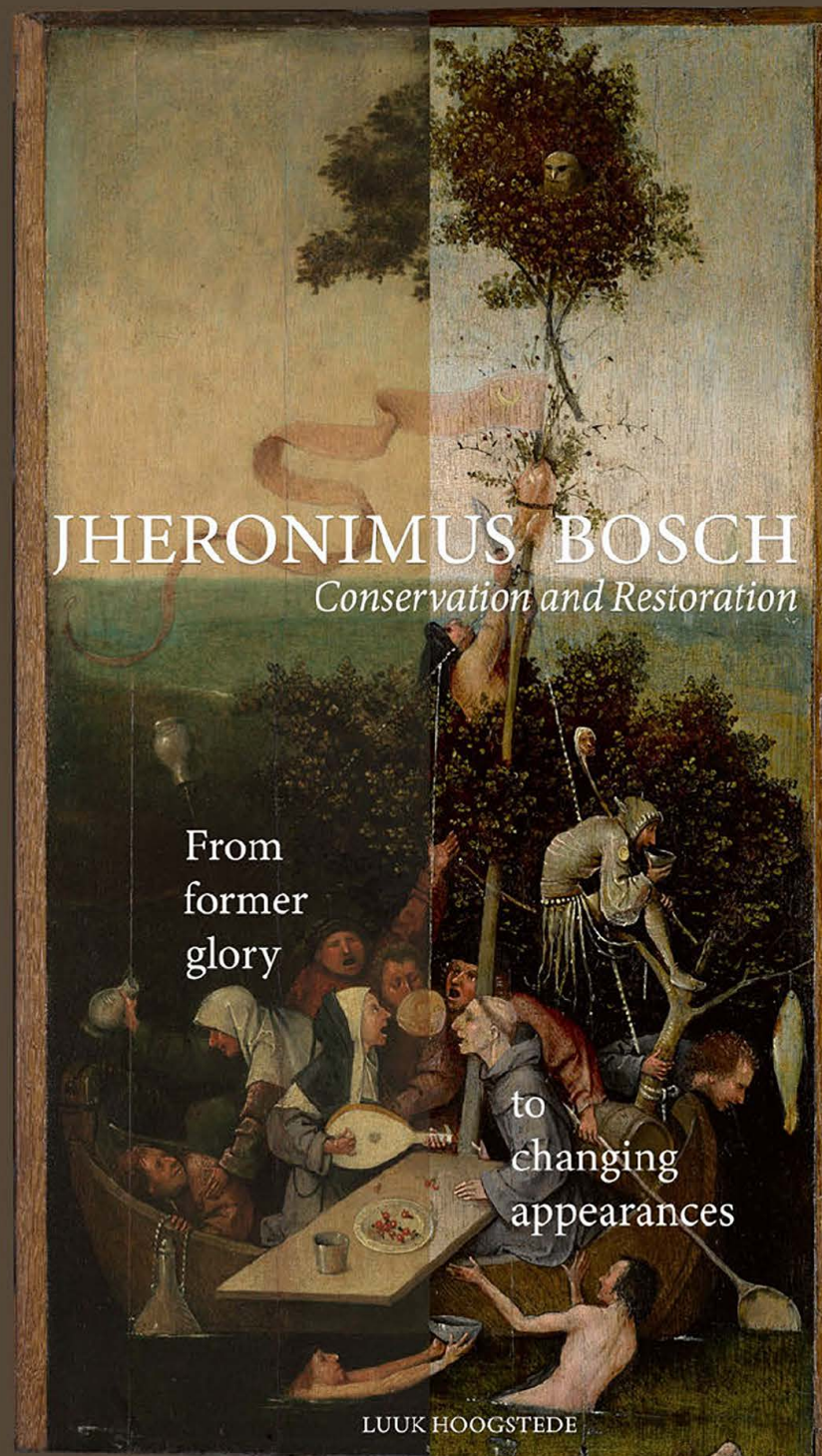


APPENDIX II



Photos courtesy Gemaldegalerie der Akademie der bildenden Künste Wien

RR 159 Saint
James the Greater



RR 160 Saint
Hippolytus



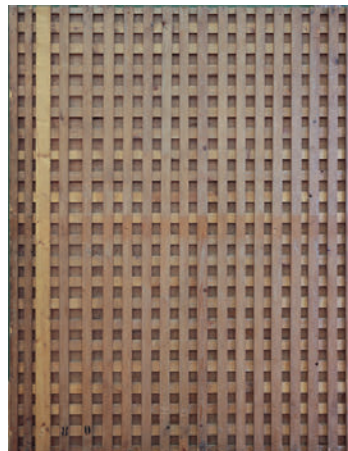
RR 162
Last Judgement



RR 161 Paradise



RR 163 Hell



RR 164 central panel reverse

Images: BRCP, unless otherwise noted

Image RR 164: Gemäldegalerie der Akademie der bildenden Künste Wien

Luuk Hoogstede, Ron Spronk, Jos Koldeweij,
Matthijs Ilsink, Rik Klein Gotink

Bosch Research and Conservation Project – Research Reports 159–164 Vienna, Gemäldegalerie der Akademie der bildenden Künste Wien, *The Last Judgement*

Summary

This BRCP research campaign confirms that the *The Last Judgement* in Vienna is a key work in Bosch's oeuvre.¹ Remnants of paint and gold leaf under the empty escutcheon in the right-wing grisaille strongly suggest a match with the coat of arms of Hippolyte de Berthoz, verifying the identification of the initial patron of the triptych. In Bosch's workshop, Berthoz's coat of arms was already covered with the architectural elements at the bottom of the grisaille. The execution of the underdrawing in the grisailles shows great freedom, with the saints drawn more neatly than the backgrounds. The lines vary considerably and appear swiftly and aptly applied with a relatively large brush in a watery medium. The execution of the underdrawing of the three interior panels differs markedly from the exterior, both in style and material. These underdrawings are elaborately detailed and vigorously sketched in a dry material.

Throughout the triptych, numerous changes were revealed between the underdrawings and the first paint layers and between the first and the final paint layers, changes indicative of a continuing creative process. A critically important change was found in the

bottom left of the central panel, where a donor and a banderole were underdrawn and left in reserve from the painting of the background, but not taken up in paint.

The grisailles were largely painted wet-in-wet, in just a few stages. The central panel has a highly elaborate build-up using many colours and extensive detailing. The meticulously applied paints were worked into an exceptionally smooth finish, whereas brush-strokes are readily seen in the freely painted grisailles. The painting's complex conservation history, with numerous changes from restoration interventions and ageing, complicates the reading of the original painted surfaces. Especially the Paradise wing and, to a lesser degree, the Hell wing were extensively overpainted, cleaned, and retouched.

The three panels were originally housed in engaged frames. Dendrochronology indicates the earliest possible creation date of 1476, with execution after 1478 more likely. As explained in the BRCP's *Catalogue raisonné* and in a subsequent publication, we propose a date of approximately 1500–05.²

Contents	1. Identification	5
	2. Examination data	7
	3. Picture support	9
	4. Ground	11
	5. Preparatory layers	13
	6. Paint layers	26
	7. Surface finish	50
	8. Frame and framing	50
	9. Condition of picture support	51
	10. Condition of ground and paint layers	56
	11. Condition of surface finish	67
	12. Visual documentation produced by BRCP	69
	13. Equipment used	90
	14. References	92
	15. Colophon	94

1 Identification

1.1 Nature of object (characteristics)

Painting, triptych; wings painted on both sides (see figs. above)

1.2 Attribution by owner

Jheronimus Bosch

1.3 Title

The Last Judgement

1.4 Alternate title(s)

Last Judgement Triptych, Vienna Last Judgement

1.5 Date

Not dated. (For results of dendrochronological analysis, see 3.11.)

1.6 Technique and support

Oil (not analysed) on oak (analysed, see 3.11) panel

1.7 Dimensions of painting (max.)

Open left wing (RR 161): 163.9 × 59.0 cm. Central panel (RR 162): 164.0 × 127.3 cm. Open right wing (RR 163): 164.4 × 59.2 cm.³

1.8 Markings on front

n.a.

1.9 Documentation on reverse

Both sides of the wings are painted. At the bottom left of 164 (central panel reverse), a 5 is scratched into the (replaced) third vertical cradle

member from the left, and next to it, using a stencil, 8 and 0 were applied in black on the fourth and fifth members. At the bottom right of 164 there is a remnant of a paper label.

1.10 Frame

The wooden frame of the triptych is from a later date. The original, engaged frame has been lost (see section 4.5 below).

1.11 Dimensions of frame (max.)

Open left wing (RR 161): 182.6 × 77.5 cm. Central panel (RR 162): 182.8 × 155.5 cm (including base: 191.8 × 163.8 cm). Open right wing (RR 163): 182.6 × 77.3 cm. Thickness of frames: (wings) c. 6.6 cm; (central panel) c. 7.2 cm. Width of framing elements: (wings) c. 10.3 cm; (central panel) c. 10.1 cm (top and bottom) and c. 14.8 cm (left and right).⁴

1.12 Documentation on frame

n.a.

1.13 Location/owner

Vienna, Gemäldegalerie der Akademie der bildenden Künste Wien

1.14 Accession number

GG 579 – GG 581

1.15 Related to

The interior panels of the Vienna triptych were copied around 1520–1525 in a triptych attributed to Lucas Cranach the Elder, now in the Gemäldegalerie in Berlin. That triptych was also documented by the BRCP (nos. 43–45). The Berlin version was probably copied

directly from the Vienna triptych, although the existence of a 1:1 intermediate version cannot be excluded (see section 2.4 below).⁵

2 Examination data

2.1 Dates of examination

26 July – 3 August 2017

2.2 Team members present

Luuk Hoogstede, Matthijs Ilsink, Rik Klein Gotink, Jos Koldeweij, Ron Spronk

2.3 Research conditions

The triptych panels were examined out of their frames in an empty gallery space. The paintings were studied upright, mounted on a wall, under strong illumination. All surfaces were accessible, except for no. 164, the central panel reverse. The end grain of the central panel was also inaccessible at the time of the 2017 examination.⁶

The triptych was studied on two occasions in 2019.⁷

2.4 Previous research and additional documentation available to researchers

Poch-Kalous 1967 described the poor visibility of the original artist's hand due to reworkings that can be dated to the sixteenth and seventeenth century.⁸

