint strata or left partly exposed (e.g. fig. 20.19).

In the top left of the open left wing, the painted clouds were extended to the right through dabbing white paint atop the blue sky (fig. 20.17). In the background of the open right wing, the smoke appears to have been dabbed in places as well. An opaque vermilion was used for the red sky there, whereas the more dominant backgrounds of the other panels were painted with slightly thicker



20.16 RR 100, VIS

20.17 RR 99, VIS

20.18 RR 100, VIS

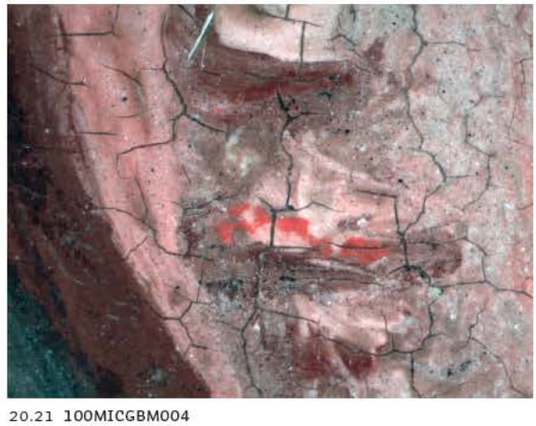
copper-green and blue paints. Areas with azurite, for example, consist of thick but medium-rich paint, as dictated by the coarseness of the pigment.

Typically the artist applied paints in thin layers. Brushstrokes were used to render contour and volume throughout the painting. They were applied in multiple directions, in a rather quick manner but usually following the forms in the composition. This applies to both the closed wings and the open triptych, but on the exteriors the brushstrokes appear even more vigorously applied. More delicate brushstrokes were used for the face of the wayfarer. For the most part, the size of the brush used depended on the feature drawn (e.g., larger brushes being used for the background). The speed at which the paint was applied appears also to have resulted in some unintended effects. For instance, at the centre left edge in the middle panel, the still-wet paint was disturbed at the outstretched hand of the half-naked man, resulting in a number of small, vertical lines running through his fingers (fig. 20.18).

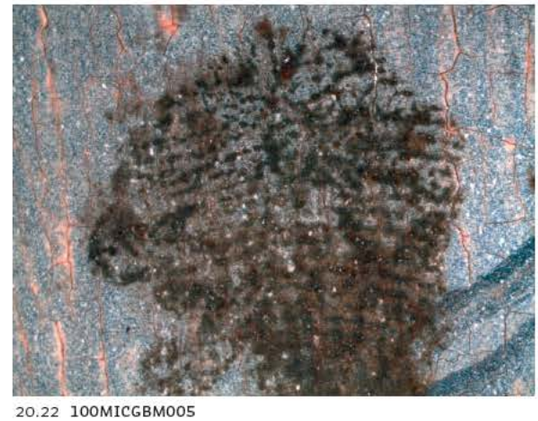
In the open right wing, in the green stonemason on the tower, multiple rows of short, pinkish brushstrokes shaped the headpiece. Dotted paint application is visible in the main foliage, with more elongated strokes used for some background greenery. These styles appear consistent throughout the entire triptych. In the central panel, background green paint seems to have been dabbed in some areas to create the appearance of foliage (fig. 20.22). Red lake was frequently mixed with lead white, either roughly or towards a more evenly blended pink. For several areas, a somewhat stiff lead-white underpaint was applied, creating a sharp, impastoed brush texture which, after setting of the paint, was covered with red lake (98MICGBM002). (Abrasion has caused the textured white underlayer to become more clearly visible.) In other sections, local white highlights were applied onto the red lake. Red lake detailing mixed with some lead white was applied onto the still-wet lead-tin yellow of the figure's robe in the centre of the central panel,[13] pushing the underlying paint aside (fig. 20.20).[14] In many areas the initial paint layer was finished in a similar fashion, applying fine touches, frequently with ample paint, for detailing, highlights or shadows, often on the still-wet underlying paint layer. Touches of this nature were also applied to a base-paint layer used for several purplish-brown background figures on either side of the haywain. In these figures, red lake was often mixed with brownish paint and used for contours of facial features and hats. Black contour lines were scarcely used, although black pigment appears to have been mixed in for several dark contour lines. Brownish lines, sparingly used to indicate physiognomic details, are visible in places. The use of ample paint, mostly for detailing and the wet-in-wet technique, also resulted in a fine relief (see, e.g., the red lake at the nose and mouth of the woman

20.19 98MICGBM004

20.20 100MICGBM010



20.21 100MICGBM004



20.22 100MICGBM005

20.23 Mapping of micrographs reproduced here (20.19–22)

seated on the haycart; fig. 20.21). The direction of the strokes appears to have depended on the type of feature painted.

- ***Texture*** All passages have a relatively smooth finish, but by using many dots and strokes of paint (mainly those containing lead white), subtle textural differences were achieved. In addition to slightly impastoed highlights, texture was used for some modelling.

- ***Build-up and palette*** The paint was generally applied from light to dark, but also from dark to light, as in the foliage. Highlights and shadows were applied later. The painting phase was planned since it was executed mainly from 'back to front', roughly following the underdrawing. The background was painted before the figures, leaving areas in reserve, although often only roughly. In the central panel, however, some main elements were painted after the sky, but before the background landscape was complete. In the final stages, details of highlights and shadows were applied, such as the dark lines in the hands and feet of the figures (see above, *Paint application* ...). Although cast shadows are absent, most shadows within the forms of some figures indicate a directional light source from the left, although other figures are lit from above or even from the front. The closed wings are also painted in colour, but more muted tones were used here.

  In all panels, the white area of the sky was painted first. Working from the horizon to the top, the artist gradually added more azurite pigment to the lead white. The blue upper part of the background landscape overlaps the white of the sky, and the bluish-green part of the landscape laps over the blue. The foliage and trunks of the trees, the anthropomorphous rock, and the haywain were left in reserve, as were larger elements in the rest of the composition.

  In the closed wings, differences are discernible in the build-up of foliage of the two large trees. For both wings, first a brownish base was laid down. This was followed by only a small amount of green in the centre of the tree in the left wing (RR 97), whereas much more green was used in the tree on the right wing (RR 98). Branches were then painted wet-in-wet, being browner in the left and blacker in the right wing. Finally, medium and then lighter green dots were applied. The result is that the tree on the left appears richer in contrast and more defined. The shrubbery here shows the same build-up process. The trees in the distant background were roughly sketched with greenish-blue paint applied directly onto the light blue background of the closed left wing.

  The dog in RR 97 was painted after the landscape, but a correction in green paint was applied before the dark spikes of its collar were added (97MICGBM003). Copper resinate has been identified in the green glazes, as in the shrubbery in the background of the *Wayfarer*, but that layer is much more likely a glaze with verdigris pigment that dissolved in the oil medium.[15] In the vermilion hat, red lake was used to indicate the area of shadow. Pinkish paint was employed in the highlight, and a small emblem appears to have been painted in lead white on the hat. The reddish robe on the ground was executed completely wet-in-wet, using a modelled pink base with lead-white highlights and pure red lake lines for additional folds and shadows. This build-up is comparable with that of the woman's robe in the closed right wing. Red lake detailing is evident, too, in all faces of the closed right wing (and in multiple faces in all three panels of the open triptych), but not in the closed left wing. For the locally applied pinkish-grey flesh tones of the wayfarer, a mixture of lead white, red lake and some black was used.[16]

  In *Paradise*, the open left wing (RR 99), the white and blue of the sky were painted first, leaving in reserve the clouds and the sphere. These were then painted, in some places widely overlapping the blue sky. After the sky, the blue water in the background was applied, cutting into the still-wet white paint underneath. After some time passed, the adjacent grey areas were done, largely extending over the sky, the paint of which by then had already set. The green landscape was then painted, leaving the other rocky features and the figures in reserve (99MICGBM005).[17]

  In the brownish areas behind the rocky features in the foreground, possibly tiny, red-dyed textile fibres were detected (99MICGBM006–009). The red glaze reportedly consists of kermes lake and tannins, and the presence of the fibres supports Parra Crego's suggestion that it was obtained from dyed rags.[18] It appears that robes with red lake were executed before the others. For example, the red cloak of the Archangel Michael in the Expulsion scene in the foreground, consisting of lead white and red lake, was painted before his white robe. And God's red robe slightly overlapped the landscape, but appears to have been corrected or cropped somewhat, using strokes of green.

  The round fruit at the top of the rock was done in lead-tin yellow with a lead-white highlight. Red lake was roughly mixed with lead white for the top and bottom. The apples in the tree may have been done in lead-tin yellow, followed by some red lake for the shadow area. Eve's hair was applied wet-in-wet, with a warm brown base followed by ochre and lead-tin yellow touches. At the base of the fountain, a supposedly omitted bird[19] was in fact painted, albeit in a subtle, sketchlike manner.

  For the fire at the tower in the background of the open right wing, both lead-tin yellow and lead white were used for many bright parts. Furthermore, bright orange vermilion paint and red lake paint were employed.[20] For the smoke, red-brown paint appears extensively, as well as a copper-green glaze and azurite paint. Blue was also employed for the figure in the window. Towards the horizon, pure vermilion was applied around the fires, and lead-tin yellow highlights were partially mixed with lead white. The background buildings were painted in black atop a red-brown base. The dark part of the gate was similarly done, but it was painted around the pierced figure on the cow. The demon climbing the ladder was left in reserve from the base background colours, such as the ochre of the landscape to the left and the pinkish hues of the tower. It was then painted with azurite blue and wet-in-wet pink and white, including the tail and highlights in lead white, with locally added red lake detailing.[21] Subsequently, red lake was employed for the hairs, neck and eye. Then a brownish paint was used at the shoulder and a dark paint was locally applied onto the ochre landscape. The ladder was done afterwards on the partially wet underlayer.

  These examples show how the initial background or base colour was more modelled or had (a) highly worked paint layer(s) to achieve the finished effect. The red carapace of the animal on the round tower was painted with a red lake glaze, followed by opaque pink highlights and a white contour line at the top. Lead-tin yellow dots followed, then blue paint was also applied. The animal's claws were detailed in lead-white and azurite paints. A greenish paint, somewhat similar to the one in the moss of the central panel, was used for the lower part of its body. Grey and pinkish hues served for its head, followed by a lead-white highlight, plus one for its bluish eye. The creature's bill was depicted in lead-tin yellow. The rope of the crane to the right was first incised and then painted. Many elements were left in reserve, as was the black figure, which was painted with azurite pigment for all highlights.

  At top centre in the central panel, the yellow area was painted after the sky, leaving Christ in reserve. Flesh-tone paint, lead white and then red lake were applied, followed by detailing in lead white, lead-tin yellow, vermilion and brown. The pinkish clouds overlapped the blue sky and partly displaced the paints used for Christ.

  It appears that for the background, first a thin or lighter blue- and green-coloured base was unevenly applied, leaving areas in reserve. Then the main parts of the composition were painted, followed by the background now visible. This final background layer overlapped,

20.24 RR 100, VIS

for example, the angel and the haywain in multiple areas. The foliage on the haywain was also painted after the figures were put in, partly overlapping the white hood of the standing woman. In this phase also, dark green landscape paint was applied up to the cross on the king's crown, extending slightly over it but leaving part of the underlying bluish-green initial background exposed (100MICGBM007).

The figures on the haywain were left in reserve, except for the one peeping out from behind the leaves; he was painted atop the blue background (fig. 20.16). The wheels of the cart were left in reserve and filled in after the clothing of the figures was finished. The raised arms of the figures standing around the haywain were, on the other hand, painted atop the base colour of the hay. For the grisaille-like figure with the branches to the right of the haywain, a wide variety of different paints were used: black, lead white, lead-tin yellow, brown earth, azurite blue, red lake, and greenish and pinkish colours. Above him, the upper part of the rocky feature was done wet-in-wet, using primarily grey paint containing azurite pigments. This area also includes lead white, red lake and some black and brown paints, and is finished with lead-tin yellow highlights. In this rocky feature and in multiple areas of the foreground landscape, a thin, semi-transparent yellow-green paint was locally applied, often (but not exclusively) in areas of shadow. This could have been intended to represent moss, and the paint has possibly discoloured over time. The bright yellow hat of the figure in the central foreground overlapped the azurite blue robe. The red robe worn by the woman at the bottom left of the central panel has some lead-white underpainting, but it appears to be blended to some extent with a red lake that was applied thicker and purer in areas of shadow.[22] The same is true of Christ's robe. In other areas, however, lead-white detailing can also be seen applied onto the red lake, as on the arm of God creating Eve.

The signature in the central panel was done in black over the already-set paint of the light underlayer. Guideline incisions are present above and below it, with black paint running into them. The signature's appearance, craquelure, adhesion and state of degradation are comparable to those of the rest of the painting.

- ***Changes*** Besides adjustments to contours, several other pentimenti can be observed. For example, a reddish-brown area to the right and above the face of the angel on the haywain was overpainted blue (fig. 20.16). This increased the contrast of the profile and may have served to strengthen the expression. In the middle of the central panel, the heads of several figures were altered. The standing man with the grey robe had the top part of his head covered by a blue-grey hood. The bluish hood of the fallen man was changed to black. In both cases, however, later abrasion has caused the initial painting to become more visible. The man on the ground dressed in brown looked to the left rather than down when left in reserve. Below him, the sleeves of the red tunic of the man who has his throat stabbed were much narrower in the underpainting. On the table at the bottom right, an underdrawn pitcher was painted in a different position but was then covered by the artist, as was the green cup (fig. 20.24). Both objects are currently visible because of abrasion and attempted removal of the top paint layer.

Similar changes in paint can be found in the other surfaces. The base of the anthropomorphous rock in the *Paradise* panel (RR 99) initially extended further into the left background, for example. After it was left in reserve from the green background, this area was overpainted with green, even before the grey of the fountain was applied. Michael's sword was much longer when left in reserve. A large opening in the rock was initially painted between Michael and Adam, but this was covered with rock and foliage. In *Hell* the vaulted opening to the plateau in the foreground appears to have initially been painted larger, but only in black. It was wider at its base. Above this, the opening to the tower was first painted larger as well, and the beam being hoisted up was longer.

FRAME

Dimensions: left wing (RR 99): 146.8 × c. 56 cm; central panel (RR 100): c. 147 × 112.2 cm; right wing (RR 101): c. 147 × 56.1 cm. The frame of the wings is about 3.4 cm thick, except for the vertical lateral sections of the wings in the open triptych, which are around 2.3 cm thick. The framing elements of the wings are about 5.1–5.5 cm wide; those of the central panel are about 7.2 cm wide. The central panel's frame is about 5.9 cm thick. At some point, the connecting sides of the wings were planed by up to 5 mm at the non-original hinges and painted black.

The wooden frames are painted black and partly gilded. The central panel is set into a non-original rabbeted frame, but the original frames of the wings did survive, and traces of original paint of the panel can locally be found on these frames' inner edges.

The wing panels are housed in engaged frames, which were modified to allow the composition on the exterior of the triptych to continue across the two closed wings within the same plane, thus without interference of central vertical framing elements. This was achieved in what is, to our knowledge, a unique manner, by planing down these two central frame members until they were level with the panels, while leaving the broader remainder of these members on the other, open side of the panels intact (see figs. 20.1 and 20.2). There, the vertical framing elements are attached to the horizontal members of the engaged frames at the top and bottom, and are further secured to the panel with sixteen dowels in each wing. These dowels can be seen in both the open and the closed positions. They are perpendicularly placed in the gilded profiles of the lateral frame members in the open position. When the wings are closed, these dowels are located just outside the narrow remaining section of the vertical frame members, placed at roughly the same level in each wing (fig. 20.5).[23]

Two paired holes are present in the thickness of the vertical frame members, thus parallel with the picture planes, positioned 41 cm from the top and 36.5 cm from the bottom of each wing. They are 7.5 mm deep in the left wing and 27 mm deep in the right wing. Presumably, two protruding pegs in the right wing originally enabled the locking of the wings. The metal lock on the left wing is old but not original.[24] Incision marks on the right wing might indicate where an earlier lock was positioned.

The frame elements on the closed wings are flat, except for a narrow inner profile, and are painted black, just as the sides, without a preparation layer. The frame elements on the open wings are profiled and gilded, except for a narrow, raised, black outer edge that serves as bumper when the wings are closed. The frame elements on the open wings have small inner profiles and *Wasserschlag* (or 'rainsill') bevels at the bottom. On the closed left wing, the inner profiles of the top and the bottom horizontal members are damaged on the right.[25]

CONDITION

Support

- ***Altered dimensions*** The central panel reverse was thinned and finished with a toothing plane before the cradle was attached. Affixing the wing panels to one of the vertical frame members (see above, FRAME) resulted in one-sided shrinkage, and a slight gap between the panel and the frame on the opposite side.
- ***Additions*** On RR 102, the reverse of the central panel, a cradle of resinous wood is attached. Apparently both the vertical and the horizontal cradle members were glued, which would block all natural panel movement.[26]
- ***Cracks*** Several old cracks are still apparent. In particular, a crack on the closed left wing near the left edge runs the entire length of the panel and is visible on both sides. Also, in the central panel there are several larger cracks that were probably caused by the cradle.
- ***Deformations*** The double-sided painted wings remain mostly flat, but each is torqued from the pulling of the frame. The central panel has a slightly convex deformation. There is also minor undulation, which might have been caused by the attached cradle.
- ***Joins*** The joins between the planks appear closed, although they do stand out slightly, as is visible in raking light. In the closed wings, the connection between the panel and the painted frame section has become more apparent over time. An open join is visible at the bottom left of the closed right wing.
- ***Coated reverse*** The wings are painted on both sides. No coating was noted on the thinned reverse of the central panel.

Ground and paint layers

- ***Stability*** In general, the adhesion of both paint and ground appears good. Most craquelure has been caused by natural dimensional changes of the panels. Locally there are some youth cracks where relatively medium-poor paint partly overlaps red lake paint, such as at the bottom of the pope's robe in the central panel. There is little craquelure in the wing panels, but at the horizon some drying and/or youth cracks are present. Slight rippling, a result of panel compression, is also evident.
- ***Losses*** There are many old losses to paint and ground in the central panel and in the wings. In places, there are scratches and dents in the paint surfaces. Most damages have been restored.
- ***Abrasion*** Mainly the lower areas of the painting are abraded, but overall the work is in relatively good condition. In places, scratches can be seen in the paint as well as in underlying layers, with later paint running into these scratches. In the grey robe of the figure in the middle of the centre panel, locally there are remnants of a thin, damaged, warm-toned paint layer (100MICGBM009). This stratum, removed in many areas, appears original. The colour of this robe would thus have been similar to that of the robes at the bottom right.
- ***Discoloration and increased transparency*** Discoloration is present, for example in the landscape. There a copper-green lake component seems to have turned brownish. Red glazes have faded somewhat, and an increase in transparency is evident in some areas of lighter paints, revealing the underlying layer. Ink dots of the underdrawing are now shimmering through the light blue sky to the right of the large tree in the right wing. A grainy, broken-up layer is discernible in several areas of the open right wing, roughly on top of zones of red lake (101MICGBM001 and 101MICGBM004).

Although it appears as a greyish toning layer, it could be the substrate (possibly starch) of a glaze that has lost its colourant effect.

- ***Filling, retouching and overpainting*** Losses to paint and ground are old but not all are filled, and some filled losses are not inpainted. At the top centre of the open right wing, reddish brushstrokes to the right of the clouds in the shape of a double crescent, better visible in IRR/IRP, seem to represent a celestial object, but these are actually retouches covering a dent. In the top of a tower window, an unretouched but filled loss now appears as a spike or tooth (101MICGBM003). The red figure in the doorway of the tower is very damaged and extensively retouched. The same is true of the green dog and certain other green areas. Extensive retouching can be found locally in the other panels as well, whereas many other areas are reasonably well preserved. It seems that for many retouches, carbon black was mixed into the paints. This is visible in the IRR/IRP imaging and makes it more difficult to distinguish the underdrawing in some places.

Surface finish

- ***Varnish*** There seem to be multiple varnish layers present that are in good condition. The appearance of the varnish is generally glossy and fairly even, but many varnish speckles and, locally, matte spots can be seen. Varnish speckles (slight matte/gloss differences) and, in places, slightly larger drops, appear mainly on the central panel. Matte spots appear in the *Paradise* panel, and the edges of the paint surface here are not completely saturated. In other panels, small areas exist with sunken-in varnish, as on the tower windows. Scratches can be seen here and there in the surface coating. Primarily in the light sky areas, a grey surface layer is present. This non-original layer continues over paint and exposed ground in several areas (99MICGBM003–004).[27] Several matte spots, possibly fingerprints, are detectable on the *Hell* panel.
- ***Surface dirt*** There is a small amount of surface dirt on the painting.[28] There remain some soft hairs and brush hairs stuck inside or on the varnish.
- ***Visibility of the original surface*** The painted surfaces of the triptych are relatively legible, with the exception of some unsaturated edges and areas with sunken-in varnish. Locally, matte spots and glossy retouchings slightly distract from the otherwise good visibility of the paint surface. Discoloured varnish residues, however, remain in the interstices of the paint. In the light-coloured figures – of Adam and Eve, for example – these darker spots somewhat interrupt the fluent modelling of the skin tones.

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1 460 is the Spanish Royal Collection inventory number from the 1854–58 inventory; 493 is an early inventory number of the Escorial. See Garrido and Van Schoute 2001, 123; their source is *Museo del Prado: Inventario General de Pinturas; I. La Colección Real* (Madrid 1990), 138, no. 460.

2 There are no indications that the *Paradise* wing was painted by a different hand, as has been suggested in the literature.

3 These elements were mistakenly listed as a third plank in Garrido and Van Schoute 2001, 124. The authors also confused the remaining section of the engaged frame with an addition, which error was repeated in Van Schoute, Verougstraete and Garrido 2001, 105–06.

4 Analyses done by Peter Klein in 1994 (central panel) and 2014 (wings, from XRS).

5 Parra Crego 2001, 230.

6 Parra Crego (2001, 233 and 247), based on a single paint cross-section of the yellow-robed figure behind the cartwheel, concluded that a second underdrawing stage, the 'retouch drawing', was applied on the pigmented isolating layer (which he interpreted as a local *imprimatura*). However, the black layer in that sample is more likely part of the painted composition, as the yellow robe partly overlaps the black background of the cartwheel.

7 Sybesma-Ironside (1973, 82–87), based on the study of IR photographs, suggested that the style of underdrawing of the left interior wing (RR 99) differs strongly from that in the rest of the triptych.

8 Garrido and Van Schoute (2001, 140) interpreted this as the animal's claws placed in the opposite direction.

9 See Campbell 2014a, 141.

10 See Parra Crego 2001, 230, 232 and 247. The initial isolating layer reportedly consists of chalk, linseed oil and a lead compound as a drying agent. Traces of pine resin were also found.

11 In Garrido and Van Schoute 2001, the discussions of this layer are sometimes confusing and even contradictory; compare, e.g., pp. 149 and 246, and 232 and 233 figs. 6a–b. The local, greyish 'imprimatura' found on the closed wings may instead concern regular local underpainting.

12 Parra Crego identified a drying oil and protein (mostly egg) emulsion for the light blues (p. 234), and a linseed oil and egg emulsion for red lake areas and its pink undermodelling (235 figs. 9–10) and for lead-tin yellow paint (247 fig. 35). This research was done before Marika Spring's work on possible false positives for protein in early Netherlandish binders was published; see further, BRCP, *Catalogue Raisonné*, Chapters III and IV.

13 The lead-tin yellow is reportedly bound in an emulsion of oil and egg. Parra Crego 2001, 247 and fig. 35.

14 Garrido and Van Schoute (2001, 152) interpreted this effect as an incised line, probably drawn with the handle of the brush.

15 Garrido and Van Schoute 2001, 254. See further BRCP, *Catalogue Raisonné*, Chapters III and IV.

16 Parra Crego 2001, 246. Other analysed flesh tones consist of a mixture of lead white, red lake and a little vermilion. Garrido and Van Schoute 2001, 152.

17 Cross-section analysis and X-ray fluorescence indicate that a mixture of copper-green with lead white and/or lead-tin yellow was used for the opaque green underlayer, with a thin copper-green glaze ensuing. See Garrido and Van Schoute 2001, 153 figs. 66–67; Parra Crego 2001, 246. It is possible that more lead white was used for light- or cool-toned green paints and that lead-tin yellow was used for warmer-toned greens.

18 Parra Crego 2001, 256 and 258 table 2. For more information and literature on the production of red lakes, see Wallert 1991, 74–83, and Hofenk De Graaff, Roelofs and Van Bommel 2004, 344–52.

19 Garrido and Van Schoute 2001, 126.

20 Parra Crego 2001, 235 fig. 9. 'Red lake glaze with binder made of a mixture of linseed oil and egg, over a base layer of vermilion in oil.' On p. 246 it is stated that 'Chemical analysis determined that the lake is kermes (from the insect species *Kermes vermilio*).' A sample from each panel of the open triptych was analysed.

21 Parra Crego 2001, 246. 'There is a first layer of ceruse tempera, and over this, another layer in grey oils. The colour layer is composed of azurite, ceruse and a small amount of earths in linseed oil.'

22 A cross-section shows the presence of red lake in the white underlayer, overlaid by a pure red lake glaze. Garrido and Van Schoute 2001, 151 fig. 61.

23 This construction was misunderstood as a partially integrated (or applied) frame in Garrido and Van Schoute 2001, 214. It is possible that the (now-lost) original frame of the Bruges *Last Judgement* (cat. 16; RR 69–74) was produced in a similar manner, albeit without added dowels.

24 Garrido and Van Schoute 2001, 125.

25 An old photograph shows that at some point, a broad, vertical wooden slat was applied in this location; see http://balat.kikirpa.be/photo.php?path=B071848&objnr=40001518&lang=nl-NL&nr=1#relatedphoto (accessed 26 February 2015). A narrower slat was also attached to the left edge of the closed right wing. At some time, the slats were removed and the locally damaged left wing was repaired with a section of wood at the top and with fill at the bottom.

26 Garrido and Van Schoute 2001, 125.

27 Perhaps this greyish surface layer relates to the 'two superimposed layers of varnish [that] were found in some of the specimens. The lower is linseed oil and the upper is egg white.' Garrido and Van Schoute 2001, 245.

28 Loose dirt was removed from the surface of the open triptych by using a soft Japanese brush.

21

The Garden of Earthly Delights

NO RESEARCH REPORT

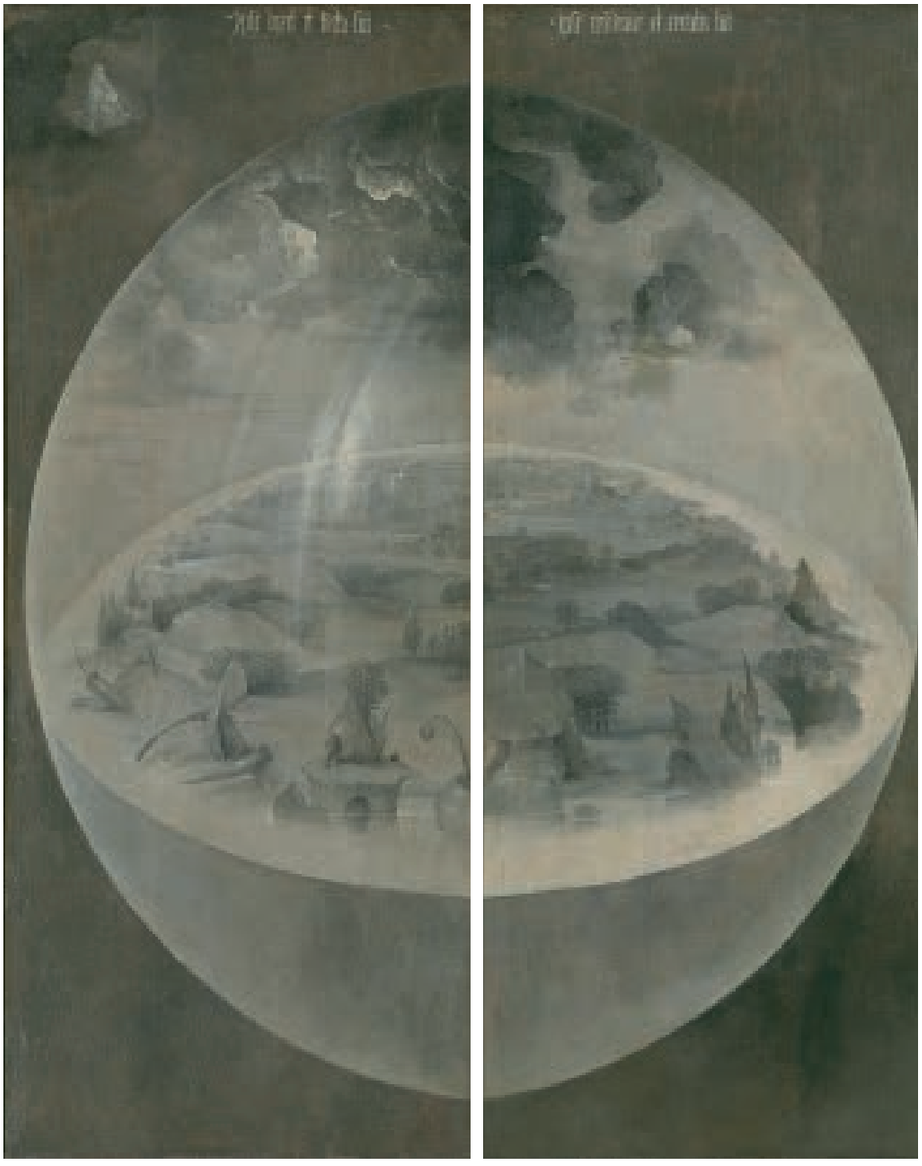
Hieronymus Bosch
c. 1495–1505

Oil on oak panels, central panel 190 × 175 cm, wings 187.5 × 76.5 cm
Museo Nacional del Prado, Madrid, 2823 (on loan from Patrimonio Nacional)

The BRCP was not granted permission to examine and document the painting. For technical notes, see BRCP, *Catalogue Raisonné*, cat. 21.

Inscriptions
Inscribed on the exterior of the wings: (upper left) *Ipse dixit et facta sunt*; (upper right) *Ipse mandavit et creata sunt* (Psalms 33:9).

Condition
The triptych's frame is modern, but traces of the original engaged frame such as barbs and unpainted edges remain. The original vertical frame members of the central panel were outfitted with a broader base. The reverse of the central panel was thinned and cradled, and wooden strips have been added to its sides. Substantial damage can be observed in the original paint and ground, especially in the central panel and in the exterior of the right wing, which was reinforced with dovetails at a later date. The adhesion of the apparently underbound paint is poor. Paint was consolidated, and gauze imprints from the 1944–45 treatment remain visible. There is severe abrasion and much of the craquelure has opened up. Green lakes are better preserved in the landscape on the inside of the left wing. Damages were restored during the 1999–2000 treatment and the original painted surfaces are easily legible.



Photos courtesy Museo Nacional del Prado, Madrid/Banco de Imágenes

SUMMARY OF CONCLUSIONS

from BRCP, *Catalogue Raisonné*, cat. 21

Garrido and Van Schoute 2001 report an unusually large number of revisions between the underdrawing and the initial paint layers of the Garden of Earthly Delights, *and, as their XRs confirm, between subsequent paint stages as well. However, any discussion of the style and method of underdrawing in the work will require new IRR documentation (see BRCP,* Catalogue Raisonné, *60–61). The dendrochronological analyses of the three panels by Peter Klein indicate that the triptych was certainly painted after 1466, and more likely after 1468. The planks of the wings were measured from the XRs. As explained in BRCP,* Catalogue Raisonné, *we date the work to about 1495–1505.*

22

The Flood

A *After the Flood* B *After the Last Judgement*

Workshop of Hieronymus Bosch
c. 1510–20

Oil (not analysed) on oak (analysed) panels: RR 3/4: 70.0 × 39.2 cm, RR 5/6: 70.5 × 37.4 cm. Both panels were cropped on all sides.
Museum Boijmans Van Beuningen, Rotterdam, St. 27 and St. 28

BRCP, *Catalogue Raisonné*, cat. 22; www.boschproject.org no. 22.

RESEARCH REPORT 3–6

SUMMARY OF CONCLUSIONS

The two double-sided panels in Rotterdam can be firmly placed within the Bosch workshop, although the fronts and the backs of the works were produced by different hands. The more direct paint application in After the Flood *and* After the Last Judgement, *as well as their generally higher quality, suggests more personal involvement of Hieronymus in the production of these two paint surfaces. The underdrawings there are also easier to link to the core of the oeuvre than the underdrawings of the roundels. All four sides show phased underdrawings and traces of a creative process in subsequent stages of production.*
The barbs and unpainted edges are partly preserved, which indicates that these wing panels were originally housed in engaged frames, now lost.

RR 4 (reverse of RR 3)

RR 6 (reverse of RR 5)

The slight cropping of the edges did not influence the outcome of the dendrochronological measurements, which indicates that they could have been painted from 1508 onwards, although a date after 1510 is statistically more probable. As further explained in BRCP, Catalogue Raisonné, *cat. 22, we date this work to around 1510–20. The 1982–85 restoration treatment has left the paint surfaces with disturbingly uneven levels of finish.*

EXAMINATION DATA

23–26 May 2011 (Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Ron Spronk).[1]

The paintings were examined both upright on an easel and flat on a table under strong illumination. Both front and reverse were easily accessible.

- ***Previous research and additional documentation available*** The museum holds several files with photographs and information on the painting, which were studied. They include IRRS by J.R.J. van Asperen de Boer (AB 399/19–AB 402/33, and AB 651–AB 653/12) and stereo XRS made in 1975. Earlier IRRS by Van Asperen de Boer and J.P. Filedt Kok, made in 1971–72, were published by Filedt Kok in 1972–73. Reports on paint samples (A36/1–8 and A37/1–3) taken by Van Asperen de Boer in 1984 are also on file. No instrumental analyses were done. Jeroen Giltaij's catalogue entry in Lammertse 1994 (96–105) also holds ample technical information.
- ***Previous treatments*** The paintings were restored between 1982 and 1985, using a rather archaeological approach and variable manners of reintegration. The restoration was carried out by P.F.J.M. Hermesdorf, who published an article on the treatment in 1990.[2] Information on the steps taken between 1979 and 1986 in research, treatment and documentation, with photographs (mainly black-and-white) is also available in the Hermesdorf archive,

RR 3, *After the Flood*

RR 5, *After the Last Judgement*

folders 22–29, kept at the RKD, The Hague. Reports describe the poor condition of the panels, with severe flaking paint issues, extensive filling and discoloured overpainting, and a poor legibility of the paint surfaces. The committee reports also reveal the amount of discussion on these topics; for example, on whether or not to replace the five metal dowels at the insert with wooden ones.[3]

SUPPORT

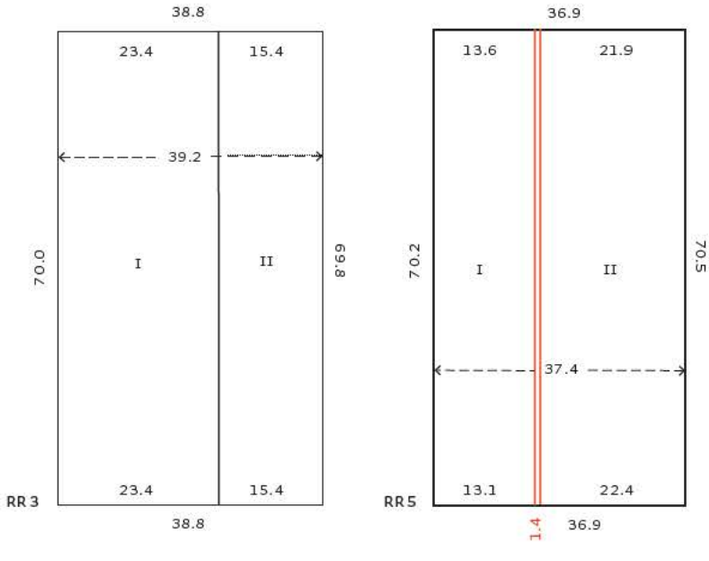
- ***Panel*** Dimensions: see construction diagram (fig. 22.1). Both panels are c. 1.2 cm thick in the centre and c. 0.5 cm at some of the edges. They were cropped on all sides.

  The wood species, Baltic oak, was identified through dendrochronology. Each of the two panels consists of two quarter-sawn planks, vertical in grain, laid vertically.

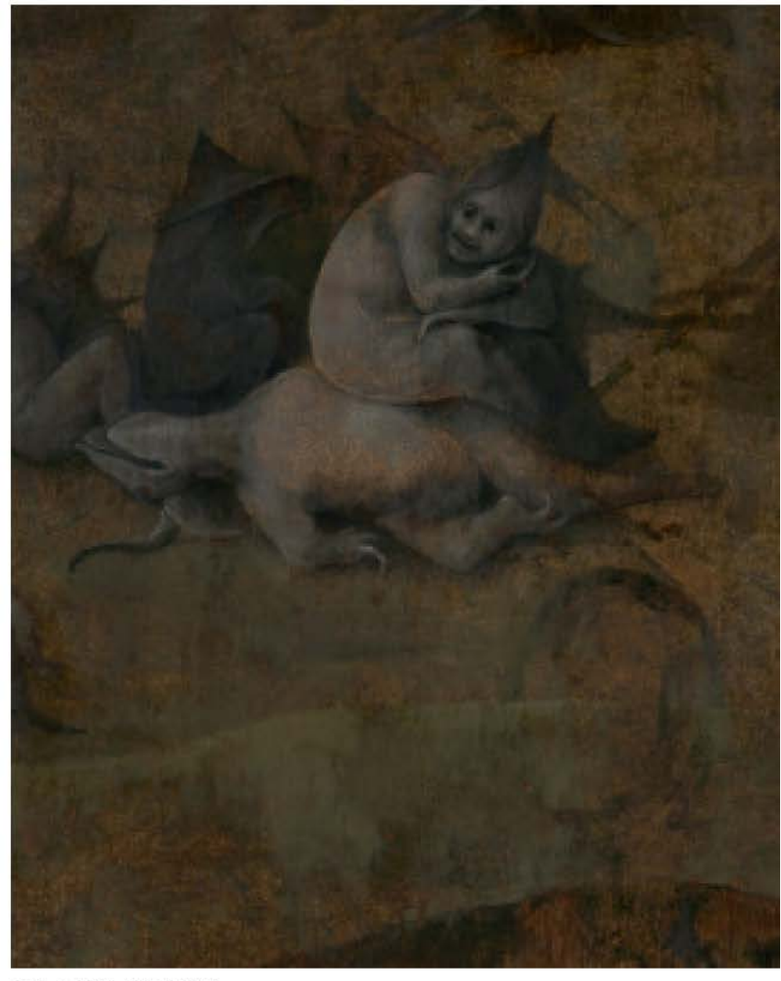
  The planks are butt-joined and glued; two dowel holes are visible in the XRS of RR 3 (at 16 and 58 cm from the top, respectively), and four (partial) dowel holes are visible in RR 5 (at c. 4, 16, 43 and 59 cm from the top, respectively). It remains unclear whether the dowels in RR 5 are original or belong to the old, narrow vertical insert.

- ***Bevelled or half-lap edges*** In *After the Flood* (RR 3), gradual, seemingly original bevelling is present on the left and right sides. In *After the Last Judgement* (RR 5), similarly gradual, apparently original bevelling appears on the bottom and left side. The sides of the roundels (RR 4 and 6) are almost flat.

- ***Dendrochronology*** Boards RR 3 (I) and RR 5 (II) came from the same tree, while boards RR 3 (II) and RR 5 (I) came from another single tree. The youngest heartwood ring dates from 1497, which, with the added minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1506 for the tree that supplied the wood for that plank.[4] An earliest felling date of 1508 is statistically more probable, however, since that would cover 93 per cent of the range of possibly missing sapwood rings. Assuming at least two more years for drying and transportation, the panel could have been produced from 1508 onwards, but a production date from 1510 onwards is statistically more probable.



22.1 Construction diagram for panels *After the Flood* [CAT 22A, RR 3] and *After the Last Judgement* [22B, RR 5]. The double red line in RR 5 indicates a narrow non-original insert.



22.2–3 RR 5, VIS and IRR

GROUND

- ***Visibility*** The off-white to cream-coloured ground, which seems to consist of chalk bound in animal glue (not analysed), is present overall.[5] It does not appear to be pigmented.

  The ground is visible in VIS. It is not completely covered by the paint layers, being discernible at contours and outer edges. The ground is also observable in losses. Visibility of the ground (or preparatory layer) was partly intentional, as it was meant to shimmer through in areas as part of the composition. However, the ageing of the paint has further increased the transparency.

- ***Barb and edges*** Ungrounded and unpainted edges of equal width are present on the *After the Flood* panel (RR 3, right side; RR 4, left side). Similarly, ungrounded and unpainted edges of equal width are present on the *After the Last Judgement* panel (RR 5, left side; RR 6, right side). The barbs on both panels, especially those on *After the Last Judgement*, are damaged. There seem to be traces of ground in the wood pores at the bottom right of the unpainted edge of RR 6, but these could be remains of previous treatments. As the presence of barbs and ungrounded edges indicates, the panels originally had engaged frames.

- ***Application*** The ground seems to have been applied using a brush and worked into a smooth finish. Brushmarks are not clearly discernible. The texture of the wood support is somewhat apparent, caused by responses of the wood to climate changes.

PREPARATORY LAYERS

- ***Underdrawing*** Extensive underdrawing is present overall and observable in IRR and VIS. The drawing was used to design and indicate the composition. It was also used for modelling of the larger figures in the roundels (as in the Christ figure, where parallel hatching indicates shadowed areas). The carbon-containing grisaille-like paint layers and underpainting affect the appearance of the underdrawing relatively strongly, since these paint layers also absorb infrared.

- ***Medium and application*** The detectable underdrawing appears applied in more than one stage. In the *After the Flood* (RR 3) and *After the Last Judgement* (RR 5), underdrawing was applied with a broad brush and a highly liquid medium, possibly ink, in generally intense black strokes. Other lines, possibly belonging to a second-stage underdrawing, are slightly narrower and less intensely black. These lines, which are visible only locally because dark paints often overlap them, should perhaps be considered a different compositional phase. Large sections of the first layout were abandoned, and in some areas the underdrawing of the first stage appears to have been reused or altered, for example in the figure sitting on the creature at the centre of *After the Last Judgement* (see figs. 22.2–3).

  In the underdrawings of the roundels (RR 4 and 6), on the other hand, no use was made of a large brush and intensely black ink. There are still two distinct compositional stages, but these seem to have been executed with a more similar medium and application technique. Brush and ink were used there as well, but the strokes resemble those of the second stage on the fronts (RR 3 and 5). The hatching was possibly applied in yet another, additional underdrawing stage.

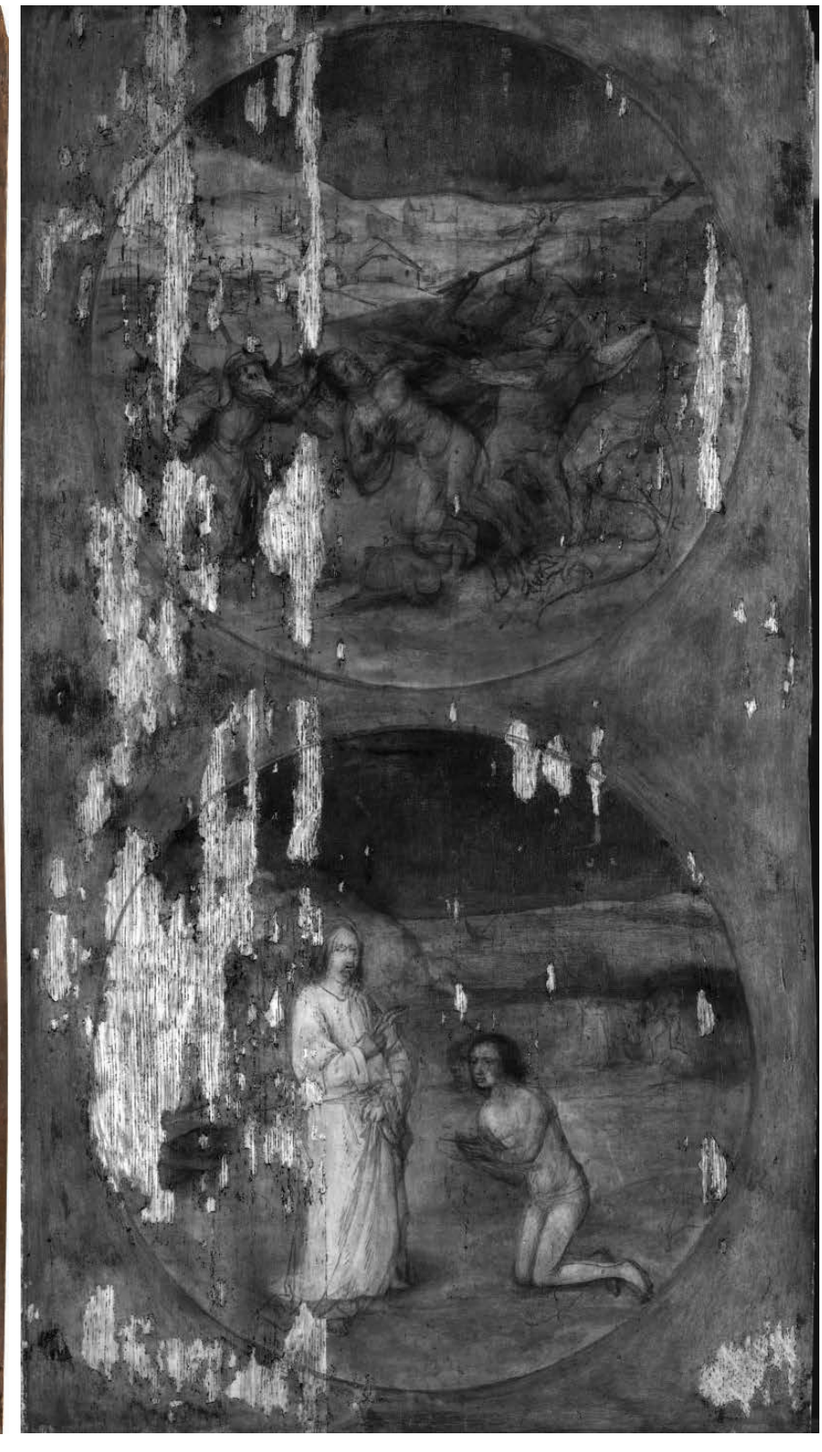
  In the centres of the roundels, small compass marks are identifiable.

- ***Style*** In *After the Flood* and *After the Last Judgement*, the first stage of underdrawing consists of broad, irregular and fairly short lines. These rough, expressive strokes depict or indicate the shapes of figures in the first composition. The main contours were drawn, in some instances with a few strokes added to indicate main folds. The second stage of the composition was executed in a distinctly different style, which might indicate production by another hand. More continuous lines are discernible that are slightly narrower, smoother and more definitive, often having tipped line endings. The style of both stages of the underdrawings in the roundels is quite similar to this, but here the underdrawing is more elaborate and detailed, just as the overall compositions in the roundels are more detailed than in the *After the Flood* and *After the Last Judgement*.

  Besides the larger alterations in composition, small changes were made as well, but reinforcements have not been observed. Some minor hatching was used in the initial drawing of the ark, but ample hatching that was used for modelling can be observed in the roundels. In the lower roundel of RR 4, folds in the robe of Christ were prepared with parallel hatching in short diagonal lines. In the roundel above that, hatching can be found in the legs of the man being beaten and in the large demon in the underdrawing at right. These all seem to relate to the first compositional stage. Hatching was done in several directions, but more often diagonally, from top right to bottom left, with relatively short lines, running roughly parallel. Line ends are usually straight, without hooks or loops, although the lines themselves can curve.

- ***Revisions in underdrawing and differences from painting stage(s)*** There are extensive changes in the underdrawings of these panels, many of which have already been observed and published earlier.[6] In addition, our examination has revealed more alterations, some of which are iconographically significant. In the *After the Flood* (RR 3), immediately below the painted and currently visible ark, a much larger ark was painted and in the same position a smaller ark was underdrawn.[7]

  In the initial composition the underdrawn ark floats in the water and the Flood was still in full swing. The monk-like figure in the lower left was also part of this first stage. He was underdrawn and left in reserve but never painted, and only shimmers through the paint surface. In the underdrawing he is crouching on something, where an animal was later painted drowned and belly up (see figs. 22.12–13). Just to the right of this figure, we see the head (also left in reserve) of a partially visible human being with an arm held high. To the right of this figure and behind him (where currently there is a hill) are at least five more underdrawn figures with their heads above the water, swimming, and perhaps waving their hands to be rescued. In the first underdrawing stage, at the foreground and the left edge there is a landmass. The man to the left of the monk-like figure makes more sense then, as he is not kneeling but attempting to reach higher ground. This figure was also partly left in reserve and another figure, just to his right, tries to do the same. At lower right, two adults are distinguishable, followed by a child with its hands held high, fleeing from the rising waters. The difference in underdrawing style makes this first composition quite readily separable from the later ones. In the second composition the Flood has receded and the ark stranded. It was painted larger on top of the underdrawn ark. From the open hatch, a ramp with animals disembarking as well as the whole foreground was painted. These animals are still visible in the final painting, but there they precede the group of beasts from

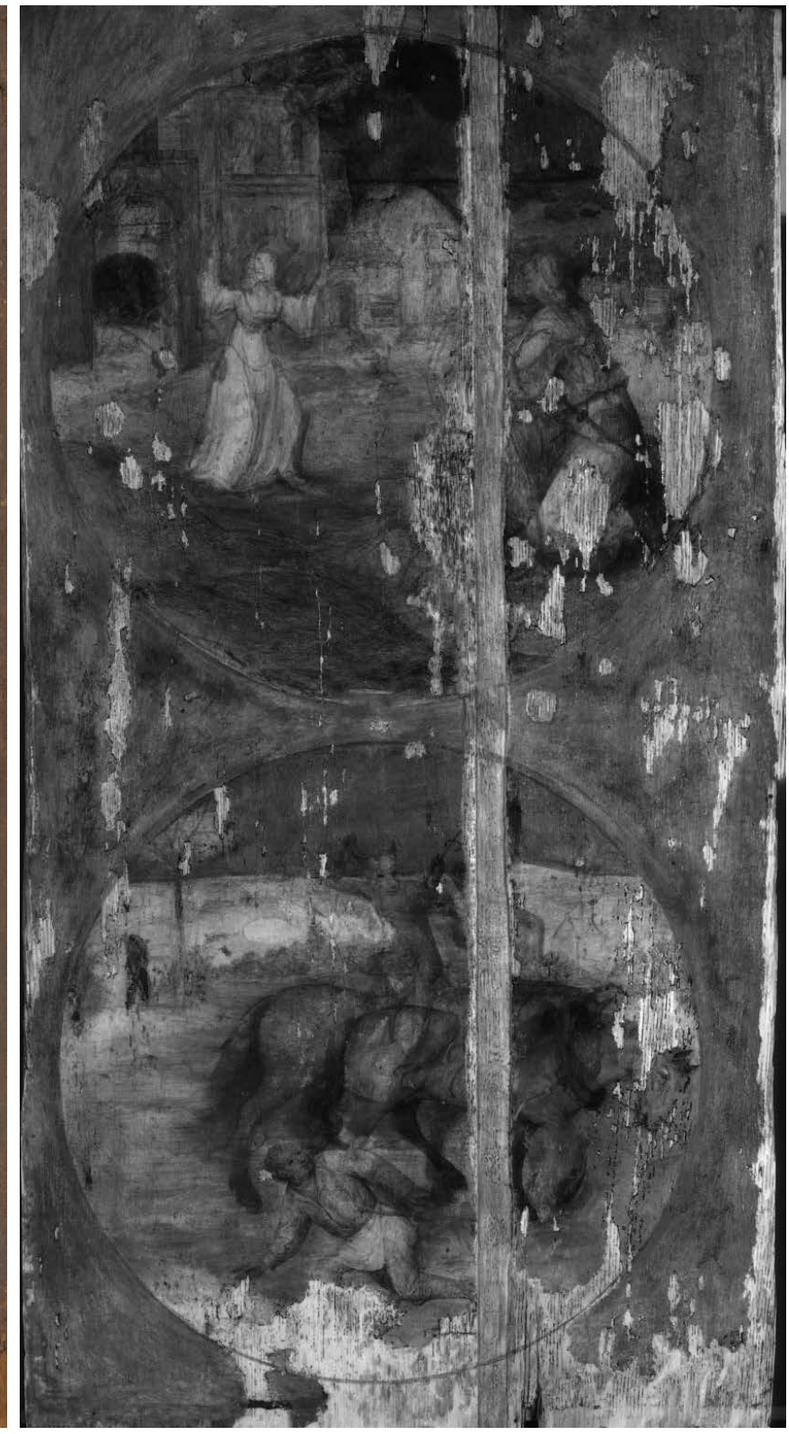


22.4–5 RR 4, VIS and IRR

the upper ark. The artist has thus reused them and added a hilltop where previously the ramp was painted. This device results in a more convincing continuation in the procession of animals towards dry land, which is littered with bodies of drowned people and animals after the Flood.

In *After the Last Judgement* (RR 5), a bird-like creature (not painted) is present in the centre, just left of the insert. In the lower right, a figure that was later changed into the one sitting on a dead monster was initially seated on a large barrel that had feet and a face. Around the back and head of the altered figure, a larger underdrawn shape is discernible.

Major changes are also notable in the roundels. In RR 4 (upper roundel), instead of the two demons on the right, initially just one much larger demon was underdrawn, with claw-like feet and a long tail. To the left of the man, who was slightly larger as well, the demon was underdrawn with a round hat and a snout rather than the currently visible beak. In the centre background, a large farmhouse was underdrawn, and further back, another building. In the lower roundel there were only smaller changes; for example, in Christ's hands, the positions of which were both changed. His right hand was further to the right (with two fingers that were left in reserve shimmering through) and the left hand was lower, the finger pointing downwards not underdrawn. Also, his right foot was drawn below the robe, which extended further down. The kneeling figure was directed more towards Christ, looking towards him with arms and head further extended. Christ was underdrawn facing more downwards – thus, initially there was more contact between the two.



22.6–7 RR 6, VIS and IRR

In RR 6 (upper roundel), the arc of the archway in the left background was prepared significantly higher, and a figure initially lay on the ground in front of the smaller, painted figures. The head of the woman was shifted a little, and she was wearing slightly different clothing. The man's head extended forward somewhat, and he may have been altered entirely or accompanied by another figure to his left, as underdrawing is visible to the left of the insert as well. In the lower roundel, more striking alterations are evident. Both the demon and the horse were shifted to the right in the final painting (see figs. 22.14–15). This was done at a later stage, since both horse and hellish rider were already underpainted. The underpainted demon's head, which resembles that of a fox, shimmers through the paint surface; the full figure is better visible in IRR/IRP. The shift to the right made it possible to include the harrow. It appears that this was already the second shift of this figure towards the right. A large shape resembling his outline was underdrawn and left in reserve to the left of the first painted position (06MCRIRP004). In the right background, the underdrawing of some buildings is discernible as well.

- ***Intermediate layers*** In some areas in the roundels, a thin, light layer containing lead white and carbon black was observed (04MICGBM001 and 06MICGBM005). This layer might be a pigmented isolating layer that was applied overall, but it could not be identified with certainty in the *After the Flood* and *After the Last Judgement*. The XRS do show broad brushstrokes in a layer that contains lead white and is not related to the final composition. The sample reports by J.R.J. van Asperen de Boer (see above, *Previous research* ...) also indicate that on top of the ground there is a thin, white layer containing black and/

22.8–9 RR 3, VIS and IRR

or brownish pigments. The underdrawing was continued with some form of underpainting as well, blocking in parts of the composition and leaving other forms in reserve (see below, *Build-up and palette*).

PAINT LAYERS

- ***Paint application and painting technique*** The brush-applied oil paint (not analysed) extends onto the remaining barb. It was often applied in one or two stages for *After the Last Judgement* and *After the Flood*, whereas for the roundels, several paint stages were identified. Details, highlights, reinforcements and dark areas were applied in additional stages. Wet-in-wet paint application was used for many of the grisaille-like figures in both panels.

  Paint application was quite thin, often utilizing the background colour, both of the underpainting and especially where figures were left in reserve. This is mostly the case for the midtones, which were followed by shading and highlights. The predominantly wet and glossy paints were applied in both opaque and semi-transparent layers. The latter was usually achieved with semi-transparent pigments rather than an actual glaze layer, which is only visible in a few instances. In general, the panels are painted in a somewhat sketchlike manner, which relates to the quick wet-in-wet execution of most grisaille figures in both panels and the backgrounds. The demons in the sky of *After the Last Judgement* were first modelled using a thin, dark brown paint,

22.10–11 RR 5, VIS and IRR

sometimes followed by a few touches of a greyish paint for final modelling.

More attention was paid to the main parts of the composition, but these still were not worked out to a high degree of finish, leaving some areas barely covered. A fleeing demon in the sky of the lower roundel (RR 4) was painted very subtly and thinly. The slightly visible brushstrokes follow the forms in the composition, rendering contour and volume throughout the painting. For larger areas, paint was applied with more random brushstrokes (although the imitation stone in the background follows the shape of the roundel). In *After the Last Judgement*, bright red paint dots (apparently original) are randomly spread over the entire paint surface (05MICGBM007–009). These could have been splattered on the surface purposely, perhaps to indicate glowing ash particles from the fire, but they could also have been applied accidentally.