The triptych was studied between 2011–2013, as the topic of a two-year Austrian Science Fund (FWF) project led by Renate Trnek, former director of the Gemäldegalerie.⁹ During that time, the painting was documented in visible light (VIS), with infrared reflectography (IRR – Osiris), fluorescence under ultraviolet (UV),

and X-radiography (XR). The painting was examined with a stereomicroscope and 53 paint cross sections were taken and analysed via optical microscopy, Raman spectroscopy, and X-ray microanalyses (SEM-EDX). To date, one published conference presentation (Trnek 2014¹⁰), two posters and a presentation abstract (Cappa et al. 2015a¹¹; Cappa et al. 2015b¹²; Colagrande et al. 2014¹³) have been published as output from the FWF project. In addition, a 2014 project report exists.¹⁴ For the current study, the BRCP had access to notes on painting technique, information on paint samples, and a selection of unpublished visual documentation (XR, UV, VIS, IRR) from the FWF project.¹⁵

At the initiative of the BRCP, and with additional financial support of the Jheronimus Bosch Art Center and the Gemäldegalerie der Akademie der bildenden Künste, the AXES research group from Antwerp University conducted elemental analysis via macro X-ray fluorescence (MA-XRF) scanning of the full triptych in August and September 2017.¹⁶ The first findings from the interdisciplinary BRCP and AXES research which verified the identification of the patron of the triptych (see section 6.5) were published in 2018.¹⁷

2.5 Previous treatments (dates, description)

Restoration work was carried out on the central panel in the 1930s by Robert Eigenberger.¹⁸ The most recent documented treatment dates from 1954 by Olga Fleissner.¹⁹ At that time, the grisailles were cleaned, partly with 'cleaning water' and a knife, and the open join in the right wing as well as other lacunae were filled and retouched. The varnish was removed from the opened wings (nos. 161 and 163). Overpaints were removed from Adam and Eve (161) and the figures subsequently retouched. Old retouches were also removed in the lower part of the Hell panel, which was then

retouched.²⁰ It is possible that the triptych has undergone some unrecorded treatment since.

3 Picture support

3.1 Dimensions²¹

161 Height (left) 163.8 cm; (right) 163.9 cm. Width (top) 59.0 cm; (bottom) 58.9 cm. Panel thickness (left and right edges) 6 mm; (top and bottom centre) 8 mm. The overall thickness was measured in November 2019 at c. 8 to 10 mm.

162 Height (left) 163.6 cm; (right) 164.0 cm. Width (top) 127.3 cm; (bottom) 126.4 cm. Panel thickness (left and right edges) 7 mm; (top and bottom centre) c. 8 mm; (including cradle, overall) c. 29 mm. The overall thickness was measured in November 2019 to be fairly even at c. 9 mm.

163 Height (left) 164.2 cm; (right) 164.4 cm. Width (top) 59.2 cm; (bottom) 58.9 cm. Panel thickness (left and right edges) 6 mm; (top centre) 7 mm; (bottom centre) 8 mm. The overall thickness was measured in November 2019 at c. 8 to 10 mm.

For other measurements, see 3.12.

3.2 Wood species

Oak (Baltic, analysed through dendrochronology – see 3.11)

3.3 Construction

The left wing, central panel, and right wing are constructed from two, six, and three vertical planks, respectively.

3.4 Grain direction

Vertical

3.5 Cut

Radial (quarter-sawn)²²

3.6 Sapwood and/or knots

Not observed

3.7 Connection of original parts

The planks are butt-joined and glued. The joins of the central panel and right wing are held internally with dowels. Dowels were not observed in the XR of the left wing.

3.8 Original reverse

The wings are painted on both sides. The central panel reverse was planed prior to cradling.

3.9 Tool marks on reverse

Marks of a toothed plane are visible on the thinned central panel reverse.²³

3.10 Bevelled or half-lap edges

The three panels are slightly thinner towards their lateral edges (see 3.1).

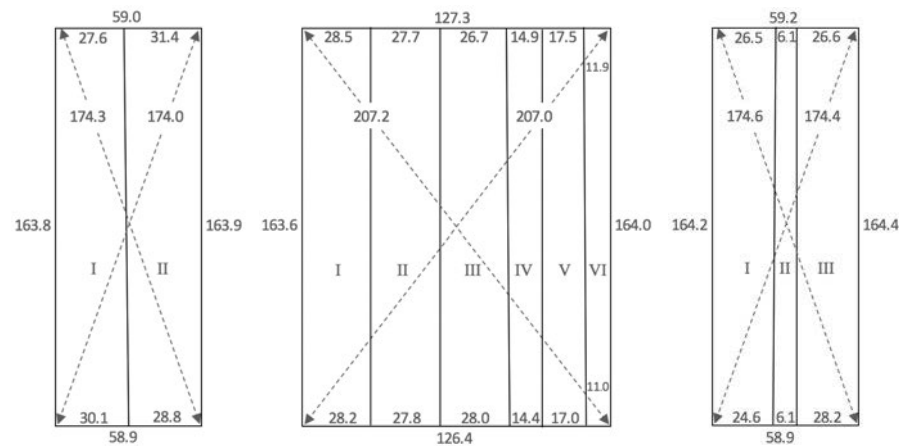
3.11 Dendrochronology

The youngest heartwood ring in the central panel dates from 1465. With the added minimum of nine sapwood rings for Baltic oak, this implies an earliest possible felling date of 1474 for the tree

supplying the wood for that plank.²⁴ An earliest felling date of 1476 is statistically more probable, however, since that would cover 93 percent 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 1476 onwards, but a production date from 1478 onwards is statistically more probable.

3.12 Construction diagram

Seen from the front, triptych opened (161–163).



4 Ground

4.1 Material between support and ground

Not observed

4.2 Sizing layer

Not observed

4.3 Ground

Present overall; off-white coloured (see 4.6 and 4.7)

4.4 Visibility

The paint layers and, at least in the grisaille, the pigmented isolating layer, cover the ground layer. Locally the ground can be observed in visible light (VIS) along some painted contours in the grisailles and, to a lesser degree, in the open triptych. The ground can also be seen in lacunae, abrasions, and along the barbs at the panel edges. In places, the underlying layer (possibly the pigmented isolating layer, see 5.5) is also detectable in paint cracks in the open triptych. In certain areas, this slight visibility of the ground tone may have been intended. The ageing of paint layers has probably increased their transparency and thus the perceptibility of the underlying strata, especially in lighter zones.

4.5 Barb and edges

The edges were almost completely accessible because of the temporary mounting on the wall. The barbs and ungrounded edges appear to have originally been present throughout. They are partly preserved on the lateral edges of the wings, except on the right of 159 (Saint James) and its reverse, the left of 161. There are traces of the onset of a barb at the top of 159, and there are remnants of a barb on the bottom edge of the central panel, 162. In many areas the barbs and edges have been damaged. Along some parts of the painted edges there is a slight indentation, as at the centre right of 160 (Saint Hippolytus), which may be related to the removal of excess ground at the barb.

4.6 Application

The ground does not hide all traces of woodworking, as broad diagonal tracks are visible in the top centre of 159, and in the top and bottom right of 160; such tracks were not observed in the open triptych. The vertical grain of the wood is also more readily observed in the closed triptych. The ground was worked to achieve a generally smoother finish in the open triptych, but the wood grain and the very slight undulation caused by the cradle are also visible there. With ageing, the vertical grain and texture of the wooden support have likely become more apparent, mainly in the central panel and in the closed triptych.

4.7 Composition

The ground consists of chalk (analysed²⁵) bound in animal glue (not analysed).

5 Preparatory layers

5.1 Underdrawing (presence, visibility, function)

The composition of the triptych was almost fully underdrawn; incised lines were noted in the closed triptych (see further, 6.2 and 6.3).

159–160 Underdrawing is present throughout and is best shown using IR(R). Underdrawing is also visible in VIS, both shimmering through and at painted contours that do not meet. For example, at the right elbow of Hippolytus, a lacuna shows the wood support and to the left of it a broad underdrawn contour, partly exposed (seen through the pigmented isolating layer) and partly shimmering through the light-grey paint. Underdrawing determined the

composition and, via parallel hatching, indicated darker zones of landscape (159) and shadowed areas (especially in 160). This aided the modelling in the painting stages and may have also functioned as a darker undertone.

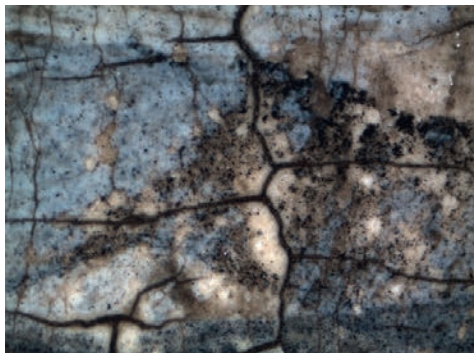
The architectural elements at the bottom of both grisailles were underdrawn in a later stage and seemingly with different material. Particularly in the right wing, this material is visible with the unaided eye on top of the streaky off-white base layer.

161–163 In the open triptych, underdrawing is present throughout and is best shown using IR(R). Underdrawing is hardly visible in VIS in 161 and 163. Underdrawing can only be seen in shimmering through locally, for example, in the fish head with the green trousers at the lower left edge of the right wing. It is also visible in broad drying cracks, for example in God's mantle at the bottom of the left wing. In 162, the central panel, underdrawing can be seen shimmering through more clearly and in many areas, especially in whitish paints and lighter brown background areas. Underdrawing roughly indicated the composition. In the central panel the underdrawing was further developed than in the wings. In 162, parallel hatching was used to indicate shadowed areas and some darker zones, and to prepare modelling. Even small detailing such as the mark on the large knife in the lower right of 162 was underdrawn.

5.2 Medium and application

159–160 In the grisailles, the detectable underdrawing was brush-applied in a liquid medium. Since tiny elongated particles are locally discernible, this may have been a finely ground carbon black in a watery solution (160MICGBM001). Drip marks, although rarely observed (e.g., 159, upper right), and local pooling of underdrawing

material in the background indicate that the panels were not lying flat when those areas were underdrawn. Underdrawing was applied in multiple stages, using relatively large brushes, with the saints possibly done first (see section 5.3). They were drawn more neatly in contrast to the lines in the background, which rendered in ample, deep-black material, and can be quite broad. The lines were often placed adjacent to one another, filling larger areas with underdrawing, thus creating the appearance of a wash.



Micrograph 160MICGBM001

161–163 Unlike in 159–160, the detectable underdrawing was applied in a dry material. This may have included a fatty substance, as the subsequent layer barely smudged the dry underdrawing (162IRREFX001). Applied on a relatively smooth ground, the lines do not skip but are discontinuous. Underdrawing appears to have been applied in a single stage in the wings, using hard, deep-black lines. This type of underdrawing is also visible in 162, but there it was apparently followed by a second stage drawing with somewhat softer, mostly less intense black lines. The spacing of the hatching varies, with lines being set closer to one another to create the darkest zones.



Detail 162IRREFX001

5.3 Style

159–160 The underdrawing in the background was applied with great freedom in both grisaille panels. Greater care has been given to the underdrawings of the saints. In particular, the hatching of Hippolytus's folds was applied more evenly and with greater control, with regular spacing and even line endings. In addition, for the swift and free background lines, more underdrawing material was employed in some areas. The strokes vary in length, and the longest lines are not continuous. Most lines, however, are rather short and irregular, and can be quite broad. They also have uneven line ends and can have hooks. Hatching was mostly applied horizontally or diagonally and is closely spaced, filling areas in the compositions.

161–163 The compositions of the open triptych were indicated in a free, energetic and sketchy style and, in 162, worked out in considerable detail. The first stage of underdrawing is relatively simple, focusing on contours. These are frequently constructed from repeated lines which are often (slightly) curved. Lines are typically relatively short and irregular, many with bends as, for example, in the right hand of Christ in 162. The first stage of underdrawing also includes longer and more continuous lines. Line ends can be straight, curved or hooked, with blunt or tipped points, an inconsistency that can be explained from the dry underdrawing material.

Long lines are more common in what appears to be the second underdrawing stage, which is restricted to 162. Here, the composition is further developed and more detailed, especially in its main elements, possibly already abandoning some of the initial drawn scenes. The careful hatching is worked out precisely. Locally, the hatching curves follow the modelling of the figures. Hatching was mostly applied horizontally or diagonally. Deeper shadows are prepared with denser hatching. Some zigzags were apparently also used in areas of deep shade, as in the squarish architecture in the left centre. Some cross-hatching is present at the bottom left of the donor's robe.

5.4 Revisions in underdrawing and differences from paint stage(s)

The underdrawings of the five panels reveal ample artistic invention in the creative process of developing forms and compositions. The examination also revealed many instances where the paint stages differ from the underdrawing.

159 The slanted escutcheon with its protruding lip was preceded by two different, upright shields. One shield was drawn slightly lower, in broad strokes, its lower tip extending beyond the bottom edge of the area of dark paint. The relatively thick, dark contours of the second shield were drawn or painted higher and smaller than the first one. The position and form of this second shield matches a similar shield on 160. Since only the form and the location of the second shield is present in 160, we can conclude that the larger, lower shield in 159 was drawn first but subsequently abandoned. Curiously, the second shield was never painted in 159, unlike its companion in 160 (see 6.6 below).

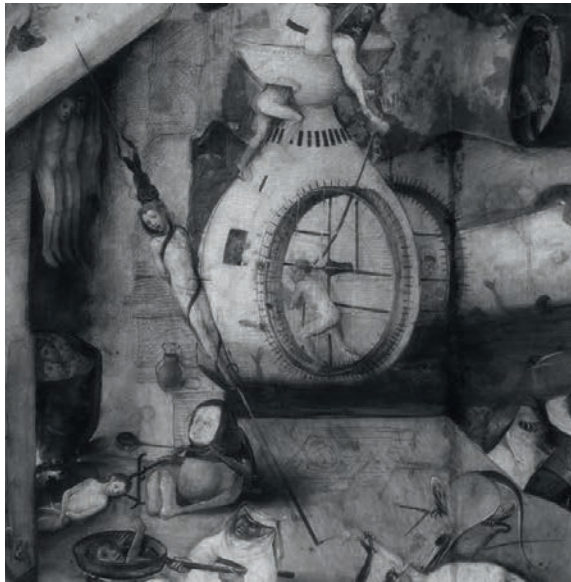
Changes to and around the water feature in the foreground include the rise at lower left, which was slightly smaller but continued lower in the underdrawing. The bank at centre right is now more irregular and without plants. In the top right background, tall underdrawn trees and shrubbery were replaced in the painting stage by a robbery scene and rocky features with a cave. The extensively underdrawn trees extended nearly to the top of the panel. The hill in central background was not underdrawn, and there are many other smaller changes here. The hill and figures at top left were also altered in the painting stage. More figures were underdrawn around the tree at upper left and under the tree at centre left, but not painted. There are additional small changes in the background below that. The section of the pilgrim staff over Saint James the Greater's shoulder was painted slightly higher.

160 The outlines of the initial, smaller escutcheon are partially visible in IR(R). (Other changes here relate to the painting stages – see sections 6.5 and 6.6.) At lower right, broad, wash-like bands above the hem of the undergarment on the leg of the dwarf-like figure

may indicate that this area was planned somewhat differently. The chin of the beggar above was drawn more pronounced, and some buildings and rooftops in the background were altered. The arch of the passageway with the city view was initially planned as a flat horizontal opening. The vertical edge of this opening was planned further to the right, apparently as a brick wall since several underdrawn horizontal lines can be observed here. A circular feature was underdrawn in the top left corner of the painting. The falcon was underdrawn larger, with its head more turned towards the saint. In the painting stage, the bottom left part of the glove was reduced in size and the string here repositioned to the right. The underdrawn saint's scabbard was wider and more vertical, with its tip positioned lower and more to the right. His robe and mantle at bottom left were changed slightly in the painting stages. Below that, the foot was underdrawn lying on its side with its heel pointing to the beggar above it. The coins on the cloth were prepared larger and higher.

161 Obvious revisions within the underdrawing of the Paradise wing were not observed in IR(R). Multiple deviations between the underdrawing and the original painted composition were detected, but the presence of extensive overpaint (see section 10.5) makes this often difficult to assess. The green landscape, which was extensively overpainted, had a significantly more varied underdrawing, with many more planes, slopes and vegetation. Many of these features do not appear to have been originally painted, such as the underdrawn slope intersecting the pond at the lower right, the extensive vegetation between the trees in the left foreground and the tree with the forbidden fruit, and the steep slope extending from there into the brown rock at right. What appears to be a manmade structure around the cave in the left middle ground was

underdrawn, but does not seem to have ever been executed in paint, although XR does reveal other changes in that area. In the upper part of the painting the landscape was changed. Around the trees in the upper centre, a riverbank was underdrawn at right. Above that, several hills seem to extend to the upper right. At left, two tall rocks were underdrawn, extending to the present clouds. Most of the figures were changed. In the top centre, God the Father was underdrawn much larger than painted. In the underdrawing, his right hand was initially raised rather than placed on the orb. The copy by Lucas Cranach the Elder in Berlin depicts a raised hand. It is possible that the hand in the Vienna panel was initially painted in a raised position as well, but later damaged and overpainted. Angels were underdrawn closer to him, to his left and right. In the scene of the Expulsion from Paradise, the position of the sword, wings and leg of the Archangel was changed, and Adam and Eve were drawn considerably larger. Eve was underdrawn close to Adam, but painted further to the right. In the Fall, Eve's right arm is around Adam's neck. She seems to reach for the apple with her left hand and the hand of the serpent was underdrawn higher still. The serpent was also underdrawn more to the left and its lizard-like tail was apparently not prepared as far down. In the scene with the Creation of Eve, Adam's head was tilted up in a more frontal position. God the Father's cloak, kept together with a large brooch on his chest, covers his shoulders and arms but exposes his lower garment. The hem and folds of cloak and undergarment were painted differently. Eve's navel was underdrawn but seemingly not painted, although many retouches complicate assessment of this area.



Detail 162IRREFL010

162 There appear to be no revisions in the stages of the underdrawing. Numerous differences have been detected between the underdrawing and the paint stages, far too many to discuss in full. The most important changes will be described here, with examples of the different types of alterations that were observed.

A single kneeling and praying figure, presumably a donor figure, and a banderole were underdrawn in the bottom left corner. These features were left in reserve from the background, which was later changed (see section 6.6). Ageing effects resulted in the increased visibility of these and other underdrawn features that were not painted, such as the gridiron with body parts below the spiked 'water wheels' (162IRREFL010), and the three 'baby-monsters' at bottom centre, only two of which were painted. Directly above, the monster wielding a knife was underdrawn with tipped

wings. The war vehicle at right was underdrawn with cartwheels and some limbs extending from under it. The figures around it were also underdrawn differently (and partly painted – see section 6.6). Numerous underdrawn elements around the bridge and in the background landscape were not painted, or later painted out. At the right of the bridge a monster devouring a person was underdrawn, but only the monster was painted (it was later painted out – see section 6.6). Additional figures were drawn in the water below it, but never painted. To the left, many underdrawn figures are caught by the net, the position of which was changed as well. It was initially larger and being pulled by two figures on the bridge. The left figure was underdrawn, largely painted, and painted out in a later stage (section 6.6). In the water behind the bridge, at right, apparently two figures were underdrawn, and at left, a crocodile-like creature carrying a monster and a woman. In the background landscape above it and towards the left background, large groups of figures were underdrawn, but positioned and executed differently in the painting stage. A striking scene at the left edge, just below the painted gallows, was never painted: two posts are underdrawn between which a body was strung. Two monsters, one of which looks like a rooster, are in the process of sawing the body in two. To the right lies another body and what appears to be a book or box and a jar. The gallows were underdrawn considerably further to the right. At the upper right edge, the top of the brown rock covers a few underdrawn figures and a ladder. There are also many other, mostly smaller changes. Throughout the panel, the angle or position of elements was often changed. For example, the hands of the man seated on the red cloth in the left foreground initially covered his groin. Christ's hands were turned, perhaps to allow the marks of his crucifixion to be shown. The lateral angels' faces and their trumpets were repositioned in paint. The sketched

angels above Christ with the instruments of the Passion were also altered significantly. At top left, rays were underdrawn that emanated from the break in the clouds, but these were not painted.

163 Clear revisions in the underdrawing were not observed in IR(R). Dark, carbon-containing overpaint is present in many areas (see section 10.5), again making it difficult to detect and interpret possible changes between the underdrawing and the paint surface. Nonetheless, there seem to have been numerous compositional changes. The middle and foreground were altered more extensively, and those most striking are described here. At the bottom left, a bird-like creature with a long beak impaling a toad (?) is underdrawn but not painted or left in reserve. To its right, a table was initially planned, rather than a fish. At the bottom right, a fish-like monster with legs and arms is devouring a lizard-like creature. The lizard's body was once partly painted, possibly with a blue paint, but later painted out. The fish-like monster itself did not progress beyond the underdrawing stage. Above and left of it, the oval-shaped pit was underdrawn lower, with one figure looking into it from the top right, initially also painted. In the lower left of the underdrawn pit, another figure is climbing a long ladder. Another ladder was drawn at right against the building, but not painted. The head of the monster initially climbing it was underdrawn further to the left and slightly higher. Instead of the two naked figures painted here only one appears to have been drawn, seated on the monster's back and turned towards the viewer. Rather than the painted clawed foot of the monster being positioned on the ladder, it now rests on a head that was not underdrawn. Another figure at the foot of the ladder is starting to climb it.