- ***Texture*** Most passages have a smooth finish, and brushstrokes are hardly visible. There are some slightly impastoed highlights.
- ***Build-up and palette*** On top of the underdrawing and the pigmented isolating layer, underpainting was applied, blocking in parts of the composition. This was done in two ways: by leaving select areas in reserve, applying paint around them,[8] and by underpainting certain areas, leaving the background open. It seems that this approach was a result of multiple compositional stages and is exemplified by the demon on horseback. After the first underdrawing stage (with the demon in the upper centre of the panel, possibly without

22.12–13 RR 3, VIS and IRR

22.14–15 RR 6, VIS and IRR

horse), this area was left in reserve. In the second phase, the demon was positioned further to the right and both demon and horse were underpainted, leaving the background open. In a third phase, the demon and horse were moved even further to the right, to their current position, and were both underpainted and painted. The harrow was painted last and the previous two compositional phases were painted out.

Paint was primarily applied from dark to light and from background to foreground, while making use of background colour, whether a local underpainting or (in areas left in reserve) the pigmented isolating layer on the ground. Shading and highlights were applied afterwards. The generally muted colouring (mostly greyish, brownish and greenish paint mixtures, as in the two figures in the archway at centre left in *After the Last Judgement* and in its foreground landscape) is interrupted by more brightly coloured accents: bright reds for fires and blues for figures, both with lead-tin yellow highlights (see fig. 22.16 for the devilish figure in the archway in the top roundel). Additional muted blues were used quite extensively and subtly for the other figures in the roundels, but also for the partially remaining head of the demon on horseback (06MICGBM008). Warmer tones can be found on sides RR 4 and RR 6 in the imitation stone background, which was executed before the roundels. This was painted with a mixture of lead white, red lake, carbon black and small amounts of yellow ochre and blue pigments (06MICGBM006–007).

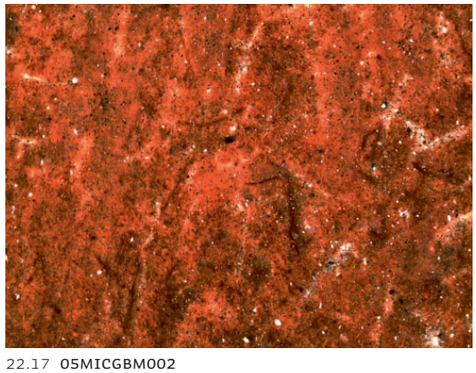
22.16 RR 6, VIS

The appearance of the sky in *After the Flood* was created by using an optical effect. An underlying dark layer, containing more black pigment closer to the top edge, was followed by a light grey layer containing mostly lead white and some black pigments (03MICGBM001). The dark paint shimmering through the thin, whitish layer creates a slightly bluish impression.

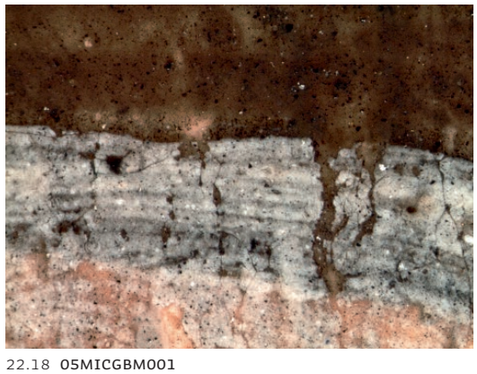
In *After the Last Judgement*, the bright vermilion (not analysed) of the fire was applied over a dark brown background, whereas higher up, it covers a lighter background colour. The reddish brown glow of the smoke above it contains many reddish fibres of wool shavings, revealing the origin of the red lake (see, e.g., fig. 22.17 and 05MICGBM003–004).[9] Also, the darker part below the fire seems to contain red lake but is otherwise left in reserve by the fire. The small, hooded figure in the centre, squatting on a branch, was painted over the darker background and water. The figure with the lute in the lower left is one of the few left in reserve. The lute itself is thinly painted in white (with black particles) over the ground and a pigmented isolating layer, and the lute overlaps the brown background colour (see fig. 22.18).

In the roundels, the dark grey-blue skies have an interesting build-up. In two separate steps, first a blue layer containing white pigment particles was applied, then a dark greyish layer, also containing white pigment particles (06MICGBM003–004). The superimposition of the dark layer on top of the blue results in the deep, dark grey-blue appearance of the sky. The landscape colour was applied more thickly to cover up the pentimenti (e.g. the lower arm of the attacked figure). There it retains more of its original greenish colour than the discoloured brownish tones we now see in many of the areas that were green.

- ***Changes*** Besides the changes in underdrawing already mentioned, there are several discernible pentimenti in the paint layer (see also *Revisions* … above). These are visible with the naked eye, with IRR/IRP and in the XRS. In *After the Flood*, the first underdrawing was followed by an underpainting (both of which shimmer through), but the first composition was completely abandoned in the final paint phase. The second composition, with a larger painted ark, appears to have been largely completed. In the final composition the ark was reduced in size and repositioned upwards. Painting additional animals disembarking from the relocated ark extended their procession (fig. 22.9). Also, some elements in the final painted composition do not seem to have an underdrawing. In part, this is also the case in *After the Last Judgement*. In addition to the change mentioned above in the figure on the barrel, just to its right, the head of the demon was reduced in size. Other minor pentimenti are detectable in the roundels – in the attacked figure in RR 4, and in the head of the kneeling figure in RR 6. The demon on horseback was greatly altered in both the underdrawing and underpainting phases (see above).



22.17 05MICGBM002



22.18 05MICGBM001

FRAME

The original, engaged frames have been lost. The panels are currently displayed without frame.

CONDITION

Support

- ***Altered dimensions*** The original panels were reduced in size on all four sides – *After the Flood* less on the right side, *After the Last Judgement* less on the left – damaging the edges of the paintings to a large extent. RR 5 is also missing a small piece in the bottom centre (flanked by two small holes on the reverse) and RR 3 has an incomplete top left corner. It had been suggested that, based on the deviation in thickness, the top third of the panel (an entire roundel) might be missing, but that does not seem to be the case.[10] Although a substantial strip on the top is missing (the top demons having been cropped from RR 5), the thickness seems to indicate a loss of roughly 5 cm or slightly more.[11] Nevertheless, the fact that the paintings were even taller is important for any discussion of their assumed original format as wings of a triptych or polyptych, since that would affect the dimensions of such a work's central panel.
- ***Additions*** In cat. 22B, RR 5–6, a 1.4 cm-wide wooden insert was added that runs the entire length and thickness of the panel. This was done during the 1982–85 treatment, replacing an earlier strip of plaster and twine that, together with iron and wooden plugs, was damaging the panel.[12]
- ***Cracks*** Two old cracks, extending about 10 and 6 cm, respectively, run from the wood loss at the bottom centre of *After the Last Judgement* and are slightly open on the reverse.
- ***Deformations*** The panels have a very slight angular deformation but are otherwise very stable, partly due to their having been 'sealed' on both sides with paint.
- ***Joins*** At the bottom centre of *After the Flood*, the join between the two planks is visible. On the reverse it extends about 12 cm from the bottom edge, with some adjacent paint losses.

Ground and paint layers

- ***Stability*** The ground and paint layers seem to be stable now, but many old losses are visible. It seems that the losses were caused by a poor adhesion of the ground to the panel. They may be related to the previous cracking or separation of part of the panel (see above). Currently there are some areas of slightly raised paint, caused by the expansion and contraction of the support.
- ***Losses*** Added to several smaller losses, there are large losses to ground and paint, leaving the oak panel bare: in RR 3 at the top edge; in RR 4 over the entire left plank and along the right side; in RR 5 at the top left and, to a large extent, in the bottom quarter; and in RR 6, along the left side, with greater concentration at the bottom, and in the entire right

22.19 RR3, VIS

plank. In RR 5/6 there is also the added and only partially retouched wooden insert. For the 1982–85 restoration, a rather archaeological approach was selected and variable manners of reintegration were applied. As a result, in the roundel panels the emphasis is shifted largely to the areas of loss rather than to original paint surfaces.

- ***Abrasion*** The painted surfaces were abraded in the past, with *After the Flood* being the least damaged. Remaining original barbs are damaged as well.
- ***Discoloration and increased transparency*** Noticeable changes have occurred throughout the paintings. Mainly, the original greenish colours of the landscapes have discoloured to a more brownish tone. Changes in refractive index due to ageing of the paint films have led to a general increase in transparency, which is aggravated by the already thin paint layers. Many parts of the underlying layers currently shimmer through. An increase in transparency can be found in the lighter paints that contain lead white, which causes the increased visibility of underdrawing.
- ***Filling, retouching and overpainting*** There are many old losses that are only partially filled and/or inpainted. In *After the Flood* and *After the Last Judgement*, many retouchings can be found spread over the surface, and of course on the central insert. In and around the roundels, there is only minor inpainting. Aside from the toning of exposed ground and some other small retouchings, only the circle around the roundels was completed. It is quite curious and distracting to see several different approaches to inpainting on these two panels. Some losses are toned, some filled and retouched, some retouched to a high level, and some not filled and/or retouched at all. Many of the retouchings have also discoloured over time and are clearly discernible now.

Surface finish

- ***Varnish*** The modern varnish, which appears to be of a natural resin, is very glossy and somewhat yellowed, with embedded or attached pigments, gold leaf particles and some dirt. Minor residues of glue can also be found along some of the edges. There are, however, several older brownish residues that can be distinguished on the surfaces of the paintings. The appearance of the varnish is relatively even, although superficial scratches are visible. The saturation of the paint surface is quite good, except on *After the Last Judgement* and in some minor matte spots.
- ***Surface dirt*** There is hardly any surface dirt on the painting.
- ***Visibility of the original surface*** The glossy, somewhat yellowed varnish and brownish residues cause a slightly reduced legibility of the original paint surface. The irregular retouching (see above) results in contradictory experiences of the state of the paintings, and the discoloured retouches (mostly on *After the Last Judgement*) distract from the original.

[1] René Hoppenbrouwers of Stichting Restauratie Atelier Limburg (SRAL) also participated in the examination and documentation.

[2] Hermesdorf 1990, 134–47.

[3] The BRCP is very grateful to Stefanie Litjens for the thorough examination of the documents in the Hermesdorf archive.

[4] The youngest or last-preserved ring on each of the four planks, respectively, dates from 1491 (RR 3 I), 1404 (RR 3 II), 1393 (RR 5 I), and 1497 (RR 5 II) ; see Klein 2001, 126–27. Since board RR 3 I came from the same tree as board RR 5 II, the outcome of the latter is valid for both. Analysis done by Peter Klein, 29 December 1983. As a result of improvements to the reference chronology for Baltic oak in 1985, Klein revised the 1983 dates, which had each been stated as six years earlier. See Klein's report in the museum files. The slight cropping of the edges does not influence the outcome of the dendrochronological measurements, since the younger outsides of the boards are joined together.

[5] The ground-like material present on the side edges of the panel is not original (05MICGBM010).

[6] Lammertse 1994, 99–101.

[7] The conservation report by Hermesdorf also mentions another ark, which was seen in the stereo XRS.

[8] The IRRs reveal which areas were left in reserve (mostly light-coloured figures and light areas of landscape), but these were often modified during the paint application phase.

[9] For more information and literature on the production of red lakes, see Wallert 1991, 74–83; and Hofenk de Graaff, Roelofs and Van Bommel 2004, 344–52.

[10] Hermesdorf 1990, 137 and n. 23.

[11] Ascertained with Friso Lammertse, curator of Old Master Paintings, Museum Boijmans Van Beuningen.

[12] Hermesdorf 1990, 144.

23

Job Triptych

BRIEF RESEARCH REPORT 63–68[1]

Workshop of Hieronymus Bosch
c. 1510–20

Oil (not analysed) on oak (analysed) panel, left wing (RR 65): 98.1 × 30.5 × 0.7 cm; central panel (RR 66): 98.3 × 72.1 × 0.7 cm; right wing (RR 67): 97.8 × 30.2 × 0.6 cm.[2]
The engaged frame and its hinges are original.
Dimensions of frame: left wing: 112.5 × 43.8 cm; thickness c. 3.5–4 cm; central panel: 112.7 × 87.8 cm; thickness c. 5 cm; right wing: 112.4 × 43.9 cm; thickness c. 3.5–4 cm.

Stad Brugge, Groeningemuseum, Bruges (on loan from the Church of Saint James the Greater, Hoeke), 0000.GR00209.I

BRCP, *Catalogue Raisonné*, cat. 23; www.boschproject.org no. 23.

Inscriptions and labels
Central panel reverse, centre right: a transportation mark; centre: possibly a large *LF* in a darker colour.

RR 63

RR 64

RR 65

SUMMARY OF CONCLUSIONS

The three panels with Saint Anthony, Job and Saint Jerome that that form the interior of the Job Triptych *in Bruges can be placed within the Bosch workshop. The style and method of the phased underdrawings, as well as the painting technique, can be linked to other works that were produced in the workshop, and traces of the creative process can be observed in the subsequent stages of production. The exteriors of the wings were only coated with a monochrome black paint at the time the triptych left the workshop. The imitation stone and the escutcheons with coats of arms were painted later, presumably in Antwerp, atop the black layer.*
The triptych is still housed in its original frame, and the positions of the hinges have not been altered. Dendrochronology indicates that the panels could have been painted from 1508 onwards, although a date after 1510 is statistically more probable. As further explained in BRCP, Catalogue Raisonné, *cat. 23, we date this work to around 1510–20.*

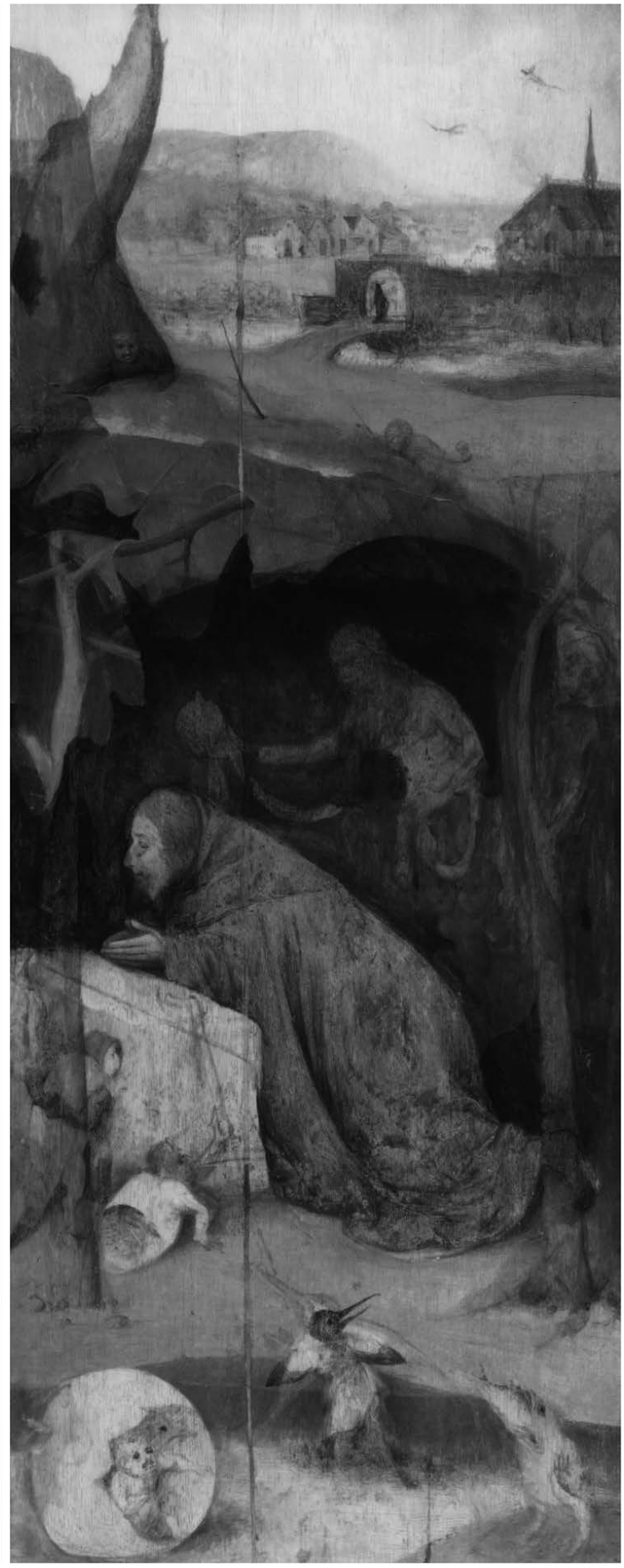
ADDITIONAL INFORMATION

The Groeningemuseum holds a file with information on the painting. There was a preliminary research report done on the painting in 2002 and an extensive examination and treatment report in 2005, both by KIK-IRPA, Brussels, as well as a 2005 dendrochronology report by Pascale Fraiture.

Dendrochronology indicates that the youngest growth ring dates from 1504 which, considering that the panel still has seven sapwood rings while the minimum number of sapwood rings for Baltic oak is nine, implies an earliest possible felling date of 1506 for the tree that supplied the wood for that plank.[3] An earliest felling date of 1508 is statistically more probable, however, since that would cover 93 per cent of the range of possibly missing sapwood rings. Assuming at least two more years for drying and transportation, the triptych could have been produced from 1508 onwards, but a production date from 1510 onwards is statistically more probable.

RR 66

RR 67



23.1–2 RR 65, VIS and IRR

23.3–4 RR 67, VIS and IRR

23.5–6 RR 66, VIS and IRR

RR 68

OBSERVATIONS

Support

On the reverse of the central panel (RR 68), half-lap edges and traces of splitting can be seen. The latter areas have darkened due to tannin in the oak migrating to the surface. A possible lumber mark is present at centre right.[4]

Preparatory layers

Underdrawing is present throughout. Little underdrawing shimmers through the paint, but it is well revealed through infrared photography and reflectography. As illustrated by IRP/IRR, the preparatory drawing shows a remarkable number of changes compared to the painted composition. The brush-applied underdrawing was carried out in multiple stages and with different-sized brushes. The broadest, rather rough strokes are visible in IRR in the upper right background of the right wing. Hatching, such as in the neck of Saint Jerome, is applied only rarely.

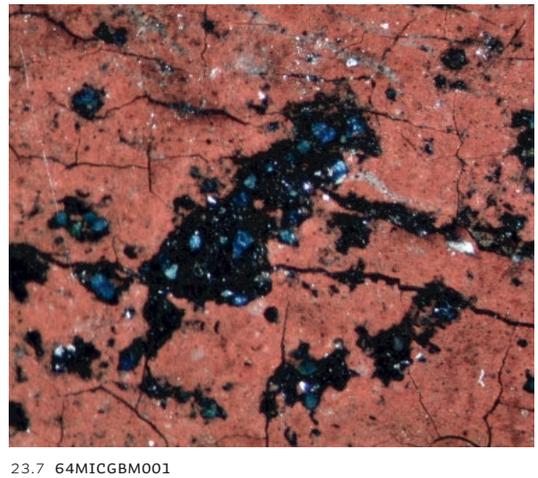
Paint layers

63 and 64 In the closed triptych paint cross-sections reveal a double black layer covering the ground, followed by an organic, fluorescing intermediate layer (probably a varnish), and then the paint of the coats of arms.[5] The marbling, applied mostly wet-in-wet, extends onto the barb but does not continue under the coats of arms, indicating that both were planned at the same time. Given the intermediate layer, the coats of arms and the marbling were most likely added later. The damage pattern on the closed wings also supports this, since paint losses often do not include the black base layers, pointing to possible interlayer adhesion problems.

On top of the black paint but below the red of the marbling, remains of blue pigment and gold leaf were observed (fig. 23.7). These remnants can be found all over both surfaces, but especially in the lower sections and on the right wing (RR 64).

65–67 Numerous changes in paint are also discernible in the open triptych, predominantly in the left wing and the central panel. For example, the initial composition of the left wing, in which Saint Anthony was positioned in a hut with a large figure painted behind him, was largely overpainted (fig. 23.1–2). A steep hill (?) was painted in the far left of the left wing. This form, visible in IRR/IRP, was initially left in reserve from the sky, but later painted out. It can be seen shimmering through the light blue paint. It may have been painted out because of the tall hollow plant-like tree that was executed atop. Strikingly similar alterations are visible in the far left of the right wing, where the hill at the right was added atop the background landscape (figs. 23.3–4).

The right-hand group of figures in the wall opening in the central panel was altered to some extent. The brown-grey skin tone of the left-hand figure in that group has a red lake paint underneath. The demon leading the group initially had light blue wings and a light blue hood. Its head was planned more in profile, with a black dot discernible in the underdrawing (between the currently visible eyes), indicating the earlier position of the eye. The wings were overpainted with the wall, and the hood with the colour of the head. The bagpipe just above the demon seems to have been added at that point. The highest points of the original overpaint became abraded, revealing the underlying blue paint.



23.7 64MICGBM001

23.8 RR63, VIS

CONDITION

The panel reverse was thinned at the two joins to adhere the wooden reinforcing blocks. Woodworm damage is quite extensive, mostly around the left and right edges of the panel.

The coats of arms on the closed triptych were later reinforced with paint. In the lower left corner of Pieter van der Voirt's coat of arms (to the left on RR 63), a damage reveals the underlying original paint. Also, underlying black paint of larger and higher-positioned mill-irons can be seen shimmering through the white repainting, which are better revealed with IRR/IRP. The red Saint Andrew's cross in the coat of arms of Maria Smaechs (to the right on RR 63) was also repainted and repositioned somewhat (fig. 23.8). Atop the ground and the black layer, original red paint was applied but subsequently covered by non-original white paint and followed by a bright red cross. The dark brown-black paint covering the barb and partially overlapping the unpainted edges is not original. This overpainting was partly cleaned at some point. It is also visible in losses, where residues remain in difficult-to-reach areas.

The opened triptych has far fewer losses but abraded paint surfaces. Older overpaints were partly left in place or thinned during the 2002–05 conservation treatment. In some areas these somewhat conceal the compositional changes that have become apparent due to ageing and the increased transparency of paint films.

23.9 **RR 65, VIS**

[1] For a variety of practical reasons, some of our research reports were produced in an abbreviated format, which resulted in a slightly different lay out. This concerns seven reports: cat. 3 (RR 155–156); cat. 23 (RR 63–68); cat. 26A–B and 26C (RR 59–62 and RR 109–110); cat. 32 (RR 87–88), cat. S2 (RR 111–112); and cat. S3 (RR 113–114).

[2] The measurements listed in Janssens de Bisthoven 1981, 55, were used.

[3] This is based on Fraiture's measurements of a wing panel. Peter Klein had earlier examined the central panel, where he established a youngest growth ring of 1490, which results in an earliest possible felling date of 1499. See Klein 2001, 126.

[4] Verougstraete 2015, 16–17.

[5] Marie-Annelle Mouffe and Claire Mehagnoul, 'Studieverslag en verslag van de uitgevoerde behandeling *Triptiek van het Geduld van Job*', Brussels (KIK-IRPA) 2005, 53. This unpublished report is on file at the Groeningemuseum, Bruges.

Ecce Homo Triptych

Workshop of Hieronymus Bosch
c. 1495–1505

Oil (not analysed) on oak (analysed) panel. Except for the predella, the panels were measured within their frames (visible size). Open left wing (RR 79): 69.3 × 26.0 cm; central panel (RR 80): 73.4 × 58.4 cm; open right wing (RR 81): 69.2 × 26.0 cm; predella (RR 83): 15.5 × 68.4 cm (panel size). The original format of the ensemble is disputed.[1]
Museum of Fine Arts, Boston, 56.171.1a–b, 53.2027, 56.171.2a–b; predella: 56.172

BRCP, *Catalogue Raisonné*, cat. 24; www.boschproject.org no. 24.

Inscriptions and labels
At bottom left in RR 79 is a coat of arms, referring to Peter van Os, while in the open right wing appears the coat of arms of the Van Langel family.[2]
The sign on the cross in the predella (RR 83) bears the *INRI* inscription.[3]
On the reverse of the central panel (RR 82) *11702* (?) is stamped in black at top left, and *886JH* (i.e. Christie's stock number, 1948) at top right. In the top right corner, *53.2027* is applied in red paint on the wax that is present on a large section of the panel reverse. Below that, partly covered with wax, are diagonally placed words, handwritten in pencil: *Produce* [sic] *of / Holland*. At bottom left, a round, possibly Dutch export stamp was applied in black, turned 90 degrees counterclockwise. The stamp has a coat of

RR 77 RR 78

RR 79

arms and royal crest in the centre, with an illegible text at the top (at right) and SCHIPHOL bottom left. In the predella reverse, top right, is the inventory number 56.172 in red paint; at centre right is a label with *Museum of Fine Arts / Flemish School, 16th Cent. / 56.172*; and in the centre a partly legible diagonal text, XRAD[IOGRAPH]Y, in blue chalk.
On the frame, central panel (top centre left): a J. CHENUE / PACKER label with names referring to the 1953 sale; (top centre): a largely illegible handwritten label with the name of the owner in 1888, F. W. Harris; (top right): 52.2027 in red paint; (centre right): a partly legible text in pencil, *Produce* [sic] *of / Holland*.

SUMMARY OF CONCLUSIONS

The Ecce Homo Triptych *in Boston is firmly linked to the Bosch workshop. The composition of the central panel is closely related to Bosch's* Ecce Homo *in Frankfurt, while aspects of the wings can be linked to the wings of the* Adoration of the Magi *in the Prado (cat. 9; RR 134–139). Three different painters produced the central panel, the wings, and the predella, and we found at least three different underdrawing styles in the triptych. No underdrawing was observed in the predella panel with the* Instruments of the Passion, *which also has a different layer build-up and painting technique. The underdrawings of the central panel and those on the interiors of the wings can be linked in style and method to other works in the*

RR 80

RR 81

RR 83

group with relative ease. The style of the underdrawings of the exterior wings, on the other hand, differs markedly from any other underdrawing within the oeuvre known to date.

The central panel and the wings are housed in their original, engaged frames, but their dimensions only match in width, not in height. The central panel is significantly taller than the wings, and the profile of its frame also differs slightly. One possible explanation for this discrepancy is that the central panel might have been outfitted with a (now-lost) protruding upper frame member, under which the wings could have closed.

The central panel with the Ecce Homo *might have already existed when Petrus van Os and his wife, Henrickxen van Langel, commissioned the triptych, which must have happened after their marriage in 1498–99. Such a phased production would fit well with the idea that the triptych was produced by multiple hands, and also with the dendrochronological dating of the central panel, which could have been painted from 1489 onwards, although a date from 1491 onwards is statistically more likely. For the predella, these dates are 1485 and 1487, respectively. As further explained in* BRCP, Catalogue Raisonné, *cat. 24, we date the triptych to around 1495–1505.*

RR 82

RR 84

RELATED WORK

The central panel of this triptych was for the most part copied after the *Ecce Homo* in the collection of the Städel Museum in Frankfurt am Main (cat. 11; RR 49–50).

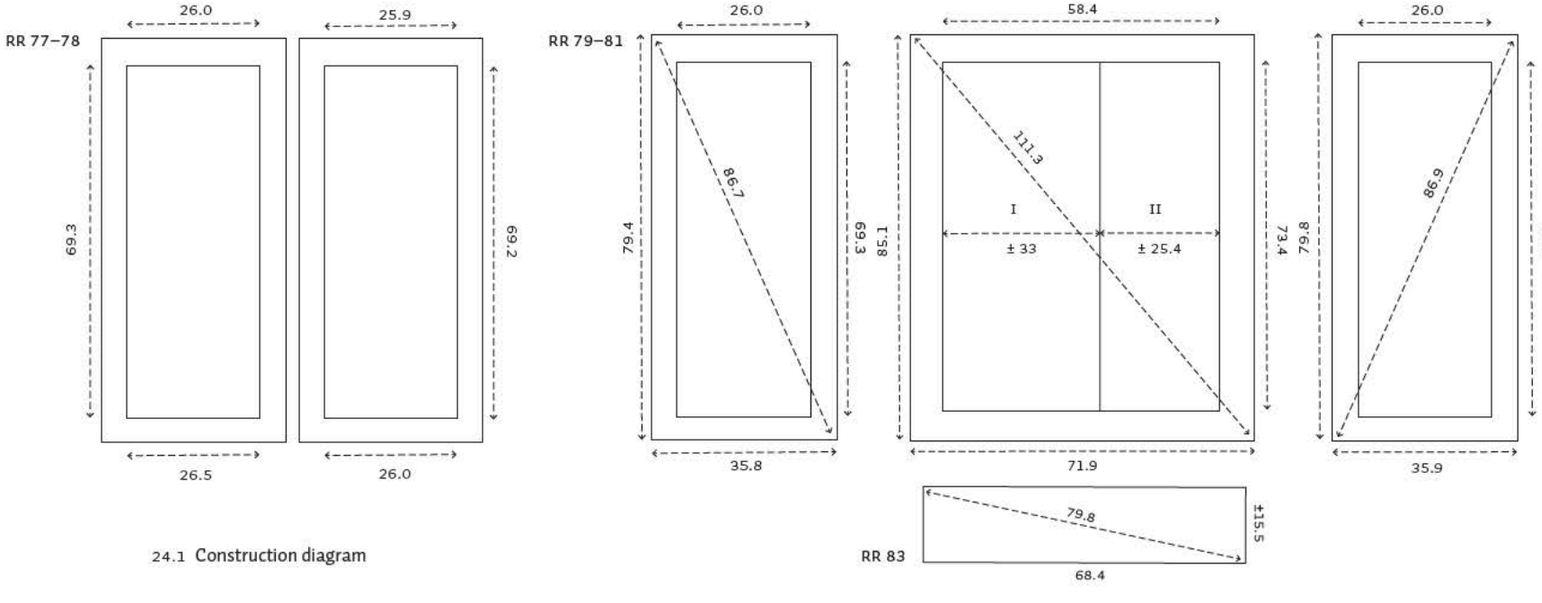
EXAMINATION DATA

25–28 September 2012 (Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Ron Spronk).

The triptych was examined in its original frame in an empty gallery space. The wings were separated and the panels were studied upright on an easel and flat on a table under strong illumination. Both front and reverse were accessible, with the exception of the panel edges that were blocked from view by the engaged frame.

The predella panel was studied unframed.

- ***Previous research and additional documentation available*** Nearly complete XR assemblies, IRR details and information and images from previous treatments were available for study. See also Swarzenski 1955; Eisler 1961.



24.1 Construction diagram

- ***Previous treatments*** The panel was treated in London around 1950 by Sebastian Isepp.[4] The conservation sheet of the central panel mentions consolidation treatments in Boston by Finlayson in September 1953, April–May 1954 and April 1962.[5] The paint on either side of both the left and the right wing was consolidated in November 1956, followed by a full treatment in May–June 1957, although overpainting in the robes was left in place at that time. The predella panel underwent similar treatment. The triptych was fully treated again in 2001, except for the open right wing (RR 81), which was only surface-cleaned and varnished.[6]

SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 24.1).

  The wood species, Baltic oak, was identified through dendrochronology. The central panel (RR 80) consists of two (not three) vertical planks.[7] The central panel is currently not positioned straight within its engaged frame, but is slanting clockwise.[8] Each wing consists of a single vertical plank, and the predella of a single horizontal plank. In the centre of the closed wings, the composition continues over the vertical framing elements (see also below, FRAME).

  All the planks were quarter-sawn. Those of the central panel and the wings are vertical in grain, while the predella plank has a horizontal grain. The two planks of the central panel were dowelled, butt-joined and glued.

  The wings are painted on both sides. The central panel reverse was worked into a relatively flat, smooth surface. The original reverse of the predella has been preserved. No tool marks were observed for the central panel. Traces of (scrub-)planing can be found on the reverse of the predella panel.

- ***Bevelled or half-lap edges*** Bevelling was not observed in the panels. The entire circumference of the central panel reverse and the bottom and side edges of the predella panel seem to have been worked to a half-lap edge or tongue, probably to facilitate insertion of the panel into the groove of the engaged frame. The half-lap edges have approximately the same width as the corresponding unpainted edges of the painted side. Half-lap edges were not observed in the wing panels, since these were painted on both sides.

- ***Dendrochronology*** Two of the four panels were analysed: the central panel with the *Ecce Homo* (RR 80) and the predella with the *Instruments of the Passion* (RR 83).

  The youngest heartwood ring for the central panel dates from 1478.[9] With the added minimum of nine sapwood rings for Baltic oak, this implies an earliest possible felling date of 1487 for the tree that provided the wood for this plank. An earliest felling date of 1489 is statistically more probable, however, since that would cover 93 per cent of the range of possibly missing sapwood rings. Assuming at least two more years for drying and transportation, the panel could have been produced from 1489 onwards, but a production date from 1491 onwards is statistically more probable.

  The youngest heartwood ring for the predella dates from 1474.[10] The method of calculation given above produces an earliest possible felling date of 1483, while 1485 is statistically more probable. Adding at least two more years for drying and transportation, the panel could have been produced from 1485 onwards, but was more likely produced from 1487 onwards.

GROUND

- ***Visibility*** The off-white ground (not analysed) probably consists of chalk bound in animal glue and is present overall.

  The paint layers generally cover the ground layer. Locally the ground can be observed in VIS in losses and along panel edges. Visibility of the ground tone shimmering through very slightly in places appears unintended, given the general use of opaque paints and their fairly thick application. The ageing of paint layers has likely increased their transparency, and thus the visibility of the underlying layers – for example, in the bluish sleeve of Mary Magdalene in RR 78, and locally in her face, revealing underdrawing.

- ***Barb and edges*** Sections, traces or other remnants of barbs and unpainted and ungrounded edges are present on all edges of each panel, confirming that all panels originally had engaged frames.

  The barbs, however, have been damaged; for example, in the predella only some of their remains are visible on the top and bottom edges. Shrinkage of the other panels has exposed large parts of the ungrounded edges. Not all edges were fully accessible owing to the presence of the original engaged frames.

- ***Application*** The ground seems to have been worked into a fairly smooth finish. In the predella panel, the ground was applied notably thinner. Here the surface texture of the wood support is also much more apparent.

PREPARATORY LAYERS

- ***Underdrawing*** In the closed triptych wings (RR 77 and 78), ample underdrawing was observed that prepares the contours of the main forms of the figures. The architectural setting was also prepared with a few contour lines, but the brocade pattern was apparently not underdrawn, at least not with a carbon-containing material. In a few areas, underdrawing shimmers through the paint surface in VIS;[11] for example, at the white frock of the young monk in the left wing (RR 77), who has been identified as Jan van Langel, a Cistercian monk. IRR reveals underdrawing very well, except beneath the black gowns, obviously. In the robes of the saints, and especially that of John the Evangelist, substantial modelling through areas of parallel hatching was revealed. In the red robes, underdrawing apparently indicated those areas where lead-white underpainting was not to be applied, and a similar use of drawing was noted for the undermodelling of some sections with green glazes. Hatching was also employed to indicate shadows, as under the left arm of Lysbeth van Langel, the donatrix's eldest daughter, who was a regular canoness at the Bethany monastery.

  Underdrawing was also observed with IRR in the open triptych (RR 79, 80 and 81), but quite a bit less clearly than in the exterior. Underdrawing prepared the contours for the figures there, but modelling through hatching was not detected; in some locations there are wash-like areas instead. In the central panel (RR 80), the underdrawing is even harder to distinguish because of the relatively poor condition of the paint surface there (see below, *Losses* and *Abrasion*).

  In the thinly painted predella panel (RR 83), no underdrawing was discerned with either IRR/IRP or VIS.

- ***Medium and application*** It appears that the detectable underdrawing was applied with the brush in a liquid medium, possibly ink (not analysed), as the lines are rather even.

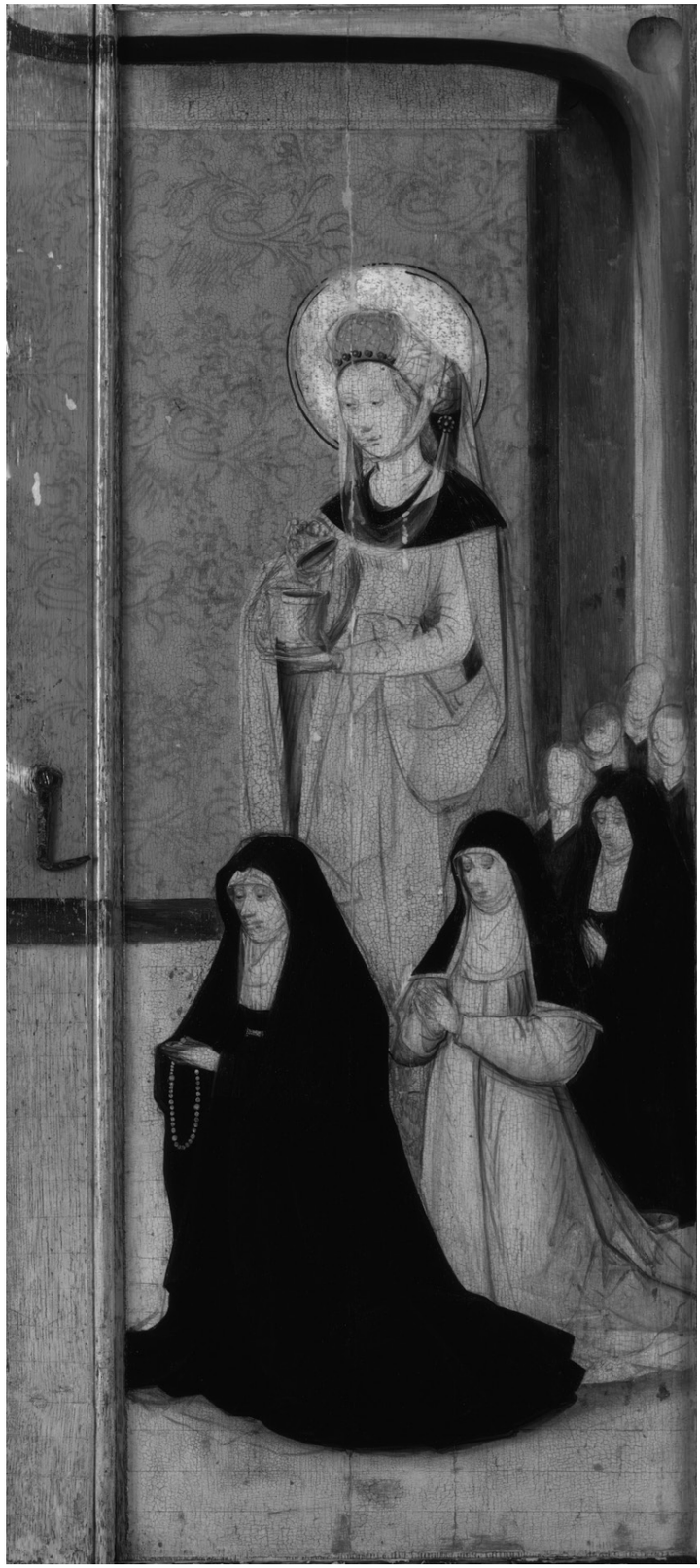
  The underdrawing in the closed triptych wings (RR 77 and 78) was seemingly applied in more than one stage, with contour lines and perhaps the indication of folds done first and hatching done later, possibly in two stages (see below, *Style*), using small to medium-sized brushes. For the underdrawing of the open wings (RR 79 and 81), generally a medium-sized brush was used. The lines of the left wing appear fairly well defined, with the alterations that are evident in the hands of the donor executed in a more opaque medium (see below, *Revisions*). The underdrawing of the central panel (RR 80) was done with a broader brush, probably in a more diluted medium.

  No underdrawing was observed in the predella panel (RR 83).

24.2–3 RR 77–78, VIS and IRR

- ***Style*** A distinctly different style of underdrawing is revealed in the closed wings, on the one hand, and in the detectable underdrawing of the open triptych on the other. In the open triptych, some differences come to light in the underdrawing of the wings and the central panel as well, but these are less clear, and observations are limited by the reduced visibility of the underdrawing.

  In the closed wing panels (RR 77 and 78), generally there are fairly sharp, narrow lines. They appear to have been applied in a controlled manner, with a tipped brush, indicating most elements in the composition. Hatching was done almost exclusively with parallel lines, following the directions of the respective features (see figs. 24.3 and 24.13). These lines are, for the most part, regularly spaced and only joined occasionally. Hatching was executed in both soft, narrow lines applied with a small brush, and in harder, more opaque lines with a medium-sized brush. The lines themselves are typically straight, but sometimes



have a slight curve. Line ends are mostly blunt or tipped, without hooks or loops.

In the open wings (RR 79 and 81), broader brushstrokes are visible at the donor's shoulder and in the initial, lower position of his hands (see figs. 24.16–17). Some similarly broad but more diluted lines were used in Saint Peter's right hand and robe (RR 79). Locally, below the robe of the female donor (RR 81), strokes appear even wider, and they spread out where applied in a more horizontal direction. Compared to those in the closed wings, the lines here are more freely executed, with more variable opacity. Line ends generally are somewhat blunt. Clear areas of hatching have not been noted.

In the central panel, broader brushstrokes are visible in the wide sleeve of Pilate's robe (RR 80). It seems that the underdrawing material was spread out more, resulting in a softer appearance of the strokes. The lines are more sketchlike and, when placed close together to indicate shadows, can appear locally as washes (e.g. below Pilate's

24.4–5 RR 79, VIS and IRR

raised hand). The lines appear shorter, for the most part, and are less opaque. They are less regular and line ends are primarily blunt and uneven.

- ***Revisions in underdrawing and differences from painting stage(s)*** Corrections in the underdrawing itself appear to be fairly limited, but there are many smaller and larger deviations from it in the painted surface.

In the closed left wing (RR 77), the leftmost boy with the purplish mantle was underdrawn holding an open book, and a slight change can be seen in his father's foot, which was prepared with a rounded rather than a pointed tip. The thumbs of both of Franco van Langel's hands were altered as well. The head of Jan van Langel, the Cistercian monk, was significantly enlarged in the painting stage, and his hands were also painted more prominently than they were prepared in the

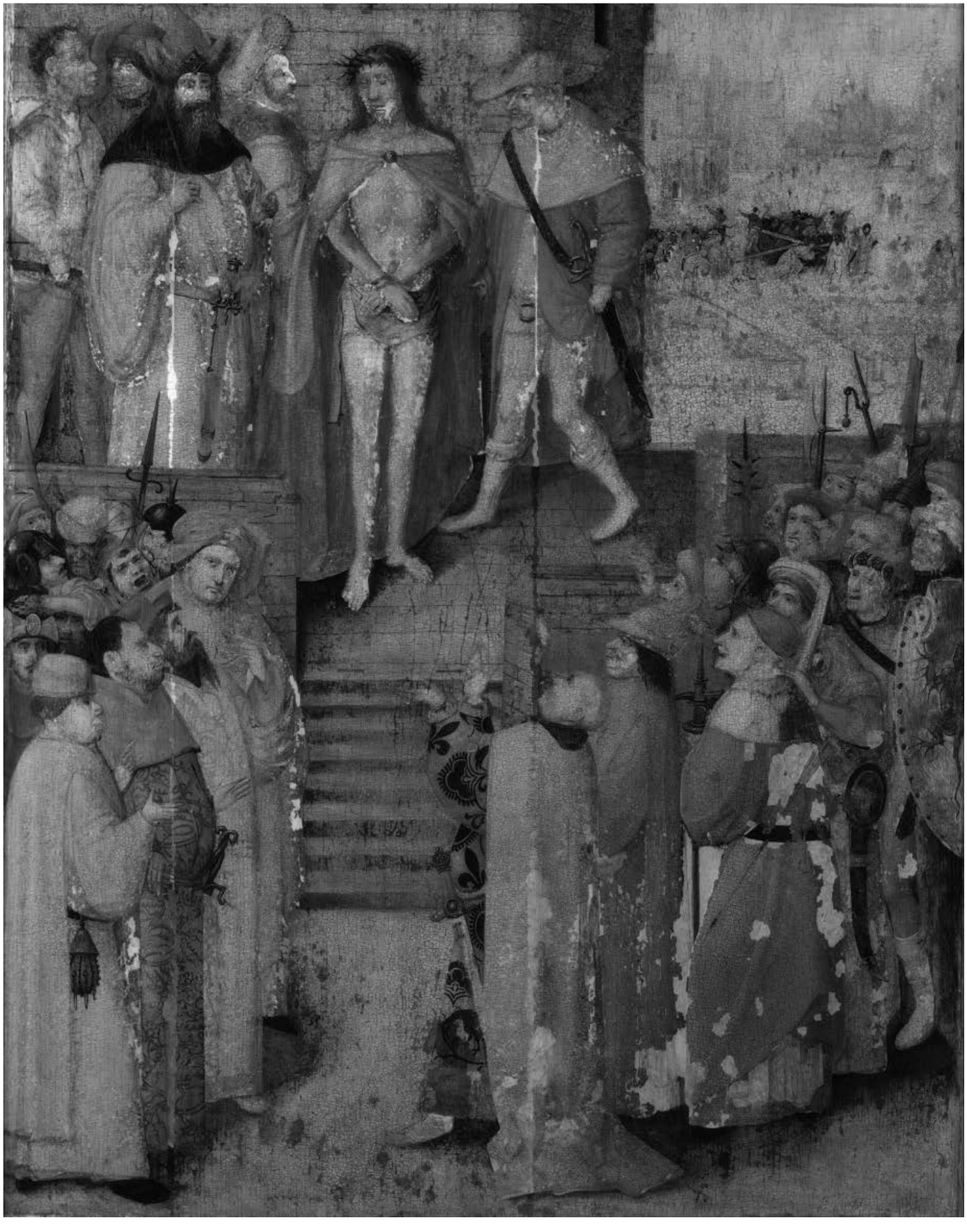
24.6–7 RR 81, VIS and IRR

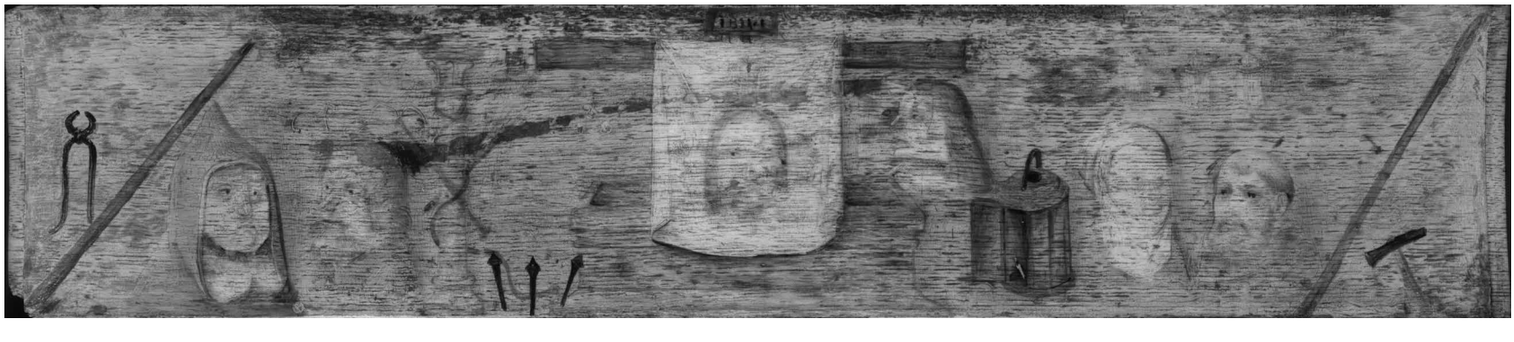
underdrawing (see figs. 24.12–13). Some folds at the right elbow of Saint John were also changed. In the closed right wing (RR 78), the underdrawn robe of the female donor extended farther to the lower left. The contours of her headwear and that of two daughters were also revised. The faces of the four youngest daughters in the background were only generically indicated with ovals, unlike those of their brothers, and the girl at the very back was initially in a higher position. The Magdalene's hand and pot were underdrawn more to the left, and her sleeve was made much fuller. Other revisions were made in the saint's head- and shoulderpiece, and in her face, which was painted more upward.

In the left wing of the open triptych (RR 79), the hands of the donor were underdrawn twice, initially in a lower position (see figs. 24.16–17). Saint Peter's robe initially extended farther downwards and to the

24.8–9 RR 80, VIS and IRR

24.10–11 RR 83, VIS and IRR





bottom left, into the area where later the coat of arms would be painted (which was itself not prepared in the underdrawing). His cloak, as prepared, did not fold open on his proper left shoulder, and it had a larger, round fold under his left arm. Saint Peter's book had a clasp in its earlier version, and his halo was drawn slightly higher. The horizon was also drawn higher, just above the halo, with some additional structures indicated in the background. In the interior right wing (RR 81), the robe of the female donor was underdrawn larger towards the bottom, seemingly with a wider hem. The double wheel was planned in a lower position. Saint Catherine's lower hand was apparently first intended higher, but was later painted atop her red robe; her blue sleeves were lengthened and widened. Her halo was painted in a lower position, compared to the underdrawing.

In the right background of the central panel (RR 80), a bridge, low walls and even a pedestal were underdrawn, closely following the situation in the Frankfurt *Ecce Homo*, but they were omitted in the painting stage.[12] Smaller alterations in the background architecture and in the figures' clothing can also be discerned, but close study of the underdrawing here is much hampered by its limited visibility.

- ***Intermediate layers*** In the two open triptych wings, along the lower left edge of RR 79 and in losses (see, e.g., fig. 24.14), what appears to be an isolating layer was applied over the ground. The presence of such a layer in the other panels could not be determined by visual inspection.

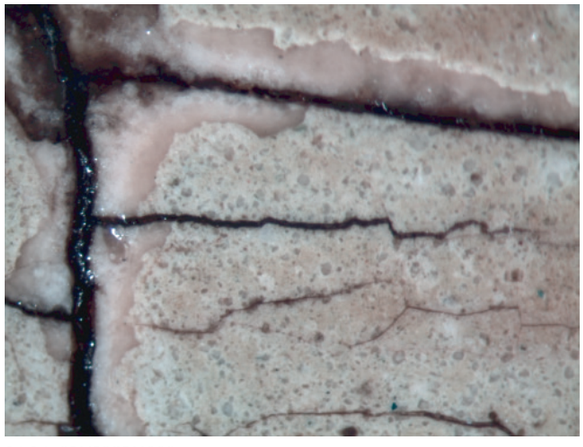
PAINT LAYERS

- ***Paint application and painting technique*** The brush-applied paint, presumably oil-based (not analysed), covers almost the entire surface of all panels. It was applied in several stages, mostly wet-on-dry, but also frequently wet-in-wet. The panels were painted within their engaged frames, since paint locally overruns the barb and edge of the frame (see below, FRAME). When the triptych is closed, the painted composition of panel RR 77 and 78 continues over the two central framing elements.[13] Incisions were noted in several areas (see below).

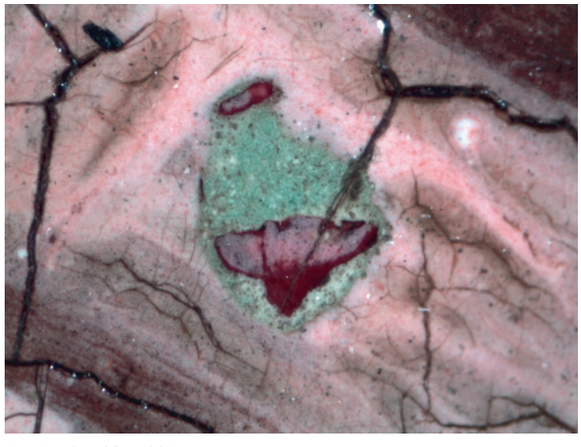
The differences in style observed in the underdrawing of the triptych are not present to the same extent in its paint application phase, except in the predella, which appears to have a markedly different painting technique. The wings (both open and closed) and the central panel (RR 77–81) are fairly close in technique but differences can also be noted. This is especially true in the depiction of the faces. The red lake accents typically found in lips of the figures in the wings are absent in the central panel. Also, the noses of the figures in the central panel are generally more accentuated by their colour, but in the wings this was done by giving these features a brownish contour line. Moreover, an unmistakably darker colour was often used for the corner of the eye or a large part of the eye socket (see, e.g., the figure in the central foreground). Similar disparities are also visible in detailing on the two sides of the wings, as in the depiction of the *lilium inter spinas* emblem on RR 77 and 79, respectively (see BRCP, *Catalogue Raisonné*, cat. 24, figs. 24.7–8).

Notably, the painted pattern of the darker brocade robe of the figure on the left in the central panel, with a swan biting the stem of a plant, is repeated in the green wall hangings of the closed triptych. More interestingly, the manner in which this robe was painted bears a close resemblance to that used in Saint Catherine's brocade robe in the open right wing (RR 81), although the pattern there does not follow the folds of the saint's drapery as it did in the central panel. Both brocade robes have a green lining and a precisely painted design applied onto a modelled base, with numerous short, lead-tin yellow hatchings indicating the individual stitches (see *Build-up and palette*).

24.12–13 RR 77, VIS and IRR



24.14 81MICGBM002



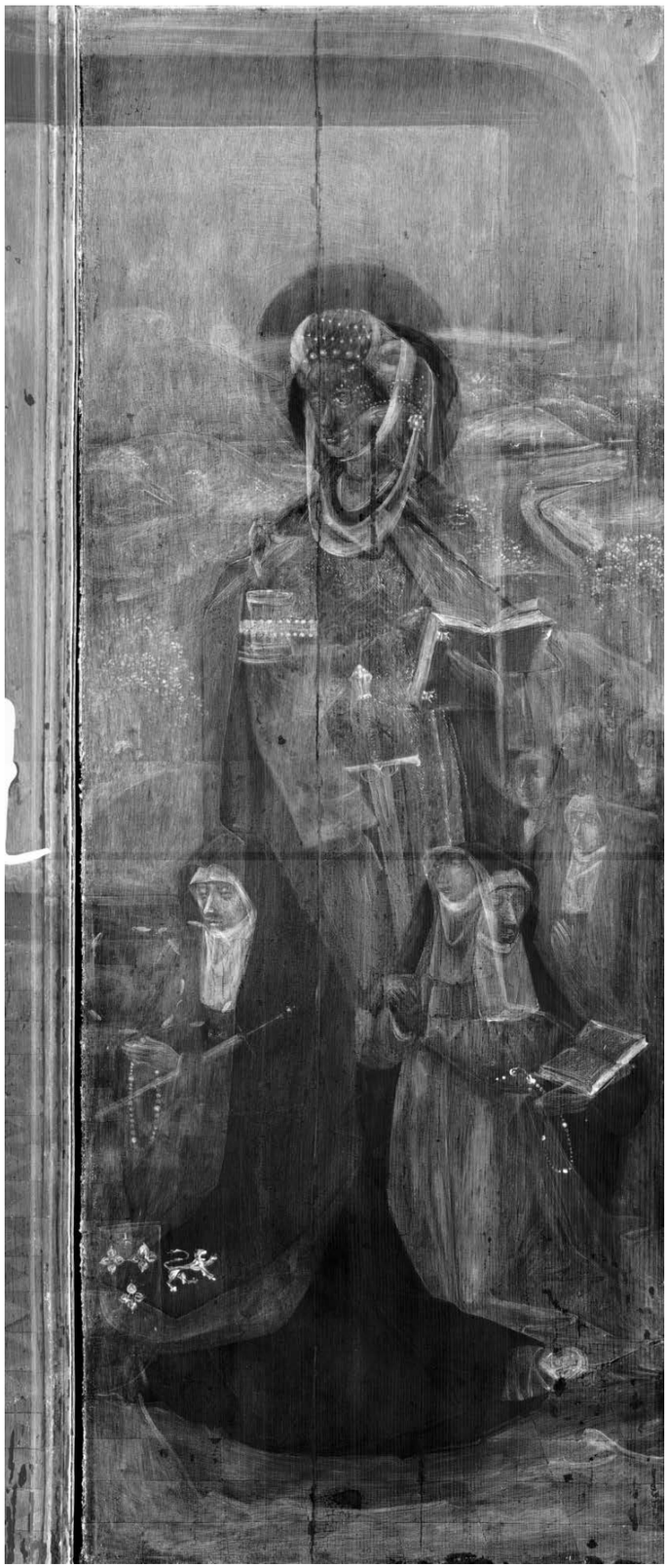
24.15 79MICGBM005

Additionally, the colouring and detailing on the hilt of her sword are highly comparable to those of other such weapons; see, for example, the hilt of Pilate's sword.

In general, a fairly similar painting technique was used throughout the triptych (not including the predella). The paint application only deviates slightly from the detectable underdrawing. Areas left in reserve were mostly followed with paints that overlapped somewhat, as in the head of Saint Peter overlapping his halo. In the central panel, these overlaps appear more frequently. Small elements, such as Saint Catherine's sword, were usually not left in reserve. Even her hands only have a small reserve, and they overlap much of the underlying paint. The composition was built up in two to three rather thick paint layers, as a rule, and was worked out to quite a high degree of finish. Paint was applied in both opaque and semi-transparent layers. Mostly rather fluid, glossy paints were used. Glazes were done in red (for both reds and purples) and in green. Scumbling is visible in RR 81, where a thin but opaque lead-white paint was applied onto the blue features in the left part of the horizon to tone them down.

Typically, the size of the brush used depended on the feature drawn (e.g. larger brushes being used for the background), as in the pale greenish base layer of the landscape (RR 79 and 81), which was brushed on rapidly in several directions. These brushstrokes have become more visible due to severe abrasion of the copper-green glaze on top, which has exposed the ridges of the underlying impastoed paint. Roughly dotted paint application is distinguishable in the background foliage of the open wings. Wet-in-wet paint application with displacement of underlying paints was observed in multiple areas (80MICGBM008), and especially in faces. The spherical hollows in the top left and right corners of the closed wings were painted wet-in-wet, from white to dark grey, onto the cool grey background.