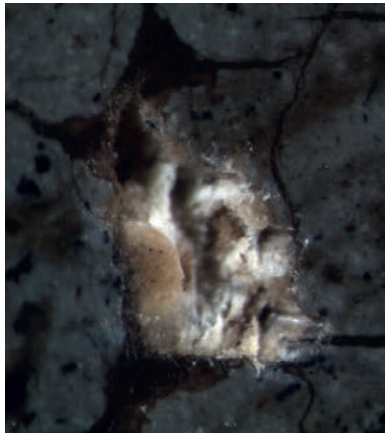
The large armoured green figure at centre right, as well as the figure with the pointed hat above it, were not planned in the

underdrawing. Instead, possibly a rock and birds were indicated. To the left, in the tent, the woman and the group of figures cover a taller underdrawn and painted figure standing in front of a sacrificial altar. Many changes to the left of it relate to the positioning of figures. To the right of the dead tree, a figure initially hung upside-down with its head in a pot. The body was left in reserve and later painted out, but it has become somewhat visible due to the paints' ageing. The figure riding a large bird to the left of the tent was not prepared in the underdrawing. The giant figure in centre left appears to have been underdrawn, since some contours for the green section of its cloak were revealed. The contours of the spherical red object were drawn, although its short spikes were not. Some alterations are detectable in the middle and background as well, for instance, the changed position of the boat (partly done in paint, with possible sails underdrawn).

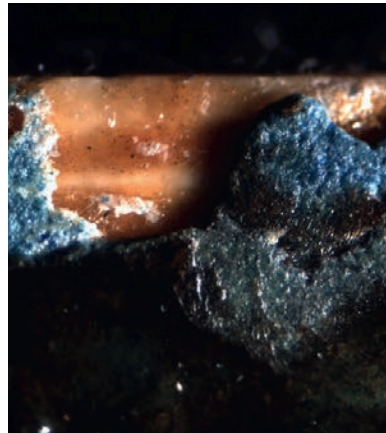
5.5 Intermediate layers

159–160 A dull, semi-transparent layer is discernible under the paint layers of the grisailles. The layer mainly shimmers through. It is more clearly visible in several lacunae (160MICGBM008) and at contours where the painted forms do not fully meet. This pigmented isolating layer was applied overall in 159–160 and appears to contain some white, black, and possibly other pigments as well. The somewhat warm tone of this intermediate layer might relate to discolouration of the binding medium. The pigmented isolating layer appears to have been applied over the underdrawing.

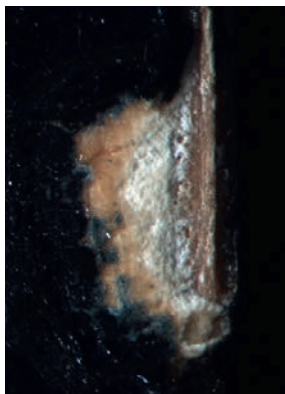
161 A rather warm, semi-transparent layer is visible in a lacuna at the top centre (161MICGBM001). It could not be determined whether this black pigmented layer is present overall.



Micrograph 160MICGBM008



Micrograph 161MICGBM001



Micrograph 162MICGBM003



Micrograph 162MICGBM001

162 An intermediate layer appears to be present in 162 as well. The semi-transparent layer is visible in a loss at the right edge (162MICGBM003) and is possibly applied overall, although it was not seen in a loss at the top left edge (162MICGBM001). This layer

appears to contain lead-white and chalk pigments, as indicated by the MA-XRF mappings of lead and calcium. It is applied in very broad strokes in multiple directions. The textured brushstrokes can be seen locally, for example below the horsemen with lances in the lower centre. At the centre left edge, the intermediate layer is also visible below the hairy arms of the brown monster.

163 The textured brushstrokes at Hippolyte's right hand may relate to a pigmented intermediate layer, but such a layer could not be identified with certainty on the inside of the right wing.

6 Paint layers

6.1 Binding medium

The medium was not analysed, but appears to be oil.

6.2 Paint application

159–160 The paint was brush-applied and covers almost the entire surfaces of the panels. Paint was applied up to the barbs. The underlying preparatory layers are sometimes visible at the interfaces between different colours and shimmer through in many areas, especially in the background. Paint was applied in a few stages, mostly wet-in-wet, although the main figures were painted wet-on-dry, slightly overlapping the background paint. Locally, paint appears dabbed, possibly using a cloth or a finger. Multiple incisions were noted in the grisailles. They indicate some contours in the architecture and landscape, and straight elements (see 6.3).

161–163 The paint was brush-applied up to the barb and covers almost the entire surface of the panels. Painted contours generally meet and underlying preparatory layers are seldom exposed.²⁶ Paint was applied in several stages, mostly wet-on-dry but also wet-in-wet. The latter applies especially to the many paint application steps in the elaborate finishing of colourful elements. Dabbing imprints of a cloth or finger were observed in many areas in 162. A few incisions were also noted in the central panel (see 6.3).

6.3 Paint technique

159–160 The off-white base layer was applied in broad brushstrokes readily visible (in VIS and raking light).

The subsequent light grey to black paint of the architectural elements was applied markedly thick, and before the lower layer had fully set. Notable differences can be observed between the left and right wing in the painting of these imitation stone bases. In 160, these elements have a stronger sculpted effect and are richer in contrast than in 159, where they are rounder. Light-to-dark gradients were utilised more frequently in 160, and the colouring differs somewhat too. The strap, buckle, and the escutcheon have a sharper definition in 160, although the visible underdrawing at some edges reinforces this perception. Paint application for the stone base of 160 appears freer, as on the floral motifs, and is also thicker. It should be noted that the right wing is considerably less abraded in this area.

There are also slight differences in the way the two saints were executed. The paint for James is more pastose, opaque and rich in contrasts, appearing more like a true grisaille. Especially the saints' heads differ, although this impression is reinforced by the stronger abrasion of this area in the right wing. Since Hippolytus is generally

painted thinner, the abrasion and ageing effects are more apparent in this figure. Over time, the increased transparency of the lighter paints has resulted in a greater visibility of the slightly warmer intermediate layer. These differences in technique are not large enough to question whether both saints were painted by the same hand, but they might not have been painted simultaneously, or side by side.

159 In the top left, a striking horizontal line – consisting of two successive brushstrokes – was applied in the wet paint of the sky. These strokes were subsequently interrupted by the paint of the tree applied wet-in-wet. This line does not appear to serve a function, and is slightly more apparent now due to varnish residues in the interstices of the brush strokes. The grey tower on the far-right horizon was painted in the still wet horizontal strokes of the background landscape, also dragging along some wet paint of the sky. In the largest tree trunks below, some painted lines were roughly feathered out. The black paint above the cave, at the base of the shrubbery, appears to have been partly dabbed with a finger or a cloth. The staff below the fighting men was painted with a dark line and a partially light line, leaving the grey background to function as middle tone. At lower right, the water line was painted after the shell, displacing some of the grey and white paint.

In the central middle ground, the lower left hill (not underdrawn) was indicated with an incision extending from just above the saint's head to the leftmost rock. After the background was painted, the cane of Saint James was incised along the contours. The transition to the darkest side was roughly incised. The incisions cease where the mantle or fingers were planned, except for the incised lower contour running through the saint's proper left hand. The base is indicated by a non-continuous and locally double incision.



Detail 160MCPVIS008

160 At the bottom centre in the exterior right wing, a large round incision was made by a compass. The compass's mark is visible at the centre point of this circle, three-and-a-half centimetres below the top right corner of the escutcheon. This incision precedes the off-white base layer and does not appear to be related to the initial and final positions of the shield (see section 6.6). There is a horizontal incision at the bottom of the dark narrow back wall, just above the floor. A non-continuous and locally triple incision, extending up to the left edge of the panel, indicated the imitation stone base. A horizontal pattern is visible in the shadow behind the dwarf-like figure at lower right in the closed right wing. The black lines in his coat were painted wet-in-wet, partially pushing aside the grey paint; the bottom contours of his coat and his undergarment were rendered in the same way. The foot on the cloth was painted wet-in-wet, onto the light grey paint of the textile. Paint was frequently pushed aside. The toenails indicated are the result both of the darker contour paint and the void resulting from the application of paint (160MCPVIS008).

161–163 The artist deviated considerably from the underdrawing of the open triptych, as appears to be especially the case for 162 and the right wing. The technique of the initial paint application in 161 can only be determined fragmentarily, if it all, because of the extensive overpaint, harsh cleaning interventions, and subsequent retouching. In comparison, the right wing was overpainted less. The paint there is also in rather poor condition, partially due to deficiencies in technique (see section 10). Numerous elements were reinforced or changed in the past, and some subsequent repaints/overpaints appear to be very old (see sections 6.6 and 10.5). Given these issues and the apparent similarities of 162 with better preserved areas in the open right wing,²⁷ the focus here is on the painting technique of 162.

162 The landscape and large structures were painted in broad brushes, whereas mostly fine to very fine brushes were used for the figures and other elements. Paint was often applied in minute strokes, hatches, and dots. More freely applied paint dabs are less common and mostly seen in the faces in the background. These were painted with a few short and sometimes parallel strokes or dabs of contrasting paints in light (mostly white or pink, and occasionally yellow or green) and dark (brown or black). In the bottom left corner of 162, an incision extends from the raised hand to the left edge. Incisions also assisted the painting of the angels' trumpets.

The mostly medium-rich and glossy paints were laid on in both opaque and semi-transparent applications. Brush strokes were applied in multiple directions but generally follow the forms in the composition. As with the seated man on the red drapery in the centre foreground, they were often utilised to render contour and volume. With strong, dark lines frequently employed to strengthen the

contours of elements such as limbs, feet, and hands, for instance, the brown contours of the plump hand holding the large sword near the bottom left, these elements stand out more from their immediate surroundings. Brown to black lines were also used to indicate physiognomic details. Dabbing of paint, perhaps with a cloth or a finger, can be seen in many areas, such as in the red monster supporting the green barrel at the lower left. Dabbing imprints also appear to be present in the grey smoke from the fire in the back-lit gate in the central background. The gate itself was painted wet-in-wet. In general, wet-in-wet painting was mainly used for local detailing, flesh tones, and some larger elements such as the grey-robed figure with the white hat on the bridge and the trumpeting angels. The latter were left in reserve from the background blue. In the two groups of apostles, the flesh tones were painted wet-in-wet. The robes were painted wet-on-dry, with the purple robe at right having a modelled base of blue and white paint.

Some of the long cylindrical shapes such as sticks and arrows were created through painting a dark and a light line, with some space in between for the background colour to act as a midtone. Elements were generally built up in multiple layers, with supplementary highlights, shadows, and detailing added. Many of the figures have small pinkish highlights in their faces and on their bodies, enhancing the modelling. Given the limited impasto, the thickness of paint layers is largely dictated by the paints used. The lead-white and lead-tin yellow paints were applied more thickly than those with earth pigments. As the coarseness of the pigment dictates, dark blue areas with azurite consist of thicker but medium-rich paint.

Numerous passages, from small to large, evidence a highly elaborate build-up employing many colours and extensive detailing. For

example, the white of the eye of the *kopvoeter* ('headfooter') creature at centre left with the large red hat consists of lead white, lead-tin yellow, and red. The brownish leg of the figure with the large knife at bottom right is finished with lead-tin yellow, lead white, red to purplish lake, black, and green detailing. In general, the intricate technique results in a remarkably rich appearance with ample depth of colour and volume, similarly evident, among many other places, in the armour and many passages with glazes. Green and red glazes have been used extensively, the latter also in variants of browner or more purplish colour, such as on the building at centre left. Glazed passages are gently modelled, with generally subtle and even transitions between light and dark passages. Some of these also have a distinctly soft feel to them, such as the woven red basket in the bottom right. Throughout the panel, exceptionally fine hatches – often in a dark paint – were observed, for instance, in the man in the tan basket at bottom right and in the face of the woman-monster with the frying pan. In the latter, minute hatching in white was applied to highlight folds in the red robe. Below it, the hem of the red fabric on which a naked man sits has parallel lead-tin yellow hatches, and red lake hatches were used for folds. Some red lake hatches can also be seen in Christ's mantle and the red robe of the Apostle to the right. Occasionally, hatching was done in a herringbone pattern.

The composition was generally worked out to a high degree of finish with abundant detail. Most areas have limited texture or relief and a smooth surface. There is an emphasis on light and dimensionality, as is evident in the many shiny features and the shadows cast. In most areas, the paint application is meticulous rather than quick and free, despite elements also painted wet-in-wet, such as the head of the monster in the egg in the central foreground.

6.4 Texture

159–160 Most passages do not have a smooth finish and brush-strokes are visible throughout. The extensive use of thick paints containing lead white (and locally lead-tin yellow) has resulted in many impastoed strokes and highlights. The texture was also used to model folds and forms. An imprint in the still wet dark paint of the back wall (at the height of the falcon's head) could be of a finger.

161–163 Most passages have an unusually smooth finish. The limited texture also applies to areas where lead-white and lead-tin yellow paints were used (162MICGBM006, raking light). Compared to the closed wings, the surface character of the panels is much less distinct in the open triptych.



Micrograph 162MICGBM006

6.5 Build-up and palette

Pigments typical for the period have been identified by Colagrande et al.: 'lead white, carbon black, azurite for the blues' and 'vermillion, iron oxides and red lakes for the reds, lead tin yellow and ochre for yellows'.²⁸ Colagrande et al. also mentions 'copper resinate for the greens', but more likely that refers to verdigris which over time

dissolved in the oil medium and to which some resin may have been added.²⁹ Green paint layers also contain the copper pigments malachite and verdigris.³⁰

159 The landscape was largely painted wet-in-wet, as well as individual elements in it. In the case of the tree with the black bird, the trunk and branches were first indicated with dark grey strokes, sometimes with small perpendicular dabs, followed by lighter grey and whitish lines. The foliage has a grey base followed by lighter grey and whitish dabs. The saint was left in reserve and painted after the landscape, generally from light-to-dark, followed by highlights and shadows (these indicate a directional light source from upper left). As such, not only dark zones (such as the beard) overlap his robe, but also later painted areas of his shadow on the landscape. The sequence of painting his feet began with grey followed by the modelled lighter grey extending to his toes, then came the dark grey and slightly wet-in-wet contour of each toe and nail as well as the shadows, and finally lighter grey to whitish dabs or strokes were added for nails or highlights. The dark grey of the water partly overlaps the off-white base and was subsequently corrected by an off-white paint stroke.

160 The right-wing grisaille is built-up in a similar fashion. Hippolytus was also left in reserve from the background, but dark paint and reinforcements overlap the figure along many parts of his contours. Lead-tin yellow was used in a detail at the falcon and for the spurs, painted after the grey background. The spurs were further detailed with black, painted wet-in-wet. The beggar at left was also painted wet-in-wet, followed by shadows and light-grey to whitish highlights. The grey background was painted after the black contour



Detail 162MCPVIS032

of the beggar's hood. The off-white wall was executed afterwards, following an incision-like mark in the grey paint. The off-white layer surrounds the interior scene and is present at the bottom of both grisaille panels. The initial, upright coat of arms in 160 was painted afterwards, on top of this layer. The changes there, and the later applied escutcheons and architectural elements, are discussed in section 6.6 below.

161–163 The paint was mostly applied from light to dark, followed by lighter details and highlights. The original foliage in 161 appears painted from dark to light. Green dabs were followed by lighter green dots and a green glaze that has discoloured brown.

Overall, the paint application was planned and was largely executed back to front, with the exception of detailing. The main figures were left in reserve from the background, such as the blue monster with the trumpet beak at centre left of 162, which was painted after the red bed. Arms and hands were left in reserve from clothing, and flesh tone was applied after the surrounding paint. For example, the legs of the human climbing the 'waterwheel house' in 162 partly overlap the blue paint of the structure and the green paint of the vase behind it (162MCPVIS032). Areas with red lake also appear to have been painted before (parts of) the figures. Large and smaller elements were left in reserve, the latter often quite roughly. Small background figures were painted over the base paint of the landscape. They were often executed in a single stage with wet-in-wet paint application.

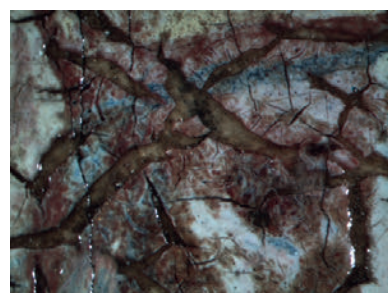
Most copper green glazed elements have a base layer that includes lead-tin yellow. For red glazed elements, often a vermilion-based layer was applied onto the ground, followed by a layer containing lead white mixed with some red lake (varying in thickness, but hardly impastoed), and then red lake (163MICGBM001). Red lake was used for detailing as well. For example, the face of Christ at the top centre of the left wing was painted in blue and white, followed by highlights, red lake for the eyes, mouth, and below the nose, and lead-tin yellow (161MICGBM003). Red lake was also used in most fires, which can also include vermilion, lead white, lead-tin yellow, pinkish paint, and dark paint to indicate smoke (162MICGBM004). Strikingly, greenish glazes were observed in multiple fires in the open right wing. Brownish glazes were used as well. The stone slab in the lower right of the open right wing has a more reddish-brown glaze, whereas the flesh tone shadows in 161 have a brownish glaze which is less warm (161MICGBM009).



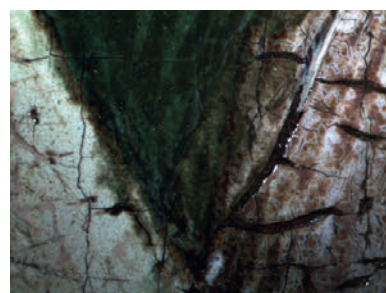
Micrograph 163MICGBM001



Micrograph 162MICGBM004



Micrograph 161MICGBM003



Micrograph 161MICGBM009

162 In the top left corner of the central panel, blue paint was followed by lead-tin yellow, lead white, and subsequently thin grey paint. The gold leaf remnants in this area appear to relate to the frame.

The two groups of Apostles were left in reserve from the blue sky. Flesh tone paint was followed by detailing in light paint, and then (dark) brown and black, after which a touch of lighter paint was applied. The purple robes have a greyish-blue base followed by red lake. Later, after the Apostle's head was painted below the

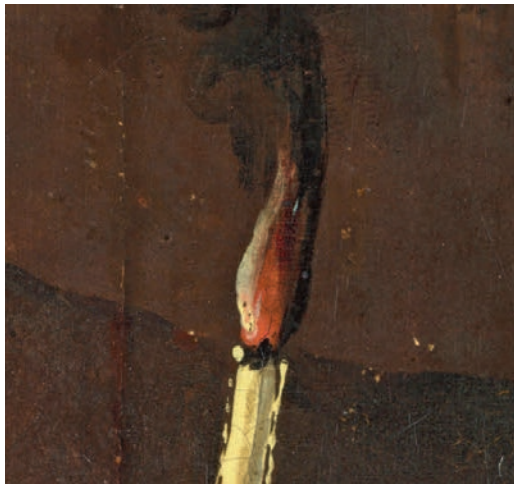
left purple robe, black paint was added for the dark shadow there. The red robes have a vermilion base, followed by thin lead-white and red lake paint. Subsequent small red lake hatchings are present in the red robe at right. The same build-up is seen in Christ, where flesh tone was applied after the red lake of the cloak. For the wound in His side and foot, black and red lake paint were used. His hands and feet are delineated in a brown paint. For some Apostles' hands, the brown contour is followed by black reinforcements and then highlights of fingers. In others, the flesh tone is followed by pink and wet-in-wet applied brown contours, or vice versa. Red lake was included in the contour of the noses of Mary and Christ.

Just below the Apostles, on the ruin with the bright fire at centre right, it is unclear whether the second figure was pushed to the rear using lead-tin yellow paint, or whether it was meant to be painted out.

The smaller figures in the middle and background appear to have been painted with lead white, black, possibly some ochre, and occasionally lead-tin yellow or a green paint. Other figures have a pinkish base, followed by light brown and then dark brown or black for details, as well as mostly pinkish highlights. Some figures deviate from this. For example, the one with the ladder at centre left, directly above the green dragon, has a much redder face that includes red lake. Above it, the monster behind the plough was painted with lead white, lead-tin yellow, red lake, pink, and dark paints. The highlights on the robe of the woman leading the plough consist of a mixture including lead white and red lake.

The small fire in the blacksmith's cauldron at centre right has a vermilion base, followed by greyish-pink, lead-tin yellow, and red lake. The flame of the candle at centre left was painted with vermilion, lead white, and lead-tin yellow paint, followed by

a dark red glaze, black smoke, and an additional blue highlight (162MCPVIS018). The fire in the building at centre left was painted in vermillion, red lake, followed by again vermillion and lead white, an orange-pink colour, and lead-tin yellow.



Detail 162MCPVIS018

Red lake paint is present on the river surrounding the water wheel. Red glazes were also used extensively on blue-grey painted areas, such as the roof of the war machine and the building at centre left. The red slab at centre right has a vermillion base, followed by lead white and red lake, after which lead-tin yellow and more lead-white highlights and red lake were applied. The spikes were painted in black, followed by a grey contour and lead-white highlights, both on the right side of the spike. In the centre, the spikes on the horizontal brown disk and the treadmills below it were similarly painted; although the lighter paints were applied on the left, the brightest spikes contain no black colour, and cast shadows were painted for the spikes.