24.16–17 RR 79, VIS and IRR



24.18 XR

24.19 RR 80, VIS

24.20 RR 81, VIS

The architecture here was locally indicated with incised lines, and the floor tiling was delineated by incisions. The two closed wings (RR 77 and 78) were placed next to each other for this purpose, as some incisions continued between the adjacent panels. In the central panel, incised lines were only noted in the back wall. It seems that the haloes in the wing panels were incised, too, with a centre point discernible, for example, in the top right section of Mary Magdalene's forehead (RR 78). The grey lines indicating text in the books depicted in the closed left wing and the open right wing were applied using a brush onto the still-wet white layer underneath (77MICGBM001). Dark contour lines were frequently used in all panels to indicate physiognomic details, such as fingers and nails.

The red lake paint in all of the robes has a rather speckled appearance where applied more thinly and may indicate the use of a cloth for dabbed paint application. Brushstrokes render contour and volume throughout the painting. They were applied in multiple directions, but generally follow the forms in the composition. Areas of red lake, mainly robes, were generally underpainted with a lead-white-bearing paint mixture that was not applied to areas of dark shadow. Given the relatively viscous nature of this underpaint, it is surprising that such undermodelling provided only limited texture, with relatively few impastoed brushstrokes being visible. Abrasion has caused the textured strokes of this lighter underlayer to become more clearly apparent.

In the predella (RR 83), a generally lower quality and different execution are evident. It is visible in the build-up as well, with most elements having been painted before the greyish background was laid in (see below, *Texture*). This background paint was also used to crop several compositional elements (see below, *Changes*). These were painted directly onto the ground, in which the surface texture of the wood support is discernible. Paints were frequently applied wet-in-wet, and paint displacement can be seen (e.g. in the rope on the column). Throughout, fine lines of textured brushstrokes remain apparent. Straight, incised lines are visible in the tomb, while the incisions in the left part of the crossbeam are quite irregular. Paint seems to have been manipulated with the back of a brush and moved aside by brushstrokes as well, as suggested by the horizontal separation of the open lantern door and the vertical in the white collar of the figure just above it. In contrast to the other panels, paint application here seems very thin (see, e.g., the column), and red glazes appear to be applied in multiple layers.

- ***Texture*** Many passages have a relatively smooth finish. However, the extensive use of thick paints containing lead-tin yellow and especially lead white has resulted in many impastoed areas, with only slight impasto in the robes but more for the detailing and highlights.

- ***Build-up and palette*** In the closed triptych (RR 77–78), the architectural elements, floor tiles and green background continue over the central framing elements. The continuation of the gilded frame's profile at the top has also been suggested by a narrow strip of oil gilding that was applied after the painted grey architecture. In general, paints were applied from light to dark, followed by detailing and highlights. The robes of the saints were painted first. They have a lead-white-based undermodelling (with blue pigments mixed in for the Magdalene's robe) and were followed by a red glaze. With the exception of these robes, the painting was built up back-to-front, beginning with the green wall hanging and the grey of the architecture and leaving the figures in reserve. The design of the green wall hanging was painted freehand in a dark copper-green lake that overlapped the red lake in places. The brocade has a light blue lining, which is visible on the left, right and bottom edges. The haloes were executed before the heads of the saints and apparently before background paint was applied. The paints of the other figures overlap the red lake of these robes, and the head of the

monk overlaps the green wall hanging. The green *chaperon* of the male donor has a light green base with a modelling that may consist of lead white and lead-tin yellow, followed by a copper-green glaze. Flesh tones appear to have been painted afterwards. Similarly, flesh tones followed the Magdalene's black shoulderpiece. The brown base colour of her hair and the lead-tin yellow and pinkish highlights there were applied subsequently. The light-coloured tiling appears to have been applied after the robes and has an alternating pattern, repeating every four vertical rows. The patterns were painted in a lead-white, blue and red lake mixture that has faded over time (see below, *Discoloration …*). Detailing (e.g. the fur trims) and shadows (as in those cast beneath the figures in a thin, semi-transparent brownish paint) were applied last. The blue belt and the rosary beads of the female donor were first indicated by a purplish lake mixed with white (78MICGBM004). For the beads, red lake was applied onto the still-wet vermilion base layer, locally followed by red lake with black and afterwards by lead-white highlights.

In the interior wings (RR 79 and 81), the composition was also largely built up back-to-front, while leaving certain areas in reserve. The red robes of the saints in the open wings were painted first, which is best revealed by a loss in the middle toe of Saint Peter (fig. 24.15). Subsequently the sky (azurite paint on top of lead white), the blue background, the haloes and the flesh tones of the saints were applied. The haloes partly overlapped both the sky and the blue background and were built up with an ochre-coloured mordant, gold leaf and black contour lines. The green landscape overlaps the blue background. The foliage has a green base, onto which light green dots or dabs were applied. A copper-green glaze (now discoloured brown and abraded) followed, and lead-tin yellow dots. In the left wing (RR 79), the blue *chaperon* was only partly left in reserve from the donor's robe, and in other areas it overlapped the background, such as the red robe of Saint Peter. Blue pigment, mixed in different gradations, was also used for the saint's keys. For the small, red-robed figure in the left background, first the grey details were applied, then red lake, modelled wet-in-wet. Then, vermilion paint and pink dabs were applied wet-on-dry.

It could not be determined in the central panel (RR 80) whether the red robes were painted first. The dark red part of Pilate's proper left sleeve appears to have black pigment mixed in as well. The green brocade shoulderpiece of the man behind Pilate has a light green base with a modelling that may consist of lead white and lead-tin yellow (80MICGBM001–003), followed by a copper-green glaze and dark copper-green paint for the motif. For the crown of thorns, light and dark green paints, lead-tin yellow and dark green detailing, as well as copper-green and red lake glazes were used. The second figure from the front, at the left edge of the panel, was initially clad entirely in green with a smaller, round, green headpiece with its top edge just above the current medallion. The medallion consists of pinkish and lead-tin yellow detailing (see fig. 24.19). This particular combination of pink and lead-tin yellow can be found in all the panels except RR 79; in the sword hilt at the wheels in RR 81, the pink is more red in colour. The poleaxe of the figure with the arrow on his back was painted in differing shades of grey, with black contours and lead-white highlights with blue mixed in locally. Purple and red lake paints formed decorations, followed by lead-tin yellow detailing and highlights. The hat of this figure and the lighter blue part of the hat immediately to the left were originally more purplish. The same applies to the light blue robe of the figure in front of him, which also contains traces of red lake paint that has since faded. The rivets on the shield at right have a black base, succeeded by light blue highlights.

A mixture of blue and red lake pigments was used for the dark brocade robe of the figure with the sword at left in the central panel (80MICGBM006–007). It was applied onto a modelled base consisting of a warm-toned opaque paint, locally topped, it seems, with a yellowish glaze. The green lining of the brocade that runs over the man's belly and appears at the bottom edge of his robe was then indicated using a mixture of lead-tin yellow and green lake, plus a copper-green glaze. Finally, short lead-tin yellow hatchings were applied extensively for the lighter areas.

Saint Catherine's brocade robe in the open right wing (RR 81) was built up in a similar way, although with slightly different colours and a pattern that does not follow the modelling of the folds here (see fig. 24.20). The base consists of a somewhat paler opaque paint, over which a thin green glaze was locally applied. The design was executed in purple (81MICGBM001), then the lining of the robe on the saint's chest and the cord on her waist followed in a dark green lake. On top of this, some lead-tin yellow lines were added, and then the hatchings were applied. The city in the right background was not left in reserve but painted on top of the blue hills. The left-hand jewel in Catherine's crown was painted with blue pigment, the adjacent one with red lake and vermilion, and the other two with copper-green glaze (now completely discoloured to brown) and red lake, respectively. The vermilion beads of the donor's rosary were first indicated by red lake, but do not have lead-white highlights.

The child in swaddles was not left in reserve but painted atop the black robe, although elements of this size typically were left in reserve. It appears thus not to have been planned from the outset but applied shortly afterwards, presumably just before the painting was finished. The technique and build-up of its face closely resemble some of the faces in the exterior of the wings; for example, that of the boy behind the donor in the closed left wing (RR 77). Possibly the dead child was added on the donatrix's robe at the same time that the coats of arms were added to the interiors of both wings: these were not planned initially, either, but painted atop the background. The coat of arms in the right wing partly overlapped the robe of Saint Catherine. The red ox's head in the coat of arms on the left wing was painted over the green landscape, but dragged along some of the still-wet lead-white paint at the edges. Black detailing was painted wet-in-wet, and two consecutive applications of lead-tin yellow were stroked onto the still-wet black field.

Most of the compositional elements in the predella (RR 83) were painted directly onto the light ground of the panel. The background paint was applied afterwards, slightly overlapping but also cropping certain elements (see below, *Changes*). This paint appears a warm greyish, but seems to consist mainly of blue and red lake pigments (see fig. 24.21, a micrograph from the left lower edge). The small instruments, shadows, and the lead-tin yellow and lead-white detailing and highlights were applied then, after which followed the background paint that overlaps the highlights at the top of the column. For the candle flame, first an opaque red paint was applied, followed by an orange dot. Red lake was apparently not used here but can be found in several other areas, such as the faces and robes. In the latter, a thin red lake seems to have been applied first, followed by lead-white-bearing paints for the lighter areas of Peter's robe and vermilion (not analysed) in the other red robe. Finally, red glaze was laid on, thickly for areas of shadow. Green glazes were used in two other robes. In the female figure, it was applied onto a dark green base with blue pigments and large, dull green pigment particles (83MICGBM004). These dull green pigments were not observed in the other panels. The difference in build-up and pigment use is also visible in IRR, where the green robe of the female appears significantly more transparent than the green areas in the wings. In the leftmost figure, glaze seems to have been mixed with lead-tin yellow, as well as being applied pure. The lead-tin yellow paint that was evidently used in several areas, mostly for detailing, seems to consist of relatively fine particles. Unlike Saint Peter's hair in the open left wing, his light hair in the predella has

some blue pigment mixed with the lead-white paint, which is also detectable in the light hair of several figures in the central panel.

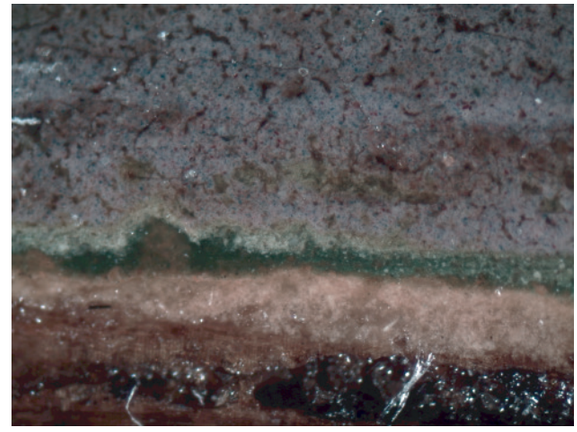
- ***Changes*** In the closed wings (RR 77 and 78), the head of the monk in white was left in reserve considerably smaller. The collar of the boy in front of him, on the left, was lowered, and the flesh tone now overlaps the black collar, which was initially rounder. In the closed right wing (RR 78), changes were made to the saint's head- and shoulderpiece where the white straps were added and the collar of the black shoulderpiece was heightened. The sleeve of the saint was initially painted narrower, following the underdrawing, but it was expanded onto the red robe. The colour of the sleeve was shot with blue and red for a *changeant* effect. The eyes of the eldest daughter were changed as they were first painted open (see figs. 24.22–23). Retouches cover the spots where the initially open eyes shimmer through the paint surface.

  The blue *chaperon* of the male donor in the open left wing (RR 79) was planned differently, and it is largely painted over the green background, the red robe of Saint Peter, and the donor's black robe. The donor's black hat was changed to a taller, narrower model with an ear flap, and the plane of the landscape at upper right was extended to roughly the centre of the current trees. Saint Peter's foot was painted on top of the green background, and the cuff of his proper right hand was initially painted in front of his robe.

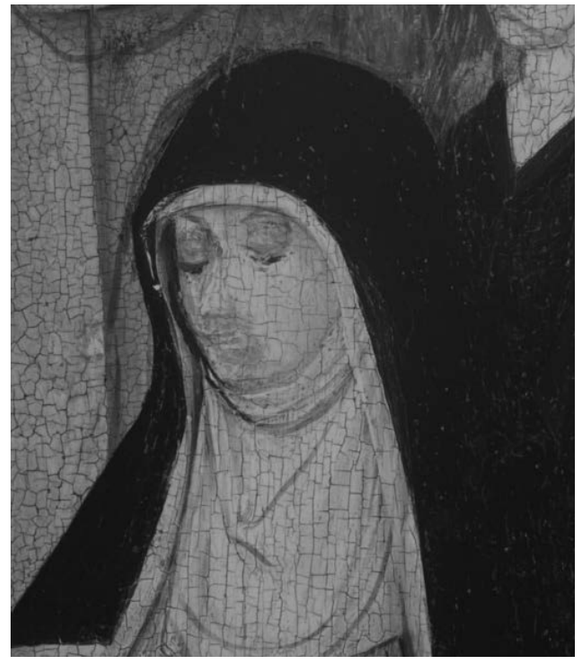
  In the central panel (RR 80), several contours were painted beyond the area left in reserve, overlapping previously applied colours. For example, the greyish face of the figure dressed in green at the left edge overlapped the red bonnet of the figure in front of him, and the sword of the central figure in the foreground was widened to the left. Many smaller elements (e.g. weaponry and some hands) were done directly atop background paints. There are some pentimenti, as well; see, for example, the neck of the dark-bearded figure in the group at the left foreground. Christ's arms were underdrawn and left in reserve lower. Also, next to Christ's proper right foot, an area was left in reserve but later painted out.

  In the open right wing (RR 81), the left-hand blue background was changed as a lead-white scumble toned down some of the blue features there. In addition, some smaller alterations are visible at the donor's face and in the robe. The saint's cuffs were broadened and lengthened, and the rising pages of her book were painted over the background. The coat of arms was painted over the saint's robe and the green background.

  In the predella (RR 83), the handle of the scourge with the white cords was initially planned behind the column but was later painted in front of it. The lower part of the rope that meanders around the column continued further to the right, behind the three nails. The tipped hood of the leftmost figure was taken in substantially. The robes of the two left-hand figures initially extended towards the bottom edge (see fig. 24.21). The red and green glazes were applied directly onto the ground layers and were later painted out with background paint.



24.21 83MICGBM002



24.22–23 RR 78, VIS and IRR

FRAME

Dimensions: central panel (RR 80/82): 85.1 × 71.9 cm. The elements of the central panel are c. 6.8 cm wide, with the bottom element being c. 4.8 cm wide. The central panel frame is c. 3 cm thick. The lower member of the central frame was cropped lengthwise at the bottom, through the (now missing) lower dowels that secured the mortise-and-tenon joins. Left wing (RR 77/79): 79.4 × 35.8 cm; right wing (RR 78/81): 79.8 × 35.9 cm. The frames of the wings vary from about 2.3 to max. 3 cm in thickness. The framing elements of the wings are c. 4.7–5.1 cm wide, with the bottom element being c. 5.5 cm wide.

With the exception of the predella (RR 83), which was examined unframed, the engaged frames are original to each panel. The faces of the wooden frames are flat, with profiled and gilded inner edges and a Wasserschlag or 'rainsill' bevel at the bottom inner edge. The flat section of the central panel is painted brown, whereas those of the wings are painted black. Surprisingly, the dimensions of the framed wing panels and the framed central panel only match in width. The frame of the central panel is currently circa 5.5 cm taller, but the difference was originally even larger, since the frame was cropped at the bottom, and only small parts of the lower dowel holes remain visible.

On the exteriors of the wings (RR 77 and 78), the composition continues over the vertical central frame members when the wings are in their closed position.[14] In the open wings and the central panel (RR 79–81), original paint was observed on the frames in several areas (e.g. 79MICGBM001), confirming that these panels were indeed painted within their current frames. Because of the shrinkage of the panels, the ungrounded and unpainted edges have become visible in several areas.

The framing elements are connected via mortise and tenon, with a half-lap join on the closed triptych side and mitre joins of the profiled frame section in the open wings. The horizontal frame sections are tenoned, whereas those that are vertical have a mortise. Two dowels reinforce each join. They are applied in the vertical frame sections and are visible from both sides. The frame of the central panel has a very similar construction.

Surprisingly, the mouldings of the frames of the interior wings (RR 79 and 81) do not fully match that of the central panel's frame. The innermost section is round in the central panel and more angular in the wings. A different moulding plane was thus used, which could indicate that the frames were not carved at the same time. The inner mouldings and the bevelled (*Wasserschlag*) sections at the bottom inner edge were gilded. The other sections are flat and painted brown for the central panel and black for the wings.

Although now attached with a modern screw, the closing hook on the exterior of the right wing (RR 78) is probably original, as remnants of green background paint can be found on it. The painted brocade pattern roughly continues across the gap between the closed wings. The left side of the closed right wing was, however, slightly planed in the past, as paint does not continue over the edge. The bottom right corner of the frame of the closed left wing is missing. All of the outermost, vertically grained frame sections covering the horizontally grained tenons are damaged or missing. Some of the holes have been filled with wood or black putty. A wooden strip was added to the entire right side of the closed right wing and to the entire left side of the closed left wing, possibly replacing sections damaged by hinges. A similar strip was added to the left frame section of the central panel. Inserts were added to the gaps of the hinges in the right frame section of the central panel. The far right hole in the top part of the frame seems to contain an additional reinforcing dowel that does not extend to the reverse of the central panel.

At its top, the frame of the central panel (RR 80) is rather irregular but it does not appear to be cropped. However, at about 1 cm above the gilded moulding, the appearance of the frame face becomes different. This transition to a more irregular surface with unidentified residues is better visible near the left and right edges. It seems plausible that an additional frame element, such as a protruding cornice, was attached to this section. That might also explain the existence of the two large, partially filled holes at the top of the frame that extend to the frame's reverse. The wings would then have closed below this element, and possibly above the predella, which would typically have had a slightly wider frame than the central panel.[15]

The top section of the central panel's frame was most likely disconnected at some point to pull the panel out for repairs (see below, *Cracks* and *Joins*).[16]

CONDITION

Support

- ***Altered dimensions*** The panels have retained their original dimensions (although the bottom member of the original frame of the central panel was cropped and its top member might have been altered; see FRAME above). Natural shrinkage of the wood has led to the visibility of the unpainted panel edges within the engaged frames. Several corners of the predella are damaged, most notably at the bottom left (seen from the front). Three holes visible at regular intervals in the top edge might relate to the initial construction.
- ***Cracks*** In the left part of the central panel, a crack runs the entire length of the picture. It seems to have come apart at some point and was possibly repaired out of its frame (see above). In the right wing, off-centre, a crack runs the entire length of the panel, following the wood grain. In the closed right wing, to the left of the large crack, a smaller fracture extends from the bottom edge of the panel into the black mantle of the donor.
- ***Deformations*** The predella panel has a concave deformation.
- ***Joins*** The join in the central panel is closed, but the two planks have come apart at some point, possibly together with the crack to the left. The panel was probably rejoined out of its frame.
- ***Coated reverse*** The wings are painted on both sides. The central panel reverse seems to have been stained brown in the past. It was also completely coated with wax, which extended onto the frame, partly overlapping the labels. The wax was applied after the pencil text, but before the red paint of the inventory numbers. It was put on in a thick coat during the 1954 treatment, probably to reduce natural dimensional changes in the panel, which were thought to be the cause of raised-paint issues (see also below, *Stability*). During the 2001 treatment, the removal of wax from the panel reverse was started.[17]
- ***Biological damage*** Old, local woodworm damage is present in the frames.

Ground and paint layers

- ***Stability*** In general, the adhesion of both paint and ground appears good for the wings and the predella. The paint in the central panel has a history of flaking but was consolidated and appears stable now. Most craquelure has been caused by natural dimensional changes of the panels.

  Lead soap aggregate formation, which can appear as small opaque points in XR, has been observed in a number of areas in all the panels. It is directly related to local paint layers, rather than an overall applied intermediate layer. Expansion of the aggregates may cause them to protrude from the paint surface, resulting in minuscule raised spots and a more granular surface texture. Loss of such metal soap aggregates results in tiny, craterlike holes that appear dark in XR. Over time, accumulation of dirt and varnish residues in these holes causes them to appear dark in VIS and IRR/IRP.
- ***Losses*** In the wings, mainly small and pinpoint losses have been observed, but some larger losses are present as well – for example, in the lower part of Saint Peter's robe, at the cracks in the right wing. There is very extensive paint loss in the central panel, and also at the join and crack, which appear to have come apart at some point. There are several old scratches in the painted surfaces, and there seems to be impact damage in the top right of the open right wing (RR 81). Most damages have been restored in the past.
- ***Abrasion*** The painting is somewhat abraded overall, but most extensively in the predella and the central panel. The

green *chaperon* in the closed left wing (RR 77) shows both abrasion of impastoed paint ridges (e.g. at the top) and scuffing of slightly raised paint edges at craquelure. The originally green glaze on top (now discoloured brown) is also unevenly abraded. The painted frame sections of the closed triptych (RR 77–78) are slightly more damaged. Their higher plane, the opening and closing of the wings (mainly from the bottom), and possibly a somewhat different build-up of the preparatory layers all seem to have resulted in a distinctive damage pattern. The green landscape in the open wings (RR 79 and 81) has been rubbed, damaging the green lake-based paint on top. Most of the gold leaf has been lost and the mordant has been damaged as well.

- ***Discoloration and increased transparency*** Red lakes have faded somewhat. In the closed left wing (RR 77), the red lake on the robe of the young man in the far left foreground, which was intended to be purplish, was preserved more at the panel edge, where it was better protected against light by the frame. Fading of red lake is also visible in the motifs of the tiling that originally would have appeared more purple (78MICGBM002) as well as in several blue areas of the central panel, most notably in the robes of Christ (fig. 24.24) and the figure in the central foreground. The background paint in the predella was originally also more purple. Brown discoloration of paints containing copper-green lake is visible throughout, especially where it was applied as a glaze. The green of the landscape in the open wings more closely resembles the better-preserved parts visible at panel edges. An increase in transparency is evident in some lighter paints, especially where applied thinly.
- ***Filling, retouching and overpainting*** Almost all losses have been filled and most have been inpainted. Some small losses have not been inpainted and show the toned fill, or were inpainted in part (e.g. in RR 80, to the right of Christ, in the blue belt), or inpainted in a base layer only (e.g. in RR 79, losses in the coat of arms that have been retouched green instead of white).

Surface finish

- ***Varnish*** The appearance of the modern varnish is quite regular and it has a fairly regular gloss. There are, however, many old, darker (varnish?) residues in the interstices of the paint (e.g. in RR 81, in the impastoed white paint at the donor's chest).
- ***Surface dirt*** There is some surface dirt on the painting. Tiny fibres are also stuck locally in or to the varnish of the predella.
- ***Visibility of the original surface*** The paint film is well saturated in most places and has an even surface appearance. The old, discoloured residues and especially the uneven (unfinished?) retouching distract somewhat from the otherwise good visibility of the original paint surface.

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[1] See the entry in BRCP, *Catalogue Raisonné*, cat. 24.

[2] See the entry in BRCP, *Catalogue Raisonné*, cat. 24.

[3] The sign reads INBI (in Greek), but is spelled from right to left (as in Hebrew). The three remaining black paint dabs probably represent nails.

[4] Swarzenski 1955, 3, states, 'Mr. Isepp, one of the most conscientious and competent restorers of our time, undertook the cleaning. He radically removed several misleading and disturbing layers of repaint which he found under the glaringly varnished surface. The cleaning revealed a number of damages which are easily recognized in the photograph taken after the restoration (Fig. 2). There are two thin cracks, one running from the hand of Pilate down to the foot of the second figure at the left, and the other from the top to the bottom of the panel, starting at the wall above the hat of the beadle leading Christ. The heads of the group at the left side of the tribune and the buildings in the background are severely rubbed. Small flakes of the pigment which have fallen from the body of Christ and from several faces and garments of the other figures reveal the white prepared ground of the panel. The old repaint of the head of Christ is not yet entirely removed. However, as a whole the painting is in very good condition. Exceptionally well preserved is the group of heads at the extreme left below the wall and the detail of the way to Calvary, the latter being done in impasto and not with glazes as is the rest of the panel.' Eisler 1961, 36, adds, 'All the old repaint was not removed from some areas, such as the group at the upper left, the parts of the sky at the upper right, the figure at the left foreground, and areas of the Christ.'

[5] Wax was used extensively, and not only for consolidation, as the panel reverse was also heavily waxed and the front surface lightly waxed in 1954, then sprayed with wax in 1962. A photograph of the fully waxed reverse is published (upside-down) in Eisler 1961, pl. XXXVIII.

[6] The 2001 treatment by Rhona MacBeth entailed the following: removal of surface dirt with saliva; paint consolidation with isinglass; varnish and overpaint removal with a mixture of isopropyl alcohol and mineral spirits (2:1); removal of both wax and gesso fills; filling losses with calcium carbonate and a little pigment (ochre and umber) bound in rabbit-skin glue; application of an isolating varnish of dammar; inpainting with Gamblin Conservation Colors (aldehyde resin); application of a final ketone resin (Winton) varnish.

[7] Eisler 1961, 33, states that 'The two vertical cracks suggest vertical grain, and the joining of three members.' However, the left crack (seen from the front) follows the grain of the wood, which is identical on either side of the crack, and is therefore not a join.

[8] This could be a result of the removal of the central panel from its frame for panel repairs (see FRAME).

[9] The youngest or last-preserved ring on the two boards of the central panel dates from, respectively, 1478 (board I) and 1469 (board II). Dendrochronological report by Peter Klein, University of Hamburg, Department of Wood Biology, 12 November 1991.

[10] Dendrochronological report by Peter Klein, University of Hamburg, Department of Wood Biology, 12 November 1991.

[11] This is likely caused by the changes in refractive index due to the ageing of the paint film, resulting in an increased transparency.

[12] Compare RR 49–50, and the entry in BRCP, *Catalogue Raisonné*, cat. 11.

[13] Compare RR 134–135, and the entry in BRCP, *Catalogue Raisonné*, cat. 9.

[14] This is relatively rare in Netherlandish painting, but was also encountered on the exterior of the Madrid *Adoration of the Magi* (cat. 9; RR 134–135).

[15] Such an additional wider frame element could have been attached onto the ottom of the central panel frame. It is technically possible that the frame of the central panel also encompassed the predella panel (RR 83), which appears to have similar half-lap edges on the reverse, but it would then only have had 2 cm-wide frame elements at the two sides. Three holes at regular intervals are visible in the top edge of the predella, and the XR reveals broken-off tips of rusted nails there. These might be traces of the initial construction, perhaps indicating that the predella was suspended from a (later removed) protruding element that was fastened onto the bottom part of the central frame.

[16] This might also explain the panel's slanted position within the frame and the additional dowel at the top right, which could have reinforced the possibly replaced tenon. Any attached additional frame element at the top must also have been removed at that time.

[17] Due to time constraints (i.e. the 2001 Rotterdam exhibition), the work could not be completed at the time.

25 *The Adoration of the Magi*

RESEARCH REPORT 57–58

Workshop of Hieronymus Bosch
c. 1495–1520

Oil (not analysed) on oak (analysed) panel, 77.5 × 56.2 cm
Philadelphia Museum of Art, John G. Johnson Collection, 1321

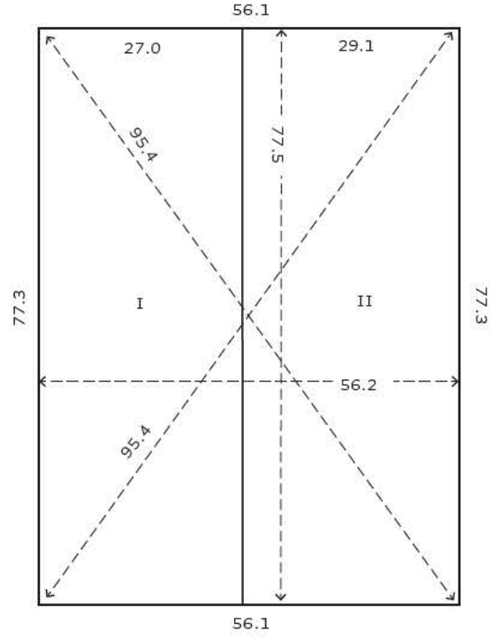
The painting was restored in 2014–15, thus after the 2012 BRCP examination of the painting on which this text is largely based.

BRCP, *Catalogue Raisonné*, cat. 25; www.boschproject.org no. 25.

Inscriptions and labels
Reverse: the inventory number, 1321, is written twice on a vertical cradle member. Frame reverse, top right: a number 3[...?]54 inscribed in pencil.

SUMMARY OF CONCLUSIONS

The Adoration of the Magi *in Philadelphia can be placed within the Bosch workshop. The style of the phased underdrawing fits well with that found in other works. Although a judgement of the painting technique is hindered by the poor condition of the paint layers, it appears that Hieronymus had little if any direct involvement in the painting process. The panel was originally housed in an engaged frame, now lost. The bottom of the panel was cropped slightly. Dendrochronology indicates that it could have been painted from 1493 onwards, although a date after 1495 is statistically more probable. As further explained in* BRCP, Catalogue Raisonné, *cat. 25, we date this work to around 1495–1520.*



25.1 Construction diagram (seen from the front)

RR 58

EXAMINATION DATA

18–19 April 2012 (Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Ron Spronk).

The panel was examined out of its frame in a conservation studio. It was studied upright on a cart and an easel, and flat on a table under strong illumination. Both front and reverse were easily accessible.

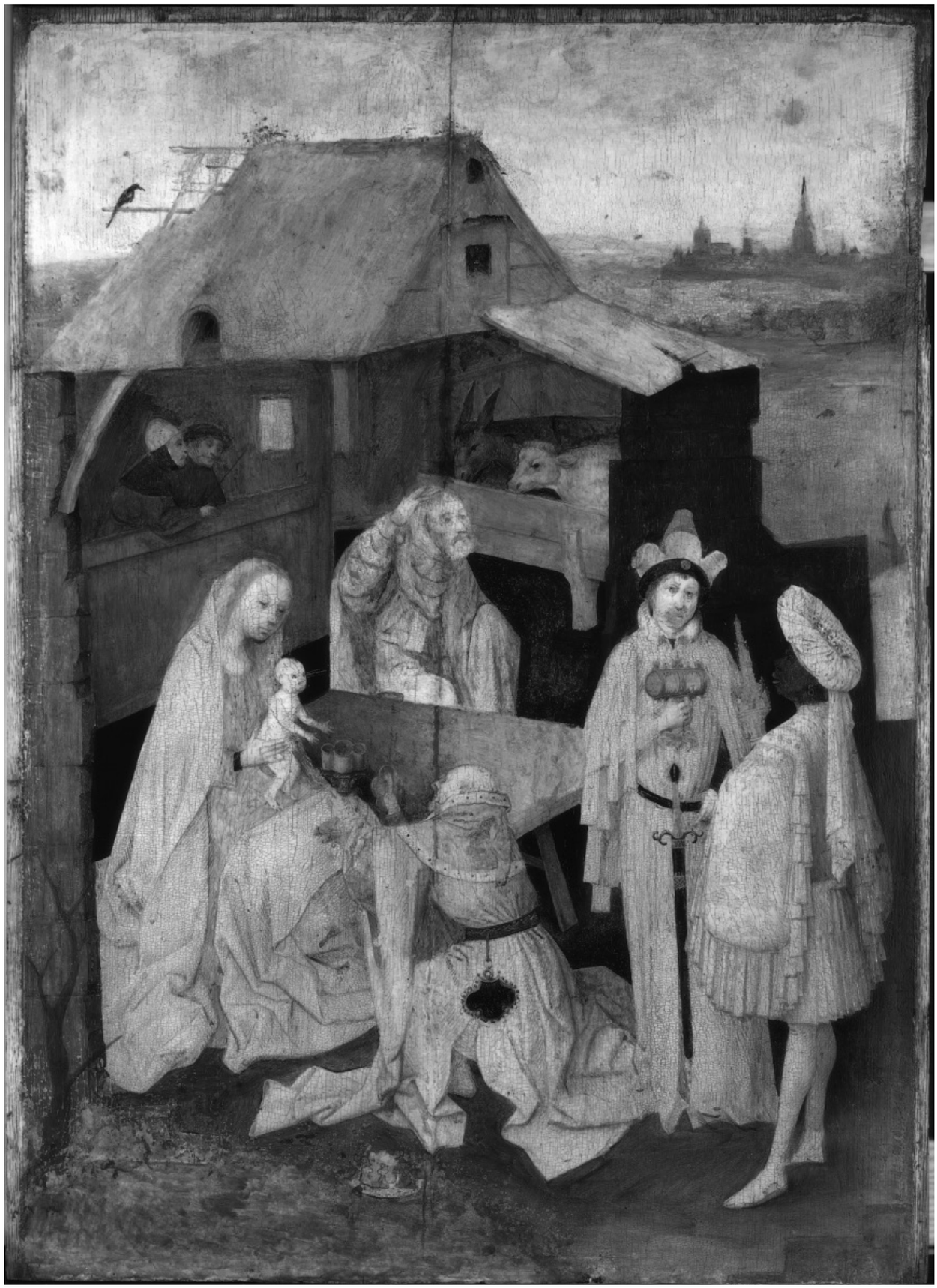
- ***Previous research and additional documentation available*** The museum's documentation on the painting includes: a photo of an XR detail probably made in 1936; the dendrochronology report from 1987; brief examination and treatment notes; and excerpts of literature discussing the painting.
- ***Previous treatments*** In 1941 David Rosen removed varnish and overpaints and retouched, varnished and waxed the painting. In 1958 restorer Ted Siegl noted that the painting had been previously cradled and extensively retouched. He impregnated four new blisters in the green robe with wax and applied a surface coating.[1] In 1962, Siegl noted issues of raised paint, especially in the lower section of the panel, and a few very small losses. He faced the entire surface with wax, removed excess and surface dirt, inpainted losses and varnished.[2] Notes dated 1979, 1984 and 1988 on a condition sheet state the poor appearance of the painting (with abrasion, losses and discoloured inpaintings and varnish) and its stability (noting the vertical crack and a convex warp).

SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 25.1).
Thickness: (max.) c. 1.2 cm; c. 0.3–0.4 cm along the edges; including cradle, c. 3.7 cm.

The wood species, Baltic oak, was identified through dendrochronology. The panel consists of two quarter-sawn planks, vertical

RR 57



25.3 IRR

25.2 VIS

in grain, laid vertically. The two planks are connected in a V-shaped tongue-and-groove join and glued.[3] Dowels were not detected.

The panel reverse is not original, as it has been thinned and cradled. The reverse is toned or painted brown.

- ***Bevelling or half-lap edges*** The left, top and right edges of the panel reverse were worked to a half-lap edge. At these outer edges, the panel is approximately 0.3–0.4 cm thick. The bottom edge was cropped (see below, *Altered dimensions*).
- ***Dendrochronology*** The youngest heartwood ring dates from 1482, which, with the added minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1491 for the tree that produced the wood for that plank.[4] An earliest felling date of 1493 is statistically more probable, however, since that would cover 93 per cent of the range of possibly missing sapwood rings. Assuming at least two more years for drying and transportation, the panel could have been produced from 1493 onwards, but a production date from 1495 onwards is statistically more probable.

GROUND

- ***Visibility*** The off-white to cream-coloured ground (not analysed) is present overall. The paint layers mostly cover the ground layer. Locally the ground can be detected in VIS at paint contours, along panel edges, and in losses, abraded areas and open craquelure. Discernibility of the ground tone shimmering through slightly in places could have been intended as part of the composition. Nevertheless, the ageing of paint layers has likely increased their transparency, and thus the visibility of the underlying layers. In the sky area, a combination of these factors appears to have resulted in the visibility of the ground.
- ***Barb and edges*** Barbs and ungrounded and unpainted edges have been largely preserved on the left, top and right sides of the panel, but not at the cropped bottom (see below, *Altered dimensions*). The unpainted edges are about 0.9–1.0 cm wide. As the presence of barbs and ungrounded edges indicates, the painting originally had an engaged frame.
- ***Application*** The ground appears to have been applied somewhat thickly and evenly, using a brush. The strokes are slightly visible (e.g. above Mary's shoulder), but currently the surface structure of the wooden support is also apparent.

PREPARATORY LAYERS

- ***Underdrawing*** Underdrawing shimmers through the paint surface in VIS in many areas and is discernible where paint is damaged, as well as at some paint contours (e.g. above the Christ Child's left eye; figs. 25.4–5). The current visibility (in normal light) of the underdrawing in light areas is likely caused by the changes in refractive index due to the ageing of the paint film, which result in increased transparency. IRP and IRR revealed underdrawing beneath paints more clearly, although the crackle pattern and carbon-containing paints used in dark areas (e.g. the middleground and parts of the stable) obscured it somewhat.

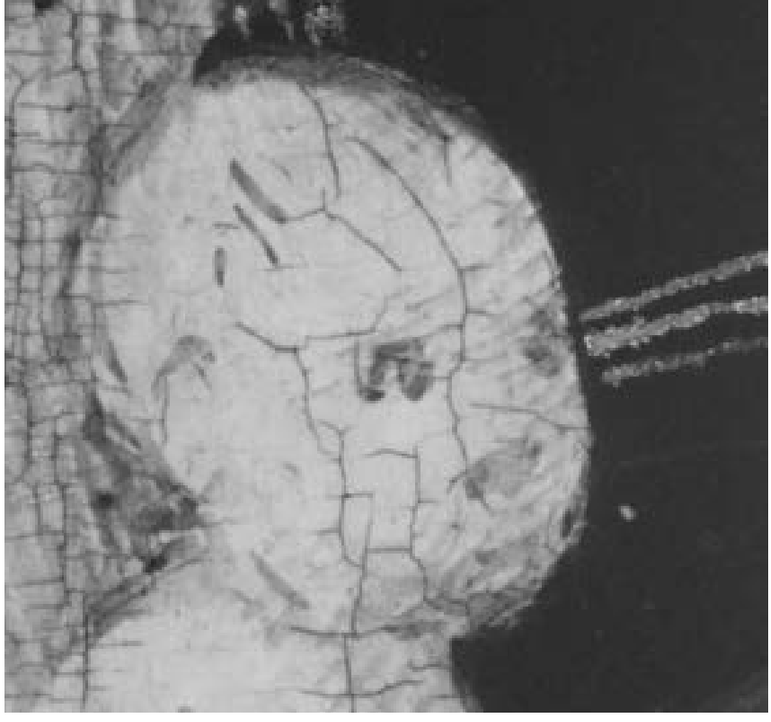
  The composition is extensively underdrawn, especially the main figures, but only a few dabs of underdrawing were observed in the fore- and background landscape. Underdrawing not only indicated the contours of the main composition, the folds of clothing, and detailing of hands and facial features, but aided in modelling as well, via parallel and cross-hatching for shadowed areas and architecture. It appears that hatchings in the green and red mantles also indicated those zones where little to no lead-white-based underpainting was to be applied and more glaze was needed.

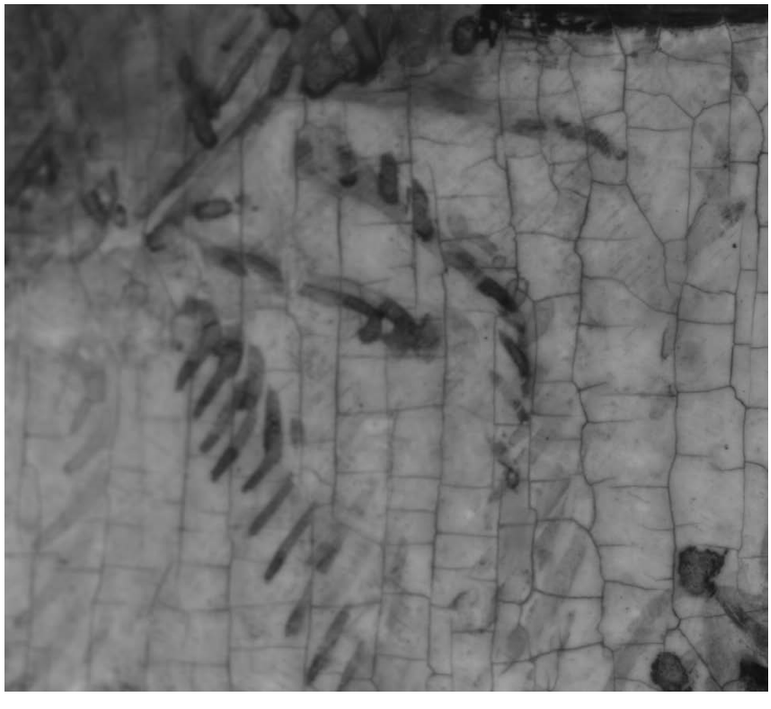
25.4–5 VIS and IRP

25.6–7 VIS and IRR macro

- ***Medium and application*** The detectable underdrawing was applied with a brush and apparently consists of at least two types of liquid medium. One was very black and highly fluid and could be a finely ground carbon black in a watery medium, as particles are discernible (fig. 25.6). The prevalent underdrawing is often more faint, possibly using ink, as many lines are relatively even. In other areas the distinction between the media is less evident.

  Underdrawing appears to have been applied in at least three stages. First, in the watery black medium, the main contours of figures, folds and the architecture seem to have been indicated using medium-sized brushes. Possibly during that stage also some facial features were roughly indicated in short dabs, as well as some hatchings (e.g. in the Christ Child). In the next stage, perhaps using ink, the artist further developed the composition. Additional contour lines and extensive hatching, done with smaller





brushes, were used to model the faces as well as the robes. In the final stage, medium-sized brushes and the watery black medium were employed once again. Many of the shadows were reinforced, in some places extensively, as in Mary's robe at her left hand; in other areas shadows were corrected, as in certain folds in the robe covering Joseph's proper left arm. It may have been at this time, too, that the cross-hatching was applied in Mary's robe. It is unclear in what phase the shadows in the stable (e.g. above the ox and ass) were indicated. Those lines are unusually broad but do appear distinct from the painting phase. Similarly broad lines were detected in the magus's red robe at bottom right.

- ***Style*** The underdrawing is highly extensive and fairly detailed. There appears to be a distinction between the faint hatching, which seems more controlled and precise, and the dark hatching, which looks rougher and more freely applied, although the difference in medium also plays a role in this. Underdrawing was applied in a variety of ways, generally using small- to medium-sized brushes; only locally were broad brushstrokes observed. The initial drawing appears rough, with free strokes quickly indicating the main elements of the composition. The hatched lines of this stage and that of the final one are often very short and dark, compared to the longer faint lines of the intermediate stage, which are also more regularly spaced. Hatching is done mainly in diagonal lines slanting left or right, or in both directions in areas of cross-hatching. Overlaps are only visible at the broad lines and at the lines of the final stage, mainly in darker areas. The strokes applied in the watery black medium are sometimes irregularly shaped. The fainter hatched lines are fairly straight to slightly curved, with straight and mostly blunt or tipped line ends.
- ***Revisions in underdrawing and differences from painting stage(s)*** It seems that local revisions were made in the final underdrawing stage, as in some folds of the robe covering Joseph's proper left arm and in the robe of the kneeling magus. The underdrawing was closely followed in the paint application phase. Apparently only the red robe of the magus was painted slightly differently at the bottom and the black hat of the shepherd was underdrawn taller.
- ***Intermediate layers*** A possible isolating layer was observed at the edges of paint losses in the back of the black magus (57MICGBM003).

PAINT LAYERS

- ***Paint application and painting technique*** The oil paint (not analysed)[5] was applied with a brush up to the barbs and the bottom edge of the panel. The underlying preparatory layers are sometimes visible at the interfaces between different colours. Paint was applied in several stages, mostly wet-on-dry, but also wet-in-wet. Incisions were noted at the right edge of the roof where it connects to the stable extension (see below, *Build-up and palette*). Several other incisions or scratches, some of which are quite long, were observed. These are mainly located in the sky area, and unrelated to the composition.

  The paint application closely followed the underdrawing. Both thick and somewhat thin paint applications were observed, the thickness often depending on the pigment used (e.g. lead-white paints generally being more impastoed). In several areas, the paint consistency is slightly coarser (see below, *Texture*). The face of Mary is modelled with a light area and a shadow on a pinkish midtone. In the red-robed magus, however, a highlight is not present in his face, which was modelled with slightly browner pink patches. Generally, fluid and glossy paints were laid on in opaque as well as semi-transparent layers. Brushstrokes of stiffer paint are present in the lead-white-based undermodelling of green and red robes, followed by glazes. In multiple areas the artist painted wet-in-wet, as is visible in the lead-white detailing blending with the red lake paint of the black magus's shoes.

  The composition was worked out to a fairly high degree of finish. The artist painted fairly precisely, although brushstrokes were generally of medium rather than very fine size. Strokes were used to render contour and volume throughout the painting, as in the meandering pleat reinforced by the dark green glazes of the garment's folds on the upper leg of the kneeling magus (figs. 25.6–7). The glaze areas here were further strengthened by dark hatching of the final underdrawing stage, which also indicated where little to no lead-white-based undermodelling was to be applied. Although light brown to pinkish shadow lines were used (e.g. in the fingers), dark brown or black contour lines to indicate physiognomic detailing were not observed. The detailing with gold leaf was adhered onto a yellowish- to reddish-brown mordant applied with a brush in impastoed lines or dots.

- ***Texture*** Most passages were worked into a relatively smooth finish, but fine brushstrokes are frequently visible. The use of thicker lead-white-bearing paints for the undermodelling of robes and lead-tin yellow for detailing and highlights has resulted in many impastoed areas. Such areas of undermodelling also have more defined brushstrokes. Flesh-tone paints are often slightly impastoed as well; for example, in the face of the red-robed magus. Here the paint also has a slightly granular appearance, as in Mary's face and hair.

- ***Build-up and palette*** The paint was applied mostly from light to dark. Dark-to-light application is evident where a darker base paint preceded lighter touches of detailing and highlights. The paint application was largely planned. It seems to have been executed 'back-to-front' only, leaving areas in reserve.

  For the paint of the sky, gradually less lead white and more azurite pigment was mixed in towards the top of the panel. Although the entire sky is heavily abraded, roughly three differently coloured horizontal bands are still distinguishable there. The brown base paint of the roof was applied after the sky was painted, but before the incisions at right were made. The green landscape paint overlapped these incisions and was followed by darker brown paint that reinforced the contour of the roof. The more impastoed lead-white-bearing highlights near the top of the thatched roof were applied before the final brown paint there. The grey wall of the stable was also painted before the green of the landscape, which appears to have a yellow-brown base. The top part of the landscape overlaps the light paint of the sky. The large tree in the right background was not left in reserve but painted atop the green landscape and the bluish sky. The tree trunk at the centre right edge was also painted on top of the landscape, and the tree at the bottom left of the panel was painted atop the wall.

  The figures were first left in reserve from a lighter brown base colour (perhaps similar to the yellow-brown base of the landscape), and then the robes were depicted, followed by dark grey or brown paint of the foreground and middleground landscape, which overlapped them. The faces were painted afterwards. Mary's face was modelled with a midtone area in pink, areas of highlight in pink with more lead white (especially at the cheekbone), and more purplish shadows containing red lake and black pigments. Mary's hair was then applied, with pink and lead-tin yellow highlights on a red-brown base. Joseph's beard overlapped the brown and dark grey paint there.

  The green robe has a lead-white-based undermodelling that may contain some green pigments as well. A generally thin green layer and a thicker green glaze for shadows followed it. Finally, local whitish highlights and dark green paints were applied, reinforcing the modelling (see e.g. in the dark green opening in the sleeve of the kneeling king, under his left arm, fig. 25.8). The blue belt and the black purse were left in reserve from the green robe, although the former was altered (see below, *Changes*). The black belt of the red-robed magus at right was not left in reserve. At the bottom of this robe, a lining in white-grey was painted onto the red lake. All red robes have lead-white-bearing undermodelling, followed by red lake. Red lake was also observed in some shadows in the back of the black magus (where it was mixed with carbon black, as indicated by IRR/IRP) and in the dark background behind him.

  The turban of the black magus was first underdrawn and then left in reserve from the grey background. The headgear was next painted in lead white, followed by wet-in-wet-applied blue paint mixed with some carbon black for the darkest parts. The orangeish- to reddish-brown mordant and the gold for the crown were applied afterwards. For the gold detailing on his robe, a more yellowish-brown mordant was used. It was also applied to create some gold highlights in the scene on his sleeve with the monochromatic pinkish figures catching and collecting the manna from heaven, which itself was represented by small, impastoed lead-white-based dots of paint (fig. 25.10). The gilded detailing on the large gift of the black magus has an orange-to-red base, followed by lead-tin yellow, yellow-brown mordant, gold leaf and a red lake glaze (see e.g. in its right pinnacle, fig. 25.9). A fairly similar build-up is found on the sword handle and fittings. The black sheath of the sword was decorated with hardly visible short, deep black strokes. Perhaps the subtlest detail is formed by four only slightly darker red circles in two strips of clothing adjacent to the table, extending from the shoulder of the red-robed magus. The upper two circles are underdrawn.

- ***Changes*** Minor changes were noted in the painting. The left window in the thatched roof was somewhat altered. The proper right ear of the cow appears to have been painted out. The angle of the extending wall at centre right was reduced at the top. The wall in the bottom right and the small, extending section at bottom left were painted over the brown landscape. The blue belt of the kneeling magus was initially black, with left-pointing chevrons in red lake paint. Since these features remain relatively transparent in IRR/IRP, they were probably painted wet-in-wet.

FRAME

The original, engaged frame has been lost. The modern wooden frame (90.0 × 69.0 cm; thickness c. 5.5 cm) is profiled and water-gilded. Small, gilded rosettes were applied to its faces, except the bottom, which has a *Wasserschlag* or 'rainsill' bevel.

CONDITION

The painting was restored in 2014–15, thus after the 2012 BRCP examination of the painting on which this text is largely based.

Support

- ***Altered dimensions*** The bottom edge of the panel was cropped, removing the original unpainted and ungrounded panel edge there. Some of the wood is missing from the panel edge elsewhere as well, especially at the upper right. The panel reverse was considerably thinned, presumably to enable the flattening of the warped panel and the application of the cradle.

- ***Additions*** A wooden cradle was attached to the reverse of the panel before 1958 (see above, *Previous treatments*). It is composed of six vertical members glued to the panel reverse and eight horizontal, non-fixed members. The cradle does not appear to be blocked and thus allows natural in-plane dimensional changes of the panel.

- ***Cracks*** Close to the upper right edge, from a place where a section of the panel edge is missing, an old crack extends halfway down the panel.

- ***Deformations*** The panel has a slight convex deformation.

- ***Joins*** The join in the panel is closed, but the two planks seem to have been separated and rejoined in the past. There is very little difference in level, but the damages and fills have resulted in a distinct edge.

- ***Coated reverse*** The panel reverse was stained dark brown.

- ***Biological damage*** Traces of old woodworm damage are spread over the panel reverse.

25.8 57MICGBM005

25.9 57MICGBM002

25.10 VIS

Ground and paint layers

- ***Stability*** In general, the adhesion of both paint and ground appears relatively good. Locally, raised paint and ground, which is mostly older, but not consolidated, was noted in the sleeve of the kneeling magus and at the bottom of the tree at the lower left. In the dark green background, somewhat broader drying cracks were observed. The extensive craquelure is mainly an effect of natural dimensional changes of the panel. In many areas, however, craquelure has widened and opened up, damaging both paint and ground. Presumably this is a result of solvent interactions during cleaning treatments.
- ***Losses*** There are many losses of differing sizes in the painting, primarily to paint, but also to paint and ground. There are larger losses along the join and a very large damage is present at the bottom left part of the panel. At bottom right, in the black magus's left shoe, there is a dent in the original paint with a few losses.
- ***Abrasion*** The work is somewhat abraded overall, resulting in increased visibility of the whitish undermodelling of robes, especially at the ridges of brushstrokes (to give just one example). Multiple areas are highly abraded (e.g. in the sky, in Joseph and in the kneeling magus). In many areas with gold leaf detailing the gold is largely abraded (as in the Star of Bethlehem and fig. 25.4), including locally applied glazes on top (fig. 25.9). There are many (and often long) incisions or scratches in the sky area that are unrelated to the composition. Two other scratches were detected below the table and near the shoulder of the black magus. Old damages at the panel edge were probably the result of framing.
- ***Discoloration and increased transparency*** Red lake glazes have faded somewhat, which is especially apparent where it was applied thinly. The copper-green lakes have held up fairly well, but slight brown discoloration is visible. An increase in transparency is evident in the lighter paints, as in areas with lead white or flesh tones that now reveal more of the underlying layer (see, e.g., the underdrawing shimmering through in the Christ Child).
- ***Filling, retouching and overpainting*** Most losses have been filled and inpainted. Extensive retouching is present, for instance, at the entire bottom left part of the panel, at the kneeling magus and Joseph, and in the upper part of the sky. The retouching appears to have discoloured somewhat.

Surface finish

- ***Varnish*** The appearance of the modern varnish is quite regular and the paints are saturated well, although dark areas appear rather matte. The varnish is damaged somewhat at the bottom edge. Although the varnish is only slightly yellowed, old highly yellowed varnish residues are visible in the interstices of the paint.
- ***Surface dirt*** There is hardly any surface dirt on the painting. Some fingerprints are present in the retouched area at bottom left.
- ***Visibility of the original surface*** The paint film is well saturated in most places and has an even surface appearance. The matte areas, highly yellowed varnish residues and especially the discoloured retouching distract from an otherwise reasonably visible original paint surface.

[1] An n-butyl polymethacrylate and polycyclohexanone (1:1) varnish.

[2] Magna colours (n-butyl polymethacrylate) retouching, and spray-varnishing with n-butyl polymethacrylate and polycyclohexanone.

[3] According to Van Schoute and Verougstraete-Marcq 1986 (21 fig. 3), this type of join appears in the beginning of the sixteenth century. This diagram was republished in Verougstraete-Marcq and Van Schoute 1989 (38 fig. 7), and in Verougstraete 2015 (46 fig. 13).

[4] The youngest or last-preserved rings on each of the two planks date from 1480 (I) and 1482 (II), respectively. Report by Peter Klein, University of Hamburg, Department of Wood Biology, 13 August 1987.

[5] The relatively broad drying cracks in the dark green background imply the use of oil there.

25.11–12 VIS, after treatment (photo courtesy Philadelphia Museum of Art)

26

Fragments of an Adoration of the Magi Triptych

A *Two Shepherds* B *Retinue of the Magi*

BRIEF RESEARCH REPORT 59–62[1]

Follower of Hieronymus Bosch
c. 1515–35

Oil (not analysed) on panel, *Two Shepherds* (RR 59): 36.5 × 22.8 cm. The top and bottom edges measure 22.6 cm. The thinned original panel is c. 1–2 mm thick and was glued into an oak tray c. 3–4 mm thick, followed by a plywood backing, totalling c. 14 mm.
Retinue of the Magi: 36.5 × 21.8 cm. The bottom edge measures 21.2 cm. The thinned original panel is about 3 mm thick and was glued into an oak tray, followed by a plywood backing, totalling c. 14 mm.
The frames are not original. Dimensions, RR 59: 48.8 × 31 cm; RR 61: 44.7 × 29.9 cm.
Philadelphia Museum of Art, John G. Johnson Collection, 1275 and 1276

BRCP, *Catalogue Raisonné*, cat. 26A–B; www.boschproject.org no. 26A–B.

Inscriptions and labels
Reverses: RR 60, top centre of plywood backing inscribed with inventory number, 1275 (with an illegible text preceding the number); bottom right, a vague remnant of a stamp; RR 62, top centre of plywood backing: inscribed with inventory number, 1276.
On the frame: *Two Shepherds*: the right edge (reverse) has an illegible text. At the top right, 39.379 // *Shepherds* is written in pencil. The left side of the frame bears the inscription 52–1930–12 in red on the gilding in the bottom left.
Retinue of the Magi: Markings in pencil include a number in the top right of the frame and just below that to the left, *Pilgrims*. The left side of the frame bears the inscription 52–1930–11 in red on the gilding in the bottom left.

SUMMARY OF CONCLUSIONS

The panels Two Shepherds *and* Retinue of the Magi *in Philadelphia were not painted by Hieronymus Bosch. Neither can the style of the underdrawings and the painting technique be easily linked to paintings from the workshop. The panels were therefore created by a follower of Bosch, although we cannot exclude the possibility that they were produced in the family workshop after the artist's death. The underdrawing was relatively closely followed in paint, but several changes can be observed between the first and subsequent painting stages.*
The panels were cropped on all sides, thinned and adhered to auxiliary supports that block access to the end grains. The panels therefore cannot be dated using dendrochronology. We can assume that they are fragments of the wings of a triptych of which the Adoration of the Magi *in a private collection in Paris (cat. 26C, RR 109–110) formed the central panel.*

RR 60

RR 62

RELATED WORK

It has been suggested that these panels are fragments of what once were the wings of a triptych of which the *Adoration of the Magi* (cat. 26C, RR 109–110) in a private collection in Paris originally functioned as the central panel.[2] This hypothesis is neither conclusively supported nor excluded by the results of this technical study but, as explained in BRCP, *Catalogue Raisonné*, cat. 26, that reconstruction can be accepted on art-historical grounds.
A later, complete copy of such a triptych is in the Noordbrabants Museum in 's-Hertogenbosch. Moreover, the ox and the ass were added late to the already completed background of RR 59, while these animals were apparently painted out on the *Adoration*.
The underdrawing of the *Adoration of the Magi* is highly dissimilar to that of the fragments and the painting technique also differs, but such dissimilarities have been encountered within another triptych by a Bosch follower as well.[3] The three panels of this triptych were probably not produced simultaneously. Instead, the wings to which the Philadelphia fragments belonged were likely added later, and painted by a different hand.