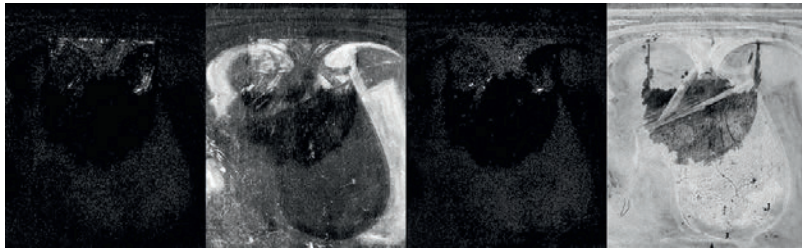
There is extensive detailing in the form of minute hatches or dots. Often, multiple colours were also used. For example, for the rivets in the armour in the lower centre with the severed, blindfolded head, black dots were applied first, followed by white dots in the upper part and lead-tin yellow and pink dots in the lower part. Blue dots were applied after white dots on the leg of the monster in the egg. The colourful amphibian-like creature to the upper left of it has blueish and light dots applied before the red lake, and white dots applied after the green lake.

The build-up of faces can be quite intricate. For example, the head of the seated man in the central foreground was painted with flesh tone, followed by highlights, brown, black, and a dark contour, after which the hair and red lake were applied. The face of the woman-monster with the frying pan is painted with a dark flesh tone, followed by pink highlights, black and brown. Vermilion was added in the eyes, and finished with lead-white accents.

6.6 Changes in the paint layer

159 The saint's head was left in reserve somewhat higher, painted as such, and subsequently lowered to its present height. Small changes were also made to the fingers of his right hand. The architectural element at the bottom of the grisaille was not planned from the outset but appears to have been underdrawn on top of the off-white base paint and subsequently painted together with the present escutcheon.

160 In the right wing, the architectural element was not initially planned either. Together with the slanted escutcheon, it covers a smaller, upright coat of arms that was gilded and painted, and later largely removed. Although the off-white base layer is less



MA-XRF detail maps of gold (Au), iron (Fe), mercury (Hg), and lead (Pb)
(Images: AXES)

X-ray opaque than the later applied architectural elements, XR of the smaller shield in 160 shows where this layer (with mostly horizontal brushstrokes) was scraped off down to the ground. The off-white layer continues under remains of bole and gold, revealed with stereomicroscopy. These remnants, and those of red paint in certain areas under the presently visible composition, indicate the initial shield was gilded and executed in paint. Results from MA-XRF analysis suggest that the colour and position of the remnants match our knowledge of De Berthoz's arms.³¹ The top field of the shield was originally covered with gold leaf, now largely removed, but numerous traces remain (MA-XRF Au map). The gold leaf was applied on an iron-containing bole that later became abraded (MA-XRF Fe map). Some vermillion containing paint from the red sun's rays survived (MA-XRF Hg map) when the red and – more thoroughly – the black paint in the bottom half of the coat of arms was scraped away (MA-XRF Pb map). The damage, including a semi-circular shape in the centre, thus corresponds with Hippolyte de Berthoz's coat of arms.

Given the otherwise visible damages mentioned above, the coat of arms was most likely replaced immediately by the present escutcheon. From visual examination, little time appears to have elapsed before the escutcheon and architectural elements were painted. The black shadows of both escutcheons cast on the dark backgrounds are original. These were painted wet-in-wet after the grey background paint was applied.

The right-hand index finger of the beggar at right now overlaps the background, but was shorter in its reserve from the background. The falcon, underdrawn larger, was left in reserve from the surrounding grey, but was already smaller and more to the right. It was painted more to the left, partly overlapping the background grey. The unpainted section to the right of the falcon was then closed with a slightly darker grey. Hippolytus's right arm and shoulder appear to have been initially been wider when left in reserve.

161 Extensive overpaint (see section 10.5) hinders the detection of pentimenti. A standing bird was once painted in the pond at bottom right. Since this is not included on Cranach's copy, it would seem that covering the bird was actually a pentimento from the initial composition.

162 Important compositional changes were observed. As mentioned, a donor and banderole were underdrawn at bottom left and subsequently left in reserve from the small double hill here, but later painted out. The initial background landscape converged more strongly in the centre of the panel (MA-XRF Hg and Fe maps), where another rocky feature was painted (MA-XRF Cu and Fe maps).



The upwards sloping hill at the upper left edge was cropped (162MCPVIS003). Initially, white painted figures – angels and human beings – were depicted standing or seated on the brownish hill. They were painted out with blue sky, and white and grey clouds.



VIS and MA-XRF maps of mercury (Hg), iron (Fe), and copper (Cu) (Images: AXES)

Abrasion has made these covered elements stand out again.³² Perhaps the horizon was lowered to improve the transition to the left wing. Slightly lower, near the right edge, another figure was painted out (see the MA-XRF Hg map above, top right).



Detail
162MCPVIS003



Micrograph 162MICGBM005

The rounded blue shape in the centre of the panel, directly above the bright red grindstones, was not meant to be visible (162MICGBM005). The blue shape and the legs painted front centre of it were first covered with grey paint before the helmet was added. The dragon at centre left did not initially have black boots, but green claws for feet. A pair of legs extended upside down from the top of the tan basket at bottom right, but were covered with background paint. Directly above, an additional figure was painted at the top of the group of nudes, of whom now only an arm and hand are visible. The right

arm and hand of the man lying on his back to the left were also painted out, but these have become visible again due to abrasion. To the right of the bridge, at the river's edge, the bird on the rock covers a monster. At the left of the bridge, a third monster was largely painted in blue (except for the hood, which was still left in reserve), and apparently painted out later. In the water behind the bridge, a monstrous fish bearing two figures (a monster and a woman) was underdrawn. Only the woman was not painted (see the MA-XRF Cu map above, lower centre). The scene was later covered with the steep shore, the figural group, and the creature to the right. Other changes were also made in this area, for example, the grotto above was initially larger and more open. There are also small changes in the rest of the panel. For example, the orange-brown belly of the blue demon at the lower left was originally blue.

It seems there was a subsequent campaign with several changes made, though their execution was less masterly and they appear almost like overpainting. However, since these details are found in the Cranach copy too, the changes may have originated in the artist's studio. In the central foreground, the winged creature with a knife initially had a human face. This was changed into a snake-like head, while the claw was painted out with a tail, now almost completely abraded (162MCPVIS048). At the war vehicle to the right, the monster above the wheel initially held the green plating and had one leg outside of the vehicle (MA-XRF Hg map). The monsters to the right were painted over a large monster standing upright and wearing a helmet (MA-XRF Cu map). The painterly quality of these changes here, and possibly also around the bridge, is relatively low, and the monsters of this stage appear less diabolical and refined. This impression is further enhanced by the many later reinforcements in red and green (see section 10.5).



Detail 162MCPVIS048



VIS and MA-XRF detail maps of mercury (Hg) and copper (Cu) (Images: AXES)

No traces have been found to confirm the small female figure at the lower left edge in Cranach's copy was also once part of the Vienna triptych. The same applies to the double-stepped roof in the centre left of the Cranach copy, and the figure hanging from the rock to the upper left of the spiked red slab. Cranach also changed

the appearance of the man at the lower right edge behind the man pierced by an arrow.³³

163 A large reptile or amphibian containing copper pigments (MA-XRF Cu map) was painted to the right of the large spiked red sphere on the kneeling giant. Left of the sphere, the paint for the feature with straight edges contained vermillion (MA-XRF Hg map). This feature could be part of the landscape, as it appears to extend down to the man on the bird and towards the right. These elements were painted out. The large figure with the tall, tapered hat at centre right was not planned. Initially, a red sphere was painted just above the nose of the green figure. In the opening of the tent, it seems that a blue slab was initially painted, similar in shape to those at the bottom left and right. A standing human form was left in reserve from the blue. The human at the bottom right was not left in reserve from the slab, but the archer below it was. Numerous other small changes were also observed.

For the open triptych, the evidence is not always unequivocally clear on whether specific changes are very old, possibly added in the artist's studio, or a result of later, albeit early overpainting. Here, the Cranach copy helps to provide more clarity. For example, it appears that the blue-helmeted creature in the centre of the right wing was originally positioned on the side of a narrow boat. The creature's left arm initially extended below him, grasping the arrow. This was overpainted with the snake, which was also the subject of later reinforcements. The creature's right hand held a sword. This sword was painted out, but abrasion has made it visible again. The snake and painted-out sword thus predate the Cranach copy and are likely pentimenti. The shoulder and head of a man left of the snake monster are not visible in the Vienna painting.



VIS and MA-XRF detail maps of mercury (Hg) and copper (Cu) (Images: AXES)

7 Surface finish

7.1 Varnish

Multiple varnish layers are present, presumably of a natural resin. The varnish does not have the same appearance across the painted surfaces of the triptych (see section 11).

7.2 Application

The varnish was brushed onto the paint surface, generally thickly applied. It appears most even on the central panel, and most uneven on the opened and closed right wing. Varnish was not applied to the panel edges throughout. Locally, there are also thicker strokes of varnish.

8 Frame and framing

8.1 Frame

The three panels were originally set into engaged frames, now lost. The present, non-original frames are rebated. The frames of the wings, at the sides of the grisailles, have a rectangular decorative gilded strip to hold the panels in place and to suggest an engaged frame.

The frames of the open triptych are profiled and have gilded inner and outer edges and a dark painted surface in between. The frames of the closed triptych only have profiled and gilded inner and outer edges, with a flat section in between. The latter had a repeating motif carved into it, and this later overpainted black.

The ornamental design of the frame suggests it may have been produced in around 1810–30.³⁴ At that time, the frames were apparently gilded in their entirety. A hard clay was applied to improve the

adhesion of the gesso and prevent the coniferous wood structure from showing through after burnishing the gold leaf. The gilded inner sections were most likely painted black in the late nineteenth century; at a similar time, to make the frame appear older, the open side was distressed to expose stone clay locally. New gesso was locally applied and roughly gilded. The inner edge of the open triptych is silvered. These changes could relate to 1877, when the triptych appears to have been exhibited publicly for the first time.³⁵

Overall, the condition of the frames is fairly good. There are relatively limited recent losses, although minuscule losses are present on the narrow outer sides of the wings. In the open triptych, some of the corner joins are slightly open.

8.2 Framing and display

The panels are positioned in rebated frames: the left-wing panel on balsa, the central panel on a hardwood slat.³⁶ The central panel is framed with spring clips and foam has been placed around its perimeter. There is no felt in the central frame rebate, but those of the wings were lined with felt.

The painting is displayed on a pedestal, with the wings positioned at an angle. Four sturdy metal hinges allow the opening and closing of the wings. A metal framework supports the reverse of the central panel frame.

9 Condition of picture support

9.1 Altered dimensions

Seen from the open triptych, the left wing was cropped at the left (unto the barb), and at the top and bottom (including nearly the entire barb). The unpainted edge is largely preserved at the right.

The panel corner at top right is damaged. At the top edge, there are some nail holes in the end grain.

The central panel was cropped on all sides including the barbs, although a remnant remains at the bottom. The missing painted surface appears to be limited to c. 5-10 mm at the top, left, and right sides of the central panel.³⁷ The panel corner at top left is damaged and the corner at bottom right was replaced. The central panel reverse was thinned to about half its original thickness, as evidenced by the shape of the remaining dowel sections.

The right wing was cropped at the top and bottom (including the barb), and at the right (to the barb). The left unpainted edge is largely preserved.

9.2 Additions

On the top of the left wing, a nail protrudes from the end grain.

A cradle, from what appears to be flexible and soft spruce, has been attached to the thinned reverse of the central panel. The top and bottom runners have a considerable chamfer and there are corresponding slots in the fixed vertical cradle members, implying that the cradle was only applied after the edges of the panel there were already cropped.³⁸ On the leftmost join (seen from the reverse), the fixed third cradle member was replaced by a much broader one, presumably after repairs were made to the damaged join. This has since remained stable. A repair is also visible at the top left, extending partly below the replaced cradle member. Cracks were observed in the second runner from the top at left and right, and in the seventh and ninth runner from the bottom at right. Eight runners can move, fourteen are blocked (the panel is quite flat, suggesting other causes – see sections 9.4 and 9.6).³⁹ The fixed cradle members are marked with many nail holes, concentrated at the top edge, the centre, and



Detail of a non-original dowel (Image: Gemäldegalerie der Akademie der bildenden Künste Wien)

the bottom edge. At each join on the top and bottom of the central panel, small holes were drilled in the end grain, dowels were inserted and glued. The glue continues onto the cradle, indicating that the repairs – probably attempting to close or reinforce the join – are from a later date than the cradle itself.

9.3 Cracks

The overall stability of the panels is good.⁴⁰

159 In the lower left, an old and stable crack is slightly open and filled with varnish.⁴¹ It extends down at a slight diagonal through the saint's proper right foot. The length of the visible crack in the paint is about 43 centimetres; on the reverse, 161, this crack measures about 21 centimetres. An old, stable crack at the top left (visible from both sides) extends about four centimetres down from the edge. At the height of the tip of the staff of Saint James, a nail was once inserted in the thickness of the panel on the left edge. As a result, the wood was locally pushed apart, raising the ground and paint with it.

160 A few small and stable old cracks extend slightly from the top edge, the most noticeable crack is one-and-a-half centimetres long on the right side. These cracks are less visible on the reverse, 163. At the bottom left edge, a nail was once inserted in the thickness of the panel, damaging the wood and causing cracks and considerable loss of paint and ground. Similarly, at the lower right edge a nail also pushed the wood apart and slightly damaged the paint.

161 At the top towards the left an old crack extends about two centimetres down from the edge. In the tree foliage at upper centre, two closed cracks appear to be present on the join. At the bottom towards the right an old crack extends about one-and-a-half centimetres up from the edge. Just to the right here, there is a slightly more recent and smaller crack. The five cracks are not visible on the reverse, 159. A larger crack intersects the bottom right corner.

162 Some issues were noted along the joins of the central panel. XR revealed an old, repaired partial disjoin of the planks furthest to the right (viewed from the front). Two small, stable old cracks were observed in other areas: extending from the top edge just to the right of Christ, and below the figures impaled on a tree. These cracks predate the addition of the cradle. On the reverse, two microcracks were detected along minute sections of the vertical cradle members (possibly caused by the water-based animal glue to attach the cradle).

163 The top edge of the open right wing shows minor damage. A narrow section of wood, ground and paint is missing at the bottom left.

9.4 Deformations

The left plank of the closed left wing is concave. The right plank is somewhat concave, but slightly convex in its centre.⁴²

The closed right wing has a slightly concave left plank, the central plank is relatively flat, and the right plank is convex at the top and minimally concave at bottom.⁴³

Individual planks of the central panel are marginally convex or flat, and the overall panel is very slightly convex and undulates to a very slight extent.⁴⁴

9.5 Joins

As the continuation of the paint film over the joins shows, the planks of the wings have never been separated. The joins have become more visible locally due to slight out-of-step alignment and fracturing of the paint layer as well as joins opening at places. This is mostly found in the right wing, for example at the red tent, the boat in the upper background, or in the grisaille on the exterior of the triptych. In the past, the openings and fractures were partly filled and retouched, and varnish has run into them. No recent changes have been observed.

The right join of the central panel has become more visible locally due to slight out-of-step alignment and stability issues of fills and retouch material leading to small cracks and raised paint. Nevertheless, these appear consolidated and stable.

9.6 Coated reverse

The wings are painted on both sides.

A thin coating, presumably a mixture of wax and perhaps colophony or a resin, was applied to the reverse of the central panel, filling pores of the wood. As can be seen through the knotholes in

the runners, the liquid coating was applied by brush before the cradle's runners were inserted, reducing the friction of the sliding cradle members.⁴⁵ The coating also acts as a buffer. It somewhat evens out the differences in moisture absorption due to the uneven surface on the reverse (panel, horizontal runners, vertical cradle members).

9.7 Biological damage (woodworms, fungi)

No biological damage was observed.

10 Condition of ground and paint layers

10.1 Stability

In general, the adhesion of both paint and ground appears very good. Most craquelure has been caused by natural dimensional changes of the panels.

In the closed triptych, what appear to be youth cracks (drying cracks caused by medium-poor over medium-rich paint application) are observed in the narrow bands of lead white embellishing the flat surfaces of the architectural elements at the base of the panel. The cracks are more prominent in the right wing. In the left wing, minor drying cracks were observed in the pupil of the saint's left eye.

In the open wings, cracks of differing widths are often found in dark zones and areas containing blue paint. These cracks have also been identified in other areas, such as the right wing and the centre right edge of the left wing, where they do not seem to be delineated by the painted forms. In areas containing azurite, the coarseness of the pigment required more binding medium, often resulting in drying cracks. This may explain why the upper half of the left wing is more affected. Excessive binding medium could also account for cracks in other areas. For example, such cracks are found on brown

and flesh tones, as well as areas with lead white and red lake. Since there are hardly any paint losses, most of these issues appear to relate to technique rather than insufficient adhesion on an isolating or intermediate layer. Moreover, the bright green areas in particular do not show any obvious drying cracks. Some raised paint was observed in the left wing in the centre of the tree group at lower left.

The paint surface of 162 has relatively few signs of broader drying cracks, with the exception of some blue zones. Raised paint issues are mostly limited to the joins and generally appear to have been consolidated.

10.2 Losses

The painted surfaces are generally well preserved. In many places, the edges show damage from past cropping. This is especially evident at the end grains where losses include the wood of the support, as at the top right of the right-wing grisaille. Other losses can be observed at or near the corners, and there are nail holes along several edges. At the top centre of the closed right wing, some wood and paint protrude from the surface. Most paint losses are relatively small or minute, including several lacunae from paint sampling. Larger areas of paint loss are confined to green zones in 162 (see section 10.3). Unrestored lacunae are also present although these are mostly extremely small.

In many areas of 159–160, tiny paint losses occurred around cracks. Combined with the slight overall abrasion of these paint surfaces (see 10.3), this suggests the triptych was at some point subjected to a relatively harsh cleaning. Locally, the cleaning agent appears to have leached and, starting from the open cracks in the paint surface, caused progressively more damage to the original paint material. This is evident, for example, in the area between Saint James's

hands and at the top of the architectural elements along the base of both grisailles. In that location in 159, the small circular shapes might have been caused by bubbles or residues left on the surface after the removal of a harsh cleaning agent, possibly bleach.⁴⁶ These circular damages are also more concentrated, for example, in front of the proper left foot (IRR), and (albeit smaller) in the tree trunk at centre left. The possible loss of raised or tenting paint at these cracks may have also played a role.

The scratches in the paint are mostly minor, for example the old scratch in the spiked red slab at right in 162. Longer and deeper scratches damaging both paint and ground were observed in 159, in the bottom section of the landscape and in the escutcheon. There are more noticeable scratches at the bottom left of 160 and also in its escutcheon, where three letters (perhaps 'vwg') were scratched into the paint in the upper left corner.

Strikingly, there are multiple small dents in 159–160, often grouped together. In 159 there are dents in the top left (partially retouched), at the rocks below the hanged figure, at the same level near the right edge, at the saint's forehead and at his left knee cavity. In 160, dents are located primarily at the beginning of the arch at the upper left edge, and at the bottom left corner of the interior space. A larger dent is present in the undergarment of the child at lower right. There are only few dents in the open triptych. Small ones are present mostly in the lower centre of 161. In 163, a dent is observed in the bottom right and two deep dents are present near the hand of the large figure at centre right.

10.3 Abrasion

159–160 The grisaille panels show overall abrasion of the paint surface. The damage is especially evident in, for example, the bowl on the child's head in the right wing and other areas of higher positioned surface paints, mostly those covering other brush strokes. The paint has been damaged, most likely from past harsh cleaning.

159 An added inventory number at top right was largely removed, resulting in local abrasion of paint. It seems as if the artist intentionally created the large worm or small snake in the centre of the saint's feet in this form, although it is presently heavily abraded and retouched, making it difficult to read.

160 Removal of the inventory number in the top left abraded the paint and resulted in the loss of several small paint chips. In general, this panel is more abraded than the other grisaille, as is particularly evident in the saint's head. The dark-grey hood of the falcon now appears warmer in tone due to abrasion and brown retouches. The odd left contour of the child's head at centre right is a result of abrasion which removed grey paint from the impastoed off-white background. At the left, just above the beggar's bowl, abrasion has brought out a strange curl-shaped feature in the ground. This feature, partially incised and partially pushed up, was later covered with paint subsequently abraded, especially on the slightly raised areas.

161 The paint surface is abraded, especially where attempts were made to fully remove past overpaint. This led to poorer legibility and sometimes almost complete loss of elements, such as the creature extending below the grey cloud at the horizon to the left (see section 10.5). Other examples in the clouds are the group of figures in

Detail 162MCPVIS034



the lower left and the large dark demon near the lower right. These and other lost details are visible in the Cranach copy, including the small waterfall at centre right. The red lake paint of God's mantle on the foreground seems dabbed, but has actually been broken up as a result of harsh cleaning.