ADDITIONAL INFORMATION

In the museum's files is a brief 'Restoration Record' of the two panels. David Rosen restored the painting in 1941: 'cradles removed from both panels, panels treated with wax and mounted on plywood supports; surfaces cleaned, retouched, resurfaced, and waxed'.
In 1965, it was treated again. Ted Siegl reattached small blisters on *Retinue of the Magi* with wax and a tacking iron. On both panels, abrasions and old losses 'were newly inpainted by Louis Sloan with MAGNA colours (n-butyl polymethacrylate). Surface was sprayed with normal butyl polymethacrylate and polycyclohexanone AW2.'

OBSERVATIONS

Support

Each remaining original panel consists of a single, vertically grained plank. The plywood backings that were applied in 1941 appear

RR 59

RR 61

adhered with wax-resin. The fragments were set in oak trays that mimic ungrounded and unpainted edges, and suggest that the panels were never cropped. These trays and the plywood backings affect the interpretation of the XRS and block access to the end grains. Dendrochronology was therefore not possible.

Preparatory layers

The ground seems to be off-white. It is not fully covered by the paint layers and visible at contours and at losses. At the lower right side of *Two Shepherds* (RR 59), traces of a more raised ground are visible, but it is unlikely that these relate to the panel's original barb.

Brushstrokes of the application of the ground are visible in raking light and under the microscope. The ground was applied thinly, causing the warmer tone of the wood to shimmer through locally. Overall, the surface texture of the wooden support is discernible. In places the vertical wood grain is visible, as not all pores are filled with ground, and some are even without paint.

Some underdrawing can be seen in visible light, shimmering through the paint surface slightly, especially in certain lighter areas and skin tones. Both IRP and IRR reveal underdrawing as well. The detectable underdrawing was applied in a liquid medium. Several lines appear broken, which seems to be the effect of an irregular underlying layer, perhaps the ground. Relatively sparse underdrawing was revealed. In the faces of the figures, some features were roughly indicated with a relatively large brush (fig. 26.5).

The shepherd's staff held by the standing figure in *Two Shepherds* appears not to have been underdrawn. A diagonal line can, however, be seen at his other shoulder. Just below the wind instrument (a wooden recorder), a rectangular shape appears underdrawn. Several contours were slightly shifted; for example, in the hand that holds the recorder and, in the left figure, the heel of his right foot and the lower left tip of his cloak.

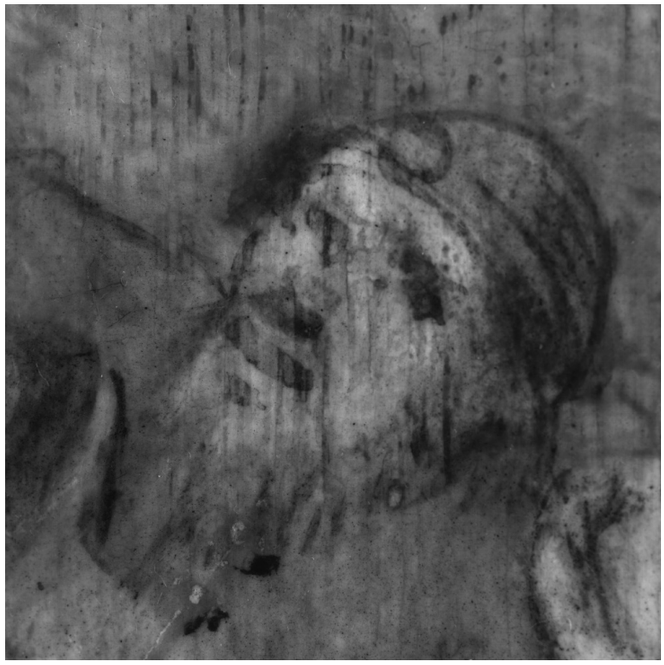
In addition to similar shifts in contours, changes between the underdrawing and paint application phase in *Retinue of the Magi* (RR 61) include the raised arm of the figure in the central

26.1 RR 59, VIS

26.2 RR 59, IRR

26.3 RR 61, VIS

26.4 RR 61, IRR



26.5 RR 61, IRR macro

background, which was drawn wider and longer than the current painted arm.

Paint layers

The oil paint (not analysed) was applied with the brush in multiple stages, mainly wet-on-dry. In *Retinue of the Magi* (RR 61), some wet-in-wet painting was also observed, and the back of the brush may have been used to create incised lines; for example, to indicate the brickwork in *Two Shepherds* (RR 59).

Glossy paints were applied in thin but mainly opaque layers. Glazes were locally mixed with other paints; for instance, the red glaze in the red cord on the robe of the cropped figure at left in *Two Shepherds*. Glazes were also used for dark reinforcements, such as the brown-red lake used for the dark area below the robe of the cropped figure. In *Retinue of the Magi*, red glazes were used for some clothing and local detailing, as in the folds of the white coat at right. The painting was worked out to a fairly high level of detail, with many small highlights.

Generally, the paint surface is rather smooth, with some local impastoed areas. Although the texture of brushstrokes is present, overall the surface has taken on the texture of the ground, which became more visible over time due to abrasion. Paints are often blended, resulting in smooth transitions, as in the face of the left-hand shepherd in *Two Shepherds*.

Paint was applied from dark to light but also from light to dark, as in glazes. The composition was built up from background to foreground, leaving areas in reserve, and followed by later detailing in the background. Those areas left in reserve are often smaller than the forms in the final composition, as paint overlaps the background in multiple areas. Reserves in *Two Shepherds* include the main figures but not the dog.

The ox and the ass in RR 59 were not prepared in the underdrawing but painted over the already-completed background. These animals appear to have been painted out in RR 109, the Paris *Adoration of the Magi* (see cat. 26c). This apparent shift in the placement of the ox and the ass supports the argument for the proposed reconstruction.[4] Other pentimenti in *Two Shepherds* include the dog, which was painted over the figures. Also, the rearmost foot and clog of the right shepherd overlap the foot of the man behind him. The hand with the wind instrument was left in reserve smaller and was then painted partially over the background.

In *Retinue of the Magi*, several major changes were observed in the paint application stage (compare the XR, fig. 26.7). The brown horse was significantly enlarged. The two figures in the centre with the pointed blue and blue-and-brown hats were painted atop a single bearded figure that had been prepared in the underdrawing and fully painted. The light grey horse at left was also added, as another horse was initially left in reserve from the background below it. The chain mail of the figure above that was fully painted before a brown jacket was added. His red hat was originally embellished on the right with a bluish plume, now painted out with foliage. The round hat to the right with the blue straps was first painted with a large spike on top. Below that, on the back of the horse, a small creature facing left (perhaps a monkey) was initially painted but later replaced with the dog with the jester's cap.

The colouring in *Two Shepherds* is somewhat muted, and only a few highlights were applied, mainly in yellow and white. The light rim on the left shepherd's hat was built up on a brown base with a greyish blue that contains both blue and red lake pigments, followed by lead-tin yellow. The legs of the foremost shepherd were painted in a dark grey layer first, then a light grey one. His clogs were painted after the landscape, but before the brown, which may be a discoloured glaze.

The colouring in *Retinue of the Magi* is more diverse than that of its pendant. Mainly lead-tin yellow and white highlights were used, locally mixed with red, as at the tip of the scabbard. The shield has a grey base, succeeded by highlighting and shadowing. The circles on the white cloak of the figure at the far right were painted in mixtures of green and blue, and the folds with red lake. Like the cloak, the hat and garment of this figure also have a lead-white base, which was followed by a brownish-red paint and detailing in grey and lead white. Beards were mainly done in brown, blue, or a combination thereof. The plant in the central foreground has a dark brown base, with ensuing green and then lighter paints. The background foliage seems to have a discoloured green-brown base, followed by green and yellowish dabs of paint. These dabs are followed by lighter paint dots, although only in places. The crescent moon on the left banner was painted in lead-tin yellow, with some red mixed in underneath.

Condition

The panels are framed with stiff metal strips in a modern, rabbeted frame. Although the surface is protected by felt, the framing has resulted in damage to the varnish, paint and ground at the edges.

The original panels were thinned and set in an oak tray before the latter was laminated with plywood. In the bottom left of *Retinue of the Magi*, an old fracture extends c. 11.8 cm from the panel edge, running along the wood grain. At the right edge of this panel, XR reveals a fracture running the entire length of the support. This is a fracture in the oak tray and is not present in the original panel.

In the paint of *Two Shepherds*, both drying cracks and ageing cracks were observed, but in *Retinue of the Magi* only ageing cracks were noted. The adhesion of the layers is good. The surface is somewhat abraded overall, especially on the raised ridges of the textured ground or underlying paint layers.

Locally there are some retouchings. The varnish is uneven, and the surface is rather matte, with glossy spots from fingerprints.

26.6–7 RR 59 and 61, XR

[1] For a variety of practical reasons, some of our research reports were produced in an abbreviated format, which resulted in a slightly different lay out. This concerns seven reports: cat. 3 (RR 155–156); cat. 23 (RR 63–68); cat. 26A–B and 26C (RR 59–62 and RR 109–110); cat. 32 (RR 87–88), cat. S2 (RR 111–112); and cat. S3 (RR 113–114).

[2] See Friedländer 1927, 144; exhib. cat. Worcester and Philadelphia 1939, 32–33; Silver 2015; BRCP, *Catalogue Raisonné*, cat. 26.

[3] In the *Passion Triptych* in Valencia (RR 91–96). See also the entry on the Philadelphia fragments in BRCP, *Catalogue Raisonné*, cat. 26.

[4] See further BRCP, *Catalogue Raisonné*, cat. 26. See also the following pages on the *Adoration of the Magi* in a private collection (cat. 26C, RR 109–110).

26

Fragments of an Adoration of the Magi Triptych

C *The Adoration of the Magi*

BRIEF RESEARCH REPORT 109–110[1]

Follower of Hieronymus Bosch
c. 1515–35

Oil (not analysed) on oak (analysed) panel, 70.8 × 55.6 cm.
The frame is modern. The original engaged frame is lost.
Private collection, Paris

BRCP, *Catalogue Raisonné*, cat. 26C; www.boschproject.org no. 26C.

Inscriptions and labels
Panel reverse, top left, an insurance label. On the added vertical bar in the centre are three French customs stamps, and 37 is written in blue crayon; top right: another round stamp.[2]

SUMMARY OF CONCLUSIONS

The Adoration of the Magi *in a private collection in Paris was painted by a follower of Hieronymus Bosch, as the painting technique and style of the underdrawing are highly atypical for the group. Although some shifts of contours and other small deviations from the underdrawing were observed, the composition was not developed there but copied after an existing model. Friedländer suggested that this* Adoration of the Magi *functioned as the central panel of a triptych, and that the* Retinue of the Magi *and its pendant panel,* Two Shepherds *(both in the Philadelphia Museum of Art; cat. 26A–B), are fragments of what once were its wings. That notion could not be conclusively supported or excluded by the outcomes of this technical study. However, as explained in* BRCP, Catalogue Raisonné, *cat. 26, this reconstruction can be accepted on art-historical grounds since a later, complete copy of such a triptych exists. The* Adoration of the Magi *in Paris was not painted by the same hand that produced the wing fragments in Philadelphia.*[3] *The panel was originally housed in an engaged frame, now lost. Dendrochronology indicates that it could have been painted from 1501 onwards, although a date after 1503 is statistically more probable.*

RELATED WORKS

See cat. 26A–B.

ADDITIONAL INFORMATION

The painting was examined and documented at the Noordbrabants Museum in 's-Hertogenbosch on 23 October 2013. XR data was not available at that time.

Dendrochronology indicates that the youngest heartwood ring dates from 1490, which, with the added minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1499 for the tree that provided the wood.[4] An earliest felling date of 1501 is statistically more probable, however, since that would cover 93 per cent of the range of possibly missing sapwood rings. Assuming at least two more years for drying and transportation, the panel could have been produced from 1501 onwards but a production date from 1503 onwards is statistically more probable.

OBSERVATIONS

Support

The panel's maximum thickness is about 1 cm. It consists of two planks, vertical in grain, laid vertically. Tool marks on the reverse, resembling gouging, seem to be original. At some point in time, the reverse was coated in black paint on a white ground. Later, a vertical reinforcing bar was partly inserted into the reverse, covering the entire join, presumably after the panel had been rejoined.

Preparatory layers

The barbs and ungrounded edges present on all sides of the painting indicate that it originally had an engaged frame. The light-coloured ground was applied overall and appears to be off-white

RR 110

RR 109

in hue. It was laid on thinly, causing the warmer tone of the wood to shimmer through in places. Overall, the surface texture of the wooden support is evident. Locally the vertical wood grain is visible, as not all pores are filled with ground, and some are even without paint.

The composition was underdrawn throughout, but less so in the background landscape (fig. 26.10). The underdrawing is locally visible with the naked eye, shimmering through in multiple areas, such as in the frieze supporting the roof construction at top right (fig. 26.8). The underdrawing is much better revealed with IRP and IRR.

The preparatory drawing was applied in a liquid medium and in different stages. The style of the carefully placed areas of parallel and cross-hatching does not compare well with other works in the group. Several hatched lines are broken up, apparently because of an irregular underlying layer, perhaps the ground.

26.8 VIS

26.9 VIS

Changes can be found in the underdrawing phase itself and between the underdrawing and painting stages in multiple instances. For example, the right arm of the Christ Child was drawn in a lower position, and the head of the king at right was planned more in profile. The underdrawn figure in the window in the back wall was never executed in paint but is discernible shimmering through the bluish paint (fig. 26.9).

Paint layers

The oil paint (not analysed) was applied using a brush in multiple stages. The painting was consciously built up utilizing underlying layers, resulting in greater depth. Overall the paint surface is fairly smooth, with local impastoes. Textured brushstrokes are visible in red areas where undermodelling containing lead white was followed by a thinly applied red lake glaze. These red sections might have been executed first, as the greyish foreground appears to overlap the red robe. Other areas were built up from background to foreground, leaving elements in reserve.

The foot of the kneeling king was left in reserve smaller and partly overlaps the grey. The lines indicating tiling appear to have been scratched into the grey paint.

For the dark, purplish purse of the kneeling king, no carbon black was used in the paint mixture, as the paint remains IR-transparent.

The brocade shoulderpiece of the kneeling king was painted in a dark blue base, then ornamented with red lake shapes and many finely hatched lines in lead-tin yellow, resembling metallic threads. A copper-green lake was used for the robe of the rightmost king.

The white paint of the lower sky area was applied in vertical brushstrokes; it extended below the horizon and was later covered by the upper background landscape. Lead-tin yellow was extensively used to render gold objects, followed by lead-white highlights. Gold leaf was applied on the star visible through the hole in the roof. A pentimento is apparent in the upper part of Mary's chair, which was painted over the red lake curtain.

CONDITION

The panel reverse has been damaged in multiple areas by micro-organisms. No traces of active wood-boring insects have been found. At the join, just above the opening in the roof, a slim, rectangular crack is discernible that is a direct result of issues caused by a dowel. Cracks were noted in the left side of the painting at both top and bottom. The bottom crack appears to be unstable and seems to extend through paint, ground and panel.

The paint surface is abraded overall, certain parts being more damaged. Areas of thinly applied, sensitive paints and the highest points of more impastoed paints are in particularly poor condition. The abraded impasto results in the presence of unintended lighter-coloured lines where the red glaze has worn off.

Several areas were heavily reworked. The ox and ass in the architectural space behind the fire are hardly visible, but they were in fact underdrawn and possibly painted, too, as was the sarcophagus from which they eat as a trough. The animals were apparently painted out in a later stage, which is important since the ox and the ass in RR 59 (cat. 26A) were not prepared in the underdrawing but painted over the already-completed background. This apparent shift in the placement of the ox and the ass from the central panel to the left wing supports the argument for these three panels having formed a triptych.[5]

The paint surface is in poor condition, with numerous retouchings and a highly yellowed varnish with multiple damages. Many retouchings are discoloured, having become lighter. This is probably a result of degradation of the zinc-white pigment within the retouching mixtures.

An increase in transparency, especially of lighter paints, and fading of red lake layers have caused an unintended increase in visibility of the underlying layers and underdrawing.

Multiple small, circular shapes are detectable just below the pentimento in Mary's chair, in both the greyish and the red lake paints. These are perhaps caused by the texture of an underlying stratum – possibly air bubbles in the ground layer.

26.10 IRR

[1] For a variety of practical reasons, some of our research reports were produced in an abbreviated format, which resulted in a slightly different lay out. This concerns seven reports: cat. 3 (RR 155–156); cat. 23 (RR 63–68); cat. 26A–B and 26C (RR 59–62 and RR 109–110); cat. 32 (RR 87–88), cat. S2 (RR 111–112); and cat. S3 (RR 113–114).

[2] The panel was sent to New York on three occasions: in 1928/29, 1938 and 1948 (email communication by the owner, 10 April 2015).

[3] See further BRCP, *Catalogue Raisonné*, cat. 26, on this painting and the Philadelphia fragments.

[4] The planks came from the same tree. Report by Peter Klein, 21 December 2011.

[5] See note 3 above.

27 *The Crowning with Thorns*

RESEARCH REPORT 157–158

Follower of Hieronymus Bosch
c. 1530–40

Oil (analysed) on oak (analysed) panel, 157.5 × 195.8 cm
Monasterio de San Lorenzo de El Escorial / Patrimonio Nacional, Madrid, 10014743

BRCP, *Catalogue Raisonné*, cat. 27; www.boschproject.org no. 27.

Inscriptions and labels
H and sun symbol on the horn on the right; *371.* in white paint at bottom left; *32.* in white paint at bottom right.
Reverse: in the centre there are residues of white chalk and paint; at centre right, there are traces of chalk markings; to the left of that, *42* is painted in black; on the upper right button block, *Escorial* is written in pencil; bottom right, a lumber mark is incised into the wood.
On the reverse of the frame, top left, a torn remnant of a label; at bottom centre, *10X1* (?) is written in red crayon; to the right of that, *4* is written in pencil.

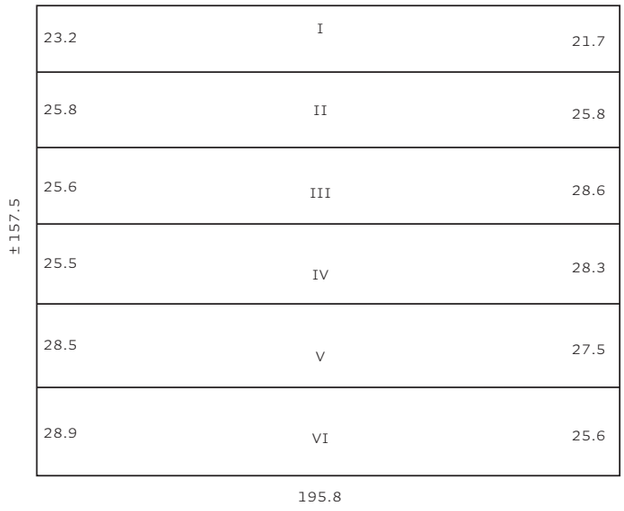
SUMMARY OF CONCLUSIONS

The findings from the technical examination confirm that the Escorial Crowning with Thorns *was painted neither by Hieronymus Bosch nor by his workshop. Neither the painting technique nor the style and material of the underdrawing bear comparison with those of works in the core group. Dendrochronology indicates that the panel could have been painted from 1527 onwards, although 1529 is statistically more probable. The panel was probably constructed and then painted using a temporary work frame. The panel was originally housed in a (now-lost) rabbeted frame, which also points to a date of production after the death of Hieronymus Bosch. As further explained in* BRCP, Catalogue Raisonné, *we date this work to around 1530–40.*

RELATED WORKS

Two similar but apparently slightly later versions of the *Crowning with Thorns* in the Escorial have survived: the central panel of the *Passion Triptych* in Valencia (cat. 28, RR 91–96), the other in the Museo Lázaro Galdiano, Madrid. A relation of these three works with the *Crowning with Thorns* in London (cat. 14, RR 142–143) has also been suggested in the literature. See cat. 28, note 1 for more information and references.

27.1 Construction diagram (seen from the front)



EXAMINATION DATA

26–29 October 2015 (Robert Erdmann, Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Hanneke Nap, Ron Spronk, Daan Veldhuizen).

The panel was examined upright in its frame in a gallery space. Both front and reverse were accessible, and the panel was briefly unframed in part to study the panel edges.

- ***Previous research and additional documentation available*** XRS were available for study. See also the information in Van Schoute, Verougstraete and Garrido 2001; Van Schoute, Verougstraete and Garrido 2003; as well as Parra Crego 2005 and Patrimonio Nacional 2005 (unpublished reports, held in research archives of Palacio Real/Patrimonio Nacional, Madrid).
- ***Previous treatments*** The documentation file mentions that in 1990, the condition of the painting was good, but with a degraded varnish and some retouchings. The panel underwent full treatment in 2004–05, and the framing was adjusted. At that time, too, eleven cross-sections were examined and documented.

SUPPORT

- ***Panel*** Dimensions: see construcion diagram (fig. 27.1).[1] Thickness of left, right and bottom edges (with half-lap): c. 7–10 mm; top edge (without half-lap): c. 11–13 mm.

  The wood species, Baltic oak, was identified through dendrochronology. The panel consists of six planks, radially (quarter-sawn) and off-radially cut, horizontal in grain, laid

RR 158

RR 157

horizontally. Sapwood was observed in the middle of the top edge of the bottom plank. It may also be present in the centre of the third (bottom) and the fourth (top) planks. The planks were butt-joined, reinforced internally at each join with five long dowels, and glued.

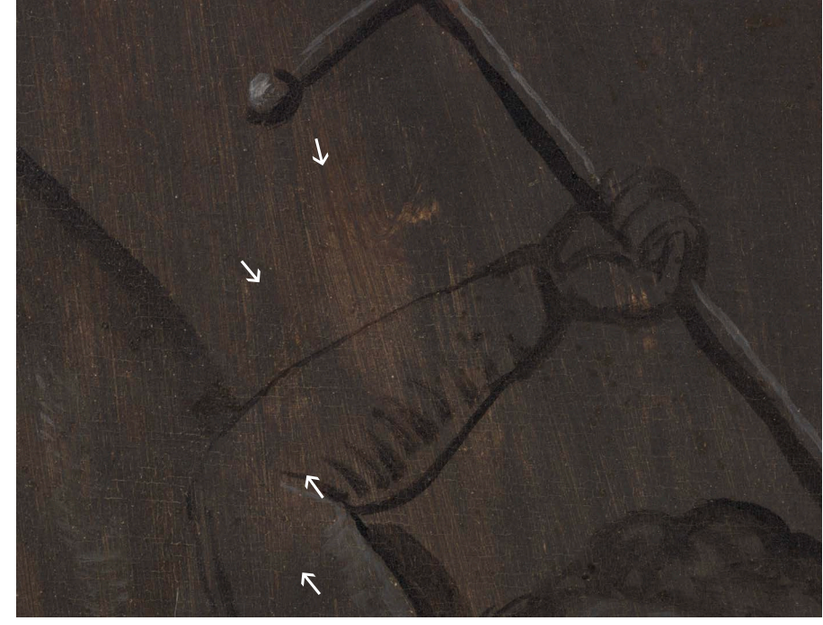
The panel reverse (RR 158) is largely original, although five large, horizontal sections were thinned or locally chiselled to allow the attachment there of non-original reinforcing button blocks. Tool marks from sawing, planing and gouging were observed. In the bottom plank is a partly preserved lumber mark of an anonymous sixteenth-century forester on the Vistula river.[2]

- ***Bevelled or half-lap edges*** Rough original bevelling is present, mainly at the left and right edges of the reverse. Both the lateral and bottom edges were worked into a half-lap. While the half-lap at the left edge is wider at the bottom, the one at the right edge is wider at the top – a situation that matches the barbs on the front of the panel (see *Barb and edges*). The half-lap at the bottom edge is considerably wider, measuring about 20–22 mm, but no barb is present on the bottom edge of the front. The top edge was not worked into a half-lap and there too a barb is lacking on the front.[3] The panel shows no signs of being cropped, and ground and paint overlap the top edge. We may therefore conclude that during the construction of the panel, the half-laps were applied to fit a temporary frame, of which the lateral elements were left in place during painting (see also *Barb and edges*).
- ***Dendrochronology*** The youngest heartwood ring dates from 1516, which, with the added minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1525 for the tree that supplied the wood for that plank.[4] An earliest felling date of 1527 is statistically more probable, however, since that would cover 93 per cent of the range of possibly missing sapwood rings. Assuming at least two more years for drying and transportation, the panel could have been produced from 1527 onwards, but a production date from 1529 onwards is statistically more probable.

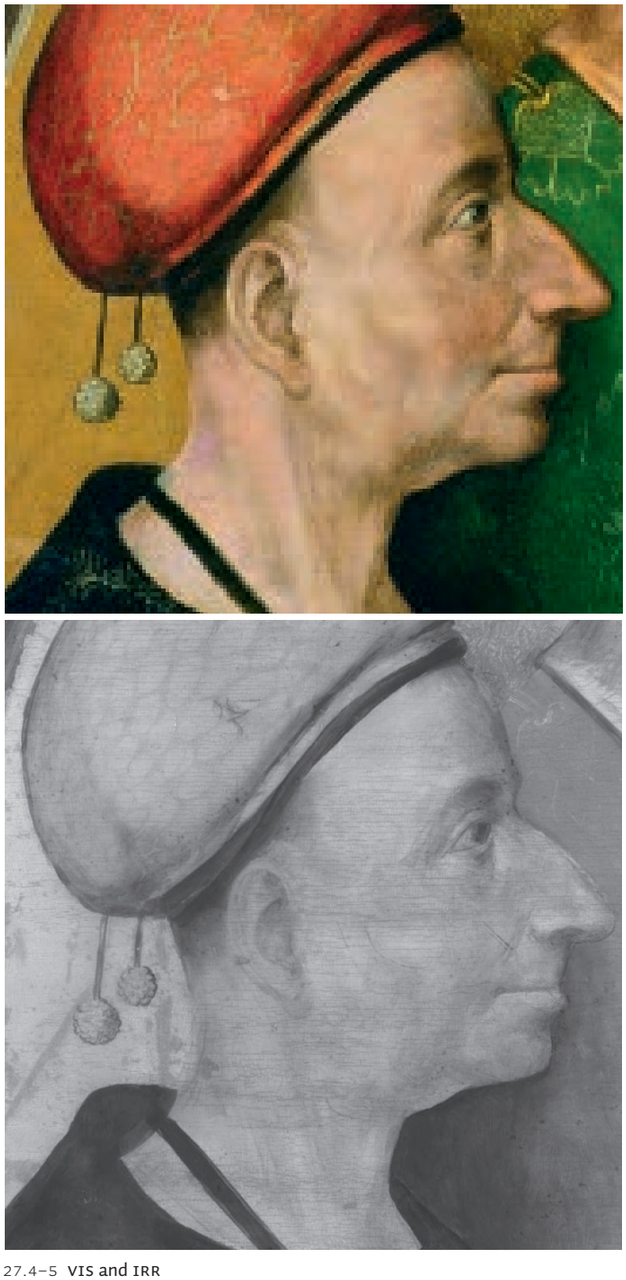
GROUND

- ***Visibility*** The brush-applied, off-white coloured ground was not fully covered by the paint layers. It can be observed in VIS in small losses, along panel edges and also at multiple painted contours. It was left exposed in several areas, as in the eyebrows of the man at bottom right (fig. 27.2). The visibility of the ground tone, which shimmers through slightly, may have been intended in certain areas. The ageing of paint layers has likely increased their transparency and thus the perceptibility of the underlying strata, especially in lighter zones.
- ***Barb and edges*** Unpainted and ungrounded edges, as well as traces of barbs, were observed on the left and right sides of the panel.

27.2 VIS



27.3 VIS



27.4–5 VIS and IRR

Ground and paint do, however, continue to the top and bottom edges.[5] Since there are no indications that the dimensions of the panel are not original, the fact that barbs and ungrounded edges are only present at the left and right edges (which match the half-lap edges on the reverse), seems to point to the use of a temporary work frame rather than an engaged frame. This work frame was probably applied during the production of the panel, with the frame's left and right members kept in place during the painting process and only removed after the work was completed. This implies that the panel, rather than having been painted within an engaged frame, was originally placed in a rabbeted one. Such frames, to our knowledge, only started to be used between about 1520 and 1525, becoming the norm thereafter.[6]

- ***Composition*** The ground consists of chalk (calcium carbonate – $CaCO_3$) bound in an animal glue.[7]

PREPARATORY LAYERS

- ***Underdrawing*** Underdrawing was observed in multiple areas, but not throughout. It is best visible in the lower part of the tondo: in the head of the man on the left (figs. 27.4–5), in the leg and the slab below it, in Christ's robe, and in the pink sleeve. In the latter especially, the preparatory drawing shimmers through the paint in VIS. Its current visibility is likely caused by changes in refractive index due to the ageing of the paint film, resulting in an increased transparency. Also, red lake may have faded locally. The underdrawing, which was used only as a rough indication of the composition, is better revealed in IRP and IRR. No underdrawing was observed in the *brunaille* around the tondo. In the lower left, brownish red lines are detectable above the angel's wing tip and at the raised arm (fig. 27.3). These lines show in VIS, but are barely visible in IRP/IRR. They probably relate to the brownish background paint rather than to underdrawing.

  Many scratched lines are discernible (for example, in the area of the raised arm), which, in view of their irregular positioning, seems unrelated to the preparation of the composition.

- ***Medium and application*** The detectable underdrawing was applied in a dry medium that possibly included a fatty substance. The fairly continuous lines were applied in at least two stages. Apart from the underdrawn black lines, some brown-red ones are also visible in the underdrawing of the bottom left of Christ's mantle, apparently indicating the contour of the tondo (fig. 27.7). These lines register in IRP/IRR (fig. 27.8), unlike the brown-red lines in the lower left of the *brunaille*.

- ***Style*** The revealed underdrawing shows a rather simple, straightforward approach and rough execution. The strokes vary from relatively narrow and sharp to broad and rather soft. Below Christ's mantle clasp, some broad hatching is visible in IRP/IRR. The artist appears to have quickly indicated the composition, after which it was painted.
- ***Revisions in underdrawing and differences from painting stage(s)*** The painted composition deviates in multiple places from the underdrawing, but that seems to be related more to the rough and sketchlike nature of the preparatory composition than to a creative process. Major changes were not observed.
- ***Intermediate layers*** Not observed. According to Parra Crego, the surface of the ground was impregnated with drying oil.[8]

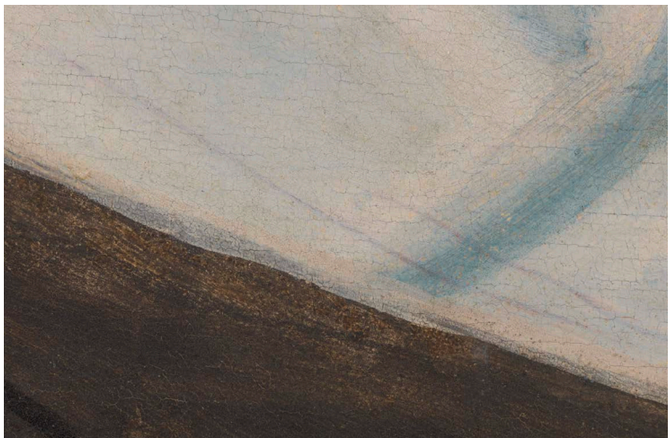
PAINT LAYERS

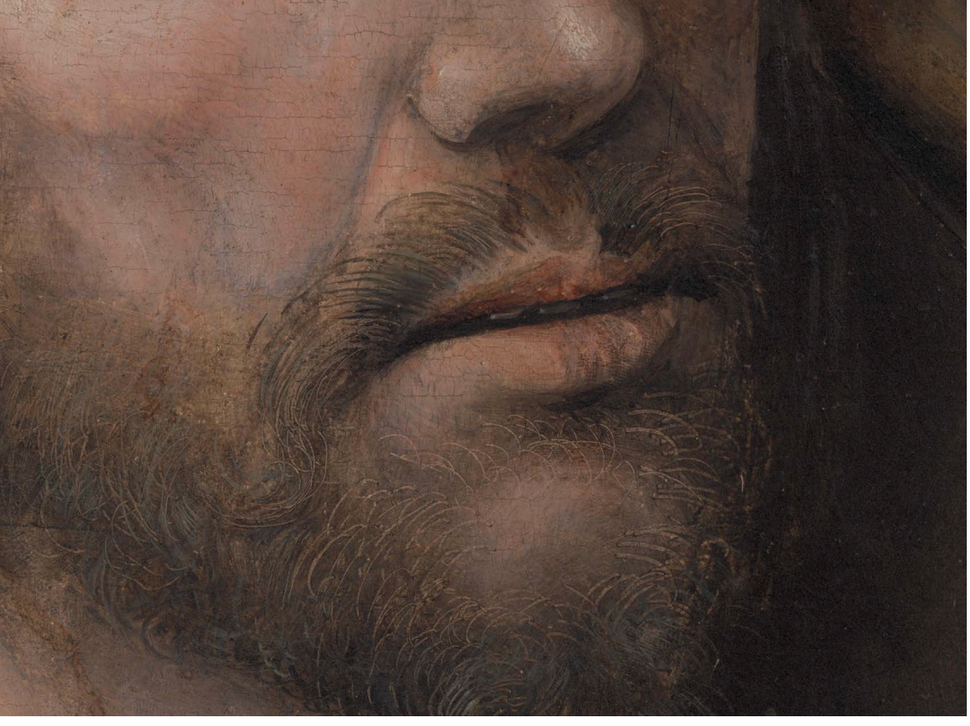
- ***Binding medium*** Linseed oil (analysed).[9]
- ***Paint application and painting technique*** The brush-applied paint extends from the top and bottom panel edges to the barbs at the left and right edges. In many areas it was reworked, apparently with fingers and perhaps a piece of cloth. Paint was applied in several stages, mostly wet-on-dry, but also wet-in-wet. Incisions made in the wet paint were noted in the facial hair of Christ (fig. 27.9) and in the legs, tail and chest of the double-headed eagle on the medallion.

  Paints were applied in both opaque and semi-transparent layers, with large areas being glazed with red or green lakes. The paints were generally applied wet or slightly dry, for many brushstrokes are still

27.6 IRR

27.7–8 VIS and IRR





27.9 VIS

27.10 VIS

apparent, and the surface does not appear very glossy. The use of very wet paint was also observed locally, for instance in the neck and red collar of the man with the green robe, where paints have contracted and broken up, forming droplets and appearing watery (fig. 27.10). The pinkish grey cap of the man at bottom right consists of many adjacently-placed wet-in-wet dabs. Brushstrokes rendering contour and volume were applied in multiple directions throughout the painting, but generally follow the forms in the composition. The latter was mostly built up in one or two paint layers, but was not worked out to a high degree of finish, and, locally, areas of ground remain exposed. Detailing is not very crisp; see, for example, the two pendant spheres of the headgear and the decoration on the clothing (fig. 27.4). The paint surface also has a rather sketchlike appearance. Contour lines were only applied in certain places, such as around the bell of the horn at centre right. The artist likely used his fingers, and possibly a piece of cloth as well, to apply the imprints found throughout, as seen above the ear of the man on the left.

Hatching in paint is evident all over the pictorial surface. In the *brunaille* composition, extensive hatching in white, black and brown is visible. In the tondo it is mostly found on the gold background, in facial hair and in areas of skin tone, where it indicates shadows. In the hand holding the sceptre and in the one holding the bottom of the wooden rod (fig. 27.11) – that is, where the brushstrokes are more muddled – this technique does not work convincingly. The hatched lines of most eyebrows go against their natural direction. Remarkably, the hairs of Christ's moustache go upward (fig. 27.9). The incisions around his chin are positioned in a similar way, followed by additional brushstrokes in rather dry paint to create the finer hairs.

- ***Texture*** Most passages have a relatively smooth finish, although the texture of brushstrokes is often slightly visible. The use of thick lead-tin yellow and lead-white paints has not resulted in strong impasto; see, for example, the two pendant spheres hanging from the hat of the man far left.
- ***Build-up and palette*** The paint was applied mostly from light to dark, followed by a final application of lighter details and highlights. Paint application was planned and executed from back to front, leaving areas in reserve. It appears that the skin tones were left in reserve from the clothing and that larger elements, such as the wooden rod, the bell of the horn and the sceptre, were painted after the skin tones. The sceptre was also roughly left in reserve from the green and red paints of the clothing, whereas the horn was added over it. The brown-grey background of the *brunaille* was roughly brushed on after the clothing but before the gold background. The late application of the gilding is surprising. It roughly leaves in reserve the men's hair, the mouthpiece of the horn, the crossbow bolt and even the two pendant spheres on the red headdress. The final details of these and other smaller elements, as well as the hair, were painted afterwards. Also applied after the gold was the detailing of the brunaille composition. The black outlines were painted on the brown-grey background. White to greyish paint was then laid on thinly to cover small areas, but more opaquely and in sharper lines for contours and hatching. Possibly afterwards, black hatching was applied, along with brown lines and hatching, as in the bottom right corner. Finally, a whitish contour was painted around the tondo, covering the edge of its composition and part of the *brunaille*.

  No red lake, either as glaze or as pigment mixed in with the paint, was found in Christ's robe. The artist used contemporary pigments and a traditional layer build-up, as deduced from eleven previously taken cross-sections and their analyses.[10]
- ***Changes*** Not observed. In a few areas paints do overlap, as in the neck of the man at left, in the stone overlapping the red mantle at bottom left, and the horn painted atop the red robe at upper right.

FRAME

The rabbeted wooden frame is modern. The moulded sections are water-gilded, and the sides are painted in an ochre colour.

CONDITION

Support

- ***Altered dimensions*** There are no indications that the panel did not retain its original dimensions. A small section of wood and paint is missing from the bottom right edge (seen from the front). The panel reverse has been thinned in several areas to accommodate later reinforcements, for which multiple slots were carved along the joins.
- ***Additions*** Thirty non-original button blocks reinforce the joins on the reverse.

27.11 VIS

- ***Cracks*** Four old and apparently stable cracks were observed. Two extend from the left edge, at the tip of the angel's wing in the lower left. Two longer cracks extend from the upper right edge; the top one, being longer, connects to the top join.
- ***Deformations*** The panel shows a convex warp at the top centre and a concave warp at the bottom centre (seen from the front).
- ***Joins*** The five joins in the central panel are closed. Local differences in level were observed, but the planks have never been separated, with the possible exception of the top two.
- ***Coated reverse*** A thin, brown stain (now damaged) may have been applied to the reverse of the panel.
- ***Biological damage*** Several small areas of woodworm damage are visible on the panel reverse.

Ground and paint layers

- ***Stability*** In general, the adhesion of both paint and ground seems very good. Most craquelure is caused by natural dimensional changes of the wooden panel. Broader drying cracks can be found where coarse azurite was applied thickly with a lot of medium, as in the blue undergarment of the man holding the rod.
- ***Losses*** Only minimal losses of paint and ground were observed. Past, retouched damages are concentrated around the joins. Other losses are visible around the edges of the panel, especially at the worn top and bottom. Old scratches and small dents are visible throughout, for instance in the face and hat of the man holding the rod. Some form of mechanical damage has resulted in a series of short, parallel indentations in the image of the metal gauntlet.
- ***Abrasion*** Overall, the painting is only slightly abraded.
- ***Discoloration and increased transparency*** The copper-green glazes have turned slightly brownish. Red glazes have faded more, especially in the arm of the man at bottom right, where a light underlayer was utilized. A general increase in transparency is evident in some of the lighter paints, causing the underdrawing to shimmer through. This is visible, for instance, in the lower part of Christ's mantle. Also, the whitish contour of the tondo has become more transparent, as is evident in the uneven edges of the gilding.
- ***Filling, retouching and overpainting*** Most areas of the painting are well preserved. The generally small losses of paint and ground are old and concentrated around the joins and edges; they have mostly been filled or inpainted. Matte spots of retouching are found in several areas, such as the gold background. Subtle retouchings, however, are found throughout.

Surface finish

- ***Varnish*** The appearance of the modern resin varnish is regular, with an even gloss.
- ***Surface dirt*** At the time of the examination, there was hardly any surface dirt on the painting.
- ***Visibility of the original surface*** Overall, the painted surface of the panel is very legible. Local matte spots from retouching are only slightly distracting.

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[1] The panel was not fully unframed at the time of examination.

[2] We are grateful to Jørgen Wadum for sharing this information by email, 14 November 2015.

[3] On the top edge of the panel an incision (perhaps of a marking gauge) was found, at about 8–9 mm from the face of the painting. This roughly corresponds to the depth of the other half-lap edges and suggests that a half-lap edge was prepared there but not actually executed.

[4] Klein 2001. Data for individual planks are not available.

[5] The panel could not be studied fully out of its frame, which hampered some observations. But images made during the 2004–05 treatment show the painting without its frame.

[6] Rabbeted frames replaced engaged frames as the standard method of framing in the second half of the sixteenth century. The earliest known example of a rabbeted frame (the central panel of Van Orley's *Last Judgement* in Antwerp) dates from 1518 to 1525; see Verougstraete 2015, 68. We are grateful to Hélène Verougstraete for communicating her findings by email (6 February 2015) before her book was published. The second quarter of the sixteenth century was a period of transition during which both methods were used side by side.

[7] Parra Crego 2005.

[8] Parra Crego 2005, 3.

[9] Parra Crego 2005.

[10] Carbon black, iron oxide, yellow ochre, calcite, lead white, azurite, copper resinate, vermilion and red lake were found. Parra Crego 2005 and Patrimonio Nacional 2005.

28

The Arrest of Christ, Crowning with Thorns and Flagellation

Followers of Hieronymus Bosch
c. 1530–40 (central panel) and c. 1540–50 (wings)

Oil (not analysed) and gold on oak (analysed) panel, open triptych (including frames): c. 164 × 385 cm; closed: c. 164 × 192 cm
Museu de Belles Arts de València, Valencia, 264, 265, 266

BRCP, *Catalogue Raisonné*, cat. 28; www.boschproject.org no. 28.

Inscriptions and labels
Left wing (open): On the blade of the knife, M; signed, central panel, bottom left: *Jheronimus – bosch*; inscribed with H and sun-shaped mark on the horn and SPQR on the red sleeve. In the top left corner of each of the three panels,

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old inventory numbers remain in white paint: 69, 70 and 71, respectively.
Reverse: On the damaged imitation-stone sides, there are several non-original markings. An inscription in the closed left wing (RR 91), top right, seems to read, e[*m*]*me W* 11; a corresponding inscription on the right wing (RR 92), top left, seems to read *cou*[*r*] *N* 11. Other inscriptions on the closed right wing are better revealed by IRR: *Isabele*, *cou*[*r*] *N* 11, *H* and 77. A small metal inventory label, MUSEO SAN PIO V / VALENCIA / *Nr Inventario* / 264, is attached to a wooden strip on the central panel reverse.
On the frame: The flat section of the profiled central panel frame bears an inscription painted in black with grey highlighting: O BONE IESV PER CORONA HANC SPINEA · QVE TVVM MVLTIS PVNCTVRIS / VERTICEM DIVVLNERAVIT · PERQVE TAM TVRGIDAM [EV…?] / PERCVSSIONIBVS FACIE · LACRIMIS ET PLAGIS LIVIDAM · AC EFFVSO / SANGVINE SPVTISQVE FEDATAM · SERVA NOS INETERNVM.
On the reverse of the frame, a fluorescent yellow exhibition transport label is attached.

RR 93

RR 94

SUMMARY OF CONCLUSIONS

The findings from the technical examinations confirm that the Passion Triptych *in Valencia was painted by followers of Bosch. The painting technique and style and materials of the underdrawings do not compare with those of the works in the core group. Notable differences were observed in the painting technique and the style and materials of the underdrawings of the central panel on the one hand, and in those of the wings on the other. The construction of the original frames also differs, in that the wings are housed in engaged frames, while the central panel has a rabbeted frame. Probably, two different hands within the same workshop must have been responsible for the production of this triptych.*

Dendrochronology of the central panel indicates that the triptych could have been painted from 1517 onwards, although a date after 1519 is statistically more probable. The use of the rabbeted frame points to a production after about 1525, which excludes production within the family workshop. As further explained in BRCP, Catalogue Raisonné, *cat. 28, we date this work to around 1530–40 (central panel) and 1540–50 (wings).*

RR 95

RELATED WORKS

There are two similar compositions of the *Crowning with Thorns* in the central panel: one in the Monasterio de San Lorenzo de El Escorial (cat. 27), from which this panel appears copied, and the other in the Museo Fundación Lázaro Galdiano, Madrid. A relation of these three works with the *Crowning with Thorns* in London (cat. 14; RR 142–143) has also been suggested in the literature.[1]

EXAMINATION DATA

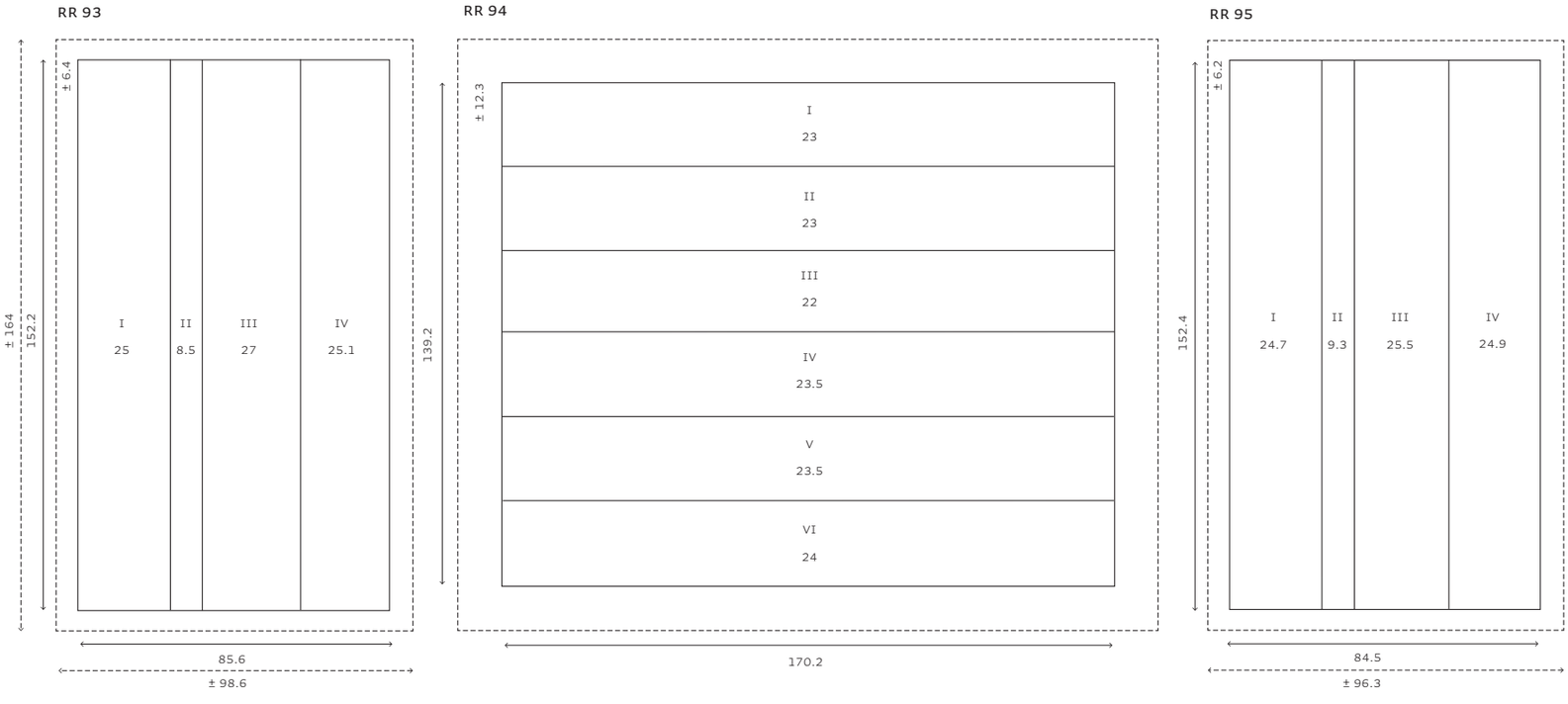
13–17 May 2013 (Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Ron Spronk).

The triptych was examined in the gallery. It was studied both upright on an easel and flat on a table, under strong illumination. The wings were in their original engaged frames, and the central panel was also studied in its frame.

- ***Previous research and additional documentation available*** Van Schoute, Verougstraete and Garrido 2001, 113–15; Ineba 2003, 58–63; Van Schoute, Verougstraete and Garrido 2003, 46–57.

  The museum's file on the painting holds some documents and many photographs of the work and its treatment. In addition to some IRR (Vidicon) details, there are several rolls of XR film documenting almost the entire painting.

- ***Previous treatments*** The triptych underwent a full treatment in 1998 by Julián Almirante Aznar, Lis Sebastián de la Cruz and María García Calvo.[2]



28.1 Construction diagram (open triptych)

RR 91

RR 96

RR 92

SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 28.1).[3] The wood species, Baltic oak, was identified through dendrochronology.

  The left and right wing consist of four planks, vertical in grain and laid vertically, the central panel comprised six planks, horizontal in grain and laid horizontally.[4] All planks are quarter-sawn. The planks were butt-joined, dowelled and glued. The dowels are visible in XR. Seen from the inside of the triptych, they were consistently first applied into the right or top planks, leaving some open space in the dowel holes of the left or bottom adjoining planks. The complete dowels in the wings are, on average, about 6 cm long and c. 0.4 cm thick. In the central panel, they are about 8 cm long and c. 0.7 cm thick.

  The central panel reverse appears to have been planed and sanded to apply the dovetail buttons (see also below, *Additions*), but some original areas and marks remain visible. The outer sides of both wings are painted in stone imitation.

  Original tool marks are barely visible, although gouging or planing appears to have occurred on the central panel.

- ***Bevelled or half-lap edges*** Examination was hindered by the presence of the original frames. In addition, non-original wooden slats almost completely cover the lateral edges of the reverses of all three panels. Although some thinning of edges was observed locally, the presence of original bevelling could not be determined with certainty.

- ***Dendrochronology*** The youngest heartwood ring of the central panel dates from 1506, which, with the added minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1515 for the tree that supplied that plank.[5] A felling date after 1517 is statistically more probable, however, since that would cover 93 per cent of the range of possibly missing sapwood rings. Assuming at least two more years for drying and transportation, the panel could have been produced from 1517 onwards, although a production from 1519 onwards is statistically more probable. The wings were not measured.

GROUND

- ***Visibility*** The off-white coloured ground (not analysed) is present overall on the open triptych. The ground on the faux-stone sides of the wings was analysed at the Stichting Restauratie Atelier Limburg (SRAL), Maastricht. It was found to consist of chalk, probably bound in animal glue.[6]

  The ground is discernible in VIS. Although the surface of the ground layer is almost completely covered by the paint layers, it is visible at some contours of the central panel, shimmering through, and at the outer edges of the wings (the edges of the central panel only being locally accessible for study), and in losses. Visibility of the ground appears to be unintended by the artist, but ageing effects have increased it in specific areas.

- ***Barb and edges*** The wing panels are still in their original engaged frames, as paint continues over the frame edge in certain places. The barb and ungrounded edges have been preserved in their entirety. Although the edges of the central panel could only be studied locally, no barb or ungrounded edges have been observed. It appears that the central panel was never painted in an engaged frame and thus lacks these features, although it may have been cropped slightly.

- ***Application*** The ground was applied rather thickly. Brushmarks are visible, mainly at the grisailles, but also locally in the open wings.

PREPARATORY LAYERS

- ***Underdrawing*** Underdrawing was observed throughout the open triptych, although this could not be determined with certainty for the semi-grisaille scenes. In some areas where the paint was applied thinly, the underdrawing can be seen in VIS, shimmering through the paint surface. IRP and especially IRR reveal underdrawing beneath the paint to a much larger extent. The drawing was generally fairly elaborate, but much more so in the central panel, where the modelling was also prepared through hatching. In the wings, mainly contours were underdrawn (figs. 28.2, 3 and 5). The current discernibility of the underdrawing in lighter areas was probably caused by the changes in refractive index due to the ageing of the paint film, resulting in an increased transparency.

28.2 RR 93, IRR

- ***Medium and application*** In the central panel the detectable underdrawing was applied in a dry medium, possibly charcoal or black chalk, and was apparently applied quickly in strokes of varying length.

  For the underdrawing of the wings, a liquid medium was used that was applied with a relatively small brush. The lines vary greatly, from fine to broad, from short to long, and with some showing much less black in IRR/IRP, which might indicate that this underdrawing was applied in multiple stages.

- ***Style*** In the central panel (RR 94), the use of dry, extensive, multidirectional hatching with varying spacing is striking (figs. 28.4 and 28.12). Parallel hatching in a free manner with long lines is visible, for example, at the exposed shoulder and upper arm of Christ. Around his eyes, too, many short, hatched lines can be seen. Locally, cross-hatching was used, as in the collar of the onlooker in the left background. Lines are mostly curved and can begin or end with hooks.

  The brushed underdrawing of the wings (RR 93 and 95) is quite sketch-like, with greatly varying lines. In general, they are rather irregular, and longer lines are often discontinuous. Lines are seldom straight, and shorter lines often end in a hook at the bottom. Frequently these latter are grouped, as in the cheek of the man holding the torch in the left wing. The broadest lines, such as those in the man's arm, have a painterly feel. Notably, the contours of each forward-facing nose are drawn with two groups of 'parentheses'.

- ***Revisions in underdrawing and differences from painting stage(s)*** Generally, the underdrawing was roughly followed in the paint application phase. In the central panel, aside from numerous smaller and larger shifts in composition, Christ's reed staff was not underdrawn, and his face was prepared in a more frontal position. The bird in the lower left was not underdrawn, nor were the owl and related motifs on the red sleeve in

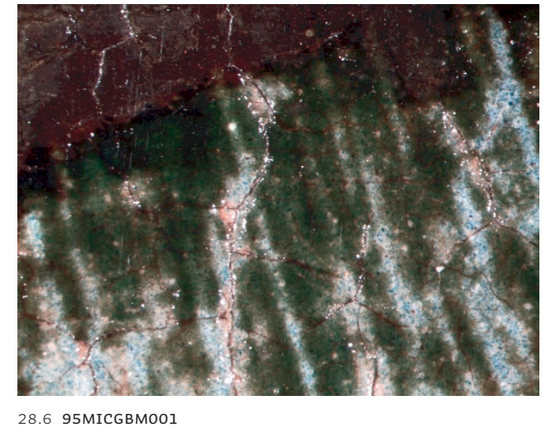
28.3–5 IRR

the lower right (figs. 28.11–12). The nose of the figure on the far left was painted significantly larger. The figures in the semi-grisailles do not appear to be underdrawn, but this could not be established with certainty.

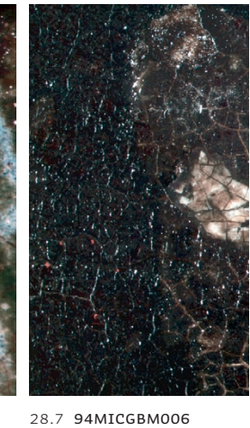
In the wings only shifts in composition were observed, some of which were quite substantial, such as at the head of Saint Peter in the lower right of the left wing.

PAINT LAYERS

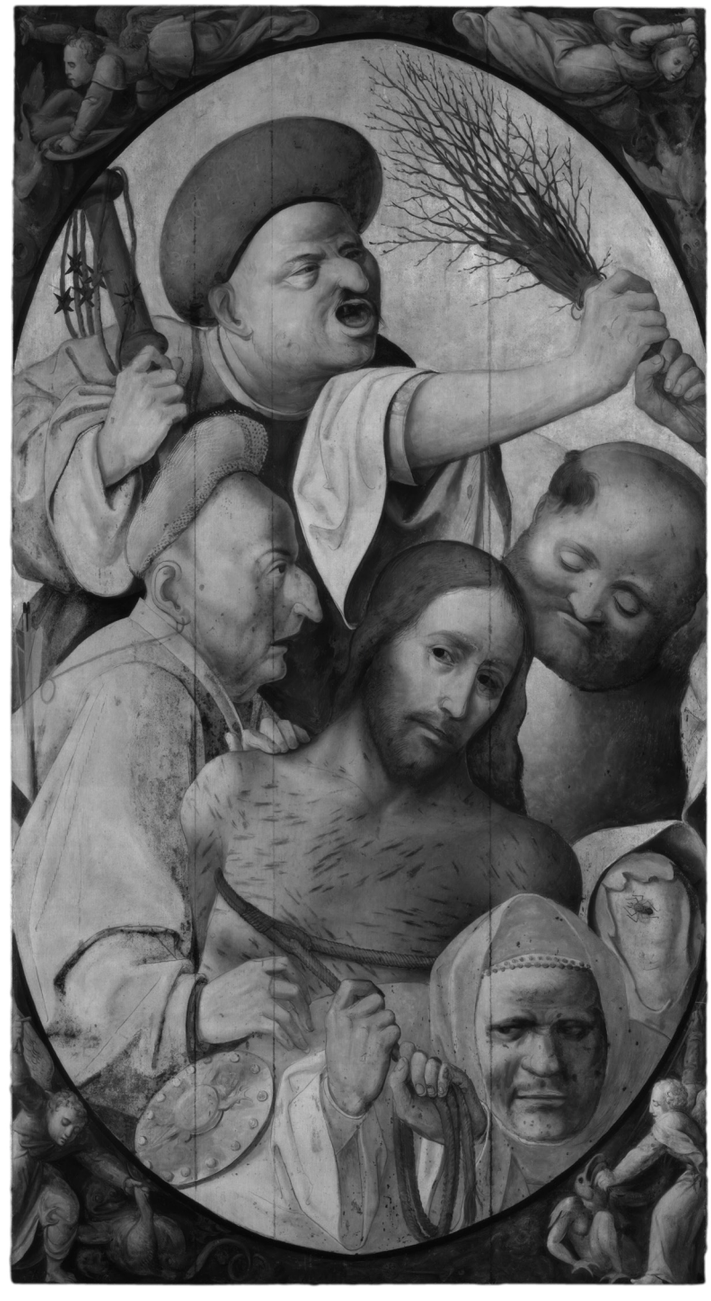
- ***Paint application and painting technique*** The presumably oil-based paint (not analysed) was applied with a brush, covering almost the entire surface of the panel. The ground is only seldom visible at the interface between different colours. Paint was applied in several stages, mostly wet-on-dry, but also some wet-in-wet, as in the mark on the blade and the angel in the semi-grisaille in the bottom right of the left wing. On the wings the paint extends up to the barb, as the panels were painted in their engaged frames. On the central panel the paint

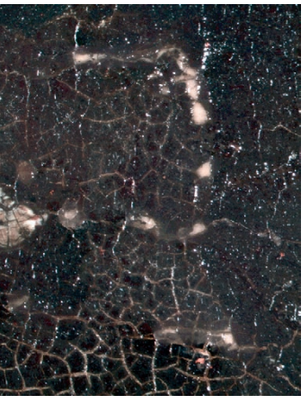


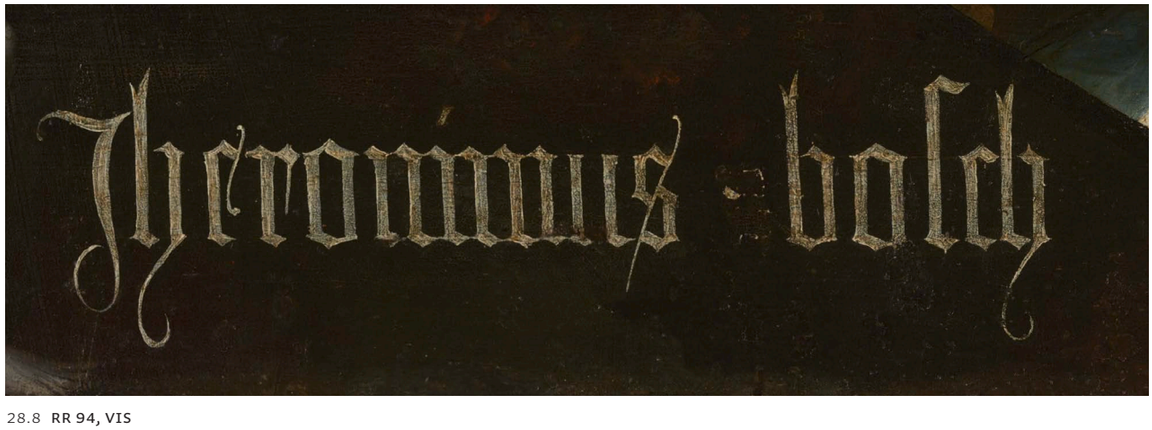
28.6 95MICGBM001



28.7 94MICGBM006







28.8 **RR 94, VIS**

extends up to the edges, which were possibly cropped slightly (see below, *Altered dimensions*).

Incisions were observed in the central panel, but not in the wings. Incised lines were used to indicate the contour of the tondo (visible in VIS and XR), with its centrepoint to the right of Christ's exposed shoulder. Other incisions (possibly made with the back of a paintbrush) can be found in the beard and moustache of Christ (fig. 28.9). In the wings, but not in the central panel, a form of dabbing (perhaps using a finger or sponge) can be seen frequently, mainly at the edges of skin-tone areas.

The mostly fluid, glossy paints were used in both opaque and semi-transparent applications. Generally, fairly thick and opaque paint layers cover almost the entire surfaces. Glazes were done in green and red, with more purplish glazes present in the central panel. There the artist painted more precisely and finely, whereas the wings were painted somewhat more roughly. The grisailles in the corners of the wings were treated with more plasticity than those of the central panel, and with an exaggerated contrast. The eyes in the central panel are generally more detailed and refined than those on the wings, which appear relatively flat. The eyebrows in all panels are more comparable, though, often consisting of fairly broad, dark brown hatchings. The moustache of the man in the left of the central panel was painted differently, with thin, light brown strokes, followed by thin black lines. The brown lines in Christ's moustache were followed by locally applied lighter lines, as well as incised, curved hatchings. This technique was not observed in the wings, but there the moustaches of both depictions of Christ do consist of initial dark brown lines, detailed by local light lines. Similar brown hatchings were used to indicate shadows in the fingers of the man holding the torch in the left wing (fig. 28.10). There also, local dabbing, perhaps with a sponge or finger, is visible. This technique appears to have been used to create subtler transitions to shadows and is mostly visible near contours of faces, arms, hands and fingers throughout both wings.

For all gold areas, gold leaf was employed, apparently applied onto a semi-transparent brownish mordant (95MICGBM002) that is redder in the central panel. In the wings, the subtle but more extensive use of greyish paints adds to their overall slightly cooler tone as compared to the central panel.

- ***Texture*** The paint generally has a smooth finish, with local impasto. The brushstrokes are often visible and follow the forms. They were probably used for some modelling, and somewhat thicker texture is visible at the outer edges of certain brushstrokes. In places, the texture of the brush-

28.11–12 RR 94, VIS and IRR

28.9 RR 94, VIS

28.10 RR 93, VIS

applied ground is discernible. Scratches in two of the fingers at the bottom left of the left-hand wing appear to belong to an underlying layer.

- ***Build-up and palette*** The closed triptych (RR 91–92) bears a colourful imitation stone, directly applied using the brush onto the white ground. It consists of alternating areas of red, blue and yellowish paint, running diagonally.

  For the central panel, the gold leaf was applied first, generally followed by robes and then skin tones. For clothing, often a light base layer or undermodelling was used. The XRS also indicate the presence of a radio-opaque layer, presumably containing lead white and/or lead-tin yellow, under the brown-discoloured green glazes in the hood of the man in the lower right of the central panel and in the robe of the man in the left background. The latter garment was decorated with a brocade pattern, which is currently better visible in IR. The Moses figurine on the staff was done with an ochre or umber base, presumably followed by ochre mixed with lead white for detailing, and then lead-tin yellow highlights and black shadows. It was painted onto the light blue underlayer of the sphere, with ensuing darker blue to blackish shadows, and then thin scumbles of lead white and impastoed lead-white highlights to suggest the glass.

  Both wings of the open triptych show a similar build-up to that of the central panel. Gold leaf was applied first, albeit on a more yellowish-brown mordant there, and skin tones were left in reserve from the robes. The skin tones also slightly overlapped clothing and gold, and the dark contour of each compressed tondo appears to have been applied in a final stage. Areas of red lake have a light undermodelling with lead white, blue and possibly some red lake pigments (93MICGBM005). Blue pigment does not appear to be present in red lake areas of the central panel. The fire of the torch consists of black, red lake, lead-tin yellow and vermilion paints. The flower stems to the right seem to be azurite based. In the central panel and the wings, brown contour lines were used to delineate fingers and fingernails.

  The signature in the central panel was applied between two incised lines, above and below the letters. A dash of paint forms a separation mark; the damages around it revealing the light ground are unrelated (figs. 28.7–8).

- ***Changes*** The underdrawing was largely followed during the paint application phase, generally with just a few slight changes, such as the shift in Christ's nose in the right wing. In the central panel, however, some elements were added after the initial composition was completed. Christ's reed staff was added late, as was the bird at the lower left. At the lower right the owl, the banderole, the thorny branches and the dots were painted over the modelled red sleeve (figs. 28.11–12) that had the same folds as the sleeve in the Escorial painting (cat. 27, RR 157). The arrow at the left centre of the right wing was not prepared by underdrawing, either, and was executed atop the painted robes.

FRAME

The frames of the triptych are original. The central panel has a rabbeted frame, while the wings are housed in engaged frames. Dimensions, RR 93: 163.5 × 95.7 × c. 5 cm; framing elements c. 6.4 cm wide; RR 94: 164 × 191.8 cm; framing elements c. 12.3 cm wide; RR 95: 163.6 × 95.6 × c. 5 cm; framing elements c. 6.2 cm wide.

The moulded and gilded frames have a brownish-black painted central section (bearing an inscription on the central panel [see above, *Inscriptions and labels*] and motifs on the wings) and a black-painted outer edge. The frames of the wings, together with the rabbeted frame of the central panel, were designed as a triptych. The single-hinge plates on both the left and right sides of the central frame appear original. On the wings, only the rabbets for hinge plates remain. Part of the closing device has, however, been preserved: the left wing has a metal eye, but on the right wing only the markings of the hook remain.

CONDITION

Support

- ***Altered dimensions*** The wing panels, though shrunken, have retained their original dimensions. Although the edges of the central panel could only be studied locally (the panel being studied in its frame), the original panel format seems to be largely intact. Its reverse, however, was planed and sanded, and wooden slats cover the left and right edges. It may have been cropped slightly, but the discontinuous form of the tondo at top and bottom can be explained by its being a 1:1 copy of the tondo in the *Crowning with Thorns* in the Escorial (cat. 27; RR 89–90). In the Valencian central panel, the corner compositions also fit accurately and appear to be nearly or wholly uncropped.
- ***Additions*** The central panel reverse was smoothed, presumably to apply the eighteen dovetail-shaped blocks covering the joins. Similarly, the imitation stone was scraped in places to apply twelve dovetail-shaped blocks on the joins of each wing. Locally, a reddish fill material was applied to the reverse of the central panel.
- ***Cracks*** There are some old cracks extending slightly from the left edge of the central panel.
- ***Deformations*** The panels have a somewhat convex deformation overall, with the opened right wing showing a slight 'belly'. The central panel is in a good condition, with a bit of washboarding but predominantly flat. The wooden supports of the wings, however, are in strong compression. This has resulted in long, broad areas of raised paint on the imitation-stone sides, as well as in narrow, finer and less pronounced areas of raised paint on the other sides – naturally, all in the direction of the wood grain.
- ***Joins*** Although nearly all planks appear to have been separated in the past, the joins in the open triptych are mostly closed. There are, however, a few slightly open joins in the sides that are not on display. There are also several small differences in level, such as in the left wing and at the top left of the central panel.
- ***Coated reverse*** The closed wings bear a painted imitation stone. Wax is present on the reverse of the central panel.
- ***Biological damage*** Minor old woodworm damage was noted, as well as possible mould on the edge of the right wing.

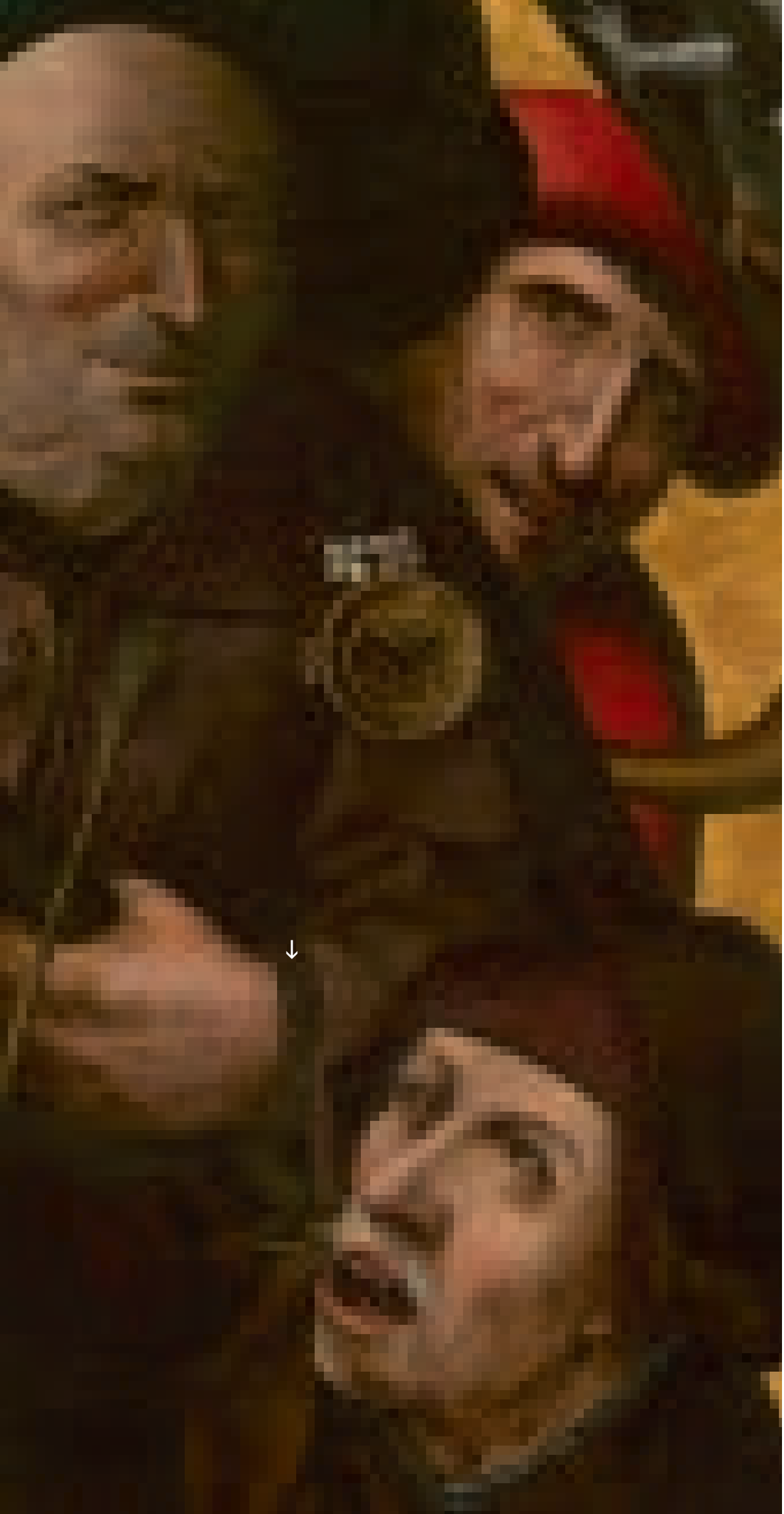
Ground and paint layers

- ***Stability*** In general, the adhesion of paint and ground itself is good, though it is a bit less secure between panel and ground. On the wings, though, the compression forces are too strong, resulting in rippling, raised and tenting paint, as well as paint losses.[7] Most craquelure was caused by natural dimensional changes of the three wooden panels. Broader drying cracks can be found in several locations, such as in the dark areas of the red hat on the left in the central panel, as well as in the dark sleeve of an undergarment (fig. 28.13). Such cracks are also visible in the dark blue areas on the left wing, where coarse azurite was applied thickly, with plentiful medium.
- ***Losses*** There are several old, filled losses in the open triptych, whereas the extensive paint losses on the imitation-stone sides have not been filled or retouched. There are currently several smaller losses at the joins and edges, and the compression of the panel has resulted in a number of other losses, including many that are microscopic, on the wings of the open triptych. At some of the joins, slight cupping of paint can be seen, as in the middle of the central panel. Around the separation mark in the signature, several small losses show the light ground.
- ***Abrasion*** The paint surface appears only slightly abraded overall. There are some older damages along the edges, with slightly more abrasion due to framing. The greenish robe of the tormentor with the birch rod in the right wing is severely abraded. The robe, however, seems to have been fully modelled with white and blue paint before the green glaze was applied (see fig. 28.6). It is uncertain whether this damaged green glaze is original or a later addition.
- ***Discoloration and increased transparency*** The red glazes and several of the light paints have increased in transparency somewhat, although this is less obvious due to the relatively thick paint application. Underlying layers shimmer through the paint as a result of its increased transparency from ageing; this is visible, for instance, in the hand holding the torch in the left wing (fig. 28.10), where paint was applied somewhat thinner. The copper-green-containing glazes have mostly discoloured and appear rather brown. Where purer, coarser azurite was used, more binding medium was necessary and it has discoloured somewhat, locally giving the blue a slightly greenish hue. At the bottom centre of the left wing, the blue robe appears greyish green.
- ***Filling, retouching and overpainting*** The majority of the damages in the open triptych have been filled and inpainted, although several smaller losses remain. The larger retouchings were generally applied in somewhat vertical strokes, using a *rigatino* technique.

Surface finish

- ***Varnish*** There are two layers of modern varnish; one of dammar and another of ketone varnish.

  The appearance of the varnish is fairly even and glossy, with a slightly matte, sprayed top layer. The paint is largely saturated, although locally the varnish has sunk into it. This has resulted in a reduced saturation that is especially noticeable in darker areas. There are several large patches and smaller spots with old varnish residues on all three panels, as in the white of an eye in the left wing (93MICGBM004).
- ***Surface dirt*** There is only a minor amount of surface dirt on the painting itself due to its being displayed behind glass. On the left wing, some fly droppings appear to be present.
- ***Visibility of the original surface*** The saturation of the paint surfaces overall is reasonable, but locally the varnish has sunk into the paint, resulting in matte areas. In places, there are small losses, as well as some abrasion along the edges. Primarily it is the areas of reduced saturation and patches of old, yellowed varnish that distract slightly from the original paint surface. The imitation-stone sides, with mainly large losses, are currently neither presented nor presentable.



[1] Van Schoute, Verougstraete and Garrido 2001, 114. De Vrij (2012, 361) mentions another version in the Carmelite monastery in Salamanca, but that probably concerns the Lázaro Galdiano panel. See Marc Borràs Espinosa, 'La taula central de El tríptic dels Improperis del Museu de Belles Arts de València, model més antic de les versions existents i possible autoria de El Bosco' (unpublished master's thesis in art history, 2014–15, Universitat de Barcelona, 67–73), who also mentions a seventeenth-century copy on canvas in the Museo Provincial de Segovia.

[2] A conservation report detailing the treatment steps undertaken and the materials used is on file at the museum.

[3] Dimensions of the wings are based on Ineba Tamarit 2003, 58–59.

[4] Plank widths of the wings are based on Ineba Tamarit 2003, 58–59. Plank widths of the central panel are based on Van Schoute, Verougstraete and Garrido 2003, 50.

[5] The youngest or last-preserved ring on each of the six planks of the central panel dates from 1489 (I), 1497 (II), 1498 (III), 1490 (IV), 1506 (V) and 1499 (VI), respectively. Planks I and VI come from the same tree. See Klein 2003a, 5–6.

[6] On 10 June 2013, two samples from the ground layer below the imitation stone (one from each wing) were subjected to a microchemical test, which established the presence of calcium carbonate (chalk; $CaCO_3$).

[7] Raised-paint issues were not observed by museum conservators when the wings were framed in their microclimate vitrines on 25 January 2008. The imitation-stone sides were consolidated in May 2013.

28.13 RR 94, VIS

29 *Christ Carrying the Cross*

RESEARCH REPORT 1

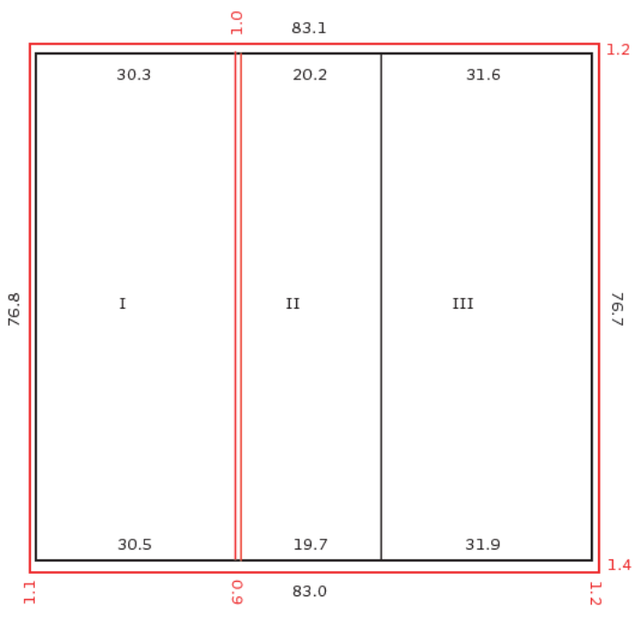
Follower of Hieronymus Bosch
c. 1530–40

Oil (not analysed) on oak (not analysed) panel, 76.8 × 83.1 cm
Museum voor Schone Kunsten, Ghent, 1902–H

BRCP, *Catalogue Raisonné*, cat. 29; www.boschproject.org no. 29.

SUMMARY OF CONCLUSIONS

The attribution of the Ghent Carrying of the Cross *has long been a divisive topic among art historians.*[1] *In our opinion, the* Carrying of the Cross *was not painted by Hieronymus Bosch. The style of its relatively tentative and contour-only underdrawing is very different from that of the autograph works. The underdrawn forms were also followed comparatively closely in paint, unlike what is observed in the core oeuvre. The painting technique deviates from that of the autograph works as well, as apparent in uncharacteristic details consisting of very fine hatched lines. In addition, it seems unlikely that the work was produced in the family workshop. It was originally painted outside of a frame and up to its very edges, which were bevelled, and the panel was only a few millimetres larger than the currently remaining painted surface. This implies that the panel was originally housed in a rabbeted rather than an engaged frame. Rabbeted frames only became customary in the second quarter of the sixteenth century, well after Bosch's death. The fact that the underdrawing was so closely followed in paint suggests that the* Carrying of the Cross *in Ghent was copied after a now-lost prototype.*
Dendrochronology has not yet been possible, since strips of wood added to the edges of the panel block access to the end grain. As further explained in BRCP, Catalogue Raisonné, *cat. 29, we date this work to about 1530–40.*



29.1 Construction diagram (seen from the front).
The modern additions and their dimensions are indicated in red.

EXAMINATION DATA

22–24 November 2010 (Luuk Hoogstede, Matthijs Ilsink, Jos Koldeweij, Ron Spronk).[2]

The painting was examined out of its frame, both upright on an easel and flat on a table under strong illumination. Both front and reverse were easily accessible.

- ***Previous research and additional documentation available*** The Ghent museum holds several files with information on the painting, which include photography and IRR (using an OSIRIS camera) by the Ghent Interdisciplinary Centre for Art and Science, Ghent University (2010), and an almost complete XR by the Royal Institute for Cultural Heritage, Brussels (KIK-IRPA, c. 1956), documenting the situation before the last major restoration.
- ***Previous treatments*** At an unknown date, boards I and II must have come fully apart. These boards were rejoined after having been planed down, in the process of which a strip of original support and paint about 1 cm wide was removed. The new join was reinforced with a single, large dovetail, the insert for which is still visible on the reverse at the centre of the join. The crudeness of this treatment suggests an early date for the intervention. At this time, or later, two long crossbars were applied onto the reverse with glue and nails, with the nails protruding through the paint surface at the front.[3] Three strips of canvas were glued onto the two joins and the long fracture in board I.

  In a later treatment, the four smaller dovetails and the two wooden buttons were added.[4] Before 1956, the smaller dovetails at the long outer edge of board I were added; these reinforce the panel at old fractures extending from the bottom.

  In 1956–57, Albert Philippot removed all previous additions from the reverse, and planed the two small dovetails at the edge. The three individual planks were separated and the supposed original panel dimensions were restored by inserting a narrow, wooden strip between boards I and II before these were rejoined. The support was impregnated and reinforced (see below, *Additions*), and new edges were created on all four sides of the painting, running with the original grain of the wood and wider at the reverse than at the front. Varnish, fillings and overpaintings were also removed, followed by new fills, retouching in egg white–tempera and subsequently oil–turpentine, and varnish.[5]

SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 29.1). Van Schoute (1959) reported pre-treatment dimensions of 74.1 × 81 cm, and a panel thickness of 0.9 cm.[6]

  The wood species has all the characteristics of oak but was not analysed. The panel consists of three quarter-sawn planks, vertical in grain, laid vertically, with a non-original narrow vertical strip inserted between boards I and II and wooden strips added around the edges afterwards. Seen from the reverse, sapwood might be present on the left edge of the centre plank and on the right edge of the right plank.

RR 1 (photo courtesy www.lukasweb.be – Art in Flanders vzw/Dominique Provost)

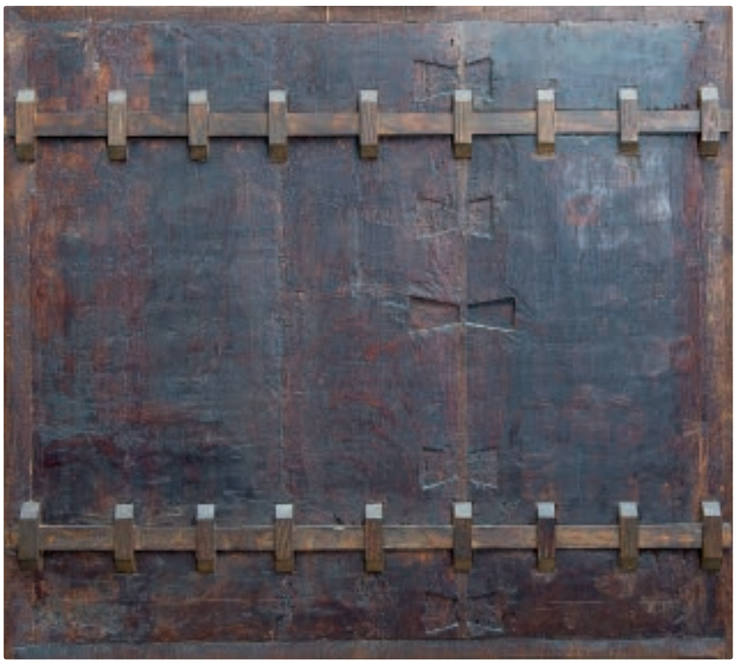
The planks were butt-joined and glued. Dowels are not visible on the reverse or in XR.

Large sections of the reverse are original. A long, 1 cm-wide wooden insert was added along the join between boards I and II in 1956–57. Non-original insets for the (now-removed) dovetails are visible along this join as well. The small dovetails at the right edge (seen from the reverse), the battens and cleats, and the wooden strips added at the edges are also later additions. The reverse shows both original and non-original tool marks. Original saw marks are visible at the centre left, and the entire reverse has been planed.

- ***Bevelled or half-lap edges*** Van Schoute reported that the edges of the reverse had bevels 4–6 cm wide before the 1956–57 treatment.[7] Although they were largely removed during the 1956–57 intervention, traces of these bevels are still present on the top, bottom and right edges (see below, *Altered dimensions*). The XR, which was made before the 1956–57 treatment, is indeed notably more transparent around the edges of the panel, which is fully in line with Van Schoute's report.
- ***Dendrochronology*** The addition of the wooden strips at the top and bottom edges in the 1956–57 restoration has made the end grain of the original panel inaccessible, making dendrochronological analysis here impossible. The BRCP commissioned Dr Peter Klein to do dendrochronological analysis from the existing XR, but that did not result in a measurement.

GROUND

- ***Visibility*** The off-white to cream-coloured ground (not analysed)[8] is present overall. The tone of the ground (and the pigmented isolating layer, see below, *Intermediate layers*) can be seen in VIS. The ground is



RR 1, reverse

almost completely covered by the paint layers, and is only discernible at the trimmed outer edges, in losses, some abraded parts and around cracks, but it does shimmer through the paint in several areas. Although ageing of the paint will have increased the visibility of the ground in certain areas, this effect seems to have been an integral part of the artist's technique.

- ***Barb and edges*** The original panel was painted up to its very edges, as is illustrated by the pre-treatment XR, where the folds of Veronica's sudarium extend to the left edge of the panel (fig. 29.8). This implies that the panel originally had a rabbeted rather than an engaged frame and is further confirmed by the dimensions of the bevels on the panel reverse (see *Bevelled or half-lap edges* above, *Altered dimensions* below, and fig. 29.7). Close comparison of the pre-treatment XR, the current paint surface and the current reverse reveals that the painted surface itself was only very slightly cropped during the 1956–57 treatment to apply the new, extended edges.
- ***Application*** The ground is evenly and thinly applied, using a large brush. It is worked into a smooth finish, with brushmarks (slightly detectable in VIS and XR) going in all directions. The surface texture of the wood support is not apparent.
- ***Composition*** According to previous research, the ground seems to consist of chalk bound in animal glue, with an average thickness of 120–160 µm, isolated with oil. Van Schoute also mentions a very thin (8–16 µm) second ground layer of the same composition as the first, but this might concern the pigmented isolating layer (see below, *Intermediate layers*).[9]

PREPARATORY LAYERS

- ***Underdrawing*** Underdrawing has been observed throughout, and is visible in VIS and IRR/IRP and (see figs. 29.3–4). The drawing was not worked out to a high degree of detail and was exclusively used to indicate the main contours.
- ***Medium and application*** The detectable underdrawing is applied with a medium-sized brush in a liquid medium, perhaps a diluted paint (not analysed). The lines seem to have been applied in a single stage.
- ***Style*** Underdrawing is applied in a somewhat sketchlike manner – very basically, but freehand. The liquid medium gives the strokes a painterly feel, but the short lines, although positioned with confidence, are executed in a less flowing and somewhat jittery fashion. Longer contours (e.g. noses) are drawn in short, irregular strokes, often discontinuously. Some detailing is indicated (e.g. the centre of the 'disc' at the upper left). Line ends are usually straight (often tipped), without hooks or loops. The lines themselves may be curved and sometimes have hooks, depending on the feature drawn (e.g. Veronica's eyelid).
- ***Revisions in underdrawing and differences from painting stage(s)*** Generally, the underdrawn composition was followed rather closely in the paint application phase, although numerous smaller shifts in contour can be seen, and the paint often extends beyond the contours indicated. Several noses were enlarged in the painting stage, which might have iconographical significance. Veronica's headpiece was slightly reduced in height. The underdrawn contours of the cross run through the underdrawing of the hands holding it up, indicating that the cross was drawn before the hands. The flail at the top left was initially planned higher and was slightly different in design. The adjacent proper right arm of the person supporting the cross was underdrawn narrower, which would have made it less strong. The eyes of the figure to the left of the pointed hat were painted slightly higher.

  A possible alteration during the underdrawing stage was revealed in the left, pointing hand of the hooded man at the top right. Originally it appears to have been drawn in a lower position (just above the helmet), perhaps as a clasping hand with a visible thumb. At a second underdrawing stage, the position of the hand was altered to its current one. The underdrawing is visible with the naked eye in several areas, but this is probably an unintended effect, likely caused by changes in refractive index due to ageing of the paint film.

29.2 VIS

- ***Intermediate layers*** What appears to be a thin, off-white to cream-coloured pigmented isolating layer seems to be present under the paint strata and in the XR.[10] This layer shimmers through in many areas and is exposed at some paint contours, for example the outer edges of the thieves' white shirts and the left edge of the red shield, where the paint layers are damaged. This layer is thinly applied over the entire panel surface with a broad brush, as evident from the XRS, which indicate that it contains some lead white. The general, overall visibility of this pigmented isolating layer suggests that the painter consciously utilized it as part of the composition.

PAINT LAYERS

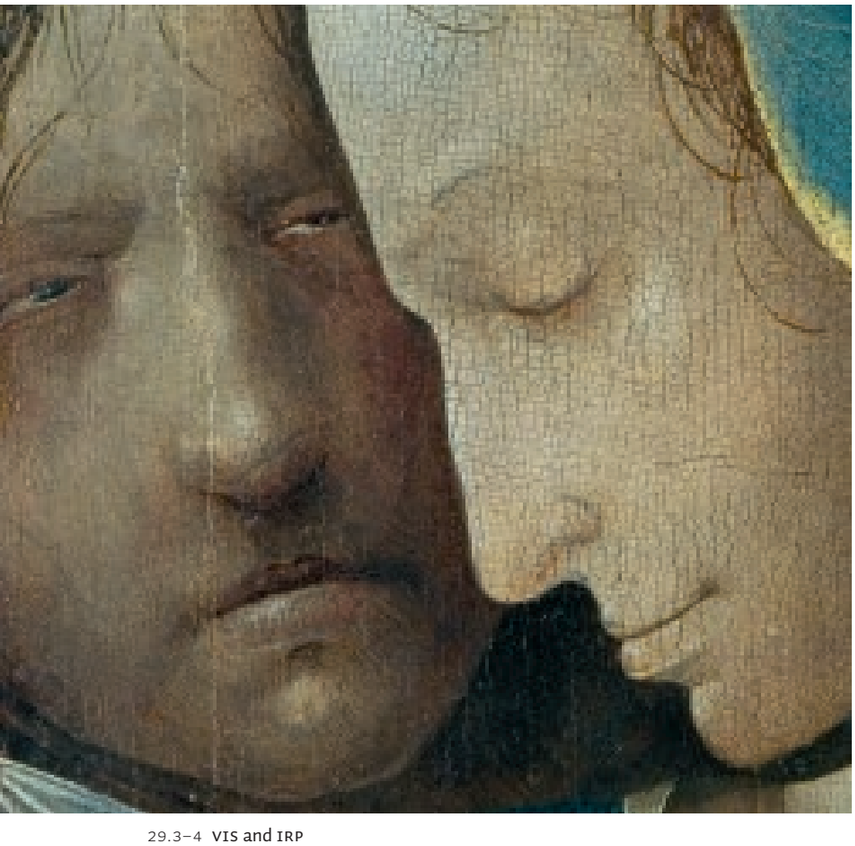
- ***Paint application and painting technique*** The oil paint (not analysed) was applied using a brush, and covers the entire original panel surface. It was applied in several stages, mostly wet-on-dry, but also wet-in-wet in some locations. See, for example, the moustache of the helmeted soldier, the forehead and nose of the shackled thief at the bottom right (01MICGBM006), and the shirt-strings of the thief at the top right. Generally, large areas were covered with a single layer of paint.

  The wet and glossy paints were laid on in both opaque and transparent applications. Glazes were applied in multiple hues: red (in all deep red areas); green (in the hat in the upper centre, the arm supporting the cross, the crown of thorns, the rim of the pointed hat, and the clothing of the figure at bottom centre – all done in a partially discoloured copper-green paint); and purple (in Christ's robe and the white-purple flaps on the hat of the figure to his left). The artist painted in manners alternately more precise and rough, depending on the feature, and mostly in a few very thin layers, revealing the surface structure of the support. The green glazes were applied somewhat more thickly, and the coarse azurite paint (seen in the pointed hat and Veronica's garment) was applied very thickly. The azurite pigment's coarseness and deep blue colour indicate its high grade, but also made it more difficult to use. The thickness of this layer and its high medium content resulted in the dark blue paint 'crust' with drying cracks (see figs. 29.2 and 29.8). Thicker paints were also used for impasto, but not to a large extent. (See, e.g., the lead-tin yellow in Veronica's headpiece and the dots in the hats.)

  Despite the sketchlike character of the paint application, it is in fact very detailed. With just a few deftly applied paint layers almost everything has been covered, but in many areas this was followed by fine strokes and detailing. Both narrow and broad paint strokes are visible, although they are mostly linear (e.g. without zigzags or curves). However, distinctions can be made. The XRS reveal the orderly style of the strokes in the blue cap, while the cheek of the helmeted soldier shows more randomly placed strokes – the manners of execution reflecting intentional differences in surface texture.[11] Brushstrokes were used with apparent ease to render contour and volume throughout the painting. An extraordinary feature can be found in the fine lines, often curved and/or hatched, that are used for detailing. This is visible in, for example, the curly facial hair, the white hatches in some of the eyes, and the hatching in some fingers. A similar feature can also be found on a larger scale, for example on the chin of the figure left of Veronica (see figs. 29.3–4).

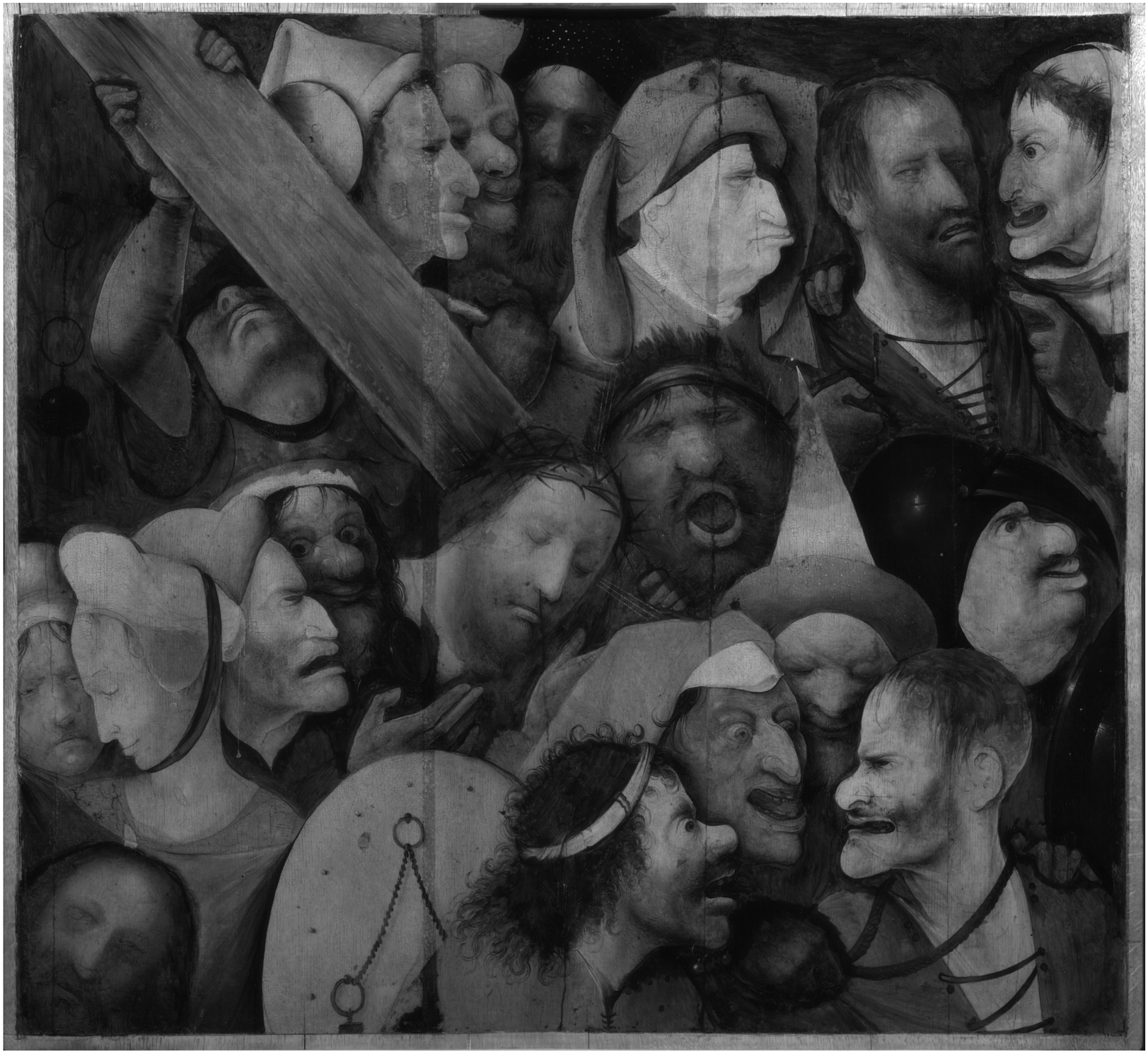
- ***Texture*** Most passages have a smooth finish, with the exception of a few areas with slight impasto, used mostly for highlights, but also for some modelling. Brushstrokes are often visible (though they blend in more for larger surface areas) and generally follow the contours of the composition.

- ***Build-up and palette*** The layers were mostly built up from light to dark. Glazes were usually applied in a final stage, with the exception of certain detailing and contour lines. Last, highlights were added (used both pure and mixed, sometimes in a series of hatchings). Black paint was used for reinforcements and contours. The golden



29.3–4 VIS and IRP

29.5–6 VIS and IRR



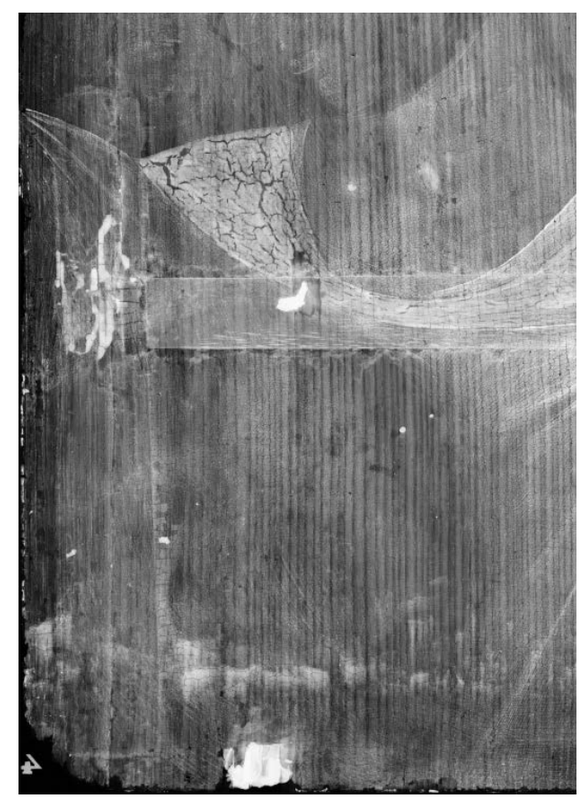
rays emanating from Christ's head lie on the paint surface, oil-gilded onto a brown/black/grey mordant (fig. 29.10 and 01MICGBM001). Other details that are supposed to represent gold in the painting were in fact painted with lead-tin yellow. At the top left, first the red hat was painted, followed by the ear disc, and then the cross, which overlaps the other layers. The hair of the two figures at the top right was first painted in a basic brown colour, followed by black and grey-brown brushstrokes.[12]

The fingers of the hooded figure, whose hand is on the shoulder of the thief at upper right, were left in reserve; his sleeve, however, was painted over the background. The same goes for the bottom part of the left-hand sleeve and the yellow hood, which was left in reserve except for the left side (which is also visible in IRP/IRR). The armour of the soldier supporting the cross is partially visible below the hat of the man in front of him, whose head was left in reserve, but the top blue-and-white parts of the hat were painted over the armour. In a similar way, the top edge of Veronica's cap was painted over the background. The red lake mixed with white on the left edge of the red shield was not painted up to the edge, and the underlying pigmented isolating layer is visible here. At the bottom centre, the lower part of the white shirt-collar was left in reserve, while the top part was painted over the flesh tone, the hair and the background.

In the thief at the lower right, the left part of the white shirt was painted directly on the pigmented isolating layer, whereas the right-hand part was executed over the flesh tone. The paint build-up in the face of this thief started with a thin, brownish flesh tone, followed by semi-transparent brownish and red accents and shadows. Next, whitish highlights were applied, and then grey (for lips) and black (for chin dimple, pupil and contour lines). The white highlight in the eye was applied afterwards. The thief's white undershirt was left in reserve, and painted after (and partially over) the flesh tone, followed by the noose and the shirt-strings, which were not left in reserve.

The metal rivets in the shield to the right began with ochre and an impastoed white paint, followed by a cast shadow in black (01MICGBM004). Similarly, on the helmet, a white or grey highlight was followed by a black cast shadow. The nails in the red shield were built up the other way around, starting with a red lake shadow, then a black one, and finally the brown-grey nail with an impastoed white highlight. Flesh tones vary greatly – from grey to pink to yellow to brown; from cool to warm; from monochrome to polychrome. The pointed hat also demonstrates a broad use of colour: a copper-green rim with lead-tin yellow dots; a thin red lake at the base making a gradient transition through blues to a thick azurite paint; a bright tip with lead-tin yellow highlights and an ochre-coloured bead; the threads extending from it painted in white, followed by a red lake and additional white highlights (fig. 29.2). The thick azurite was also used in Veronica's garment, where the characteristic drying cracks are revealed in XR (fig. 29.8). White hair on the heads of three figures is mixed with blue. A similar technique can be found in some of the white shirts, and blue and red paints were also used for flesh tones. The artist used red lake paint around the eyes of all the prominent figures depicted in the light (but not of those in the shadow), with the exceptions of Veronica, Christ and the thief at upper right. The horizontal interruption in the large highlight on the soldier's helmet is original and not the result of a damage; it suggests the reflection of a window with a horizontal mullion. According to Van Schoute, the pigments the artist used seem to be azurite for blues, malachite for greens and madder for reds, plus ochres, bone- or ivory-black, lead white, and type I lead-tin yellow.[13]

- ***Changes*** Several (small) changes in overlap are visible with the naked eye. The top part of the hood on the figure at top right was painted later, in a lighter colour, over the already-completed background. A similar case appears in the figure with the blue-and-white cap opposite the thief at the lower right. The blue-and-white collar of the figure in the central background was painted over the flesh tone and



29.8 XR (photo courtesy KIK-IRPA, Brussels)

29.7 VIS: the arrows indicate the start of the bevels.

29.9 VIS

the dark background (under the chin). So, too, was the white collar of Veronica, and the brown part was painted last.

FRAME

The rectangular, black-painted wooden frame (97.9 x 104.5 cm) is not original. The inner and outer profiles are unpainted, showing the wood, but the field in between is painted in a brownish colour.

CONDITION

Support

- ***Altered dimensions*** The original panel was slightly reduced in size on all four sides. The photographs and XRS made before the 1956–57 treatment reveal the fragile and damaged original edges of the painting (see fig. 29.8). During the restoration, the panel edges were probably cropped very slightly for better alignment and adhesion of the wooden strips that were added to construct new edges (see *Additions* and fig. 29.7). The XRS show that no barbs or original unpainted and ungrounded edges are present, but they do show bevelled edges. The bevels of the panel reverse did not extend beyond the painted edge, as determined from a close comparison of the XRS and the image of the reverse.[14] Comparison of the XR and VIS image of the front also shows that the original painting was about 1 cm smaller on all sides than its current dimensions (including the strips), and that the original edges were cropped by no more than a few millimetres.
- ***Additions*** The XRS made before the 1956 restoration show two horizontal wooden bars glued and nailed to the panel reverse. The nails protruded through the panel, ground and even the paint layers. During the 1956–57 treatment – a major structural intervention – these nails and bars were removed and replaced with two long sliding battens (currently jammed). To accommodate these, the horizontal tracks were enlarged and the battens held in place by series of wooden cleats glued to the reverse of the panel. Also, a long wooden insert, circa 1 cm wide, was applied between boards I and II to compensate for the materials that were removed there at an unknown date (see *Previous treatments*). Placed to the left of Christ, this strip runs the entire height of the panel and consists of several adjoining pieces. Moreover, wooden strips that now suggest the presence of an unpainted edge were added to all four sides of the painting. These strips are between circa 1.0 and 1.2 cm wide at the front and circa 3.1 cm wide at the back. They are applied with a half-lap join, removing circa 2 cm of the original bevel on the reverse. The wooden strips are sectioned at the top and bottom to reduce possible tension on the panel from differing reactions to climate changes. In several areas at the interface with the paint, chiselling or planing of

the strips reduced slight level differences. Locally, this has also resulted in accidental damage to the original paint.

- ***Cracks*** Besides several older fractures and a crack that runs the entire length of the panel in board III, two slightly opened cracks currently exist in the panel. From the top, just left of the insert, a crack runs 3 cm along the wood grain. At bottom centre, a vertical crack runs parallel to the wood grain, extending 4 cm from the bottom edge (front). Both cracks run through the panel (including the added wood strips at top and bottom), ground and paint layers and are unstable. Some older cracks, such as the one at the bottom edge in the red shield, seem to be caused by the shrinkage of the added strips of wood or local pressure from framing clips.[15] Some of these half-lap applied sections seem to be connected in rather long strips, so upon shrinking they exert a greater force on the panel. The permeability of the added strips also seems different from that of the original panel, resulting in slight reaction differences under changing climate conditions.
- ***Deformations*** The panel has minor undulation and a slight convex warp overall.
- ***Joins*** Some of the joins between the planks are partially open and there are visible differences in level.
- ***Coated reverse*** There seems to be a wax coating present on the reverse.
- ***Biological damage*** A few traces of old woodworm damage are visible.

Ground and paint layers

- ***Stability*** Overall the ground and paint layers are stable and in excellent condition. Most craquelure is caused by natural dimensional changes of the panels. Broader drying cracks are present in thick paint layers with azurite. (See also the radio-opaque section in the top centre of fig. 29.8.) There are several older fractures through ground and paint layers, and there are two active cracks. Spread over the surface are some areas of slightly raised paint.
- ***Losses*** Losses are present at the cracks and at the edges of the painting, as well as spread over the paint surface. To level the edges of the joins after they were glued in the past, the paint surface was scraped or planed, resulting in extensive paint loss at the joins (see figs. 29.9 and 10). The nails that held the old battens in place (see *Additions* above) but protruded through the paint surface also caused extensive local losses.
- ***Abrasion*** The paint surface is only slightly abraded overall (with some damaged paint at higher points on the surface). In addition to abrasion at the joins, however, there is also some wear at the edges of the painting. The brighter spots in the eye 'white' of the thief at the lower right were also caused by abrasion.

- ***Discoloration and increased transparency*** The copper-green glazes were applied relatively thickly, so despite some discoloration (and probably darkening), they are still legible as green. The red lake is still in excellent condition. An increase in transparency can be found in the lighter paints that contain lead white, which causes the increased visibility of underdrawing (e.g. in the face of Veronica).
- ***Filling, retouching and overpainting*** There are a few areas with delaminating filling and retouching: at the top centre, the top left corner, and the bottom left and right corners. Besides other fillings, there are many areas of retouching in egg tempera, mostly concentrated around the joins, cracks and edges. These retouchings have been mostly limited to areas of damage with very little overpaint, but they have not been executed to a high degree of finish and are easily distinguishable, also from some distance. Other damages were not filled and retouched properly, causing them to stand out. This is most clearly visible at cracks, i.e. at the figure left of Veronica where the damages are very disturbing. Slight discoloration over time has caused the retouchings to become even more clearly discernible.

Surface finish

- ***Varnish*** The brush-applied varnish (predominantly the older residue) has yellowed a great deal. It has an uneven and matte appearance.[16] Large areas of the paint surface are not saturated properly. This is more clearly visible in the darker passages, where the matte areas have a greyish appearance that blocks the visibility of the underlying paint.
- ***Surface dirt*** There is a small amount of surface dirt on the painting.
- ***Visibility of the original surface*** The original paint surface appears unnecessarily uneven and matte. The combination of the yellowed varnish and varnish residues with large, unsaturated areas causes a reduced legibility of the painting overall. Dark colours appear lighter and less deep, resulting in an imbalanced visual effect. The uneven filling and minimalist retouching in areas of damage clearly distinguish original from addition, but the ageing process has made these inpaintings even more apparent and unnecessarily distracting.

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1 See BRCP, *Catalogue Raisonné*, cat. 29.

2 Alexander Gabov (then Queen's University), René Hoppenbrouwers of Stichting Restauratie Atelier Limburg (SRAL) and Luc Van Muylem of Van Muylem Photogravure also participated in the examination and documentation.

3 The XR, which was taken immediately before the 1956–57 intervention, documents this situation.

4 This is revealed in a 1956 pre-treatment photograph published in Marijnissen and Kockaert 1995, 162.

5 Van Schoute 1959, 47–58.

6 Van Schoute 1959, 47 n. 2.

7 Van Schoute 1959, 48 n. 1.

8 Van Schoute 1959 reported a second ground layer of similar colour, but this concerns probably a pigmented isolating layer; see *Intermediate layers*.

9 Van Schoute 1959, 51–52.

10 The presence of this layer was detected in a paint cross-section; see Van Schoute 1959 (54 n. 1), who interpreted it as a second ground layer.

11 Van Schoute 1959, 55.

12 Van Schoute 1959, 57, refers to a build-up in two stages instead of three.

13 Van Schoute 1959, 54 sample and 55 n. 1.

14 Van Schoute mentions bevels of maximum 6 cm wide before treatment. Extending the currently remaining bevelling to the original edge in the XR also gives a maximum bevel of about 6 cm.

15 Jean-Albert Glatigny, oral communication, Brussels, 30 July 2014.

16 According to Van Schoute (1959, 48), the brown varnish in the robe of Veronica is possibly original.

30 *The Last Judgement (fragment)*

Follower of Hieronymus Bosch
c. 1530–40

Oil on oak (analysed) panel, 59.6 × 113 cm
Bayerische Staatsgemäldesammlungen, Alte Pinakothek, Munich, 5421 (old: 5752)

BRCP, *Catalogue Raisonné*, cat. 30; www.boschproject.org no. 30.

Inscriptions and labels
RR 129, bottom left: four inventory labels of the Bayerische Staatsgemäldesammlungen are glued to the panel reverse. One of these labels is dated 1822; another is dated 1855 and has an illegible inscription. Upper right, an inscription, XR23/30 (with the X closed at the top and bottom), applied in chalk.
On the reverse of the frame, a transparent polycarbonate name plate is attached; on the reverse of the frame, on the closing tray holding the panel, there are two inventory labels (one partial) of the Bayerische Staatsgemäldesammlungen.[1]

SUMMARY OF CONCLUSIONS

The findings from the technical examinations confirm that the fragment of the Last Judgement *in Munich was painted by a follower of Hieronymus Bosch. The painting technique does not compare with that of the works in the core group, and underdrawing was only revealed in a single, small detail. Large sections of the panel were cropped from the top and the left, and a small section from the bottom. The current top edge of the fragment was initially the join between two planks. The panel was originally housed in an engaged frame, now lost. Dendrochronology indicates that it could have been painted from 1442 onwards, although a date after 1444 is statistically more probable. As further explained in* BRCP, Catalogue Raisonné, *cat. 30, we date this work to around 1530–40.*

RELATED WORK

The panel is generally assumed to be a fragment of a large *Last Judgement* painting, the rest of which is now missing.

EXAMINATION DATA

23–24 June 2014 (Robert Erdmann, Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Hanneke Nap).

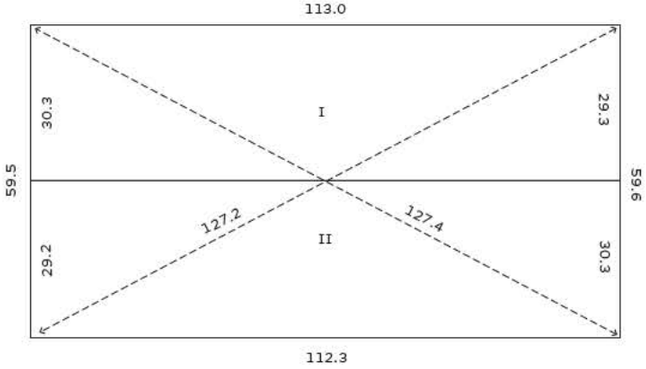
The panel was examined in the paintings conservation studio. It was studied upright on an easel under strong illumination.

- ***Previous research and additional documentation available*** The Alte Pinakothek's files on the painting hold many black-and-white photographs taken in both VIS and UV radiation, several old IRR details,[2] a brief dendrochronology report, and documentation on technical analyses acquired during the 1977 treatment of the painting. These consist of an analytical report on two cross-sections (emission spectra analyses and staining) and one XR diffraction film (see below, *Composition*). The two cross-sections were re-examined in 2015, using XR microanalysis (SEM-EDX).[3] The museum also has XRS of the entire painting.
- ***Previous treatments*** The painting was fully treated between October 1935 and July 1936 by Mr Müller at the Alte Pinakothek, after its rediscovery in the Museum depot.[4] Although the event remained undocumented, photographs reveal that the painting must have undergone a full treatment in 1959, certainly ending before 1961. In 1966 the painting was treated again, this time leaving the major damages in the centre and at the top and bottom edges exposed, showing the wood. These losses were filled and retouched during the 1977 treatment by Hubert von Sonnenburg. The 1977 treatment protocol states nothing else.

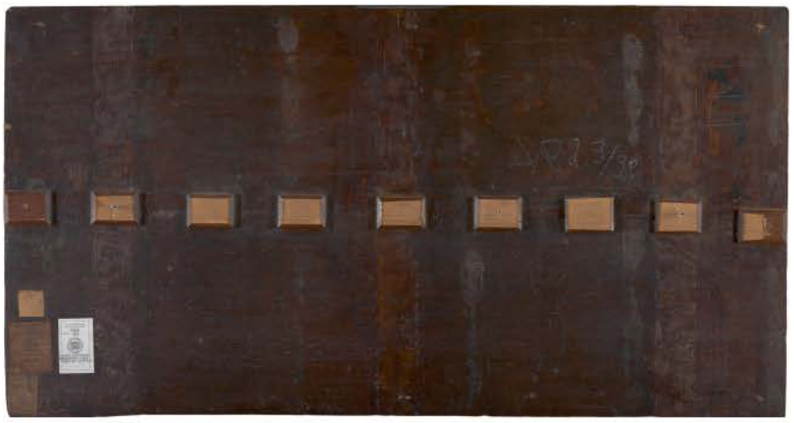
SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 30.1). Thickness: c. 0.8 cm (c. 0.6 cm at the preserved original edge).

  The wood species, Baltic oak, was identified through dendrochronology. The panel consists of two quarter-sawn planks,



30.1 Construction diagram (seen from the front)



RR 129

RR 128

horizontal in grain, laid horizontally. The artist possibly reused or modified an older panel (see below, *Altered dimensions*).

The planks were butt-joined and glued. Remnants of small, possibly original dowels (about 3 mm wide) are detectable in the XR (fig. 30.8).

The panel was largely thinned. The original reverse seems to have been preserved along the top and bottom (see below, *Altered dimensions*). There are several tool marks visible, which seem to relate to past conservation treatments rather than to the production of the panel.

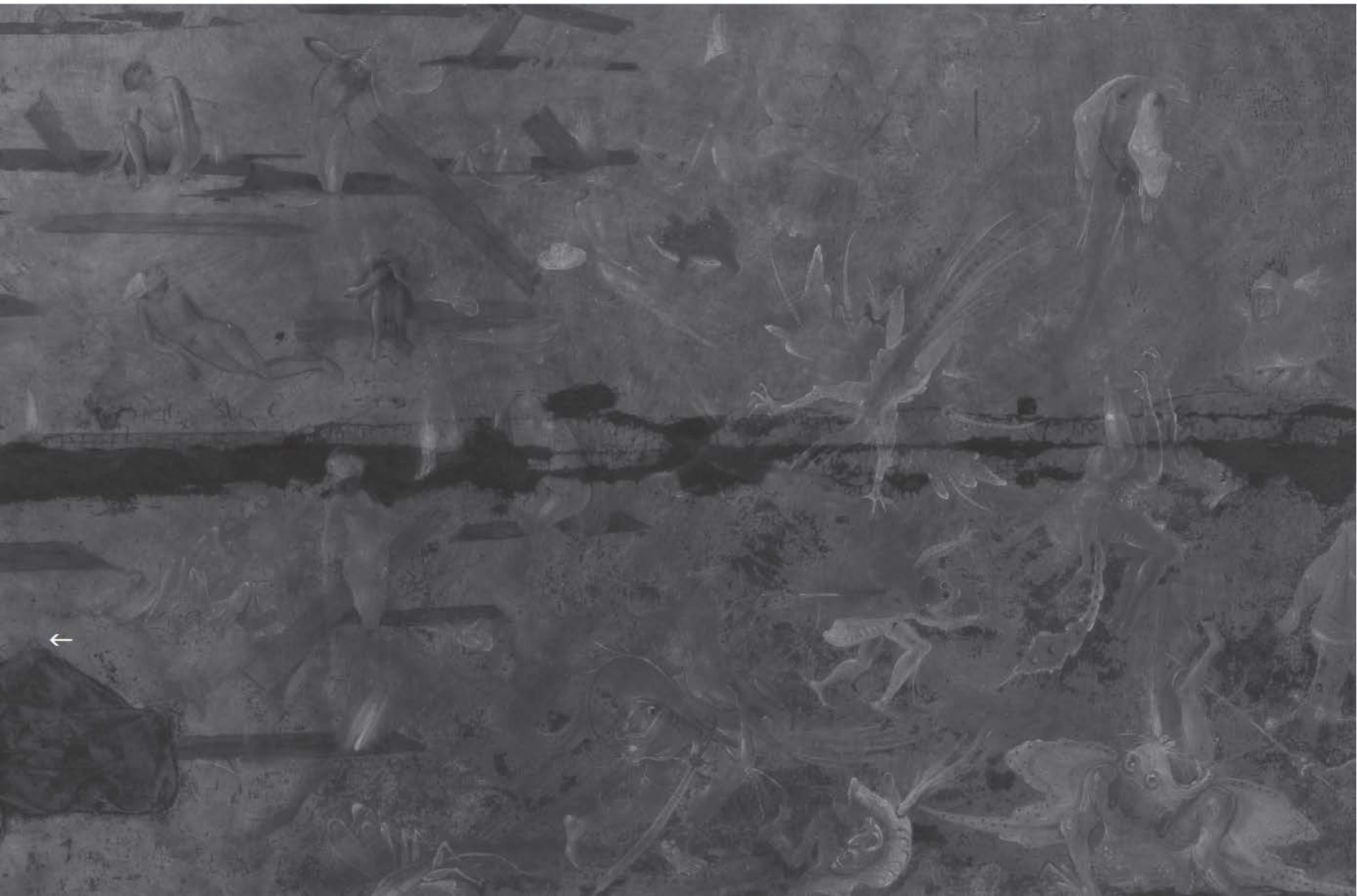
- ***Bevelled or half-lap edges*** Bevelling can only be observed on the right edge (seen from the reverse; see RR 129). The bevel has only a slight angle and is irregular. The other edges of the panel are cropped.
- ***Dendrochronology*** The youngest heartwood ring dates from 1431, which, with the added minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1440 for the tree that produced the wood for that plank.[5] An earliest felling date of 1442 is statistically more probable, however, since that would cover 93 per cent of the range of possibly missing sapwood rings. Assuming at least two more years for drying and transportation, the panel could have been produced from 1442 onwards, but a production date from 1444 onwards is statistically more probable.

GROUND

- ***Material between support and ground*** A strip of canvas about 3.5–4.0 cm wide covers the entire join. At the top edge of the panel a strip is present as well, measuring about 1 cm wide at the left and 2 cm wide at the right. At the top right edge, a small section of canvas is exposed in a loss (see below, *Altered dimensions*).
- ***Visibility*** The off-white ground can be seen in VIS. Its surface is almost fully covered by the dark brown underpainting, but it appears in losses, locally at the barb and slightly shimmering through in the blue robe at the bottom left. The visibility of the ground layer appears to be unintended.
- ***Barb and edges*** An original barb and an ungrounded and unpainted edge have been preserved on the right side of the panel, which establishes that the panel was originally housed in an engaged frame. The ungrounded and unpainted edge varies in width, with a maximum of 1.9 cm in the centre. An incised line is present, running parallel to the barb at 1.5 cm from the edge.
- ***Application*** The ground seems to have been applied in a single coat.[6] Although the visible surface is generally fairly smooth, the ground was not applied evenly. Locally it is thicker, and long, sharp lines discernible in the XRS suggest that a knife might have been used in applying the ground material. Possible unevenness in the finish of the wooden support could play a role as well. The ground was then roughly sanded to achieve a more even finish, possibly removing a considerable amount of the material in some places. This would explain the patchy nature of the XRS, especially in its dark areas (see below, *Intermediate layers*).
- ***Composition*** The crystalline structure of the ground was analysed with XR diffraction,[7] and the elements of the ground with XR microanalysis (SEM-EDX).[8] The ground consists of chalk (calcium carbonate – $CaCO_3$, with coccoliths).

PREPARATORY LAYERS

- ***Underdrawing*** Underdrawing was revealed in only one location. At the top of the blue robe in the lower left corner, an underdrawn line of a peaked fold can be observed in IRR/IRP, as it extends slightly beyond the painted contour of the blue robe. Other underdrawing has not been noted. This could relate to the panel's dark brown underpainting, which contains carbon black, resulting in very dark IRR/IRP imaging. It seems more likely, however, that only the robe was underdrawn with a carbon-containing material, as this is also the only area left in reserve from the brown underpainting (see below). The detectable underdrawing appears to have been applied in a liquid medium, possibly ink. Too little underdrawing was revealed to remark on style.



30.2–3 VIS and IRR

- ***Intermediate layers*** The cross-sections show that the white ground is slightly yellowed due to absorption ('sinking in') of the paint-binding medium on top. SEM-EDX of the two samples excludes the presence of a lead-white-containing intermediate layer.[9]

  A dark brown underpainting was applied evenly over the entire surface, except where the blue robe was planned. This underpainting consists of carbon (bone?) black, brown ochre and a little red ochre.[10] At the upper left, a small amount of lead white may have been added to the mixture, as the lighter brown brushstrokes are also visible in the XRS. Here, these brushstrokes continue over the dark patches, confirming that the latter relate to the ground layer.

  Visual examination, via stereomicroscope, of the blue robe area suggests that perhaps a very thin and more grainy, light-hued layer is locally present under the blue paint (128MICGBM003).

PAINT LAYERS

- ***Paint application and painting technique*** The oil paint[11] was applied with a brush and covers the entire surface of the panel, with the exception of the ungrounded right edge. The ground is only visible shimmering through. Paint was applied in multiple stages, both wet-on-dry and extensively wet-in-wet. The paint extends onto the cropped edges and the barb of the right edge, as the panel was originally painted in an engaged frame. In some areas, such as a fold in the left of the large white cloth of the seated man at the lower left, dark, defined lines are detectable in the paint. Although they resemble incisions, they are neither sharp nor deep. Executed in a greyish paint, they only slightly push aside the still-wet lead-white layer underneath (see also the XR, fig. 30.8).

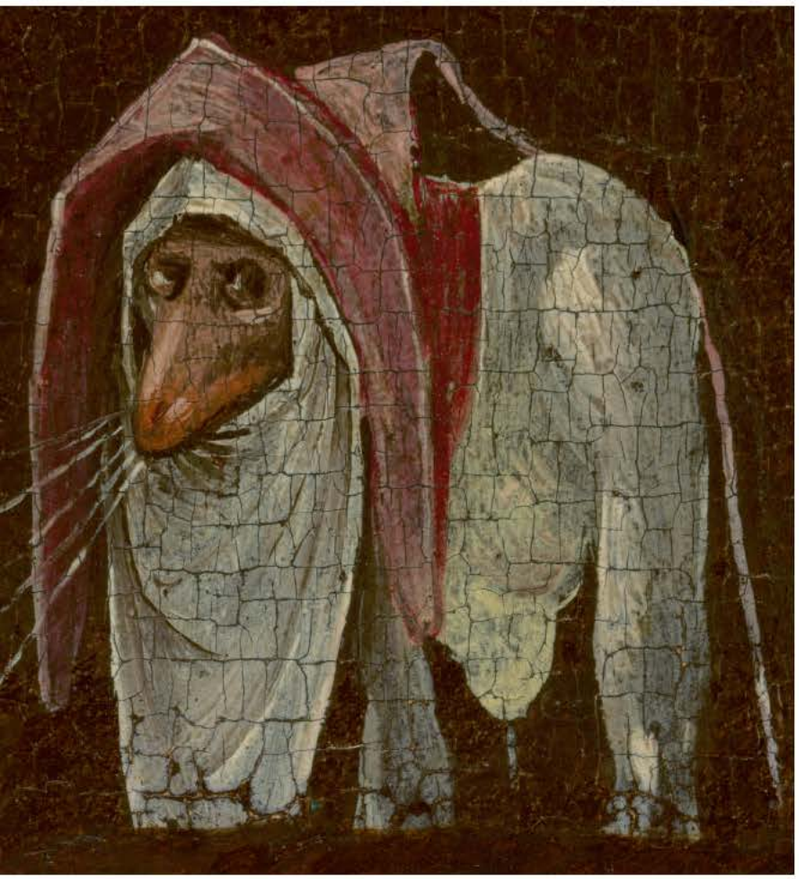
  The fluid, glossy paints were applied fairly thickly for the most part, and in both opaque and semi-transparent layers. Glazes were done in red (in mixtures for both red and purplish areas). In places, scumbles are present in the form of opaque paint covering glazes. Relatively medium-poor paint application appears in several of the flames, where thin, distinct lines did not flow out into a continuous paint film. In general, the painting was worked out to a moderate degree of finish. Although many details were added, they are not highly finished. Many fine lines of paint application are evident, for example, in the wings of the creatures. A relatively thin brush was used there, whereas for the brown background, a broad brush was employed. Brushstrokes were applied in multiple directions. The paint is generally built up in several layers, but due to the frequent wet-in-wet painting, only a few stages were needed. Brushstrokes were utilized to render contours and volume throughout the painting, but often not very convincingly. Dark lines were frequently but inconsistently used to strengthen contours and major physiognomic details.

- ***Texture*** Paints were mostly applied rather thickly, so that textured brushstrokes are often visible. These were not worked out to a smooth finish and were sometimes used for modelling. Impastoed lead-white and lead-tin yellow highlights stand out in particular. At the fire behind the standing woman, several marks can be found in the paint, possibly from fingerprints.

- ***Build-up and palette*** The paint was applied mostly from dark to light, followed by dark detailing and highlights. Only the blue robe at the bottom left was kept in reserve from the brown background paint, locally overlapping the brown at the edge (128MICGBM002). All other elements were positioned on top of the brown, without there being a true back-to-front build-up. Layers were often applied wet-in-wet. A clear painting sequence is visible in the demon's leg overlapping an arm in the top centre.

  The bright contrast of the colouring stands out with the artist's extensive use of lead-tin yellow, azurite, vermilion, lead-white, and red lake pigments, as well as ochre and black paints. Green pigments, however, were not used. Some green particles were noted in blue

30.4 VIS

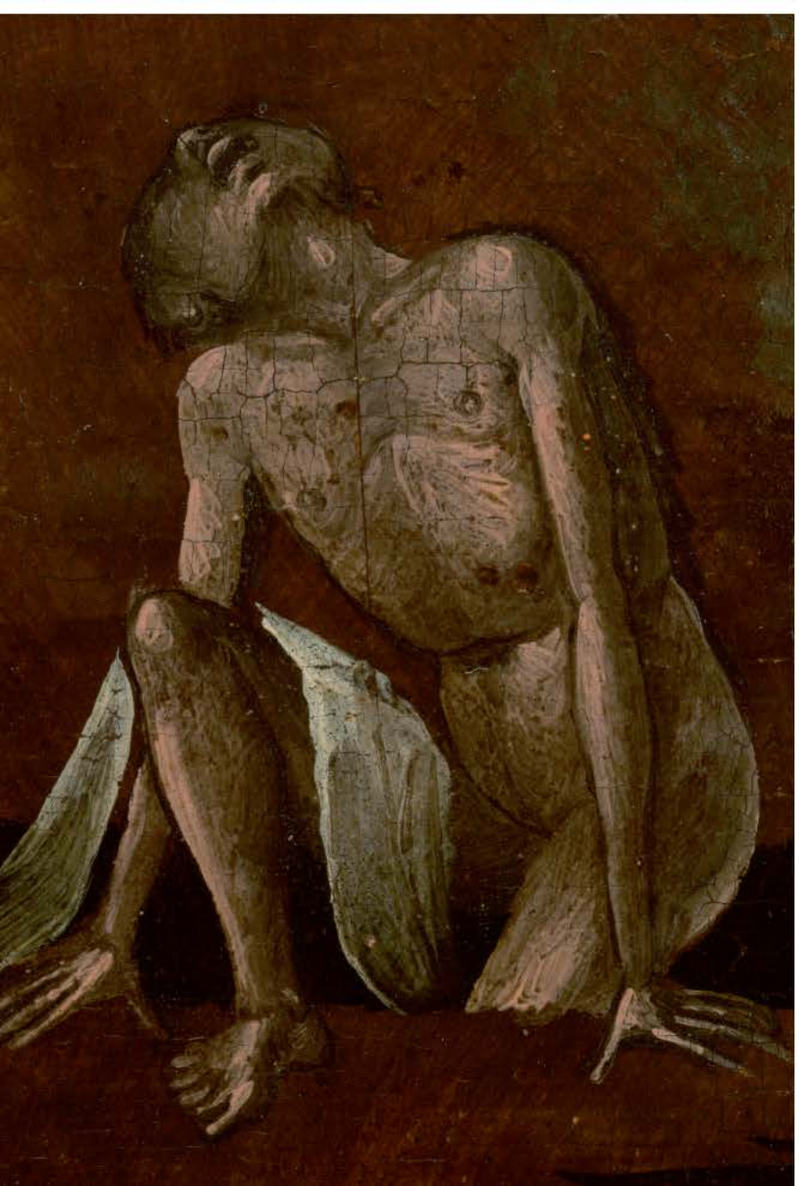


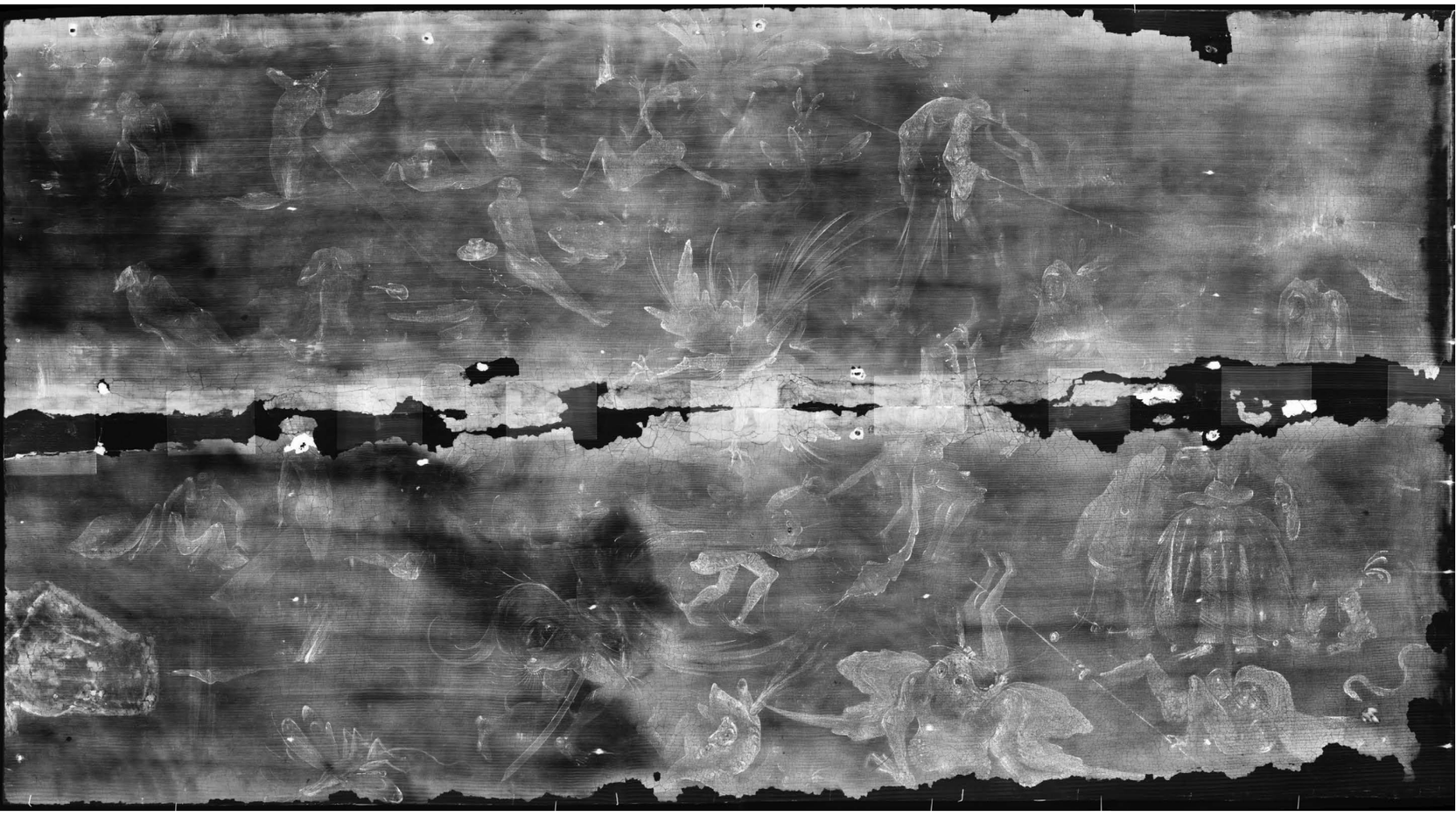
areas, but these appear to be malachite contaminants often found in conjunction with azurite. The greenish head of the monster in the bottom centre consists of azurite paint mixed with lead-tin yellow in differing gradations, resulting in the current transition from blue to greenish yellow (fig.30.6). Detailing was applied in the form of lead white for the teeth, black for contours and wrinkles, pink for the ears, lead-tin yellow for whiskers, and lead-white highlights for the eyes. The fires are generally painted with lead-tin yellow, mixed with red lake and vermilion, and sometimes ochre. Smoke is rendered with grey to blue paint, sometimes mixing in some red lake and lead white for highlights.

A doglike creature with a ratlike face stands at the centre right, painted in lead white and locally lead-tin yellow, followed by both red lake and red lake mixed with lead white (fig. 30.4). The face has a pinkish base with vermilion used for the nose. Black and lead white were then applied wet-in-wet, followed by red lake and, finally, black and lead-white highlights. Even though the number of paint stages was limited, the paint build-up was rather extensive. Another good example of multiple paints often applied wet-in-wet can be found at the back of a large, standing bird-creature with a long tail in the upper right centre (fig. 30.7). The lead-tin yellow cloth was followed by the pink-grey of the bird's back. Grey and then black were next laid on over the lead-tin yellow. Red lake was painted atop the pink-grey, with ensuing black and lead white.

For the human figures, a somewhat greyish flesh tone was followed by wet-in-wet dark contour lines and detailing (see fig. 30.5). The contour lines vary in colour from black to brownish. Muddy lines with a green hue suggest a mixture containing carbon black and

30.6 VIS





30.8 XR

some yellow ochre. Then pink highlights and further elements were put on, as in the red lake base and lead-tin yellow detailing of the crown of the figure in the top left. The women's hair consists of an ochre base followed by brown and lead-tin yellow for modelling.

The black lines visible in the blue robe are not from the underdrawing but were painted over the blue. Although they already appear in 1935 photographs, it is doubtful whether they are original. The gold contour lines at some of the folds were applied using powdered gold (shell gold) and appear to be original.

- ***Changes*** A minor change in the paint layer can be found at the elbow of the standing man with the crown, which was initially larger.

FRAME

The original, engaged frame has been lost. The panel is displayed in a wooden frame, the size of which is substantially larger than the panel to emphasize the fragmentary nature of the object. The modern wooden frame (79.4 × 132.9 × c.7 cm – 8 cm thick, including build-up to which the panel is attached) is painted brown, with a black-painted, flat bottom.

CONDITION

Support

- ***Altered dimensions*** The panel was cropped and thinned in the past. Only the barb and the unpainted edge on the right (seen from the front) were partly preserved. Currently, the top and bottom right corners are damaged.

The composition suggests that a large section is missing at the left and top, and that a smaller section is missing at the bottom. Technical examination revealed a strip of canvas below the ground on the join, as well as a partial strip at the top (see above). This indicates that the current top edge was a join in the past, and that at least one other plank was attached at the top. This is supported by traces of nails used to attach horizontal battens covering the joins of the panel reverse, possibly using brackets. Remnants of these nails are still visible along the central join and at the top edge. These battens were thus present before the cropping of the panel. No traces remain of the battens themselves, since the panel was thinned. Instead, remnants of three transverse or cross-battens are present on the thinned panel reverse. These are evenly spaced, making it likely that the panel was already cropped to its current shape before these vertical battens were applied.

The three cross-battens were later removed by first sectioning them (multiple saw marks being visible), removing the bulk of the material (probably with a chisel), and finally, planing the remnants with a damaged plane blade (from which many scratches are visible). After that, six other cross-battens were glued and nailed to the panel reverse. These were later replaced by the currently visible nine wooden blocks glued to the join (see RR 129).

Holes are visible on either side of the central join, apparently the result of the partial removal of the dowels in these locations after the boards came apart. Dowel holes were not detected in the top edge, which used to be a join, too. The artist may have reused or modified an older panel.

In the past, narrow strips of wood were nailed to all sides of the panel twice. Both old nail holes and new nails are detectable in the old XR. Presumably, these strips (now removed) were used for a previous framing method.

<< 30.5 VIS
< 30.7 VIS

- ***Additions*** Nine wooden blocks are glued to the join in a somewhat irregular pattern.
- ***Cracks*** A small but unstable crack can be seen in the top right corner of the panel.
- ***Deformations*** The panel is slightly torqued, with a somewhat convex deformation (seen from the front).
- ***Joins*** The join in the centre of the panel is closed. Locally there appears to be a minimal difference in levels, but in many areas filling covers the join. It appears that the planks were separated in the past, although locally paint and canvas still seem to continue over the join (see below, *Losses*). The large holes and fills apparent in the XR on both sides of the join are from previous reinforcements attached there (see fig. 30.8). On the top and bottom edges, at about a quarter of the painting's width from the left edge, a regular pattern of indentations is discernible. These were probably caused by a gluing clamp used during the last structural treatment.
- ***Coated reverse*** The oak panel seems to have a dark brownish coating.

Ground and paint layers

- ***Stability*** In general, the adhesion of paint and ground itself is very good. Most craquelure is caused by natural dimensional changes of the wooden panel. In areas with thicker azurite paint containing more binding medium, slightly broader drying cracks have formed. A more pronounced, larger craquelure pattern is visible in areas where canvas was applied to the panel or where an underlying layer was applied more thickly, as at the waist of the naked woman to the left. Here also, slightly raised and cupping paint is detectable. A much finer, smaller craquelure pattern can be observed in areas that relate to less radio-opaque (darker) areas in the XR. Possibly an underlayer was applied more thinly there or was sanded to an uneven thickness, resulting in different craquelure patterns upon ageing.
- ***Losses*** The main losses are at the central join. Given the damage pattern, it seems possible that the painting fell in the past, marring the join, which seems to have completely separated, pulling canvas and paint along with it. In places, though, paint and canvas appear to continue over the join. There, paint remained attached to the canvas, which was detached from the wood and overlapped the join. There are large losses at the bottom and the top, especially towards the right. Multiple smaller losses occurred at the left edge as well, probably from sawing the panel. The remainder of the paint surface is fairly intact, with the exception of losses around the screw or nail holes and other tiny losses. The bright spot on the nose of the forward-facing figure in the group at the lower right is not a highlight but a small loss, showing the light-coloured ground (fig. 30.9).
- ***Abrasion*** The paint surface is only slightly abraded overall. In places, though, as in the rooster figure on the right, paint is severely damaged. In several areas the paint is scratched, as in the winged fish at the upper centre.
- ***Discoloration and increased transparency*** The red glazes have held up fairly well, though a slight fading seems to have occurred in the wings of the figure in the top centre. The skin tones, which contain lead white, have increased in transparency as well, causing the greater visibility of the dark brown underlayer and an unintended change of appearance. Where purer, coarser azurite pigment was used, more binding medium was necessary and it has discoloured somewhat, locally giving the blue a slightly greenish tinge.
- ***Filling, retouching and overpainting*** The majority of the losses have been (filled and) inpainted, although several damages were not treated. At the screw/nail holes, dents are visible, and other areas appear roughly filled. Several tiny losses remain unfilled and/or unretouched. Most retouching was done around the join and the edges. Large abraded areas or scratches were only retouched in a brown base colour, slightly darker than the background brown. The blue robe at the bottom left has been painted out multiple times in the past. Remnants of at least two different overpainting stages are still discernible that can probably be dated to the twentieth century.

Surface finish

- ***Varnish*** The appearance of the varnish is relatively even. The thinly applied varnish has hardly yellowed visibly and appears slightly glossy. Locally, residues of an older, more yellowed varnish are visible.
- ***Surface dirt*** There is barely any surface dirt on the painting because it is displayed behind glass.
- ***Visibility of the original surface*** The saturation of the paint surface is good, with the varnish being even and having a soft gloss. On the edges, only a few matte spots can be observed. In addition to a few tiny remnants of old varnish, there are residues of brown overpaint on the blue robe. Also, the uneven filling distracts slightly from an otherwise excellently legible original paint surface.

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[1] Two additional inscriptions in pencil seem unrelated to the painting.

[2] IRR examination was done in 1967 by the Amsterdam Central Research Laboratory for Objects of Art and Science, probably during display of the painting in the Noordbrabants Museum, 's-Hertogenbosch.

[3] Analysis report, 6 February 2015, by Dr Heike Stege of the Doerner Institut, Munich.

[4] The handwritten treatment protocol in German describes many paint losses in the brown ground. The old chalk fillings in the centre were preserved. They were coated in black-coloured wax and imprinted with canvas, making the losses identifiable. Under a magnifying glass, brown oil paint was used to retouch all the losses. In the blue robe to the left, small losses were retouched with a blue base and a dark final tone. Most retouchings were done at the top and bottom edge. Nothing was lost from the original, as that paint is rock-hard. Flesh tones were not retouched, as nothing was lost there during cleaning. A thin resin varnish and a new frame were applied.

[5] Analysis done by Peter Klein (2000). The youngest or last-preserved rings on each of the two planks of the panel date from 1431 (I) and 1419 (II), respectively. Klein 2001, 123. The numbers of rings and the ring density of the planks are quite different, with 238 rings (7.9 rings/cm) for plank I and 156 rings (5.3 rings/cm) for plank II.

[6] This is supported by the analysis report on two cross-sections.

[7] An X-ray diffraction film is preserved in the Alte Pinakothek's file on the painting. The Debye-Scherrer method was used.

30.9 VIS

[8] Analysis report, 6 February 2015, by Dr Heike Stege of the Doerner Institut, Munich.

[9] Analysis report, 6 February 2015, by Dr Heike Stege of the Doerner Institut, Munich.

[10] Analysis report, 6 February 2015, by Dr Heike Stege of the Doerner Institut, Munich.

[11] Oil was identified via staining techniques, but some protein was also found in all layers of the two cross-sections.

31

The Temptation of Saint Anthony (fragment)

NO RESEARCH REPORT

Follower of Hieronymus Bosch
c. 1530–40

Oil on oak panel, 73 × 52.5 cm
Museo Nacional del Prado, Madrid, P2049

The BRCP was not granted permission to examine and document the painting; www.boschproject.org no. 31.
For our technical notes, see BRCP, *Catalogue Raisonné*, cat. 31.

Condition
See Garrido and Van Schoute 2001, 58–67.

SUMMARY OF CONCLUSIONS

from BRCP, *Catalogue Raisonné*, cat. 31

The Temptation of Saint Anthony *was originally rounded at the top but was extended at some point to make it rectangular. Large parts of the composition were repainted at the same time. Garrido and Van Schoute (2001) published* IRRs *and* XRs *showing that the figure of Saint Anthony (which Garrido and Van Schoute consider to be part of the original paint layer) was painted atop an extensive area of damage. As no underdrawing was detected, it seems highly unlikely that traces of an original composition by Hieronymus Bosch are concealed beneath the overpainting. We need to keep in mind, however, that any discussion of the underdrawing of the* Temptation of Saint Anthony *will require new* IRR *documentation, as set forth in* BRCP, Catalogue Raisonné, *60–61. The original, rounded panel is old, and could have been reused. The dendrochronological analysis of the panel by Peter Klein indicates that the work was certainly painted after 1462, and more likely after 1464. As is explained in* BRCP, Catalogue Raisonné, *cat. 31, we date the work to around 1530–40.*

Photo © Hugo Maertens, Bruges

The Conjurer

Follower of Hieronymus Bosch
c. 1530–40

Oil (not analysed) on oak (analysed) panel, 53.6 × 65.3 cm. The black-painted wooden frame (80.0 × 68.3 × 8.4 cm) is modern.
Musée Municipal, Saint-Germain-en-Laye, 872/1/78

BRCP, *Catalogue Raisonné*, cat. 32; www.boschproject.org no. 32.

Inscriptions and labels
Reverse, top left: an exhibition label: *Les Primitifs Flamands*; below it on a small, round label: 1; to the right, an illegible black text; and to the right of that an illegible, faded, dark text. Centre: some markings in chalk; below these, a large number 560 …[?] in chalk. Bottom right: a handwritten inventory label; below it, 872.1.87 in black.

SUMMARY OF CONCLUSIONS

The findings from the technical examinations confirm that the Conjurer *was painted by a follower of Bosch. The composition must have been copied after an existing model, since the underdrawing consists only of contours and was carefully followed in the paint layers. The style and material of the underdrawing and painting technique are also highly atypical for the Bosch group. (A somewhat comparable method of underdrawing was used in the* Cure of Folly, *cat. 33.) The panel was apparently not painted within an engaged frame. A small section of a barb in paint only and a correlating partial edge that remained unpainted do survive at the top right corner, but the ground continues to the edge of the panel there. We may therefore assume that the grounded panel was placed in a temporary work frame during the painting process, after which it was transferred to a rabbeted frame. Dendrochronology indicates that the panel could have been painted from 1496 onwards, although a date after 1498 is statistically more probable. The framing method indicates a production date after about 1525. As is further explained in* BRCP, Catalogue Raisonné, *cat. 32, we date this work to around 1530–40.*

ADDITIONAL INFORMATION

The painting was studied in storage at the Musée du Louvre in Paris 25–26 March 2013).[2]

Dendrochronology determined that the youngest heartwood ring dates from 1485, which, with the added minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1494 for the tree that supplied the wood.[3] An earliest felling date of 1496 is statistically more probable, since that would cover 93 per cent of the range of possibly missing sapwood rings. Assuming at least two more years for drying and transportation, the panel could have been produced from 1496 onwards, but a production date from 1498 onwards is statistically more probable.

OBSERVATIONS

Support

The panel's thickness is about 1 cm.It consists of two horizontal planks, with an off-radial cut (false quarter-sawn) and a horizontal grain direction. The planks were butt-joined, apparently without the use of dowels, and the edges were bevelled. The format appears to be

32.1 IRR

RR 87

RR 88

32.2–3 VIS and IRR

32.4 VIS

largely original.[4] In the upper right edge of the painted surface a barb remains, but the ground continues up to the panel edge (fig. 32.4). This indicates that a temporary work frame was applied there, on top of the ground, but before the panel was painted. A barb at the top left edge indicates the former presence of a frame member there as well. Both elements were applied at a slight angle. The remaining edge with ground at the upper right was roughly covered up with paint afterwards, but appears to have been abraded.

Preparatory layers

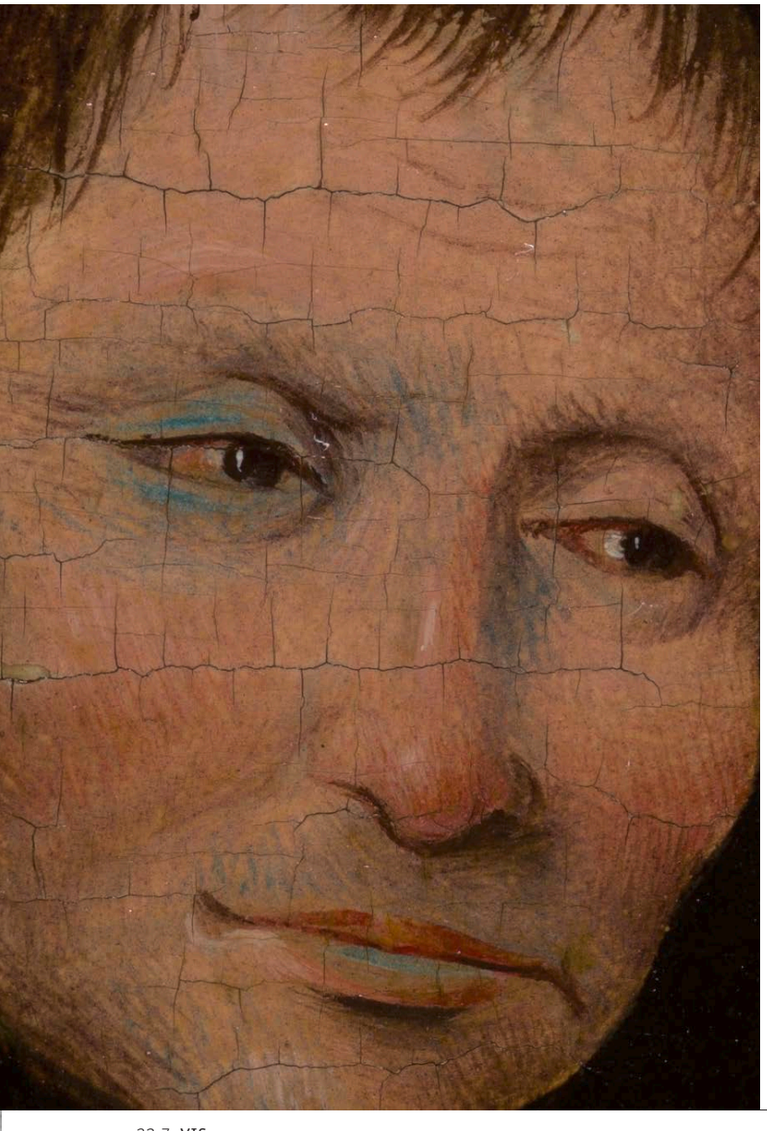
An off-white ground (not analysed) seems to be present. It is completely covered by the paint layers and is visible only at the panel edges, especially at top right. The underdrawing appears executed in a dry but fatty material and only indicates contours in relatively broad lines lines (figs. 32.1 and 32.3). A somewhat comparable underdrawing material was revealed in the *Cure of Folly* (cat. 33, RR 85).

Paint layers

The paint application closely follows the underdrawing, although some contours, as well as the dog and a few elements on the table, were shifted. The oil paint (not analysed) was applied with a brush in several stages, from background to foreground, leaving areas in reserve. Some small overlaps were observed among several figures' clothing, which generally appears painted before the flesh tones.

At the upper right edge, the paint barb is most pronounced at the boundary of the azurite blue sky. The foliage and the lines indicating brickwork partly continue onto the edge with the visible ground. Paint was laid on thinly, in fine brushstrokes with minimal use of texture. These strokes remain visible, especially in the faces, where blue paint was also sometimes used. In the face of the hatless man in the centre of the group, for example, hatched strokes in varying colours – pink, red, purplish and dark blue – partly overlap each other

32.5–6 VIS and IRR



32.7 VIS

(fig. 32.7). Light blue was used for the lower lip and the proper right eyelid, as well as black and white highlights.

The conjurer's robe and the child's garb both appear to have a vermilion base and a coat of red lake. The red robe of the person whose purse is cut has a lead-white base layer with some blue pigments, followed by red lake (see fig. 32.8). In some areas the red lake paint has a finely speckled appearance, which may reflect the use of cloth for dabbed paint application.

Green glazes were applied onto a light green base that contains lead white, but were abraded or have discoloured brown (see, e.g., at the undergarment of the victim (fig. 32.9). Lead-tin yellow was not detected.

CONDITION

The wooden support is severely warped (convexly) but otherwise in excellent condition; it has a nearly invisible join.

The adhesion of ground and paint layers is very good, and no recent losses were observed. There are, however, small damages around the edges along with several restored losses and abraded areas, especially in the lower left and in the centre of the panel, in and around the green-robed man. The barely visible second bird on the wall was executed in brown paint atop the blue sky, but is quite abraded (87MICGBM009). It is much more easily detected in IRR/IRP (figs. 32.5–6).

Ageing cracks are relatively obvious in white areas, and broader drying cracks are visible in the sky (87MICGBM002). The varnish appears even and saturates the paint well, although the retouchings have a slightly uneven gloss and some fingerprints are visible to the left. There are residues of old varnish, but overall, the legibility of the original paint surface is excellent.

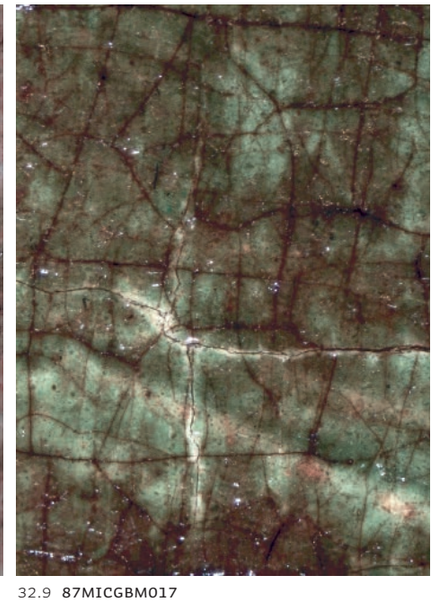
[1] For a variety of practical reasons, some of our research reports were produced in an abbreviated format, which resulted in a slightly different lay out. This concerns seven reports: cat. 3 (RR 155–156); cat. 23 (RR 63–68); cat. 26A–B and 26C (RR 59–62 and RR 109–110); cat. 32 (RR 87–88), cat. S2 (RR 111–112); and cat. S3 (RR 113–114).

[2] Gwendoline Fife of the Stichting Restauratie Atelier Limburg (SRAL), Maastricht, replaced Luuk Hoogstede on this occasion.

[3] Both planks came from the same tree. The youngest or last-preserved rings on each of the two planks of the panel date from 1485 (I) and 1482 (II), respectively. Klein 2001, 126.

[4] The originality of the panel's dimensions have been doubted (see Elsig et al. 2006, 120 and 121 fig. 1).

32.8 87MICGBM014



32.9 87MICGBM017

33 *The Cure of Folly*

RESEARCH REPORT 85–86

Workshop or Follower of Hieronymus Bosch
c. 1500–20

Oil (analysed) on oak (analysed) panel, 48.8 × 34.6 cm
Museo Nacional del Prado, Madrid, P02056

BRCP, *Catalogue Raisonné*, cat. 33; www.boschproject.org no. 33.

Inscriptions and labels
Gothic lettering with cadels and other flourishes in gold: *Meester snijt die keye ras/ Myne name Is lubbert das*. Bottom left, 981, the painting's number in the *Inventario del Museo del Prado*, is painted in orange-brown. Bottom right corner: 317 is written in a bronze-like paint.[1]
Reverse, top centre: traces of pencil markings, and just below these, remnants of a paper label with numbering (possibly including 21).
On the frame: a small metal sign inscribed MARCO DONADO POR D. CARLOS BEISTEGUI is attached to the left side of the frame (seen from the reverse).
Top right: a small metal Prado tag inscribed with the painting's inventory number, 02056, and bottom right, a blue Prado sticker with M6054 in ink.

SUMMARY OF CONCLUSIONS

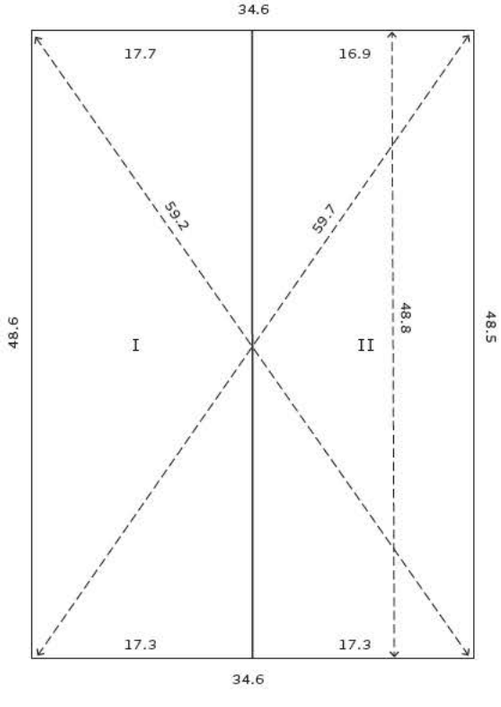
The Cure of Folly *in the Prado must have been copied after an existing model, since the underdrawing, which consists of contours only, was carefully followed in the paint layers. The painting technique and the style and material of the underdrawing are highly atypical for the group. An attribution to Hieronymus Bosch therefore has to be rejected, although it remains possible that the panel was produced within the family workshop without Bosch's direct involvement.*
The panel was originally housed in an engaged frame, now lost.
Dendrochronology indicates that it could have been painted from 1488 onwards, although a date after 1490 is statistically more probable.
As further explained in BRCP, Catalogue Raisonné, *cat. 33, we date this work to around 1500–20.*

EXAMINATION DATA

15–17 October 2012 (Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Ron Spronk).

The panel was examined in a large corridor outside the X-radiography examination room. The painting was studied both upright on an easel and flat on a table, under strong illumination.

- ***Previous research and additional documentation available*** The Prado conservation studio's file on the painting holds many old IRR details, as well as documentation on technical analyses. The documents also indicate that seven spots were examined with X-ray fluorescence (XRF), and six paint samples were taken.[2] The Prado has several XRS and some XR photos; new XRS of the panel were made in October 2012.
- ***Previous treatments*** The painting was most likely fully treated in 1967 by Gonzalo Perales at the Museo Nacional del Prado. Notes in the conservation department indicate that some minor treatments have occurred since.



33.1 Construction diagram (seen from the front)

RR 86

RR 85

SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. 33.1). Thickness, c. 0.8 cm (about 0.6 cm at the edges).

  The wood species, Baltic oak, was identified through dendrochronology. The panel consists of two quarter-sawn planks of similar dimensions, vertical in grain and laid vertically. The two planks were butt-joined and glued, without the use of dowels (see below, *Additions*).

  The entire central section of the panel was thinned, but the remaining original reverse seems to have been preserved (see below, *Altered dimensions*). There are hardly any tool marks visible, with the exception of some traces of planing.

- ***Bevelled or half-lap edges*** What appears to be original bevelling is present on all edges of the panel reverse. The top and bottom edges show highly irregular bevelling (from 0 to 5 cm wide). Bevelling is between 1.2 and 1.8 cm wide at the left edge. At the right edge, the bevel is 1.2 cm wide at the top, from which it gradually decreases to 0 cm, over about 18 cm (see below, *Altered dimensions*).

- ***Dendrochronology*** The youngest heartwood ring dates from 1477, which, with the added minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1486 for the tree that supplied the wood.[3] An earliest felling date of 1488 is statistically more probable, however, since that would cover 93 per cent of the range of possibly missing sapwood rings. Assuming at least two

33.2–3 VIS and IRR macro

more years for drying and transportation, the panel could have been produced from 1488 onwards, but a production date from 1490 onwards is statistically more probable. Both planks came from the same tree.

GROUND

- ***Visibility*** The off-white to cream-coloured ground is present overall and fully covered by the white-pigmented isolating layer. Only at the extreme outer edges and in losses can the ground be observed in VIS.
- ***Barb and edges*** The original barb and remains of the ungrounded and unpainted edges have been preserved on all sides of the panel, which establishes that the panel was originally housed in an engaged frame. These ungrounded and unpainted edges vary in width at the top and left edges, but are more consistent at the bottom and right edges, with a width of about 6 mm (see below, *Altered dimensions*).
- ***Application*** The ground was applied in a single coat and seems to have been worked into a fairly smooth finish. Fine brushmarks can be observed because the lead-white-containing isolating layer runs into the interstices of the ground.
- ***Composition*** The ground was analysed and consists of chalk (calcium carbonate – $CaCO_3$) bound in animal glue.[4]

PREPARATORY LAYERS

- ***Underdrawing*** Underdrawing was observed throughout the entire roundel, but could not be detected outside of it. In some areas, where the paint is applied thinly, the underdrawing can be seen in VIS, shimmering through the paint surface. IRP, and especially IRR, revealed ample underdrawing beneath the paint. The drawing is fairly concise and not very detailed, but most elements, including the landscape, are indicated. The function of the drawing was not only to determine roughly the elements in the composition, but also to aid in minor modelling with some parallel hatching to indicate shadowed areas.[5] The current visibility of the underdrawing in light areas is likely caused by changes in the refractive index due to the ageing of the paint film, resulting in an increased transparency. The current degree of visibility in several parts was probably not intended.

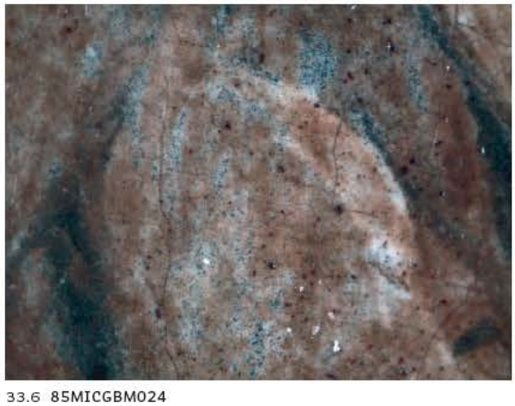
  In the centre of the panel, a horizontal indication line is discernible over the entire width of the panel. The line is positioned exactly in the centre of the roundel and not in the centre of the painted surface, located about 2.5 cm higher. This line was probably used to position the roundel, which was indicated by an underdrawn circular line. A mark for its centre point was not observed, but that would have been positioned on the join.

- ***Medium and application*** The detectable underdrawing was applied in a dry medium. It possibly included a fatty substance, as the later paint layers hardly disturb the dry underdrawing. However, more displacement was detected in the surgeon's face (see figs. 33.2–3). The lines are discontinuous and often skip, as the carbonaceous material is only deposited on the top ridges of the underlying pigmented isolating layer (see fig. 33.4, in which the position of the underdrawing has become more apparent due to abrasion (see below, *Intermediate layers*). This and the rather schematic nature of the underdrawing could be indicative of a tracing, but there are many smaller changes between the drawing and painting phases, which would not necessarily have occurred in the case of an exact copy from a transferred composition.

  There seem to have been at least two underdrawing stages. Thin lines appear to have been used to indicate the main contours and elements of the composition, such as the planes of the background landscape, but also smaller elements like the belt of the surgeon. In many areas, however, the thin lines are likely obscured by the broader

33.4 85MICGBM006

33.5 85MICGBM010



33.6 85MICGBM024

33.7 85MICGBM023

33.8 VIS

33.9 Mapping of micrographs reproduced here (33.4–7)

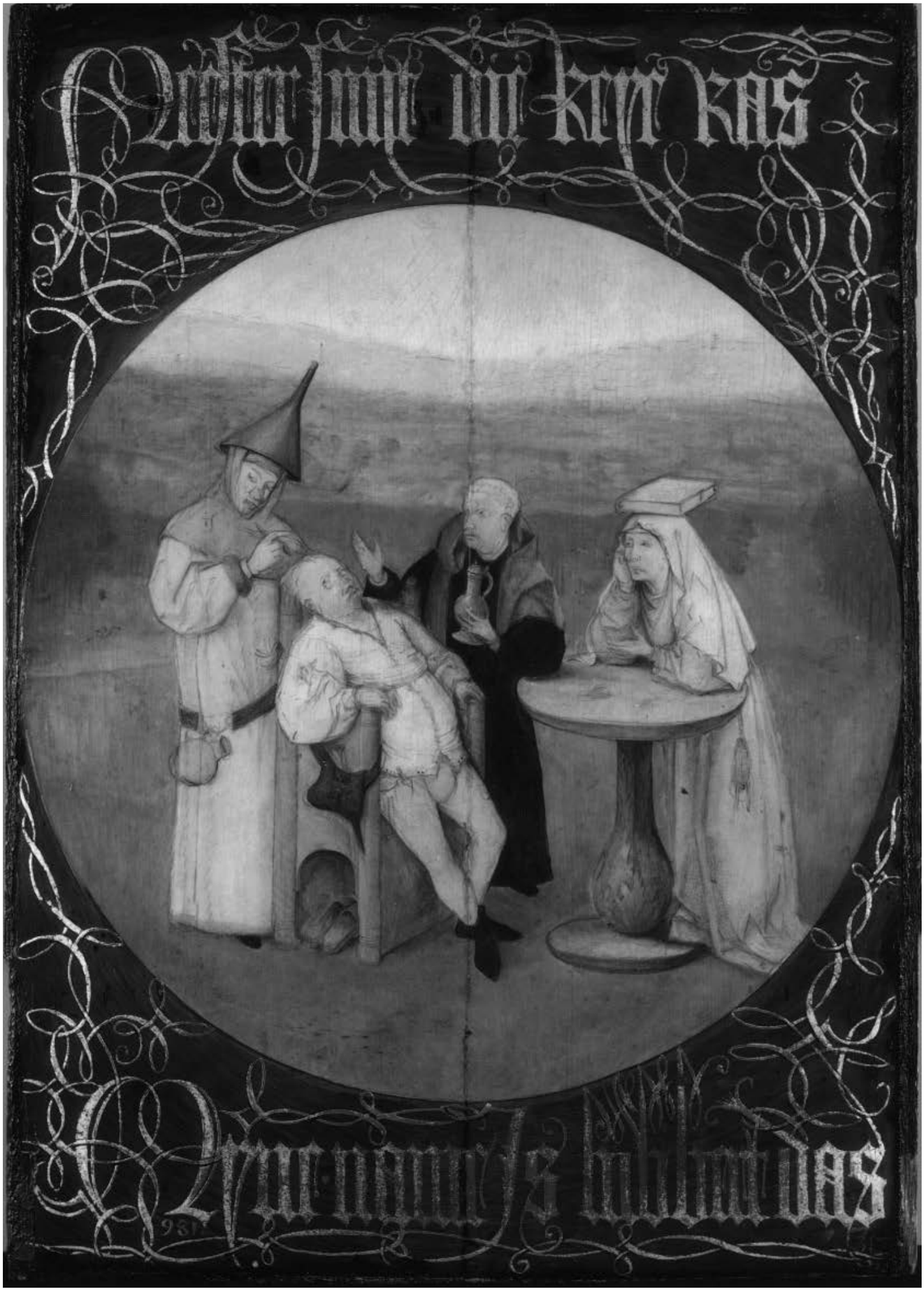
lines of the second stage. Modelling was done using short, parallel hatching to indicate darker shadow areas, as in folds or in a leg of the chair.

- ***Style*** The underdrawing is rather simple, often with short lines at sharp angles, especially those of the first underdrawing stage. The somewhat discontinuous lines – at times partly doubled – were applied in a straightforward manner. Changes in the underdrawing were fairly small, as in the faces of the surgeon and the patient. There were no major revisions in the underdrawn composition, with the exception of the jug on the surgeon's hip, which was only drawn later, on top of continuing long folds of the man's cloak, and thus apparently an afterthought. Hatched lines to indicate folds or shading were done diagonally and in parallel, and seem to serve only as indicators. The hatching in the robe of the surgeon was done from top right to bottom left, whereas the hatching in the leg of the chair runs from top left to bottom right. Line ends are mostly straight and perhaps slightly tipped, but not consistently, because of the dry material used. The lines themselves are often curved.

- ***Revisions in underdrawing and differences from painting stage(s)*** The underdrawing was not followed exactly in the paint application phase, but generally there are only slight differences. Several small changes can be observed, for instance in the background, in the shoes below the chair, in the faces and hands of the figures, in the surgeon's blade and in his belt, as well as in contours. These are all positional alterations, while in the woman's purse, the shape seems to have been altered.

- ***Intermediate layers*** Cross-sections seem to indicate that the ground 'was coated in an oily layer that is more visible in some microsamples than others'.[6] The build-up continued with an impastoed, white-pigmented isolating layer and then the underdrawing. This is also visible in a published cross-section of the paint.[7] Although the image shows a thin, whitish layer on top of the underdrawing, this could

33.10–11 VIS and IRR



be a local undermodelling for the red breeches, since it has not been observed elsewhere. Also, the diagonal strokes of flesh tone in the surgeon's face pulled along some of the underdrawing, indicating that the underdrawing must be atop the white-pigmented isolating layer (figs. 33.2–3).

Brushstrokes from the application of the pigmented isolating layer are visible in XR (fig. 33.12), indicating a lead-white component. This is supported by the published cross-section analysis, which indicates a fairly thick layer (about 30 μm) of white with some black impurities.[8] The brushstrokes also reveal that the pigmented isolating layer was applied in two separate sections, with predominantly vertical strokes overlapping in a horizontal band just below the level of the tabletop, where the layer appears denser in XR. Broad brushstrokes from the application of this layer are also visible to the right of the table. Although the later paint strata cover most of the pigmented isolating layer, it is still detectable in the edges of the roundel, in contours and in other areas. It is also visible in losses and shimmering through locally. Although this effect is partly due to ageing of the paint and was unintended, it is debatable whether visibility of the pigmented isolating layer in areas not completely covered by paint was, in fact, intentional.

PAINT LAYERS

- ***Paint application and painting technique*** The brush-applied oil paint (analysed)[9] covers almost the entire surface of the panel. The underlying white-pigmented isolating layer is sometimes visible at the interface between different colours. Paint was applied in several stages, mostly wet-on-dry, but also wet-in-wet. It extends onto the barbs because the panels were originally painted in an engaged frame. A sharp incision was made in the paint around the roundel to indicate its contour (see below, *Build-up and palette*).

  The paint was mostly applied in fairly thin layers. The wet, glossy paints were applied in both opaque and semi-transparent layers. Glazes were done in red, which was also used in mixtures for purplish colours, and in green. Relatively medium-poor paint application was not noted, and even the areas of impasto seem to have had an unusually wet consistency. In some places, slightly broader drying cracks formed (e.g. in part of the woman's proper right red sleeve). In general, the painting was worked out to a high degree of finish with a fairly large amount of detail. Very fine brush handling is perceptible overall, done in minute strokes. Brushstrokes were applied in multiple directions. The paint was worked into an even smoother finish for the group of figures. It was generally built up in one or two layers, to which were added supplemental highlights, shadows and detailing. Brushstrokes were sometimes utilized to render contour and volume throughout the painting, and this is most apparent in the robes of the surgeon and the woman. Contours were sometimes reinforced with dark lines, for example at the right side of the patient's head. Irregular black lines were often applied for the physiognomic details, as in the faces of the patient and the woman, and in the latter's proper left hand. Small, smooth, pinkish highlights appear in the faces of the figures and contribute to the modelling.

- ***Texture*** Most passages have an unusually smooth finish. Slightly textured brushstrokes are primarily discernible in the background landscape. Texture is, however, used for modelling in some cases. The surface texture of the wooden panel itself is hardly visible.

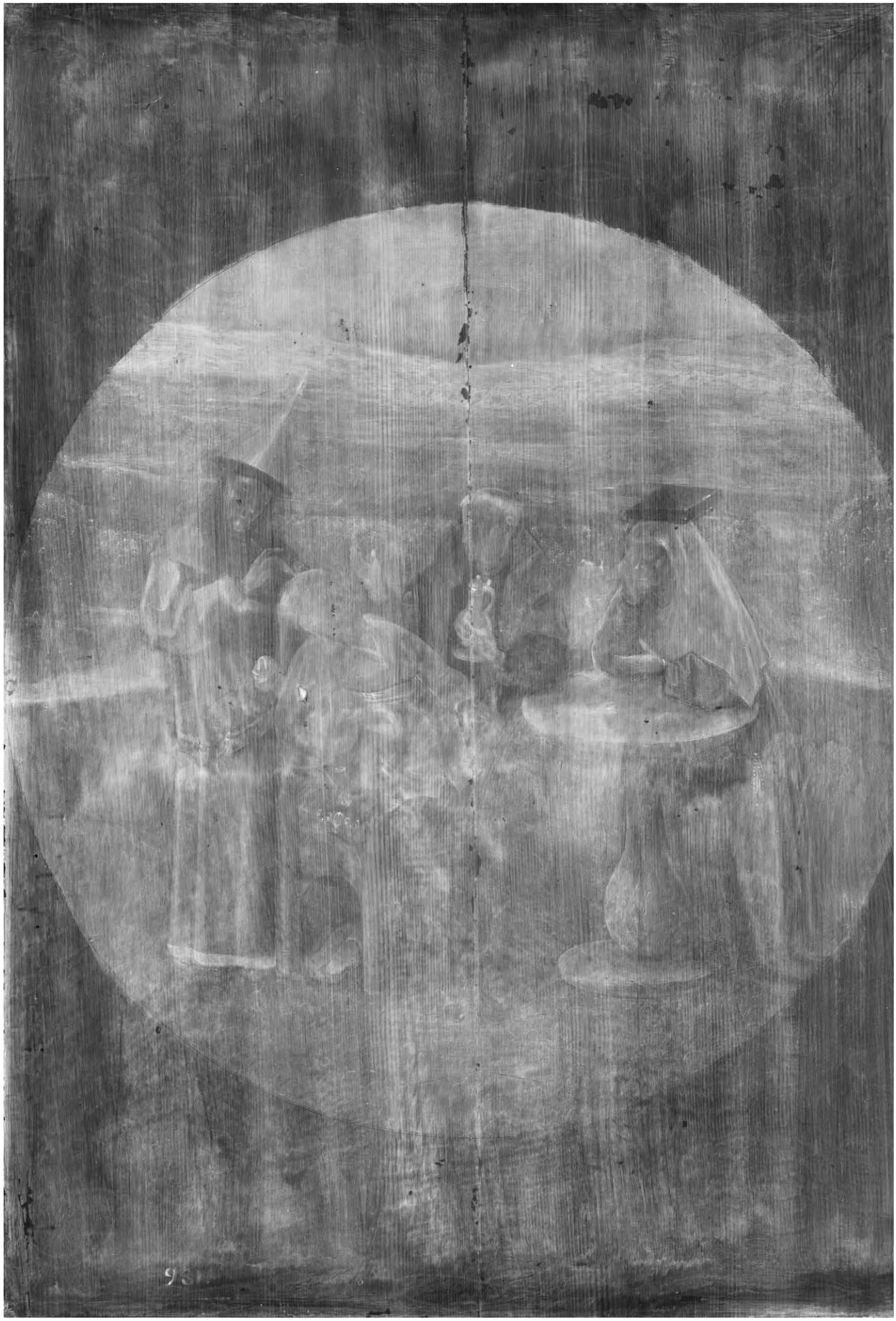
- ***Build-up and palette*** The paint was applied mostly from light to dark, with a final application of lighter details and highlights. The paint application was almost completely planned and was executed 'back to front', except in details. The group of figures was left in reserve from the background, and their faces and hands were then left in reserve from their clothing. This can be seen in the hands, where the thin skin tone partially overlapped the thicker surrounding paint and became more abraded.

  The entire blue background consists of a layer of lead white mixed with azurite pigment (15–20 μm thick), which is unusually smoothly painted. This is followed by a layer of pure azurite pigment (20–25 μm) in oil.[10] This second layer was gradually applied more thickly towards the upper part of the sky and was also painted thicker on the hills. The green background landscape partly overlaps the blue. The darker green layer of the upper background was followed by a considerable amount of detailing in white paint. Besides indications of towns, figures and a gallows, some of the tree trunks were also highlighted (85MICGBM009). The foliage in this area was indicated by some additional light green dots. In the centre background, immediately left of the steeple, a brighter, reddish paint seems to indicate a fire.

  Judging by a cross-section, the more yellowish central background tone apparently consists of a base layer of lead white (and/or lead-tin yellow), mixed with copper-green malachite pigment (45 μm), followed by a copper resinate glaze (25 μm).[11] In a loss close to the sampling spot at centre right, however, a bright green layer of malachite pigment is also discernible underneath these layers (85MICGBM022). The foliage in this section consists of rather sharp, short, light-coloured dashes, some possibly containing lead-tin yellow. There is some schematically applied but very convincing middleground detailing, such as a woman milking a cow (see fig. 33.13). The green landscape in the foreground has a darker, copper-green glaze onto which individual blades of grass were painted in a fluid, light green. This detailing, though, was done after the figures, chair and table were completed. In places, it also overlaps the black area around the tondo, further indicating that the blades of grass were painted in a late or final stage. The table is painted in blue, and on the column there is a shadow painted with a brown glaze.

  The black surface framing the roundel was painted after most of the blue-and-green background and – possibly – the figures were finished. An incision was made to indicate the outline of the roundel. This had probably become necessary because paint covered the initially underdrawn contour line of the circle, at least partly. The incision of the upper half is continuous, but at the bottom it was restricted, since three partial and overlapping circular incisions can be seen in XR. The centre point is on the join, just below the jug. No compass mark was located with certainty. The incision was made in the paint of the background landscape, as seen in XR. The black paint that was applied afterwards partially ran into the incision.

  The funnel-shaped headpiece of the surgeon was largely left in reserve, but its tip overlaps the blue of the hills. The figures show the same build-up, as they were painted slightly larger than their reserves and thus overlap the background landscape. A loss at the bottom of the surgeon's robe shows that at least that section was first painted in a purplish colour, a mixture of azurite pigment and red lake (85MICGBM004). Over that, a brighter layer containing red lake and lead-white pigment was applied, followed by the furry edge of the robe, consisting of black and white pigments. The purplish hue does not seem to be present in the area below the chest, where a greyer brown is visible. The layer of brighter red lake and white paint was applied directly on top of it, followed by a red lake filling in some of the shadow areas. The pink patch below the surgeon's hand is a highlight. A mixture of red lake and azurite pigments can be detected in the shoulder cape of the surgeon. His brooch was built up using ochre[12] and lead-tin yellow highlights. The jug on the surgeon's belt slightly overlaps the green background. Highlights were done in lead white, with a mixture of blue and white to indicate the top of the jug. Shadows were indicated in red lake, followed by black paint.



33.12 XR

The patient's shirt is made up of lead white, and its shadow areas were modelled with grey. Detailing was done in black or grey paint (partly overlapping the painted chair) with additional white, blue and red lines. The red cord was painted in red lake, locally applied from left to right and dragging along the still-wet paint beneath it (fig. 33.5). The red breeches of the patient were executed in a layer (10–25 µm) of red lake composed of kermes and madder, mixed with some finely ground vermilion.[13] The metalwork on the pouch was done in a bluish paint with lead-white highlights.

As mentioned above, bluish paint was also used to depict the metal jug. The dark robe of the man holding this jug consists of a single layer (30 µm) of vegetable black mixed with azurite pigment, applied over the white-pigmented isolating layer.[14] At the bottom, a light brownish colour was used to indicate the furry edge of the robe. The dark bluish cape contains azurite pigment; it overlaps the landscape and was left in reserve from the black.

The headdress of the woman was painted before her dress. The violet of the dress consists of azurite and organic red lake (85MICGBM019–020), as well as slight traces of vermilion and lead-tin yellow pigments.[15] The red book on the woman's head was left in reserve. A pinkish paint was locally applied on top as highlighting. The book pages and the clasp were painted in ochre, followed by lead-tin yellow highlights. Her red purse seems to contain iron-oxide red pigment as well as red lake, followed by black, vermilion and lead-tin yellow highlights (not analysed, see figs. 33.7–8). The flowers on the table also contain lead-tin yellow, mixed with green.

The hands and faces of the figures were painted after their clothing. Several hands were roughly left in reserve, as in the hand on the metal jug. The flesh paint of the hand overlaps its reserve, but abrasion has revealed the underlying paint and possibly underdrawing. These skin elements are often made up of a basic flesh tone with gradations to a greyer hue for darker areas. Fairly short, smooth, lighter pinkish strokes were added to further model the hands and faces. Facial features were indicated by dark brown and black outlines, black pupils and white highlights (85MICGBM007 and 85MICGBM015).

For the gold lettering, an oily, impastoed mixture containing lead white, ochre and black pigments was first applied atop the black background.[16] This mixture was used as a mordant, onto which the gold leaf was applied.[17] Finally, several of the contours of the gold were adjusted or sharpened with black paint, which was also used to outline most of the intersections of the gold lines (85MICGBM001). Generally, the garlands cross alternately over and under each other.

- ***Changes*** The robe of the surgeon extended downward slightly, and its bottom edge appears to have been purple. The knot of the sash was not left in reserve, but painted over the paint of the chair and the surgeon's robe. The lower hand of the woman was initially positioned more in profile.

FRAME

The original, engaged frame has been lost. The non-original wooden frame is carved, gilded, painted and decorated. It also carries the inventory number of the panel in a red-painted shield top centre.

CONDITION

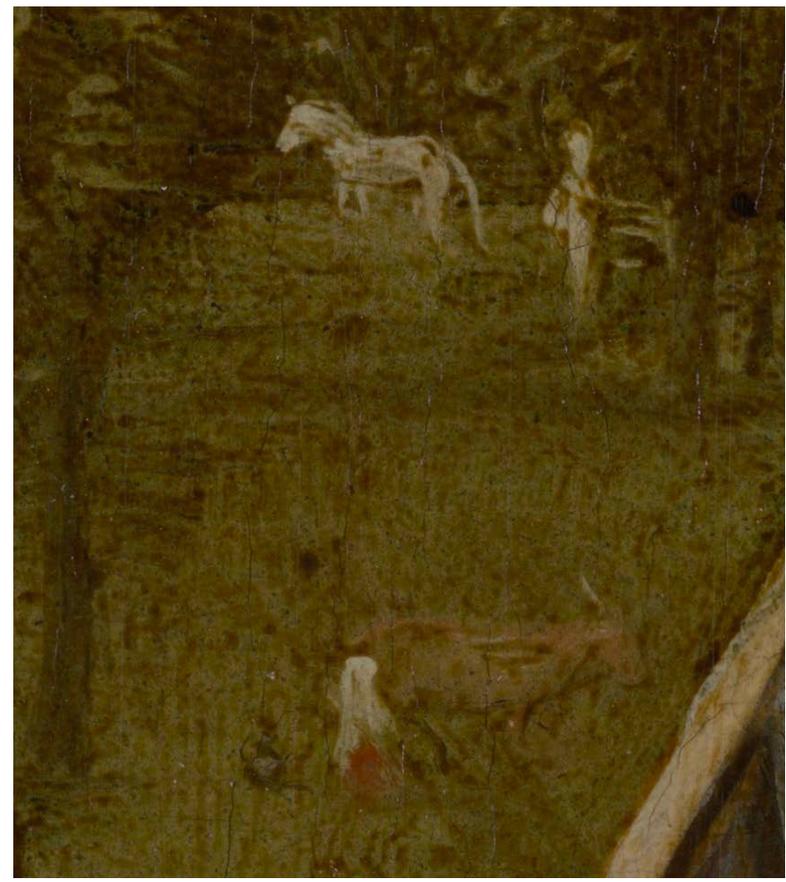
Support

- ***Altered dimensions*** The panel was thinned slightly in the centre, along the join. Presumably this was done after the insertion of the two dovetails and the strips of wood (see also below).[18]

The length of the barb on the bottom is wider than at the top. From this we may deduce that the original panel and its engaged frame were shaped more like a trapezium. The panel was cropped slightly on all sides in the past, so as to obtain opposite sides of equal length.[19] However, since the diagonals have an uneven length, the painting currently has a very slight rhomboid shape.

- ***Additions*** The two dovetail inserts on the reverse are later additions. One is placed 9.6 cm from the top edge, and the other is 10.2 cm from the bottom edge. Although the dovetails are positioned in a cross-grain direction, which could lead to structural conservation issues, no cracks have formed so far. Strips of wood about 1 mm wide and roughly 3 mm deep were inserted at the join on the reverse of the panel, in between the two planks. This was likely done to ensure a better gluing face when rejoining the two planks, which were originally butt-joined.
- ***Cracks*** At some point in the past, the bottom left corner of the panel (as seen from the front) was damaged, resulting in a roughly 10 cm-long crack running along the wood grain. This 1 cm-wide strip of wood was partly loose owing to woodworm damage. When this section was repaired, it was glued at a slight angle.
- ***Deformations*** Seen from the front, the panel has a convex deformation of about 8 mm maximum, when measured from the thinned bottom edge.
- ***Joins*** The join in the centre of the panel is closed and the planks, which have been separated and rejoined in the past, are level.
- ***Coated reverse*** The reverse has not been coated, but several areas with what appear to be glue residues are visible on the right side of the panel. Dabs of green and bright yellow paint are present top left.
- ***Biological damage*** Old woodworm damage is evident on the reverse of the panel, being more concentrated at the left and right edges of the painting. Small exit holes are also observable on the painted surface, at the lower left edge of the panel.

33.13 VIS



Ground and paint layers

- ***Stability*** In general, the adhesion of paint and ground is very good. There is one old and stable spot of raised paint just above the left knee of the patient. Most craquelure is caused by natural dimensional changes of the panel. In the woman's red sleeves there are slightly broader drying cracks.
- ***Losses*** There are a few minor losses, mostly just to the paint. The join was separated in the past, resulting in several small losses along it. In the top left background landscape, there is a small dent in the paint.
- ***Abrasion*** The paint surface is somewhat abraded overall. This is more apparent in areas where the paint layers were applied thinly – for example, in the white shirt of the patient, the tabletop and the faces of the figures. It is even clearer in the hands, where the thin skin tone partly overlaps the thicker surrounding paint, resulting in its being on a higher plane and thus more susceptible to abrasion. There are some older damages along the edges, with slightly more abrasion from previous framing.
- ***Discoloration and increased transparency*** The red glazes have faded somewhat. This is visible in the surgeon's robe and shoulder cape, as well as in the woman's robe. The latter two areas originally appeared much more purple. The glazes containing copper green have partly discoloured and appear somewhat brownish. The brownish, semi-transparent paint that was used as a shadow on the table support has presumably discoloured slightly (see fig. 33.6). Some paints that contain lead white (including skin tones) appear to have increased in transparency, causing greater visibility of the underlayers and an unintended change of appearance. The vermilion paint on the woman's purse shows locally darkened areas caused by natural, light-induced degradation of the pigment (figs. 33.7–8).
- ***Filling, retouching and overpainting*** The majority of the losses were filled and inpainted, although several smaller damages remained untreated (85MICGBM012). Most retouchings were done around the join and to the gold calligraphy top right, and these areas have discoloured slightly. They were mostly applied in dabs or vertical strokes and sometimes cover parts of the original paint. The barbs and outer edges of the panel were almost completely overpainted in black.

Surface finish

- ***Varnish*** The appearance of the brush-applied varnish is relatively even, although the area of the roundel was locally cleaned in the past, which is visible in UV radiation. The thickly applied varnish layers have yellowed and appear highly glossy and fatty. There are several long surface scratches in the varnish.
- ***Surface dirt*** There is only a small amount of surface dirt on the painting, but some brush hairs are trapped in the varnish.
- ***Visibility of the original surface*** The saturation of the paint surface is relatively good, but in some places the varnish has sunk in, resulting in matte areas. In parts of the black background (e.g. top centre), a blanching effect is also apparent. The yellowed varnish layers and the slightly discoloured retouchings further cause a somewhat reduced legibility of the original paint surface.

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[1] Garrido and Van Schoute 2001, 51. The publication mentions that in old photographs taken in 1952, the number 317 was also present in the bottom left section of the circle.

[2] Four of the cross-sections are described in Parra Crego 2001 (a chapter in Garrido and Van Schoute 2001), 240. One cross-section is illustrated in Garrido and Van Schoute 2001 (56), and two in Parra Crego 2001 (239 and 241). Further information on the other samples was not available.

[3] Klein 2001, 125. The youngest or last-preserved ring on each of the two planks of the panel dates from 1471 (I) and 1477 (II), respectively.

[4] Garrido and Van Schoute 2001, 55, and Parra Crego 2001, 230.

[5] Garrido and Van Schoute, who probably used a vidicon IRR camera without a daylight-blocking filter, mentioned that 'no underdrawing was detected in the landscape' and that there were 'no signs of shading'. Garrido and Van Schoute 2001, 52–54; see also BRCP, *Catalogue Raisonné*, Chapter III.

[6] Garrido and Van Schoute 2001, 55.

[7] Parra Crego 2001, 241 fig. 24. On p. 233, the author calls this a 'retouch drawing' and distinguish it from preliminary drawing done on the ground layer.

[8] Garrido and Van Schoute 2001, 55, and Parra Crego 2001, 238. The impurities could be consistent with the use of a blackened sheet in the tracing of a calque for the underdrawing..

[9] Oil was identified in two of the paint samples. Garrido and Van Schoute 2001, 240.

[10] Parra Crego 2001, 240.

[11] Parra Crego 2001, 240. Garrido and Van Schoute, in the same publication, mention lead-tin yellow instead of lead white (p. 55). Also, the use of copper resinate (verdigris dissolved in hot varnish) is doubtful. This layer is more likely a glaze with verdigris pigment that over time has dissolved in the oil medium. Van Eikema Hommes 2004 (51–89) has shown that copper resinate was most likely not used for paintings on panel or canvas.

[12] Iron-oxide yellow and iron-oxide brown were also detected in the paint layers. Garrido and Van Schoute 2001, 42.

[13] Parra Crego 2001, 240–41 fig. 24 and 258 table 2.

[14] Parra Crego 2001, 240. On p. 56, Garrido and Van Schoute describe a 'blend of black and azurite'.

[15] Garrido and Van Schoute 2001, 56. XRF indicated the presence of traces of lead-tin yellow in the patient's red trousers and in the black robe of the man holding a jug.

[16] Parra Crego 2001, 239.

[17] Our examinations did not reveal preparations for the calligraphy.

[18] The scarcity of tool marks could indicate that the panel reverse was sanded at some point.

[19] Probably this was done to fit the panel into a new, rectangular, rabbeted frame. The 'correction' has resulted in the current shape of the panel and rules out the possibility that it was originally positioned in its engaged frame at a slight angle.

34

The Seven Deadly Sins and the Four Last Things

NO RESEARCH REPORT

Workshop or Follower of Hieronymus Bosch
c. 1510–20

Oil on poplar panel, 120 × 150 cm
Museo Nacional del Prado, Madrid, 2822
(on loan from the Patrimonio Nacional)

The BRCP was not granted permission to examine and document the painting; www.boschproject.org no. 34.
For notes on technique, see BRCP, *Catalogue Raisonné*, cat. 34.

Inscription
Lower centre: *jheronimus bosch*

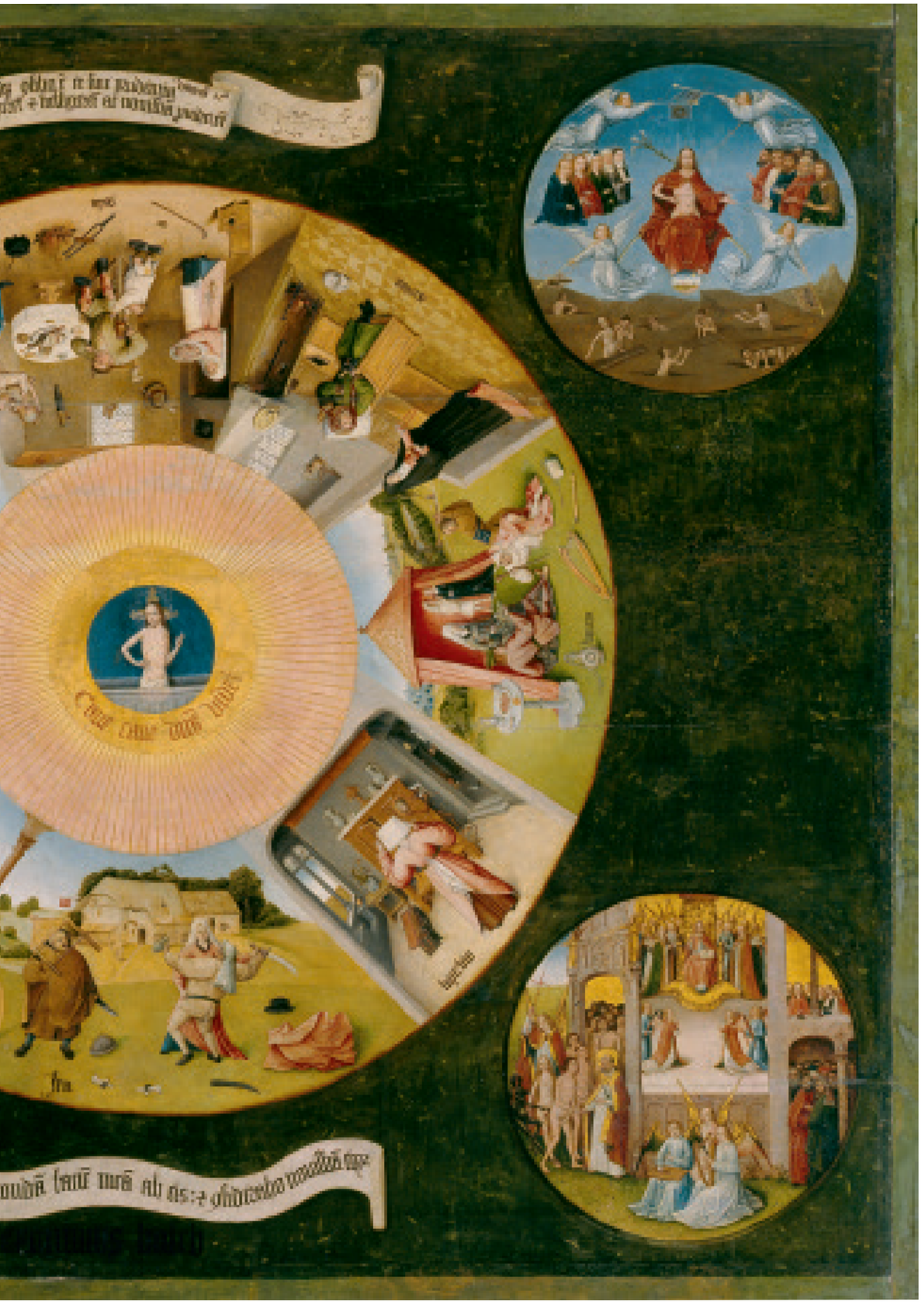
Condition
The poplar support was enlarged at some point with two strips that were nailed to the sides. On the reverse, dark red paint, oakum and other materials were added later, including a strip of canvas that covers the crack in the centre that runs over the entire length of the panel. Other cracks were observed as well and although there are multiple losses and damages, the original paint surface appears to be in a fairly good state overall.

Photo courtesy Museo Nacional del Prado, Madrid/Banco de Imágenes

SUMMARY OF CONCLUSIONS

from BRCP, *Catalogue Raisonné*, cat. 34

As is discussed in BRCP, Catalogue Raisonné, *cat. 34, the attribution of* The Seven Deadly Sins and the Four Last Things *has been the subject of considerable debate. In as early as the sixteenth century, it was suggested that it was not painted by Hieronymus Bosch, but by an apprentice. Several excellent* IRRs *were published (exhib. cat. Madrid 2006, 92–101), showing an unusually precise and detailed underdrawing. Multiple styles of underdrawing can be observed, but these cannot be readily linked with that found in other works from the larger group. In spite of the numerous revisions between the underdrawing and the paint layers, especially with regard to the perspective system, the painterly execution is likewise difficult to link to the output of Bosch and his workshop. Dendrochronological dating is impossible, since the painting was not executed on oak but on poplar. To our knowledge, it is the only known example of a Netherlandish painting on such a support, but this can be explained from its assumed function as a tabletop.*



S1

The Haywain

RESEARCH REPORT 103–108

Follower of Hieronymus Bosch
after c. 1525

Oil (not analysed) on oak (analysed) panel, left wing (RR 103): 143 × 52.8 cm; central panel (RR 106): c. 135 × 99 cm; right wing (RR 104): 142.8 × 52.7 cm. The frames are original.
Monasterio de San Lorenzo de El Escorial / Patrimonio Nacional, San Lorenzo de El Escorial, 10014740

The painting was restored in 2015–16, thus after the 2013 BRCP examination of the painting on which this text is largely based.
BRCP, *Catalogue Raisonné*, under cat. 20 (pp. 328–29); www.boschproject.org: no. S1 (RR 103–108).

Inscriptions and labels
Open left wing, bottom left: *Jheronimus bosch*. The number 378 is applied on both the bottom right of the central panel and the closed right wing; neither one is original. Central panel reverse, top centre, in white chalk: B.154.
Frame, closed right wing (RR 104), bottom left inside edge: an illegible label.
Central panel, bottom centre: a museum name plaque; top centre of the central frame's reverse, B.154. in white chalk; to the right of that a large, illegible number. In the upper part of the right edge, a faint 1 X is discernible. The B.154 marking is also written at centre right, and just below that, in red crayon, 1 × 9 [or 2?]. Bottom centre, 9 written in white chalk.

RR 103 RR 104

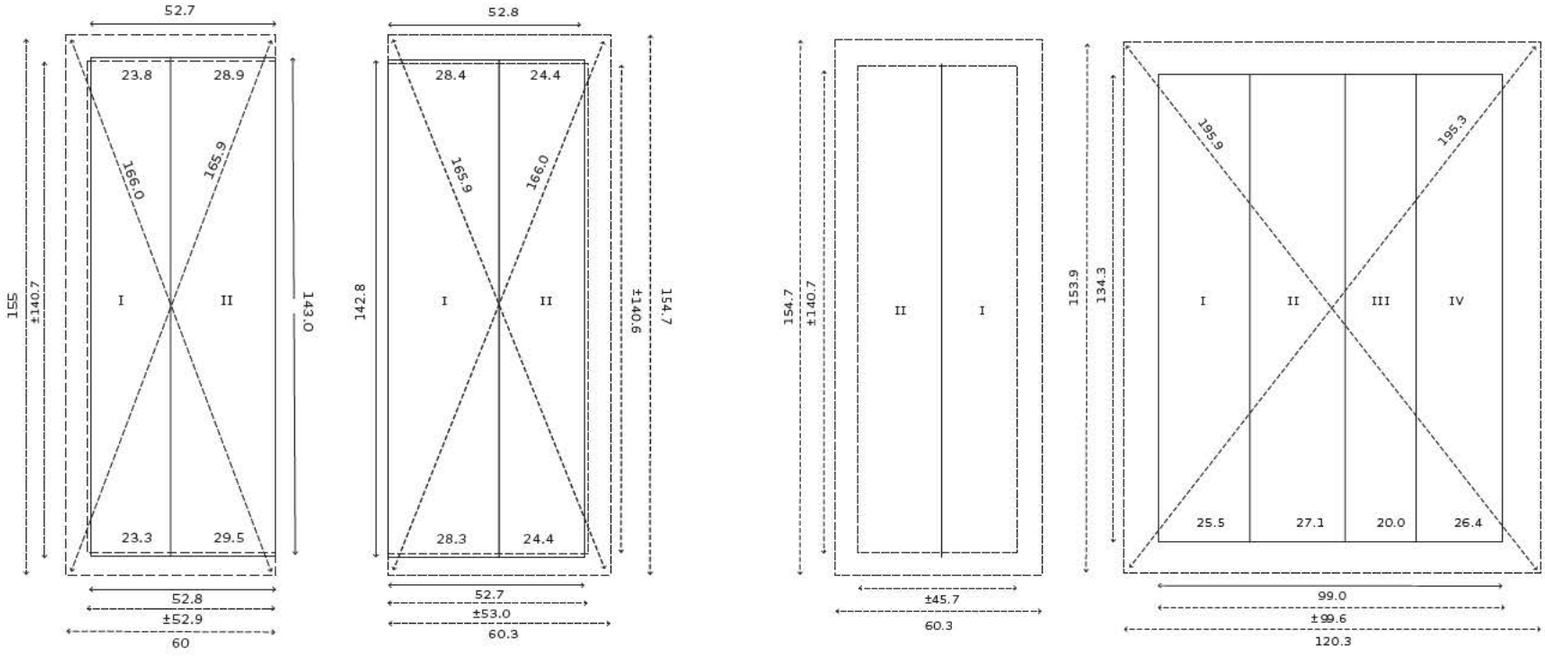
RR 105

SUMMARY OF CONCLUSIONS

The Haywain Triptych *in the Escorial is a close copy of the* Haywain Triptych *in the Prado (cat. 20). Unlike the work in the Prado, the Escorial version shows no traces of a creative process. In regard to painting technique and style and material of the underdrawings, the Escorial* Haywain *cannot be linked to other works in the Bosch group. The frames are overpainted but original. As in the Prado version, the composition on the exterior continues over the two closed wings within a single plane, uninterrupted by frames, but the structure of the frames differs between the two triptychs. In the closed wings of the Prado version, the central vertical engaged frame members were planed down. The Escorial triptych never had engaged frame members there, but integrated frame members were applied in the corresponding locations on the open triptych instead. Dendrochronology has established that the central panel could have been painted from 1498 onwards, although a date after 1500 is statistically more probable. The central panel is set in its original rabbeted frame, which indicates a later production date, after c. 1525. It was therefore most probably not produced within the family workshop. No traces of a transfer of images were observed. The close relationship, including colour scheme, to the Prado* Haywain Triptych *implies that the painter of the Escorial copy worked either from the original triptych or from an intermediate version, now lost.*

RR 106

RR 107



S1.1 Construction diagram (seen from the front)

RELATED WORK

This triptych is a copy of the *Haywain* (cat. 20) in the Museo Nacional del Prado, Madrid. It is possible that it was copied through an intermediate version.

EXAMINATION DATA

23–27 September 2013 (Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Ron Spronk).

The triptych was examined in its original frame in the gallery. The wings were separated and the paintings were studied upright on an easel under strong illumination. Both front and reverse were easily accessible, with the exception of several panel edges that were blocked from view by the frame.

RR 108

- ***Previous research and additional documentation available*** Complete set XRS, in long film format. A curatorial file with pictures from circa 1958 onwards is kept in the Palacio Real, Madrid.
- ***Previous treatments*** The triptych was restored in the Museo Nacional del Prado between 1933 and 1935.[1]

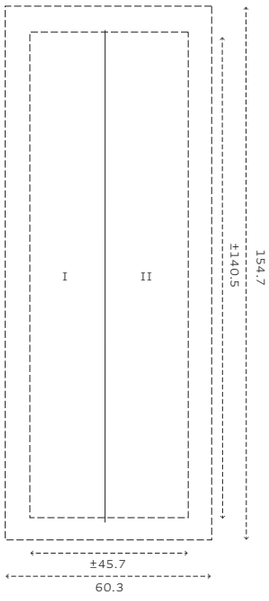
SUPPORT

- ***Panel*** Dimensions: see construction diagram (fig. S1.1). Thickness at edge, RR 103: c. 5.5–6.8 mm; RR 104: c. 5.2–6.7 mm.

  The wood species, Baltic oak, was identified through dendrochronology. The central panel consists of four planks, the wings of two planks each. The quarter-sawn planks are vertical in grain and laid vertically. The planks were butt-joined, dowelled and glued.

  The wings are painted on both sides. The original central panel reverse was thinned in part. (At the top centre, part of a dowel is still visible.)

  Tool marks of original bevelling can be found at the top and bottom left and in the centre and lower right of the central panel's reverse. Also, tool marks of original adzing, scrub-planing and gouging are visible. This reverse also has non-original saw marks.
- ***Bevelled or half-lap edges*** Traces of original bevelling are preserved on RR 108, the reverse of the central panel. All edges there have been worked to a half-lap. The edges on the front of the central panel have a narrow but distinct bevelling. Some nail marks from a previous framing are detectable around the edges.
- ***Dendrochronology*** The youngest heartwood ring dates from 1487, which, with the minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1496 for the tree that supplied the wood for the central panel.[2] (The wings were not measured.) A felling date after 1498 is statistically more probable, however, since 93 per cent of the possibly missing sapwood rings would be covered by this range. Assuming an additional minimum of two years for drying and transportation, the triptych could have been produced from 1498 onwards, although a production from 1500 onwards is statistically more probable.



S1.2–3 RR 103, VIS and IRR

GROUND

- ***Visibility*** The off-white ground (not analysed), which seems to consist of chalk (calcium carbonate – $CaCO_3$) bound in animal glue, is present overall.

  The ground layer is almost fully covered by the paint layers. It can, however, be observed in VIS at some of the painted contours, along the visible panel edges and in losses.

- ***Barb and edges*** On the wings, barbs, ungrounded and unpainted edges are present, except where the wings of the closed triptych come together; there, the paint continues onto the edge of the panel. The ungrounded and unpainted edges are, on average, 9 mm wide. This implies that the wings were framed before they were painted (see below, FRAME).

  In the central panel, the paint continues to the edges, as is confirmed by VIS and XR.[3] The central panel thus never had barbs or unpainted and ungrounded edges, and must therefore have been painted before it was housed in its original rabbeted frame.

- ***Application*** The ground was worked to achieve a generally smooth finish. Locally visible brushmarks appear to be from the pigmented isolating layer on top, rather than in the ground layer. With ageing, the texture of the wooden support has become more apparent.

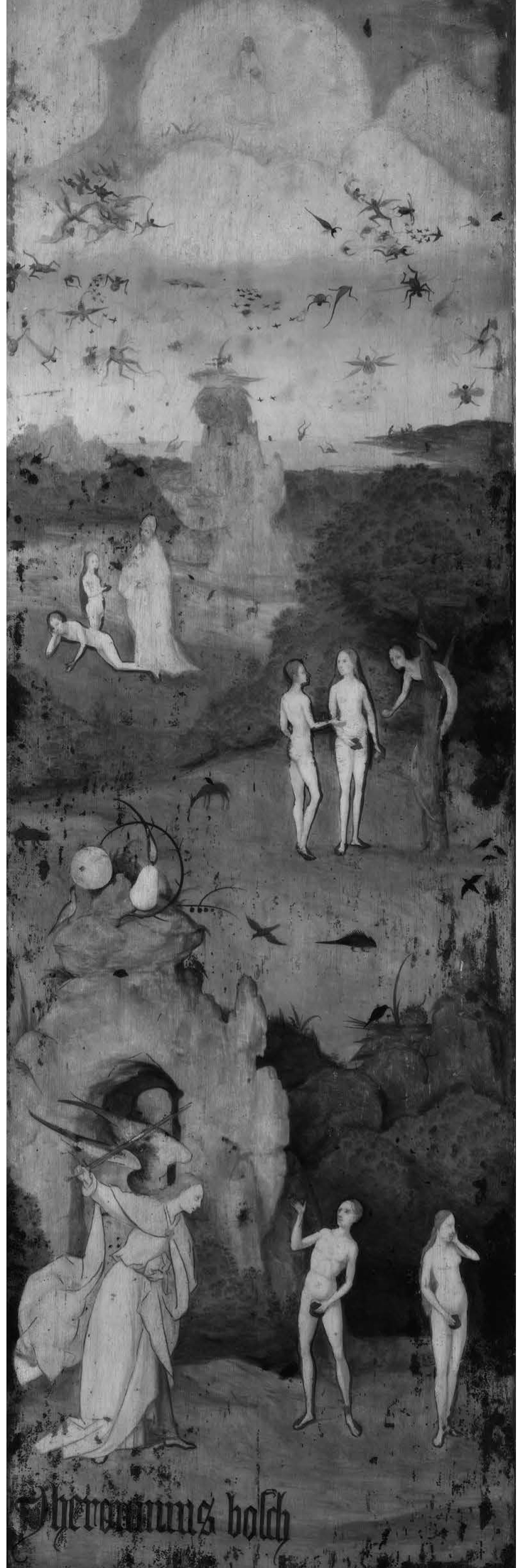
PREPARATORY LAYERS

- ***Underdrawing*** The underdrawing shimmers through the paint surface slightly in several areas and is visible in VIS. It is evident, for example, around the dog in the closed left wing and behind the ladder in the open right wing. Through IRR/IRP, underdrawing was also revealed beneath paint in many locations, more clearly in lighter paint areas that do not contain carbon. With IRR/IRP, the visibility does differ considerably; for example, the underdrawing can be readily observed in the dog and in the road and the legs of the pedlar in RR 103 and 104, but is very difficult to see in his face in the closed right wing, probably due to carbon-black pigment used in the paint there. The current visibility (in VIS) of the underdrawing in light areas is probably caused by the changes in refractive index due to the ageing of the paint film, resulting in an increased transparency. Underdrawing was mainly used for the composition, indicating contours and elements like the main folds and facial features. Modelling in the form of hatched lines has not been detected.

- ***Medium and application*** Underdrawing was applied in a dry medium that may have included a fatty substance, as the later paint layers did not disturb the dry underdrawing. The lines are largely continuous, with slight interruptions possibly caused by irregularities in the underlying pigmented isolating layer. Where underdrawing appears in IRR/IRP to be applied in a more liquid medium, this is in fact due to carbon-containing pigment in the paint layers.

  Curiously, the IRR/IRP images show broad, highly opaque contour lines in certain areas of all the painted surfaces of the wing panels (see e.g. fig. S1.3). Although these lines are ink-like in appearance, they are not part of the initial underdrawing. They were applied at a later stage and functioned in a way similar to underdrawing. When the background was painted, many elements (such as the figures) were left in reserve, but this was often done in a rough and cursory manner, not leaving reserves for smaller facial features such as noses. In a dark but fairly fluid, carbonaceous paint, many contours were locally reinforced, corrected and extended over the background to give better form and more detail to the figures. This resulted in the broad, dark contours visible in IRR/IRP. This also coincides with areas of paint overlap – for example, where skin tone partially overlies the background paint. Nevertheless, a dark contour paint was clearly used, as it shimmers through the upper paint layer and is visible in abrasions. Areas with paint overlap where the dark paint is not present have a comparatively lighter grey value in IRR, as in the reddish cloth hanging from the spear in the closed left wing (RR 103). In this wing, the colour of the correcting paint is similar to the dark additions at the bottom of the tree, visible in VIS. The dark hue was applied on top of the green landscape, leaving the leg in reserve, and was later partially covered by skin tone. Finally, a local contour line was applied. The thin line has a purplish colour and appears to consist of a mixture of red lake and carbon-black pigments. This line is visible in IRR/IRP, and it reinforces or slightly adjusts certain contours. In the open left wing, this line can be seen in the profile of Adam (figs. S1.12–13). The line is not painted very precisely, and therefore does not seem to be a correction of the contour here. In the closed left wing, at the right foot of the figure tied to the tree, a similar contour line resulted in a more arched foot, but some skin tone can still be seen extending below this line.

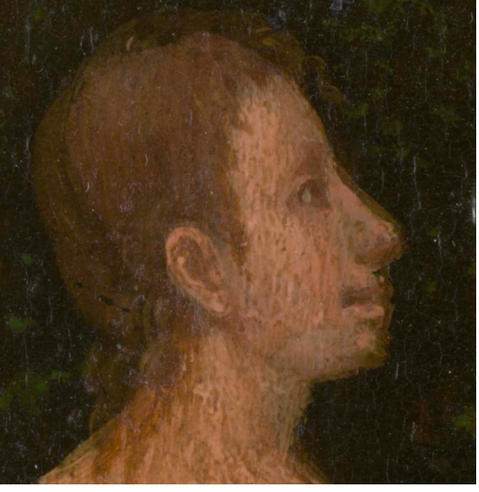
S1.4–5 RR 103–104, VIS and IRR

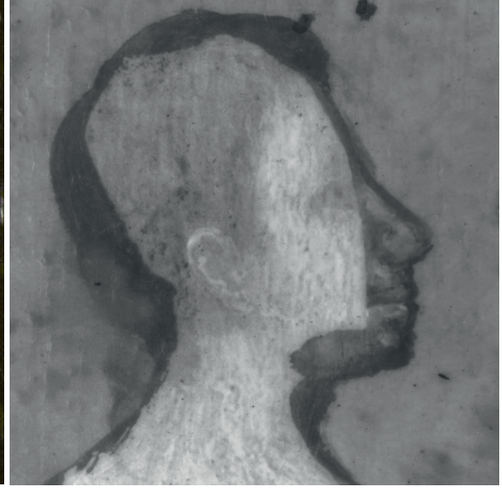


S1.6–7 RR 105, VIS and IRR

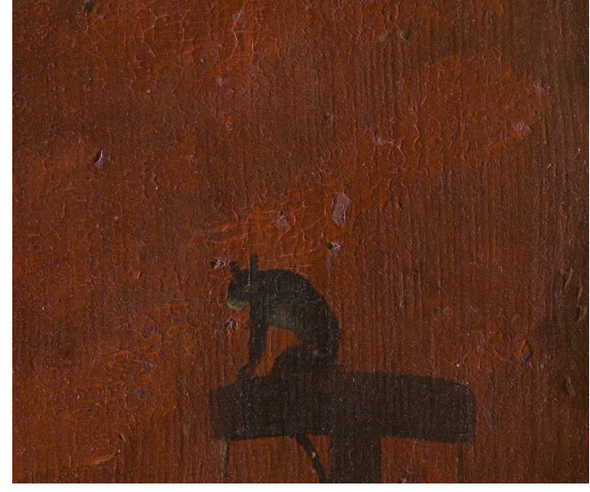
S1.8–9 RR 107, VIS and IRR

S1.10–11 RR 106, VIS and IRR





S1.12–13 RR 105, VIS and IRR macro



S1.14–15 RR 107, VIS and XR

- ***Style*** The compositions are largely underdrawn, in a fairly rough manner. Only contours were prepared, and modelling or shading were not indicated. The underdrawings are schematic in nature and do not reveal any inventions or artistic process, indicating that these compositions were not developed here but copied after existing ones (i.e. the Prado *Haywain* or an intermediate copy). The initial dry underdrawing appears fairly similar in all five painted surfaces, and the majority of the lines on each panel have about the same width. Differences are evident in the forcefulness of application, which has often resulted in much denser and – as seen in IRR/IRP images – more opaque lines. In areas, the dry underdrawing appears to have been reinforced by underdrawing in a wet medium. However, these more fluid lines seem to be either from the contour lines applied later or from carbon-black pigment mixed in with the later paints.
- ***Revisions in underdrawing and differences from painting stage(s)*** Since the underdrawing was not very precise, areas were also roughly left in reserve during the initial paint stage. The contour lines were adjusted with a dark paint (see above, *Medium and application*), so the later paint often overlapped the background. The slight changes from the underdrawing to the painting phase were therefore more the result of technique and build-up rather than artistic intervention.
- ***Intermediate layers*** A whitish pigmented isolating layer is visible under the paint layers (exposed in losses, as in the yellow hat in the central panel). This layer was thinly applied over the entire panel and probably contains lead white, since brushstrokes are evident in the XRS. The underdrawing appears to have been applied atop this streaky isolating layer, which shimmers through the paint surface very slightly in the open triptych wings. This clearer visibility does not seem to have been an intended effect, but due to the increased transparency of the paint layers upon ageing. It is also visible in a few areas at the interface of different colours (103MICGBM003).

  Spread throughout the wing panels, many patches of impastoed strokes can be distinguished under the paint layer. They seem to contain lead white, as they stand out in the XR (figs. S1.14–15). Each patch was applied in a few strokes, and the thick paint has fairly sharp edges (103MICGBM002). A spatula does not appear to have been used, however. The patches seem to correlate approximately to irregularities in the underlying ground layer. After the lead-white strokes were applied roughly covering these uneven spots, they were not worked into a smooth finish. Instead, the underdrawing applied afterwards can be seen skipping over the bumps in these patches, as in the mantle of the Archangel Michael. Similar strokes have not been observed in the central panel.

PAINT LAYERS

- ***Paint application and painting technique*** The brush-applied oil paint (not analysed) covers almost the entire surface of the panels. It was applied onto the edges in the case of the wings and over the edges of the central panel. The underlying preparatory layer is sometimes visible at the interface between different colours. Paint was applied in several stages, mostly wet-on-dry, but some wet-in-wet application was used locally. At the top left of the central panel, at the edge of the cloud, dotted marks are discernible that could be fingerprints (106MICGBM003).

  During the painting process, most areas were only roughly left in reserve, and paints frequently overlapped. Nevertheless, the painting was generally worked out to a high degree of finish. Paints were applied in opaque as well as semi-transparent layers. The use of relatively medium-poor, opaque paint resulted in a slightly shallow, flat appearance, especially where applied in multiple layers. The relative physical flatness of the paint surface is also distinct, especially compared to the version in the Prado (figs. S1.17–18). More medium-rich, fluid and glossy paints were used, too, especially for the glazes. Generally the composition was built up in several paint layers, and the preparatory layers seem to have only played a limited role. The underlayer appears to have been used somewhat more in the open right wing, but this also relates to the differences in composition. There, mainly for the red sky, a more opaque vermilion paint was used, whereas the more dominant backgrounds of the other panels were done in thicker greens and blues.

  Overall, there are only minor differences in surface texture. Although brushstrokes were used to render contour and volume throughout, many areas appear to have been filled in, with modelling achieved through build-up of layers. Wet-in-wet painting is scarce (107MICGBM003). Detailing, such as the very wet paint of the black strings in the pedlar's shirt, was generally applied on an already-dry paint film underneath. Locally, traces of a blending of the paint layers are observable. It is visible at the folds of the pedlar's left sleeve and in the trunk at the bridge (fig. S1.16). This even pattern of paint lines could have resulted from the use of a blending brush to feather out the paint, even though the hues were not completely intermixed. In the other panels, similar fine, slightly separated brushstrokes are visible, often in a rather diagonal direction. These lines can be narrow and finely tipped (107MICGBM001) or somewhat broader (107MICGBM002 and 105MICGBM001).

  The foliage, as in the crown of the tree on the haywain, consists of both dots and more elongated paint splashes. The medium- and lighter green paints are more grouped here than in the foliage of the closed wings. The lead-tin yellow dots on the hilt of the sword in the central panel were applied in a more continuous manner. Sometimes a rather fluid, black contour line was used to indicate an area of shadow. This

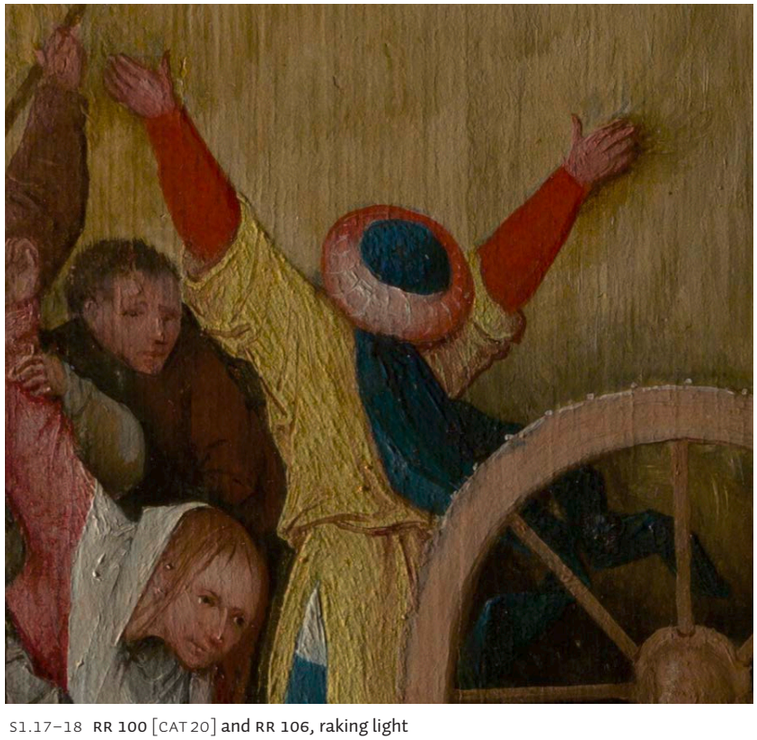
S1.16 RR 104, VIS

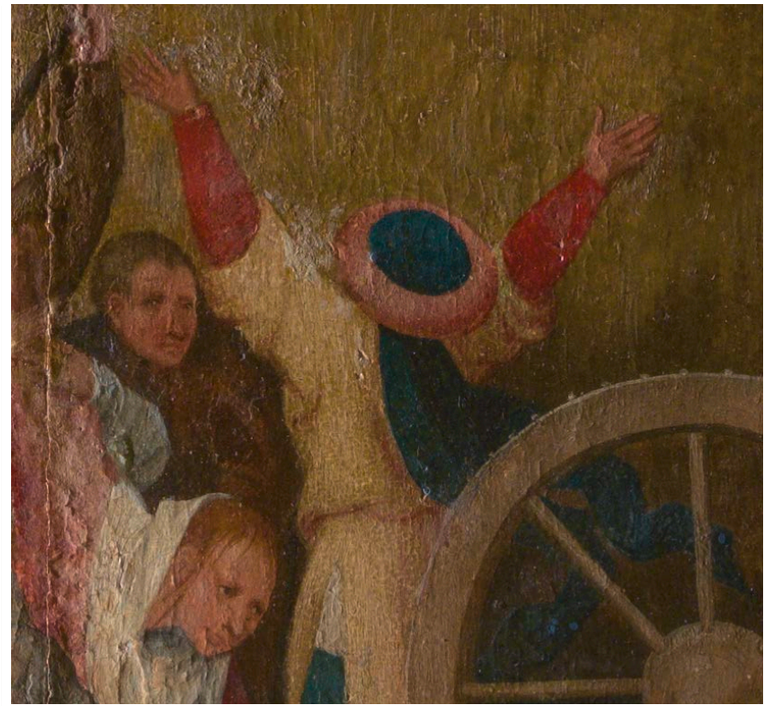
is visible, for example, below the sword in the foreground, in the red plaque above the table, and in the rosary at the lower right. In all the panels, dark red-brown lines are discernible that were used for physiognomic detailing (e.g. at the hands) or for areas of shadow. Similar dark lines for adjusting contours are distinguishable in other areas as well.

- ***Texture*** All passages have a relatively smooth finish. The slightly textured brushstrokes are not used for modelling, and the highlights are relatively flat. The texture of patches underlying the paint layer are visible, however.
- ***Build-up and palette*** The paint was applied mostly from light to dark, but also from dark to light, as in the foliage. Highlights and shadows were applied later. The painting phase was completely planned and was executed from 'back to front'. The background was painted before all of the figures, leaving areas in reserve, though often only roughly. In a dark paint, many of these contours were then adjusted, resulting in the broad contours visible in IRR/IRP (see above).

Following the corrected contours, the later paint layers also overlapped the background paint underneath. Both the closed wings and the open triptych were executed in colour. In the final stages, details of highlights and shadows were applied, such as the dark lines in the hands and feet of the figures. At the feet of the pedlar and at some feet in the central panel, cast shadows were painted. Form shadows were also painted in some figures, indicating a directional light source from the upper left side.

In the closed wings and the central panel, the white area of the sky was painted first, apparently using pure lead white. The blue upper part of the background landscape overlapped the white. The headpieces of the figures in the middleground of the central panel extended over the green of the landscape. The figures on the haywain were left in reserve, as was the figure peeping out from behind the leaves. The wheels of the cart were left in reserve and painted after the clothing of the figures was finished. Red lake detailing was applied on the already-dry lead-tin yellow of the figure's robe (106MICGBM006). The red robe worn by the woman at the bottom left of the central panel





S1.17–18 RR 100 [CAT 20] and RR 106, raking light

has a lead-white underpainting, followed by a red lake that was applied thicker in areas of shadow. For the robe of Christ, the red lake was covered by a thin, semi-transparent white scumble. The edge of the bright yellow hat of the figure in the central foreground overlapped the azurite blue robe. Just to that man's left, a white undergarment was painted beyond the area left in reserve, overlapping the vermilion trousers. For the grisaille-like figure with the branches in front of the haywain, lead-tin yellow and azurite paints were used, as well as pinkish colours.

In the closed left wing (RR 103), horizontal brushmarks can be seen from the application of the white of the sky. The base of the tree was not left in reserve there, but the foliage was. For the leaves of the tree, a dark green base was laid down, followed by medium and then lighter green dots. The foliage of the shrubbery appears to have a dark brown base, with the same build-up process as in the tree. For the greenery in the more distant background, a bluish base was overlaid with green dots applied to the upper and left parts of the tree, thus reinforcing its dimensionality. In the vermilion hat, red lake was used to indicate the area of shadow. The reddish robe on the ground was painted mostly wet-in-wet, with a first modelling apparently in a mixture of lead white and red lake, followed by pure red lake for shadows. This build-up is similar to that of the woman's robe in the closed right wing (RR 104). The large tree was left in reserve from the sky. After painting the trunk and then the small leaves, the artist cropped the tree's contours somewhat, using very small amounts of lead-white paint mixed with a little blue. The figure with the bagpipe was roughly left in reserve from the background water, partly overlapping it. The green part of this landscape was also painted after the water. In the beard of the pedlar, in addition to lead white, black and some blue pigments can be found.

In the open left wing (RR 105), the white and blue of the sky were applied first, leaving in reserve the white and red-brown clouds, as well as the sphere. These were then painted overlapping the sky. Within the pink colour at the edge of the sphere around Christ, figures of angels are discernible. After the sky, the blue and then the grey of the distant background were painted. An incision-like line visible there could have been used to indicate the horizon (105MICGBM001). The green landscape was then added, leaving the rocky features and the figures in reserve.

It appears that robes with red lake were then executed before the others. For example, the cloak of the Archangel Michael, consisting of lead white and red lake, was painted even before his white robe. God's robe slightly overlaps the landscape but was corrected or cropped slightly, using green strokes of paint. The stem of the pear-shaped fruit on top of the rock was partially left in reserve, but an increase in transparency has resulted in differences in appearance. The round fruit to the left was painted in lead-tin yellow, which was mixed with lead white in its upper part. Red lake appears mixed with lead white for the top, and pure red lake was applied over the lead-tin yellow at the bottom. The apples in the tree were done in lead-tin yellow followed by a red lake brushstroke for the shadow area. Eve's hair has an ochre colour, with a brown base and highlights consisting of a mixture of ochre and lead-tin yellow.

For the fire at the tower in the background of the open right wing (RR 107), mainly lead-tin yellow was used, with lead white for the brightest parts. For the smoke, red-brown paint was used extensively, as well as a dark green glaze and a blue paint. Blue was also used for the figure in the windowsill. Towards the horizon, in addition to the red-brown paint, pure vermilion was used, and lead-tin yellow highlights were partially mixed with lead white. At the corner of the building a pinkish paint was used, and just above that, there appears to be a fingerprint. The few small, circular shapes visible at the centre left, just above the sand pile, were caused by the texture of an underlying layer, possibly by air bubbles in the ground layer. The red carapace of the animal on the round tower was painted with a red lake glaze, followed by opaque pink highlights and a contour line at the top. Glaze-like copper-green dots were also applied, with verdigris highlights. Green paint was used for the lower part of the animal's body as well. Lead white served for its head and the highlights in its black eyes. The bill was painted with lead-tin yellow. The rope of the crane to the right was not incised but rather painted, as confirmed by XR. Most elements were left in reserve, but the black figure was not. He is painted directly over the background, using azurite paint for the highlights on nose and arm. In the white of the bridge, grey steps are slightly visible. These are not from an underlying layer shimmering through, but are painted on top of the light colour.

The rather large signature was applied in black over the already-dry green background. Guidelines or incisions were not noted. The signature's craquelure seems to correspond to the condition of the rest of the painting, but it has a rather poor adhesion. Many scratch marks can be found between and around the letters (105MICGBM004).

- ***Changes*** Besides minor adjustments to contours (see also above, *Revisions …*),[4] pentimenti have not been observed, which further confirms that the compositions were copied.

FRAME

The profiled wooden frames are original but overpainted with black and gold. Dimensions: left wing (RR 103): 155 × 60 cm; central panel (RR 106): 153.9 × 120.3 cm; right wing (RR 104): 154.7 × 60.3 cm. The frame is about 7.1 cm thick; only the vertical sections in the centre of the closed wings are around 4.9 cm thick.

Curiously, the frames of the central panel and the wings are of different types. The central panel is set into a rabbeted frame, while the wings are housed in what we can call 'semi-engaged' frames, a hybrid of engaged and integrated (or applied) frames. As in the Prado *Haywain*, the composition on the closed triptych continues across the two closed wings, without the interference of central framing elements, but this was here achieved with different means. To enable this continuing surface within the same plane on the closed wings, the open wings have integrated (or applied) framing elements in these locations. These applied sections are connected to the wing panels with two rows of dowels. The three other frame members of each wing are engaged. (See also fig. S1.1 and compare with cat. 20, RR 97–102.) The original surface of the overpainted framing elements can be seen at the inside corners of the closed wings due to abrasion from opening and closing the triptych.

The central frame has two separable hinges on either side for the wings. The wrought-iron hinges are nailed onto the frame in a slight rabbet. All are original, with the metal likely having been cut and folded. The wing panels are still in their original semi-engaged frames.[5] The central section of the applied frame member on the left wing is partly detached. There is a crack in the same section on the right wing. The half-lap edges of the central panel were largely inaccessible because of the screwed, non-original wooden profiles covering the entire perimeter.

CONDITION

The painting was restored in 2015–16, thus after the 2013 BRCP examination of the painting on which this text is largely based.

Support

- ***Altered dimensions*** The central panel reverse was thinned, mainly in the centre. Part of one dowel is currently visible. On the reverse of this panel, all edges have a half-lap. A small section in the bottom right corner of the central panel appears damaged (seen from the front).

- ***Additions*** On the reverse of the central panel, the centre join is reinforced by four countergrained dovetail insets. Along the join there is a large amount of cracked brown filling material. The XR films reveal that the two wooden strips, partly observed in VIS, were nailed to the vertical sides of the central panel.
- ***Cracks*** Some cracks are visible on the central panel reverse, running adjacent to the centre join.
- ***Deformations*** The double-sided painted wings remain mostly flat, but each has a slight bulge in the centre where the closed wings are not attached to the frame. The right wing (or its frame) is slightly torqued. The central panel has a slight convex deformation.
- ***Joins*** The central join in the middle panel is somewhat open, but there are no differences in level.
- ***Coated reverse*** A coating was not observed, but there are several white paint drips present.
- ***Biological damage*** Minor old woodworm damage was noted at the centre left and right of the middle panel. On the reverse of that panel, there are small areas of dry rot (brown rot) at the upper right, towards the lower right, and at the lower left, indicating exposure to high levels of humidity.

Ground and paint layers

- ***Stability*** In general, the adhesion of both paint and ground is good, but there are several issues with raised and tenting paint. The wing panels are in compression somewhat, which has resulted in raised paint over longer sections following the grain (105MICGBM002–003). Minor blisters and raised paint are present in the central panel. Here, the raised paint is quite pronounced in places. At the centre left edge of the closed left wing, glue residues are pulling up the paint (103MICGBM001). In the central panel, a small crack at the top left extends slightly from the edge. Most craquelure has been caused by natural dimensional changes of the panels. The craquelure pattern of the lower part in the central panel deviates from that of the sky. In the open right wing, slightly broader drying cracks were formed, such as the fine but open craquelure in deep red areas. In the open left wing, just above the fountainlike rocky feature and at the right edge at the horizon, there are non-original paint areas that are flaking and highly damaged.
- ***Losses*** There are many losses to paint and ground in the central panel and in the wings. For instance, mainly in the central panel, parts of certain figures are missing. In places, there are scratches and dents in the paint surfaces.
- ***Abrasion*** The painted wings are slightly abraded overall, but the central panel is more severely damaged. In several areas, such as the hay and the yellowish foreground, the top layer of paint has only been preserved in part and has been extensively retouched. The central panel edges are somewhat abraded due to framing. Locally, small areas are slightly crushed from previous consolidation.
- ***Discoloration and increased transparency*** Discoloration is present, for example in the landscape. There a copper-green lake component seems to have turned brownish. An increase in transparency is evident in areas of red glazes and of lighter paints. This is not of much consequence for the overall appearance, though, where paint is thicker or more opaque. Where paint extends beyond the area left in reserve for it, as in overlapping of background, it does become obvious. Especially for lighter paints over a darker background, an increase in transparency has caused a change in appearance. For example, the head of the figure tied to a tree in the closed left wing appears rather small, but was in fact painted in a more normal size. In the closed right wing, the pot at the base of the tree is currently difficult to distinguish. In both wing panels, too, patches that were applied atop the ground (see above, *Intermediate layers*) have become visible to the naked eye.
- ***Filling, retouching and overpainting*** Filling, retouching and overpainting are readily visible on all panels, in part because of their discoloration (fig. S1.18). Small losses were often not filled but directly inpainted. In the closed right wing, residues of apparent filling material can be seen at the hands of the pedlar. Most panel edges were in part retouched, and in the central panel these retouchings and overpaintings are especially numerous. In the lower left at the two standing women, large parts of the young child are missing and a baby was painted out completely.

Surface finish

- ***Varnish*** The appearance of the varnish is uneven and yellowed, and there are local varnish drips. The paint surface is poorly saturated and has an uneven gloss, mainly due to the extensive retouching. Also, a greyish layer is observable on the paint surface of the central panel. In places, scratches can be seen in the surface coating and there are some damages to the panel edges from the framing.
- ***Surface dirt*** There appears to be a small amount of surface dirt on the painting, which generally has a somewhat grimy appearance.
- ***Visibility of the original surface*** The painted surfaces of the triptych are poorly legible, especially in the central panel. This is mainly due to later additions, such as extensive retouching and overpainting that overlaps original paint underneath. The paint saturation is insufficient in areas, and with the yellowed varnish, reduces the legibility of the original paint surface. There are also many discoloured varnish residues in the interstices of the paint. In the light-coloured figures – of Adam and Eve, for example – these dark spots interrupt the fluent modelling of the skin tone. The extensive and discoloured retouching primarily distracts from the original surfaces.

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[1] Carmen García-Frías Checa and Angel Balao González, oral communication, 11 December 2013.

[2] Klein 2001, 126. The four planks of the central panel come from the same tree. The youngest rings on each of the four planks of the central panel date from 1468 (I), 1476 (II), 1487 (III) and 1472 (IV), respectively.

[3] Only the left and right edges are accessible for visual inspection. There the paint actually continues over the edges, onto the sides of the panel. XR confirmed that the paint also continues to the panel's top and bottom edges.

[4] The observed changes in contours appear to be corrections towards the situation in the Prado *Haywain*.

[5] The top left corner of the frame of the open left wing was previously detached. Before the BRCP visit, it was reconnected with screws.

S2

Ecce Homo

BRIEF RESEARCH REPORT 111–112[1]

Follower of Hieronymus Bosch
after c. 1525

Oil (not analysed) on oak (analysed) panel, 73.4 × 55.2 cm.
The frame (not studied) is modern.
Museum voor Religieuze Kunst, Uden
(on loan from Rijksmuseum, Amsterdam, SK-A-4252)

BRCP, *Catalogue Raisonné*, under cat. 11 (p. 232); www.boschproject.org: no. S2 (RR 111–112)

Inscriptions and labels
Reverse, top left: a small, square label with the inscription *K.U. 1219*;
top right: *Vogelpoel & Noorweegen N.V.* exhibition label.
Bottom right: orange Rijksmuseum label (with the old inventory number, *M.N. 1219*); to the left of that, two chalk inscriptions, *I* and < [?].

SUMMARY OF CONCLUSIONS

The findings from the technical examinations confirm that the Rijksmuseum Ecce Homo *(originally from the Mariënwater monastery), was painted by a follower of Hieronymus Bosch. The composition was largely copied after that of the* Ecce Homo *in Frankfurt, although the Rijksmuseum work is taller and narrower. The colour schemes are virtually identical in both works. No underdrawing was revealed. The incarcerated figure in the lower left was not kept in reserve from the lower layers and differs markedly in painting technique and style. It was apparently added much later.*
The panel was originally housed in an engaged frame, now lost.
Dendrochronology indicates that the panel could have been painted from 1522 onwards, although a date after 1524 is statistically more probable, which excludes a production in the family workshop.

RR 112

RELATED WORKS

Ecce Homo, Städel Museum, Frankfurt am Main (cat. 11; RR 49–50);
Ecce Homo Triptych, Museum of Fine Arts, Boston (cat. 24; RR 77–84).

ADDITIONAL INFORMATION

The painting was examined in the Noorbrabants Museum in 's-Hertogenbosch on 23 October 2013.

Dendrochronology indicates that the youngest heartwood ring dates from 1511, which, with the added minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1520 for the tree that supplied the wood for that plank.[2] An earliest felling date of 1522 is statistically more probable, however, since that would cover 93 per cent of the range of possibly missing sapwood rings. Assuming at least two more years for drying and transportation, the panel could have been produced from 1522 onwards, but a production date from 1524 onwards is statistically more probable.

OBSERVATIONS

Support

The maximum thickness of the panel is about 1 cm (c. 0.5 cm at panel edge), narrowing towards the bottom. The panel consists of two quarter-sawn planks, vertical in grain, laid vertically. Possible marks from hand-sawing were observed on the panel reverse. At some point in time, the reverse was coated in a brush-applied black paint.

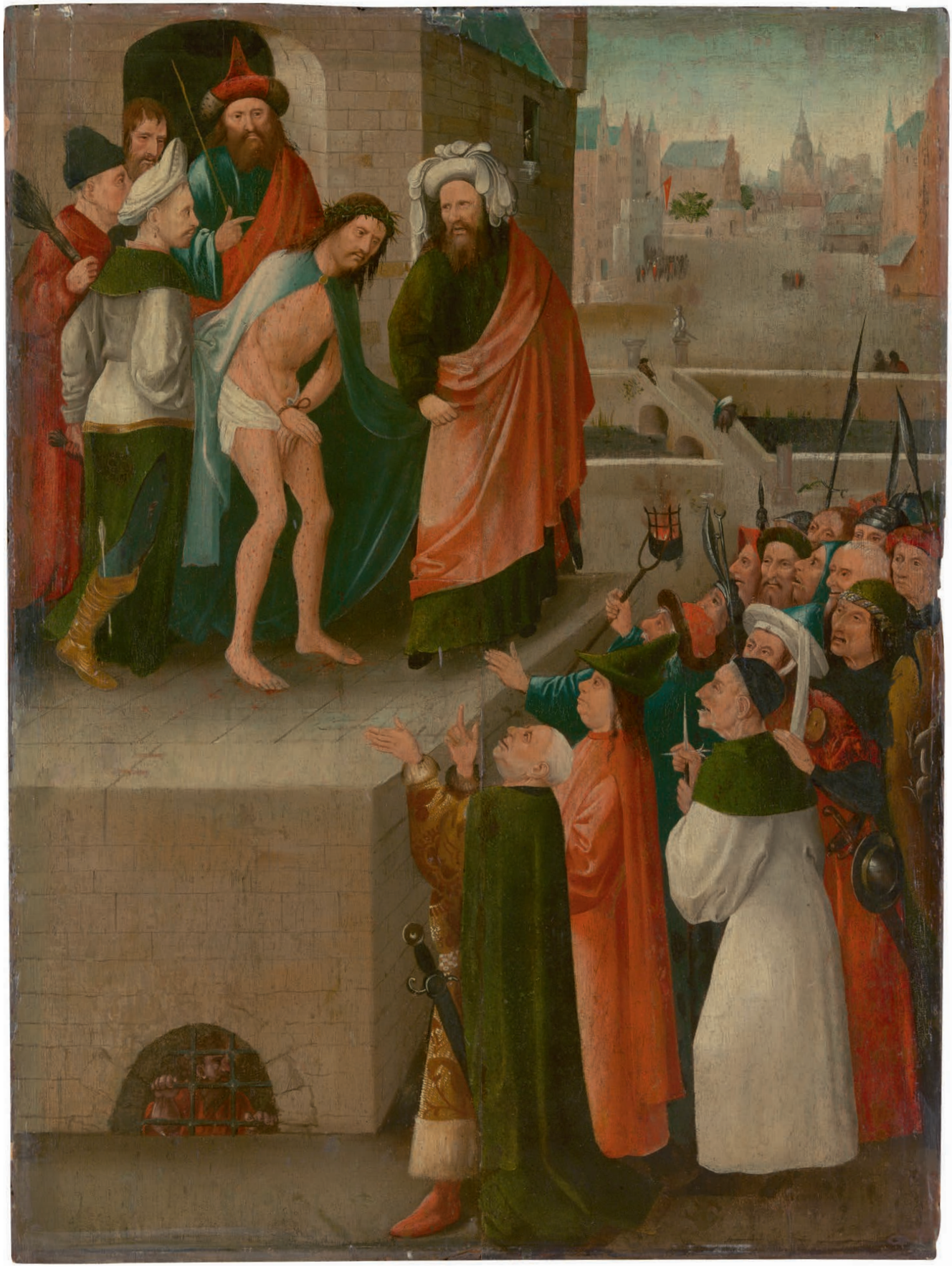
Preparatory layers

An off-white ground (not analysed) seems to be present. It is not fully covered by the paint layers and is visible at contours and losses. At the left and right sides of the panel, there are unpainted and ungrounded edges with traces of a barb. This indicates that the painting originally had an engaged frame. The top and bottom edges are painted, and there is an incomplete incision on the bottom edge.

Neither overall IRP nor IRR revealed any clear underdrawing. Most lines visible in IRR/IRP could not be distinguished with certainty from painted contours or detailing.

Paint layers

The oil paint (not analysed) was applied with a brush in several stages, and underlying ground or paint was hardly utilized, resulting in a rather flat appearance (figs. S2.1–2; compare the same detail in the Frankfurt report, cat. 11, RR 49–50). The faces of the figures appear to have a softer finish, with their brushstrokes more blended than those



RR 111

S2.1–2 RR 111 and RR 49 [CAT 11], VIS

in some of the clothing. The painted surface is generally opaque, except where green and red glazes were applied. Only limited texture was evident, and it does not appear to have been used for modelling. Some impastoed highlights were noted; see, for example, the lead-tin yellow dots on the brocaded garment of the figure in the central foreground. Paints were mainly applied wet-on-dry, but some wet-in-wet painting was also observed. For instance, the hair of the figure with the earring, at top left, was brushed into the still-wet flesh-tone paint underneath.

The dark blue of Christ's mantle was applied before the light blue part, which was roughly left in reserve. When the light blue was added, it overlapped the red of Pilate's mantle. Christ's flesh tones and then his loincloth were executed afterwards, locally overlapping the blue but also intentionally changing the contour at his waist. The paint of the wall continues (at least in part) under the prison. The flesh colours here were applied after the bars were painted and the man appears different in painting technique and style.

For red elements, a vermilion base, adjusted in places with iron oxide-based paint, was followed by red lake for darker areas. For lighter areas, lead white appears mixed in with the vermilion. Facial features, as well as several hands and fingers, were generally delineated with a single line of brown paint. Additional reinforcements are scarce. Onto the brown base of Christ's hair his crown of thorns was added, mainly in green, with some lead-white detailing (fig. S2.3). Neither copper-green glaze nor lead-tin yellow was observed there.

Gold leaf was not used in the painting. Instead, yellow ochre served to depict gold, locally followed by lead-white and possibly lead-tin yellow highlights.

Changes in the paint layers can be found in several overlapping contours, some purposefully altered, as at Christ's waist.

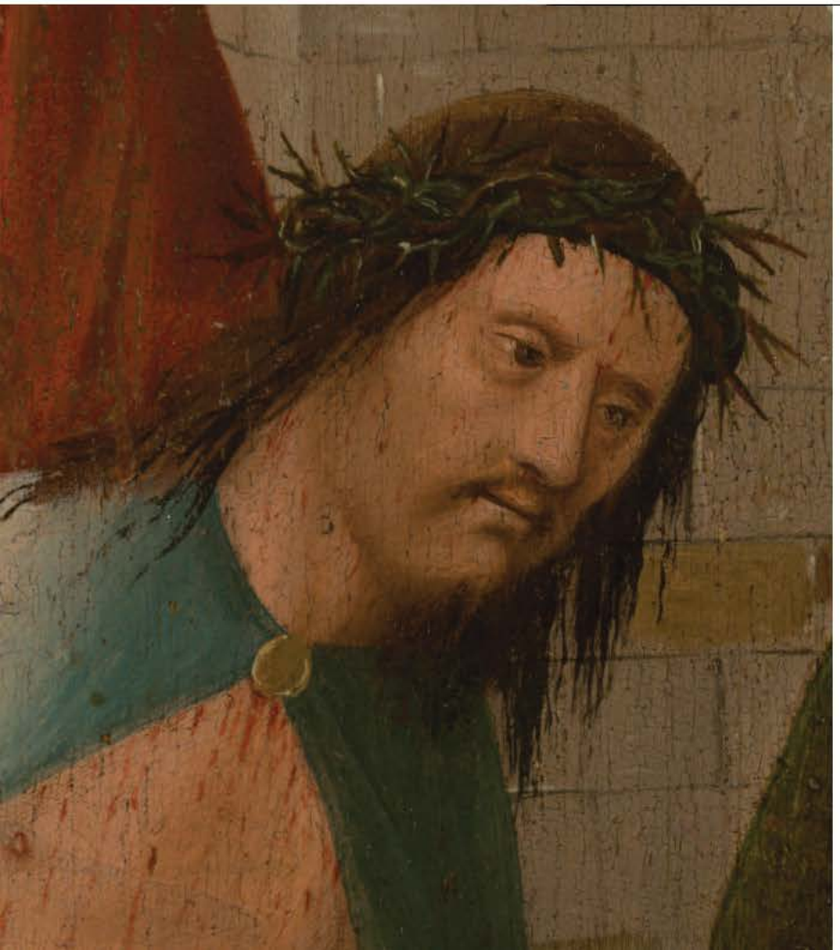
CONDITION

The panel edges are damaged. Old degradation from micro-organisms is discernible, mainly at the bottom of the panel reverse. No traces of active wood-boring insects have been found. Near the bottom of the panel reverse, the join is also open in places.

Along the entire top edge a horizontal strip of canvas was applied before the panel reverse was painted black.

Multiple fractures extend from the top and bottom and run parallel to the wood grain, affecting the support, ground and paint layers.

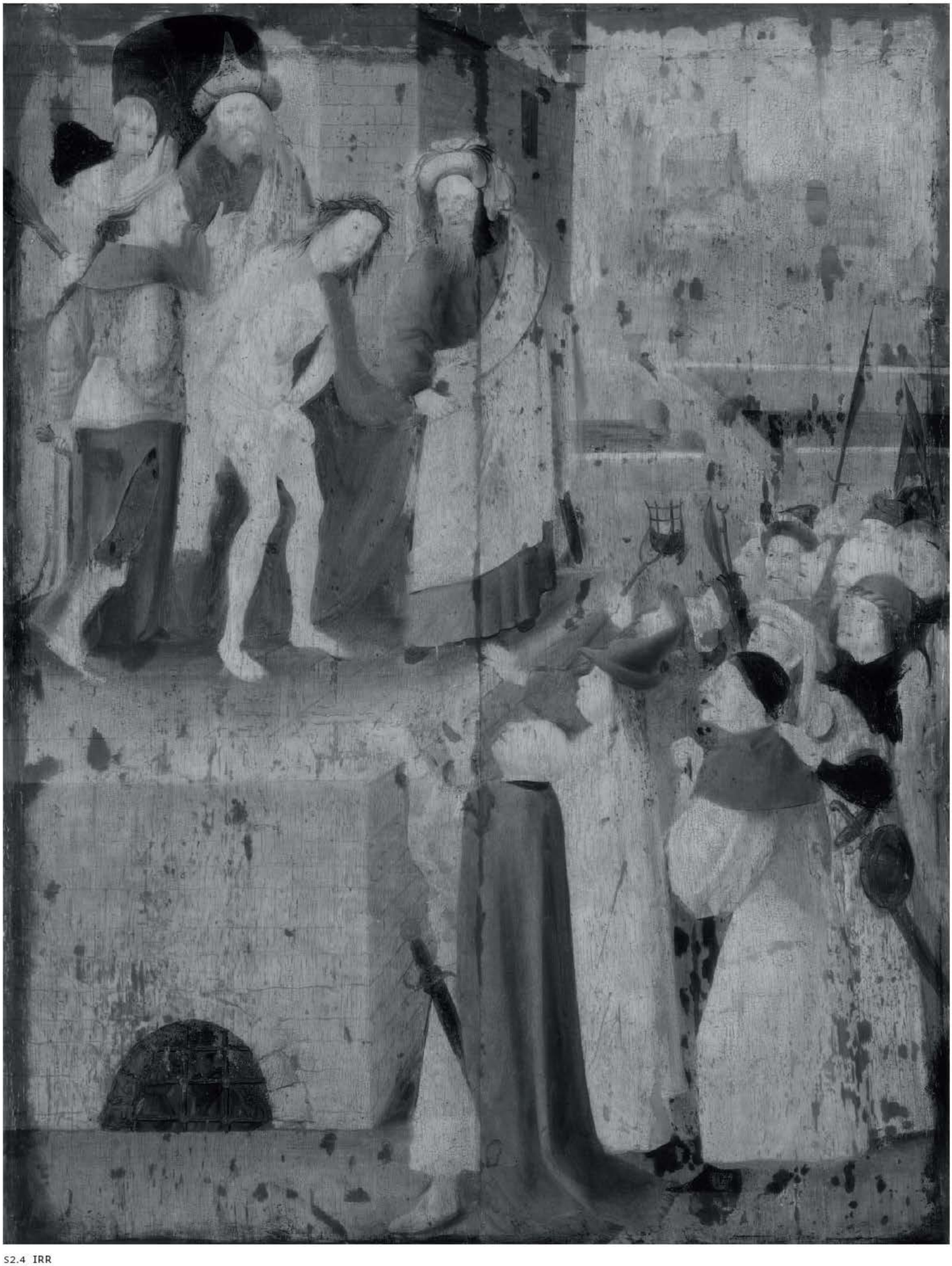
The paint surface is in poor condition, with many small and some larger losses, abrasions of the painted surface, and numerous discoloured retouchings and overpaintings. The inpaintings are often wider than the damages and are sometimes crudely applied; see, for example, the black paint to the left of the shield. Extensively damaged craquelure and locally raised and tenting paint are detectable in raking light. The varnish layers, now discoloured, were applied while the panel was still in its frame, and there are multiple wax residues along the edges.



S2.3 VIS

[1] For a variety of practical reasons, some of our research reports were produced in an abbreviated format, which resulted in a slightly different lay out. This concerns seven reports: cat. 3 (RR 155–156); cat. 23 (RR 63–68); cat. 26A–B and 26C (RR 59–62 and RR 109–110); cat. 32 (RR 87–88), cat. S2 (RR 111–112); and cat. S3 (RR 113–114).

[2] Klein 2001, 128. The youngest or last-preserved rings on each of the two planks of the panel date from 1508 (I) and 1511 (II), respectively. Peter Klein noted that 'only 8 cm [was] measurable'.



S2.4 IRR

S3

The Temptation of Saint Anthony

BRIEF RESEARCH REPORT 113–114[1]

Follower of Hieronymus Bosch
c. 1530–40

Oil (not analysed) on oak (analysed) panel, 60.0 × 52.0 cm
Art Collection Van Lanschot, 's-Hertogenbosch

BRCP, *Catalogue Raisonné*, under cat. 30 (pp. 452–54); www.boschproject.org: no. S3 (RR 113–114).

Inscriptions and labels
Reverse, top centre, on the cradle: a small label; below that, a restorer's label: *Michel van de Laar*.

SUMMARY OF CONCLUSIONS

The findings from the technical examinations confirm that the Temptation of Saint Anthony *in the collection of Van Lanschot Bankers in 's-Hertogenbosch was painted by a follower of Hieronymus Bosch. The genesis of this work was complex, since two different compositions were discovered under the present one. The initial composition depicted a standing, full-figured Man of Sorrows between the larger, seated images of God the Father and of the Virgin Mary, with one breast bare. All three figures are adorned with nimbuses. Two male and four female donors were depicted in the lower left and right, respectively. This composition was underdrawn with a brush and appears to have been fully finished in paint. There are no indications that it originated in Bosch's workshop. For the second composition, the panel was turned 90 degrees counterclockwise. A building was underdrawn and partially painted, and a bell-shaped form underdrawn. The drawing was executed in sharp, crisp lines, possibly using a pen. This stage was not far developed when it was abandoned for the final composition. The style and material of the underdrawing of the present composition are fully comparable with those of the second stage but completely different from those found in the core group. The panel was originally housed in an engaged frame, now lost. Dendrochronology indicates that the first composition could have been painted from 1461 onwards, although a date after 1463 is statistically more probable. The final composition was probably painted considerably later.*

RR 114

ADDITIONAL INFORMATION

The painting was examined in the Noordbrabants Museum in 's-Hertogenbosch on 23 October 2013. XR data was not available. Photographic documentation is kept by Michel van de Laar, who restored the painting in 1995.

Dendrochronological analysis indicates that the youngest heartwood ring dates from 1450, which, with the added minimum of nine sapwood rings for Baltic oak, implies an earliest possible felling date of 1459 for the tree that supplied the wood for that plank.[2] A felling date after 1461 is statistically more probable, however, since that would cover 93 per cent of the range of possibly missing sapwood rings. Assuming at least two more years for drying and transportation, the panel could have been produced from 1461 onwards, although a production date from 1463 onward is statistically more probable.

OBSERVATIONS

Support

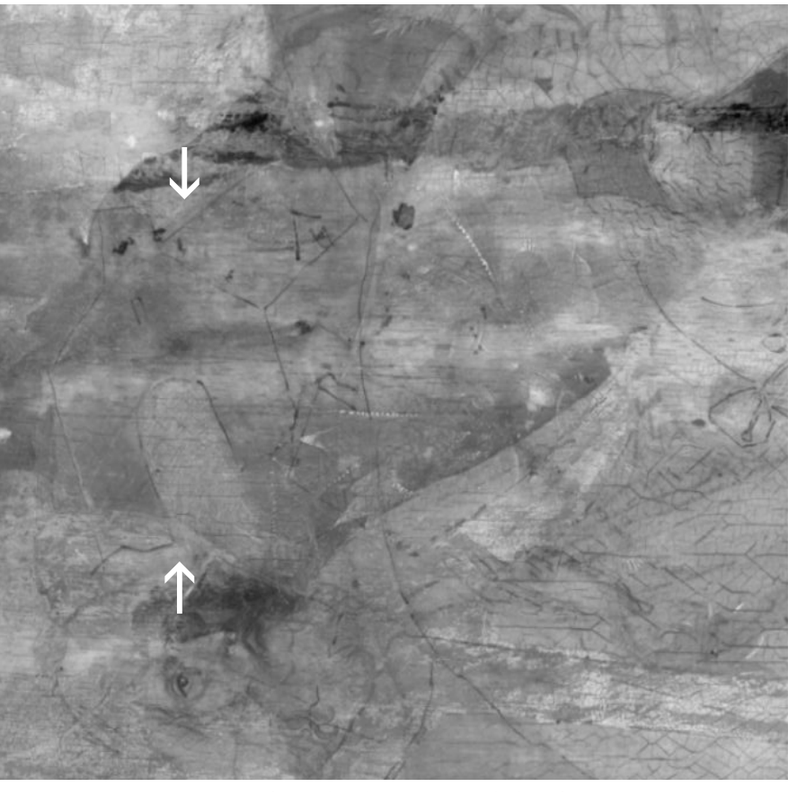
The maximum thickness of the panel is about 0.5 cm. The panel consists of two quarter-sawn planks (the left one is an off-radial cut), vertical in grain, laid vertically.[3] A crack runs the entire length of the left plank. At some point in time, the panel reverse was thinned and cradled.

Preparatory layers

An almost complete barb and ungrounded edge are present on all sides of the painting. The barb appears to have been preserved from the initial, underlying painting, indicating that the panel originally had an engaged frame.

Multiple compositional phases precede the current depiction. The initial composition that currently shimmers through depicts Christ as Man of Sorrows in the centre, with the seated God the Father to the left and Mary to the right (fig. S3.2). Apparently also part of this composition are three additional, fainter aureoles in the background, perhaps remnants from earlier positions of the three main figures or from additional ones. Architectural shapes are present at the top left and right. In the foreground, several donor figures were represented. Two male donors were painted on the lower left, and four female donors were found on the lower right. IRR/IRP reveals two additional donors underdrawn in front of the left-hand group, one of which is

RR 113



S3.1 IRR (rotated 90 degrees counterclockwise)

visible between the painted donors. The composition as described was executed in paint and was later partly removed, but the possibility remains that the painting was not fully completed. This composition was unevenly and partially covered, apparently with a thin, light-hued layer. The Virgin's blue robe and one of the female donors appear to have been directly overpainted by the currently visible landscape.

The panel was then rotated counterclockwise for the apparent second composition. At the centre left (in the rotated panel), a building can be seen that was partially painted (fig. S3.1), and at the upper right, there seems to be a large bell or helmet. That underdrawn composition, which seems far from completed, was then abandoned. The painting was then turned back upright again to construct the currently visible composition.

Underdrawing of the initial composition is only visible with IR and was applied mainly in a liquid medium, with a brush. Some of the thin lines visible in IRR could also relate to finely painted contours. The underdrawing of the second composition and that of the final one are both visible to the naked eye, locally shimmering through. They are characterized by thin, sharp lines, usually applied in short sections. A pen and a liquid underdrawing medium appear to have been used. Minor hatching can be observed in places.

Paint layers

The oil paint (not analysed) was applied with the brush in multiple stages, predominantly wet-on-dry. Glossy paints were used, mainly in thin, opaque layers. Slightly textured brushstrokes were used to a small extent for modelling. Many slightly impastoed dots indicate detailing and highlights.

For the background, primarily ochre pigments seem to have been used. The figures were frequently embellished with colourful motifs, mainly in lead white, lead-tin yellow, azurite blue, red lake and copper-green pigments. Pink paints were used only locally; for example, in the arrow feathers at the bottom right. Lead-white highlights were applied to the blue wing tips of the walking creature approaching Saint Anthony from the left, and later covered by a copper-green lake. In other areas, a similar build-up was used, but was also followed by dotted highlights in lead white. For several of the faces, lead-tin yellow was employed extensively.

CONDITION

The original panel reverse was thinned before the cradle was applied, and traces of a toothing plane are still visible. Tunnelling from wood-boring insects is now exposed. Double vertical cradle members were applied at the panel joins.

Multiple damages visible in IRR/IRP relate to the initial composition. Especially at the bottom centre, these damages to the initial paint layers can also be seen with the naked eye. It is possible that the panel was reused because of the damaged painting, or that the damages are a result of the preparations (scraping or sanding) for the repainting itself.

The main shapes of the initial painting, especially the dark colours, shimmer through slightly and are visible in the current composition. This seems mainly due to an unintended increase in transparency, particularly of the lighter background paints.

In the robe of Saint Anthony, rather large, wide cracks are apparent in the paint. In these cracks, filling material, red lake paint and brownish dirt and/or retouchings are locally present. There are retouchings in other areas of the painting as well.

[1] For a variety of practical reasons, some of our research reports were produced in an abbreviated format, which resulted in a slightly different lay out. This concerns seven reports: cat. 3 (RR 155–156); cat. 23 (RR 63–68); cat. 26A–B and 26C (RR 59–62 and RR 109–110); cat. 32 (RR 87–88), cat. S2 (RR 111–112); and cat. S3 (RR 113–114).

[2] Dendrochronological analysis of the panel was done by Pascale Fraiture in 2002; her unpublished report was kindly made available by Michel van de Laar.

[3] Pascale Fraiture, unpublished report, 2002, 3. Fraiture lists the following dimensions, seen from the front. Height left: 60.0 cm; height right: 58.7 cm. Width top: 51.9 cm; width bottom: 52.0 cm. Left plank, width top: c. 26 cm; width bottom: 28 cm. Right plank: width top: c. 25.5 cm; width bottom: 24 cm. Width of unpainted edges: 1–1.3 cm.

S3.2 IRR

APPENDIX I Dendrochronology

Dendrochronology aims to determine the earliest possible felling date for the tree that provided the timber used to produce a wooden object and thus to provide a *terminus post quem* for that object. In the case of panel supports used by early Netherlandish painters, which were almost invariably made of Baltic oak, dendrochronological dating is often used to refute attributions.[1]

A tree's annual growth varies with fluctuations in temperature and rainfall. This growth pattern is reflected in the width of the annual growth rings, which can be measured at the end grain of the radially sawn boards.[2] The specific pattern for a single board can then be compared with the master chronology for a species in a specific region – in this case, thus, Baltic oak. If this comparison results in a statistical match, the date of the youngest ring of the board can be established, to which some years need to be added to account for cropped-off sapwood and for seasoning and transportation. In this study, two years are added for seasoning and transportation, which is regarded as a minimum value.[3] Establishing the number of cropped-off sapwood rings that also needs to be added to the date of the youngest growth ring is more complex. Panelmakers would typically use boards from a tree's heartwood and remove the outer sapwood, which is softer and more vulnerable to wood-boring insects. An examination of 174 living oak trees in Poland showed that these trees had a minimum of 9 and a maximum of 36 sapwood rings, with a median of 15.[4] In the art-historical literature, this median value of 15 sapwood rings is regularly but erroneously applied as a hard or even absolute number to be added to the youngest heartwood ring, given that 81 of the 174 trees examined had fewer than 15 sapwood rings. We therefore chose to avoid the use of that median value in this study.

In the table below, three separate dates are listed: (1) the youngest measured growth ring; (2) the earliest possible production date; and (3) the statistically more probable earliest production date. If we define the date of the youngest measured growth ring as *x*, the earliest possible production date will be *x*+2+9 (X plus seasoning and transportation time, plus the minimum number of cropped-off sapwood rings, respectively), which makes the statistically more probable earliest production date *x*+2+11.[5] The latter assumes a minimum of 11 missing sapwood rings rather than 9; this covers 93 per cent of the range of possible missing sapwood rings.

The large group of panels painted by Hieronymus Bosch, his workshop and his many followers has received ample attention from dendrochronologists, and especially from Peter Klein. The table below consists of 98 entries, making it the largest group by far of early Netherlandish paintings examined with dendrochronology.[6] In the table below, Klein's data from 2001 are augmented with measurements published in 2003,[7] and with new, previously unpublished measurements, commissioned from Peter Klein by the BRCP. Among the latter are those of highly important works such as the *Adoration of the Magi* (cat. 9) and the wings of the *Garden of Earthly Delights* (cat. 21), both in the Prado. Additional, unpublished data from measurements by Ian Tyers and Pascale Fraiture are also included, together with Fraiture's information on the panels in Brussels, published in Stroo et al. 2001.[8]

When individual boards of different panels come from the same tree, this is listed in a footnote. When a later date can be inferred from the dating of a board from the same tree, that date is listed as well, within square brackets. The years of death of Hieronymus and some of his relatives who were painters are also included in the table.

ABBREVIATIONS

ABKW	Akademie der bildenden Künste Wien
AP	Alte Pinakothek
BF	The Barnes Foundation
BVB	Museum Boijmans Van Beuningen
CAI	Chicago Art Institute
CM	Centraal Museum
FGJMC	Fundação Maria Isabel Guerra Junqueiro e Luís Pinto de Mesquita Carvalho
FLG	Fundación Lázaro Galdiano
GM	Groeningemuseum
IUAM	Indiana University Art Museum
IMA	Indianapolis Museum of Art
HB	Huis Berg
KHM	Kunsthistorisches Museum
MASP	Museu de Arte de São Paulo
MBA	Musée des Beaux-Arts
MBAV	Museu de Belles Arts de València
MDL	Musée du Louvre
MFA	Museum of Fine Arts
MMA	Metropolitan Museum of Art
MNAA	Museu Nacional de Arte Antiga
MNP	Museo Nacional del Prado
MOC	Museum of Opočno Castle
MPG	Museo Palazzo Grimani
MRBAB	Musées royaux des Beaux-Arts de Belgique
MRK	Museum voor Religieuze Kunst
MSK	Museum voor Schone Kunsten
NAMA	Nelson-Atkins Museum of Art
NBM	Het Noordbrabants Museum
NG	National Gallery
NGA	National Gallery of Art
PMA	Philadelphia Museum of Art
PN	Patrimonio Nacional
PUAM	Princeton University Art Museum
RMA	Rijksmuseum Amsterdam
SLM	Suermondt-Ludwig-Museum
SMK	Städel Museum
SPK-GG	Stiftung Preußischer Kulturbesitz, Gemäldegalerie
VLC	Van Lanschot collection
WRM	Wallraff-Richartz-Museum

Title, city (museum, inventory no.)	BRCP cat.	*Research report*	*Number of boards*[9]	*Youngest ring*	*Sapwood rings*[10]	*Earliest possible production*[11]	*More likely earliest production*[12]	*Source of data*[13]
Two Mitred Figures, Rotterdam (BVB, 1177)	–	–	1	1366	–	1377	1379	Klein 2001
Saint Christopher (art market)	–	–	1	1424	–	1435	1437	Tyers 2012[14]
Last Judgement fragment, Munich (AP, 5752)	30	128–129	2	1431	–	1442	1444	Klein 2001
Temptation of Saint Anthony, Utrecht (CM, 2537)	–	–	1	1433	–	1444	1446	Klein 2001
Paradise, Escorial (PN, 50000009)[15]	–	–	3	1438	–	1449	1451	Klein 2001
Arrest of Christ, Amsterdam (RMA, 3113)[16]	–	–	2	1445	–	1456	1458	Klein 2001
Temptation of Saint Anthony, 's-Hertogenbosch (VLC)	–	113–114	2	1450	–	1461	1463	Fraiture 2002[17]
Temptation of Saint Anthony, Madrid (MNP, 2049)	31	–	2	1451	–	1462	1464	Klein 2001
Hieronymus's uncles Thomas and Hubertus van Aken die in 1462 and c. 1463, respectively.								
Garden of Earthly Delights, Madrid (MNP, 2823)	21	–	3, 7, 3	1455[18]	–	1466	1468	Klein 2001, 2014
Hieronymus's uncle Goeswinus van Aken dies in 1467.								
Adoration of the Magi, New York (MMA, 13.26)	10	55–56	2	1457	–	1468	1470	Klein 2001
Ecce Homo, Frankfurt (SMK, 1577)	11	49–50	3	1459	–	1470	1472	Klein 2001
Adoration of the Magi, Madrid (MNP, 2048)	9	134–139	2, 3, 2	1461[19]	–	1472	1474	Klein 2014
Temptation of Saint Anthony, Madrid (MNP, 2913)	–	–	3	1461	–	1472	1474	Klein 2001
Saint John the Baptist, Madrid (FLG, 2119)	5	47–48	2	1463[20]	–	1474	1476	Klein 2001
Paradise, Chicago (CAI, 1936.239)	–	–	1	1464	–	1475	1477	Klein 2001
Saint Jerome, Ghent (MSK, 1908HMK)	1	2	3	1465	–	1476	1478	Klein 2001
Last Judgement, Vienna (ABKW, 579–581)	17	–	2, 6, 3	1465[21]	–	1476	1478	Klein 2001
Calvary with Donor, Brussels (MRBAB, 6639)	15	19–20	2	1466	–	1477	1479	Stroo et al. 2001
Cure of Folly, private collection	–	–	1	1467	–	1478	1480	Fraiture 2012[22]
Hieronymus's father, Anthonius van Aken, dies in 1478.								
Crowning with Thorns, London (NG, 4744)	14	142–143	3	1468	–	1479	1481	Klein 2001
Last Judgement; central panel, Bruges (GM, 208)	16	69–74	2	1469	–	1480	1482	Klein 2001
Temptation of Saint Anthony, Kansas City (NAMA, 35-22)	3	155–156	1	1471	–	1482	1484	Klein 2005[23]
Saint Anthony, Berlin (SPK-GG, 1647)	–	–	1	1481	10	1483	1484	Klein 2001
Visions of the Hereafter, Venice (MPG)	18	32–39	2, 2, 2, 2	1473[24]	–	1484	1486	Klein 2001
Instruments of the Passion (predella *Ecce Homo Triptych*), Boston (MFA, 56.172)[25]	24	77–84	1	1474	–	1485	1487	Klein 2001
Hermit Saints Triptych, Venice (MPG)	2	27–31	2	1476	–	1487	1489	Klein 2001
Cure of Folly, Madrid (MNP, 2056)	33	85–86	2	1477	–	1488	1490	Klein 2001
Ship of Fools, Paris (MDL, RF2218)	19B	17–18	2	1474 [1477][26]	–	1485 [1488]	1487 [1490]	Klein 2001
Wayfarer, Rotterdam (BVB, 1079)	19A	8	4	1476 [1477][27]	–	1487 [1488]	1489 [1490]	Klein 2001
Death and the Miser, Washington, DC (NGA, 1112)	19C	53–54	2	1477[28]	–	1488	1490	Klein 2001
Saint John on Patmos, Berlin (SPK-GG, 1647A)	6	51–52	2	1478	–	1489	1491	Klein 2001
Ecce Homo Triptych; central panel, Boston (MFA, 53.2027)	24	77–84	2	1478	–	1489	1491	Klein 2001
Christ in Limbo, Dublin (NG, 1296)	–	–	2	1478	–	1489	1491	Klein 2001
Ecce Homo, Bloomington, IN (IUAM, C10006)	–	–	2	1479	–	1490	1492	Klein 2001

Title, city (museum, inventory no.)	*BRCP cat.*	*Research report*	*Number of boards*[9]	*Youngest ring*	*Sapwood rings*[10]	*Earliest possible production*[11]	*More likely earliest production*[12]	*Source of data*[13]
Vision of Tondal, Madrid (FLG, 018146)	–	–	2	1479	–	1490	1492	Klein 2001
Saint Christopher, Rotterdam (BVB, ST26)	7	7	2	1479	–	1490	1492	Klein 2001
Last Judgement, New York (MMA, 26.244)	–	–	2	1480	–	1491	1493	Klein 2001
Saint Wilgefortis Triptych, Venice (MPG)	8	21–26	1, 3, 1	1480[29]	–	1491	1493	Klein 2001
Christ Carrying the Cross, Escorial (PN, 100 14739)	13	89–90	4	1484	3	1492	1494	Klein 2001
Ecce Homo, Indianapolis (IMA, 2014.88)	–	–	?	1481	–	1492	1494	Klein 2012
Adoration of the Magi, Philadelphia (PMA, 1321)	25	57–58	2	1482	–	1493	1495	Klein 2001
Last Judgement, Aachen (SLM, 50)	–	–	3	1483	–	1494	1496	Klein 2001
Virgin and Child, private collection	–	–	3	1483	–	1494	1496	Klein 2001
Saint Anthony Triptych; central panel, Lisbon (MNAA, 1498)	4	11–16	4	1484	–	1495	1497	Klein 2001
Conjurer, Saint Germain-en-Laye	32	87–88	2	1485	–	1496	1498	Klein 2001
Haywain, Escorial (PN, 154)	–	103–108	4	1487	–	1498	1500	Klein 2001
Hieronymus's brothers, Goeswinus and Jan van Aken, die in c. 1498 and 1499, respectively.								
Adoration of the Magi, private collection, Paris	26C	109–110	2	1490	–	1501	1503	Klein, 2011
Temptation of Saint Anthony, São Paulo (MASP)	–	–	4	1494	–	1505	1507	Klein 2001
Ecce Homo, Princeton, NJ (PUAM, Y771)	–	–	4	1496	–	1507	1509	Klein 2001
Ecce Homo, Rotterdam (BVB, 2438)	–	–	2	1497	–	1508	1510	Klein 2001
Job Triptych; central panel, Bruges (GM, 209)	23	66	3	1490 [1504][30]	–	1501	1503 [1510][31]	Klein 2001[32]
Job Triptych; wings, Bruges (GM, 209)	23	65, 67	2, 2	1504	7	1508	1510	Fraiture 2005
After the Last Judgement, Rotterdam (BVB, ST27)	22B	5–6	2	1497[33]	–	1508	1510	Klein 2001
After the Flood, Rotterdam (BVB, ST28)	22A	3–4	2	1491 [1497][34]	–	1502 [1508]	1504 [1510]	Klein 2001
Haywain Triptych, Madrid (MNP, 2052)	20	100	4	1499[35]	–	1510	1512	Klein 2001, 2014
Adoration of the Magi, Philadelphia (PMA, 354)	–	–	3	1501	–	1512	1514	Klein 2001
Adoration of the Magi, Cologne (WRM, 475)	–	–	2	1503	–	1514	1516	Klein 2001
Saint Anthony Triptych; central panel, Brussels (MRBAB, 3032)	–	–	5	1503	–	1514	1516	Stroo et al. 2001
Hieronymus Bosch dies in August 1516; his cousin Anthonis van Aken dies in the same year.								
Passion Triptych; central panel, Valencia (MBAV, 264–66)	–	94	6	1506	–	1517	1519	Klein 2003
Ecce Homo, Amsterdam (RMA, SK-A-4252)	–	–	2	1511	–	1522	1524	Klein 2001
Christ in Limbo, Vienna (KHM, W2715)	–	–	2	1513	–	1524	1526	Klein 2001
Temptation of Saint Anthony, Bloomington, IN (IUAM, C10008)	–	–	2	1514	–	1525	1527	Klein 2001
Temptation of Saint Anthony, Valenciennes (MBA, P46.1.44)	–	–	2	1515	–	1526	1528	Klein 2001
Crowning with Thorns, Escorial (PN, 100 14473)	–	–	6	1516	–	1527	1529	Klein 2001
Temptation of Saint Anthony, Amsterdam (RMA, SKA1795)	–	–	3	1519	–	1528	1530	Fraiture 2012[36]
Temptation of Saint Anthony, Vienna (KHM, 3688)	–	–	4	1520	–	1531	1533	Klein 2001
Adoration of the Magi, Amsterdam (RMA, A4131)	–	–	3	1521	–	1532	1534	Klein 2001
Temptation of Saint Anthony, Rotterdam (BVB, 2441)	–	–	2	1522	–	1533	1535	Klein 2001
Adoration of the Magi, Aachen (SLM, GK49)	–	–	3	1523	–	1534	1536	Klein 2001
Adoration of the Magi, Rotterdam (BVB, 2440)	–	–	2	1525	–	1536	1538	Klein 2001

Title, city (museum, inventory no.)	BRCP *cat.*	*Research report*	*Number of boards* [9]	*Youngest ring*	*Sapwood rings* [10]	*Earliest possible production* [11]	*More likely earliest production* [12]	*Source of data* [13]
Hieronymus's cousin Jan van Aken and second cousin Goeswinus van Aken die in 1537.								
Christ among the Doctors, Opočno, Czech Republic (MOC, 4679)	–	–	3	1528	–	1539	1541	Klein 2001
Paradise, Vienna (KHM, 5686)	–	–	1	1539	11	1541	1541	Klein 2001
Vision of Tondal, Porto, Portugal (FGJMC)	–	–	2	1542	11	1544	1544	Klein 2003
Temptation of Saint Anthony, Amsterdam (RMA, 3240)	–	–	2	1534	–	1545	1547	Klein 2001
Cure of Folly, Amsterdam (RMA, 1601)	–	–	1	1535	–	1546	1548	Klein 2001
Christ among the Doctors, 's-Heerenberg (HB)	–	–	1	1537	–	1548	1550	Klein 2001
Marriage at Cana, 's-Heerenberg (HB, 58)	–	–	2	1537	–	1548	1550	Klein 2003
Shrovetide and Lent, 's-Hertogenbosch (NBM, 12076)	–	–	2	1538	–	1549	1551	Klein 2001
Adoration of the Magi, 's-Hertogenbosch (NBM, 15257)	–	–	2	1539	–	1550	1552	Klein 2001
Last Judgement, private collection	–	–	2	1539	–	1550	1552	Klein 2001
Garden of Earthly Delights, private collection	–	–	2	1539	–	1550	1552	Klein 2001
Crossbowman, Madrid (MNP, 2695)	–	–	1	1540	–	1551	1553	Klein 2001
Conjurer, Philadelphia (PMA, W1412)	–	–	4	1540	–	1551	1553	Klein 2001
Crowning with Thorns, Philadelphia (PMA, 353)	–	–	2	1542	–	1553	1555	Klein 2001
Christ among the Doctors, Philadelphia (PMA, 77)	–	–	2	1544	–	1555	1557	Klein 2001
Marriage at Cana, Rotterdam (BVB, ST25)	–	–	3	1544	–	1555	1557	Klein 2001
Ecce Homo, Philadelphia (PMA, 352)	–	–	2	1546	–	1557	1559	Klein 2001
Last Judgement Triptych; central panel, Uden, NL (MRK, 272)	–	–	2	1548	–	1559	1561	Klein 2001
Temptation of Saint Anthony, Vienna (KHM, 958)	–	–	1	1548	–	1559	1561	Klein 2001
Adoration of the Magi, Cologne (WRM, 474)	–	–	3	1551	–	1562	1564	Klein 2001
Resurrection, 's-Heerenberg (HB, 57)	–	–	2	1556	–	1567	1569	Klein 2001

Examined without result					
Christ Carrying the Cross, Ghent (MSK, 1902H)	29	1	3	Measurement not possible (including from X-ray)	Klein 2001 (2014)
Christ Carrying the Cross, Vienna (KHM, GG6429)	12	9–10	1	Measurement not possible (including from X-ray)	Klein 2001 (2014)
Two Shepherds, Philadelphia (PMA, 1275)	26A	59–60	1	Measurement not possible	Klein 2001
Retinue of the Magi, Philadelphia (PMA, 1276)	26B	61–62	1	Measurement not possible	Klein 2001
Temptation of Saint Anthony, Philadelphia (BF, 962)	–	–	?	Measurement not possible	Klein 2015
Nativity, Brussels (MRBAB, 368)	–	–	2	Measurement not possible	Stroo et al. 2001
Female Heads, Rotterdam (BVB, 2439)	–	–	1	Dating not possible	Klein 2001

1 See also BRCP, *Catalogue Raisonné*, Chapter III.

2 See BRCP, *Catalogue Raisonné*, Chapter III.

3 Klein 2003, 71.

4 Klein 2003, 69, table 4b.

5 The Research Reports in this volume provide two additional values: the earliest possible felling date (x+9) and the statistically more probable felling date (x+11).

6 Much of the data listed in the table was compiled and published by Klein in 2001 in conjunction with the Bosch exhibition at the Museum Boijmans Van Beuningen. However, that publication is quite difficult to use since the column with sapwood rings was erroneously omitted and the headings and columns do not match. Some typographical errors have also been corrected here. See Klein 2001, 123–30. Many findings were also published elsewhere.

7 Klein 2003b.

8 Tyers and Fraiture, following a recent statistical study of sapwood ring estimates, now apply the value of 6 (rather than 9) for the minimum number of sapwood rings for Baltic oak. Since Klein still uses 9, and the bulk of the data used here is based on his measurements, we have opted to use the latter value and to adapt the data from Tyers and Fraiture for the sake of consistency. See also BRCP, *Catalogue Raisonné*, Chapter III, note 21.

9 The number of boards in works with multiple panels, such as triptychs, are separated by commas and given from left to right in open position.

10 The softer, more vulnerable sapwood was usually fully removed by panelmakers, but in a small number of boards sapwood is still present, affecting the calculation of the earliest possible felling date.

11 Assuming a minimum of 9 sapwood rings and a minimum of 2 years for seasoning and transportation. See also note 8 above.

12 Assuming a minimum of 11 sapwood rings (which covers 93 per cent of all values) and a minimum of 2 years for seasoning and transportation.

13 The publications in this column are listed in the bibliography. Previously unpublished reports are listed by dendrochronologist and the year of the report, separated by a comma.

14 Ian Tyers's unpublished report was kindly provided by Christie's, London.

15 Copy of the left wing of the *Garden of Earthly Delights*.

16 On loan to Het Noordbrabants Museum, 's-Hertogenbosch.

17 Pascale Fraiture's unpublished report was kindly provided by Michel van der Laar.

18 The youngest ring of the central panel is datable to 1449 (see Klein 2001). In 2014 the BRCP commissioned Peter Klein to measure the wings using the XRS at the Prado, from which he established a date six years later.

19 The BRCP commissioned Peter Klein to examine this work in 2014. The central panel was measured directly on the boards, while the wings were measured from XRS. Only the right wing was datable this way.

20 The measurements are affected by the fact that this panel was cropped on all sides.

21 The wings are linked by the use of wood from the same tree.

22 Pascale Fraiture, 'Rapport d'analyse dendrochronologique: Peinture sur panneau; Suiveur de Jérôme Bosch, L'excision de la pierre de la folie. Collection privée', Institut royal du Patrimoine artistique (unpublished report), 2012, 32 pages.

23 Peter Klein, 'Dendrochronological Analysis of the Northern Renaissance Panel Paintings in the Nelson-Atkins Museum of Art', in Burton L. Dunbar, *The Collections of the Nelson-Atkins Museum of Art: German and Netherlandish Paintings*, 1450–1600, Kansas City (MO) 2005, 25–32, esp. 29. Klein's report dates from 24 March 2003.

24 These four panels are strongly linked by the use of wood from the same trees.

25 The relationship among the components of this triptych is very complex, see cat. 24, RR 77–84.

26 Same tree as *Wayfarer* and *Death of the Miser*.

27 Same tree as *Ship of Fools* and *Death of the Miser*.

28 Same tree as *Wayfarer* and *Ship of Fools*.

29 Klein's measurements of the wings did not result in a reading.

30 Assuming that the wings were produced simultaneously with the central panel.

31 Assuming that the wings were produced simultaneously with the central panel.

32 This panel was also examined in 2005 by Pascale Fraiture, who established a youngest growth ring of 1489. Fraiture's unpublished report is on file at KIK/IRPA and at the Groeningemuseum in Bruges.

33 Linked with *After the Flood* by wood from the same tree.

34 Linked with *After the Last Judgement* by wood from the same tree.

35 In 2014 the BRCP commissioned Peter Klein to measure the wings from XRS. One board of the right wing could be dated; its youngest ring is from 1494.

36 Pascale Fraiture, 'Report of dendrochronological analysis: Painting on panel; "Temptation of Saint Anthony", after Hieronymus Bosch (Amsterdam, Rijksmuseum, inv. SKA 1795)', University of Liège, Centre européen d'Archéométrie (unpublished report), 2012, 6 pages.

APPENDIX II Equipment Used by the Bosch Research and Conservation Project[1]

INFRARED REFLECTOGRAPHY

Queen's University's Osiris infrared camera (Opus Instruments)[2]
InGaAs linear array of 512 pixels, spectral response 900–1700 nm
Complete scan of 64 subscans of 512 × 512 pixels, results in total scan of 4096 × 4096 pixels
Standard lens: Rodenstock 150 mm f/5.6 Rodagon enlarging lens, specially coated for NIR
Macro lens: Rodenstock 75 mm f/4.5 Rogonar enlarging lens, specially coated for NIR

Standard camera set-up
Standard lens
Scan area on object: 40 × 40 cm. Net surface area per capture, with 20% overlap: 32 × 32 cm
Camera-body-to-object distance: 90 cm, with focusing set to 43 mm
Resolution: 260 ppi (4096 pixels @ 260 ppi = 15.75 in. = 40 cm)

Macro camera set-up
Macro lens
Scan area on object: 3.5 × 3.5 cm
Camera-body-to-object distance: 35.2 cm, with focusing set to 270 mm, maximum extension
Resolution: 2900 ppi (4096 pixels @ 2900 ppi = 1.38 in. = 3.5 cm)

PHOTOGRAPHY

VIS macro camera set-up
Hasselblad H4D-60-IR, modified for IR, CCD sensor: 8915 × 6708 pixels
Lens: Hasselblad HC 4/120 mm
Filter: BG-39, from June 2012 onward: a lighter version of BG-39 from Optic Makario GmbH[3]
Resolution: 1200 ppi
Photographed area on object: height 6708 pixels @ 1200 ppi = 5.6 in. = 14 cm; width 8915 pixels @ 1200 ppi = 7.4 in. = 19 cm
Net surface area per capture, with 25% overlap: 10 × 14 cm
Working distance: 435 mm object to lens

Also used *(May–June 2011 and from September 2015)*[4]
Hasselblad H3DII-31, not modified (internal filter), CCD sensor: 6496 × 4872 pixels
Lens: Hasselblad HC 4/120 mm
Resolution: 1200 ppi
Photographed area on object: height 4872 pixels @ 1200 ppi = 4 in. = 10 cm; width 6496 pixels @ 1200 ppi = 5.4 in. = 13.7 cm
Net surface area per capture, with 25% overlap: 7.5 × 10 cm
Working distance: 365 mm object to lens

IRP macro camera set-up
Hasselblad H4D-60-IR, modified for IR, CCD sensor: 8915 × 6708 pixels
Lens: Hasselblad HC 4/120 mm
Filter: B+W 093
Resolution: 1200 ppi
Photographed area on object: height 6708 pixels @ 1200 ppi = 5.6 in. = 14 cm; width 8915 pixels @ 1200 ppi = 7.4 in. = 19 cm
Net effective area, with 25% overlap: 10 × 14 cm
Working distance: 435 mm object to lens

Also used *(from September 2015)*[5]
Canon 5D mark II, modified for IR, CMOS sensor: 5616 × 3744 pixels
Lens: Canon EF100mm f/2.8 Macro USM
Filter: 850 nm
Resolution: 1200 ppi
Photographed area on object: height 3744 pixels @ 1200 ppi = 3.1 in. = 7.9 cm; width 5616 pixels @ 1200 ppi = 4.7 in. = 11.9 cm
Net surface area per capture with 25% overlap: 6 × 9 cm
Working distance: 360 mm object to lens

Camera movement/grip
Specially designed *x-y*-axis camera movement device, set parallel to painting with laser measurement device

Lighting and exposure
2 Broncolor monobloc flash units, Minipuls C200 1500J with softboxes
With Hasselblad: flash used for both VIS and IRP, preferred aperture f/13 and f/9.5, respectively
With Osiris: 2 tungsten 650 W modelling lights, illumination EV 7.7 @ 100 ISO, aperture f/9.5

Colour management
Metamorfoze guidelines
Camera calibrated for visible with BasICColor input, on Gretag ColorChecker® Digital SG
Output colour space: eci-RGBv2 16-bit, Hasselblad visible
Output colour space: greyscale 16-bit, Hasselblad IR
Output colour space: sRGB 8-bit bitmap, Osiris
TIFF 16 bits/channel
JPEG 8 bits/channel sRGB
Raw data stored as well.

MICROSCOPY

Olympus stereo microscope SZ61TR/45: working distance 110 mm (RR 1 and 2: Olympus SZ40 with SZ-CTV Microscope Camera Adapter)
Olympus 0.5× C-mount camera adapter
Olympus WHSZ 10×-H oculars
110AL objective 0.5×: working distance 200 mm
110AL objective 1.5×: working distance 61 mm
Olympus STS holder with focus adjustment and a Linhof microrail for precise horizontal movement
Photonic PL 300 cold light source, 150 W adjustable with a fibre-optic illumination system
(RR 1 and 2: Olympus Highlight 2000 light source 125 W adjustable)
Leica EC3 high-speed digital colour camera, TIFF 16 bits/channel, RGB.

[1] See also Chapter I, 'Photography for the Bosch Research and Conservation Project'.

[2] Except for the IRR documentation of Lucas Cranach's copy of the Vienna *Last Judgement* in Berlin, for which the Osiris of the Rijksmuseum Amsterdam was used. The Osiris camera was acquired through the generous support of Dr Alfred Bader.

[3] See Chapter I, pp. 15 and 28.

[4] The documentation in November 2010 (RR 1 and 2) was done by Luc van Muylem, using the same IRR equipment but a Sinar P3 camera with a Sinarback eVolution 75H back (4-shot mode) for VIS and IR macro photography. For full specifications, see cat. 1 (RR 2) and 29 (RR 1) on www.boschproject.org. The BRCP photo equipment was stolen in Paris in 2015. A Hasselblad H4D with a PhaseOne IQ 150 back were rented to document the Bosch drawings in the Louvre (RR 142–149). Without the proper colour chart it was not possible to make a camera profile. On experience, shots were taken the best possible way, and close to BRCP standards.

[5] See note 4 above.

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