162 The central panel is mostly very well preserved, although abrasion is noticeable, for example, in the sky and in the figures impaled on the tree. The small flag painted towards centre right was painted out. Although not intended to be seen, it has become visible again due to abrasion. The tail of the snake-like creature bottom centre is almost completely abraded. Natural ageing led to the brownish discolouration of copper green glazes. These may have been mistaken for aged varnish, as past cleaning of these areas led to considerable damage to the green paint. This is evident in the lower left and lower right, as well as the centre of the panel where

large parts of the pitcher have been repaired. The edges of the ribbon of the monster seated on the woman in the foreground are brightly marked, though this was not intentional, but the result of abrasion of the discoloured green glaze (162MCPVIS034).

163 In the centre, abrasion has exposed the blue helmeted figure's sword, which had been painted out. The helmet originally had a brownish-red glaze that is now largely abraded, revealing the underlying blue. Abrasion has also resulted in loss of detail, for example in the red vase at bottom right, which is much better preserved in the Cranach copy.

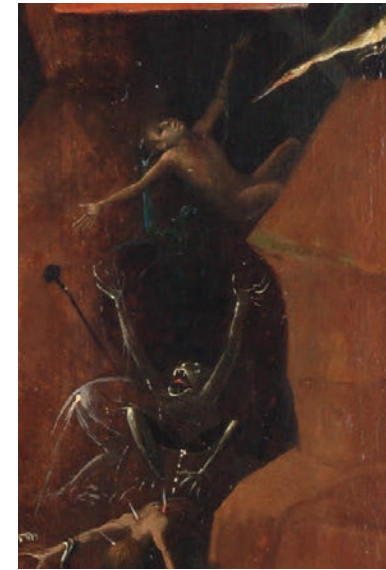
10.4 Discolouration and increased transparency

The present clarity in visible light (VIS) of the underdrawing in the central panel and the closed triptych is due to changes in the refractive index as the paint film has aged, resulting in increased transparency.

The small earthenware pot near the centre left edge of 162 was left in reserve considerably smaller. Increased transparency has made this evident and as a result the pot now appears to have an awkward colouring. This applies to many other elements as well that were left in reserve quite roughly.

The figures painted in the centre of 162, above the man leaning on the barrel, have become more poorly distinguishable because of the increased transparency of the flesh tone paint. The three monsters to the centre right, below the red slab, have also become more difficult to discern, although they seem to have been painted thinly as well (162MCPVIS079).

The touches of whitish material in the faces of figures in the procession at centre right and on the edge of the rock may be later



Detail 162MCPVIS079



Micrograph 162MICGBM007

reinforcements. They appear quite coarse and possibly degraded (perhaps the substrate of a lake paint – 162MICGBM007). The whitish veil on the water at centre right is also possibly a degraded paint. The shoulder cape of the horseman with the blue face in the lower centre was originally more purplish; the red lake on top of the blue paint has faded somewhat (and is also slightly abraded). This change is also visible in other areas, such as in the blue monster with the basket at bottom right, where the red lake appears to have been applied more subtly.

Copper green glazes used in the open triptych have discoloured to a brownish hue and are often damaged. The green legs of the colourful amphibian-like creature in the lower centre of 162 provides an example of an intact but discoloured glaze.

10.5 Filling, retouching, and overpainting

Non-original remnants of gilding can be observed in multiple areas along the edges of the panels, sometimes rather far inwards (e.g., to the right of the cave in the left-wing exterior).

159 Remnants of the inventory number '579' at top right are partly covered by retouches. In the bottom left corner, a number '267' was applied in black. In the bottom right corner there are remnants of a reddish inscription. Throughout, there are several relatively small fills and retouches, with slightly larger ones in the escutcheon covering the scratches, and in the sky, especially at the upper right. Several damages and losses in dents were also retouched. Many small and most of the tiny losses have not been retouched, nor have most abrasions been reconstructed. This is also the case for the right grisaille, where the texture of brush strokes of underlying layers has become more dominant than originally intended.

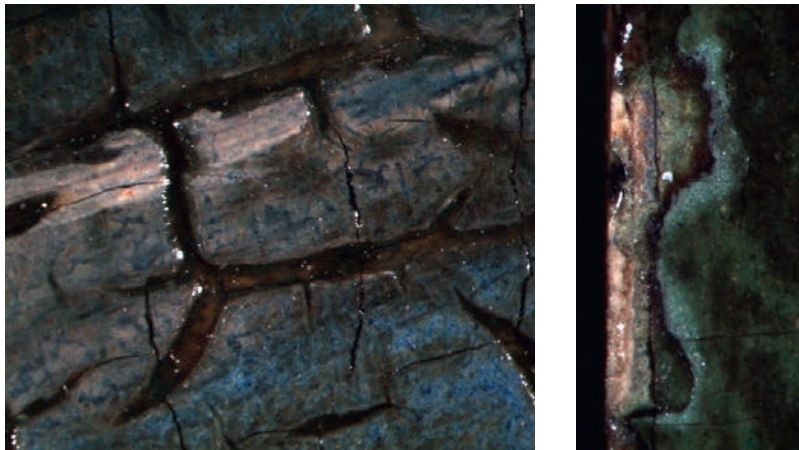
160 Remnants of the inventory number '581' at top left are only partly covered by retouches. At top centre reddish remnants of a large applied number '268' are visible. The same number was applied in black in the bottom left corner. In the bottom right corner there are remnants of a reddish inscription. As in the left wing, relatively small fills and retouches are present throughout, but there are also retouches from a more recent treatment. The latter are concentrated along much of the right join and in a few other areas (they appear darker in UV than other retouching). In UV two round spots to the lower left of the escutcheon also stand out. MA-XRF indicates that they contain iron, copper, and zinc (which fluoresces in UV), but given their very glossy appearance in VIS, a resinous compound is likely present as well.

161 Especially the open left wing is overpainted extensively, and many details have been reinforced. Individual elements in the green landscape, such as figures and some animals, were partly or fully left in reserve from the green overpainting of the field (161MICGBM008). According to Colagrande et al., these overpaints can be dated to the sixteenth century.⁴⁷ The dog at bottom left is an example of this, whereas the chickens were largely repainted on top of the green overpaint. The fowl below the owl is a non-original addition. Here, Cranach depicted three deer with a rabbit and groups of small birds close by. These, as well as additional animals, are not present in the Vienna panel. The elements left in reserve from the overpainting subsequently received thinner or partial overpaints and retouching as well as reinforcements of details, for example in facial features and highlights in hair or clothing. Many contours were reinforced, such as those of the Archangel, which were emphasised with black paint. The lion and the deer were largely repainted. Tree foliage and other areas were also overpainted, although not entirely. In some areas, such as the lower left of the tree in the central foreground, the original foliage is visible, more dotted and with discoloured green glazes. The reason for their overpainting may well have been the brown discolouration of the green glazes.

There appear to be multiple stages of overpainting. In the sky for example, after prominent drying cracks occurred in the original layer build-up, a sequence of interventions followed. A blue to greenish paint layer was applied followed by light paints and reinforcements of the angels now visible (161MICGBM002 and 004). Ageing cracks indicate that some time had passed before rough cleaning campaigns partially removed the blue/green paint. Overpaint was left behind in drying cracks, and as thin residues elsewhere. Further cleaning resulted in damage to the initial overpaint.



Micrograph 161MICGBM002



Micrographs 161MICGBM004 and 008

Later, more retouches and overpaints were applied. Ample residues of varnish and dirt presently further complicate any reading of these areas as, for example, with the creature once painted at the centre left of the horizon. Although the white headpiece is still visible, the creature can only be fully seen in the Cranach copy. Evidently, at some point this creature was painted out here. During later removal of the blue-green overpaint, the creature became largely abraded. The white headpiece alone was completed by retouching, but is still poorly visible due to various non-original residues. The body was not retouched. Cranach copied the Vienna triptych before the left wing was overpainted. The damage to the panel at the bottom right corner was filled and heavily retouched.

162 The central panel is relatively well preserved. Fills and retouches are mostly concentrated at joins and at losses in green paints. Minor retouching is present throughout. At the contour of the divine sphere, the retouching was applied in a thin wash. Similar thin overpaint is observed in the foreground landscape, for instance, to the right of the large knife and below the group carrying the knife. Extensive, old reinforcements and overpaints are present mostly in and around the water, at the bridge, and around the war machine. The reinforcements in green and vermillion red are most conspicuous. In the case of the war machine, the overpaints of the two monsters at the front are most striking, as well as the two monsters added at the upper right of the roof. None of these features are present in the Cranach copy.

163 The open right wing appears to have been selectively cleaned and subsequently retouched in the past. Many non-original reinforcements and overpaints can also be observed. Most of the visible

vermilion red paint is a later addition. This can be seen around the fires, where originally vermilion was used much more sparingly. Bright sections of fires and smoke have been reinforced with whitish paint that sometimes covers original details, such as one of the two sticks or spears in the upper left. White and red paints were also used to reinforce many other details, for example in the creatures. A thin veil of dark, carbon-containing paint was apparently applied to large parts of the upper background, most likely to cover the drying cracks. In areas, the deeper and darker original black can be seen. The Cranach copy also depicts figures and a large group with a flag in the upper left seemingly largely lost or overpainted in the Vienna triptych. The body of the large figure in the centre with the oversized blue helmet was initially a more intense blue, and the helmet more purplish, just as in the Cranach copy. To the centre left, above the man on the bird, the large kneeling figure's hand was overpainted and various details in this area were reinforced, as can be seen in comparison with the Cranach copy. Multiple figures were added in the central background of the group at the lower right. It appears that the animals in the hole in the central foreground are largely non-original. The two birds at left initially formed one creature ascending a ladder, again as in the copy in Berlin.

11 Condition of surface finish

11.1 Varnish

Overall, the varnish seems fairly even. Uneven gloss and local matte areas due to deteriorated varnish are visible on closer inspection. In particular, the varnish on the insides of the wings has a more irregular appearance (which may relate to the 1954 treatment). Several brighter red, white, and blue zones in the open right wing appear

to have been selectively cleaned in the past. The rest of the panel is more affected by the discoloured, yellowish varnish. This also applies to the rest of the triptych, with 162 seemingly being less affected. Here, the varnish is locally damaged and there are vertical scuff marks overall.

11.2 Surface dirt

There is only some surface dirt on the painting.

11.3 Visibility of the original surface

The paint film is reasonably well saturated in most places. Unsaturated areas in the central panel background result in a reduced depth and many subtle colours are not easily visible. Aged and scuffed varnish hinders visibility of, for example, the red glaze on the water (162MICGBM008). Glossy spots from retouching are visible in the central panel background, but also in other areas of the triptych. Accumulation of dirt and old varnish along the edges of the panels has resulted in considerably darker areas, especially apparent in the grisailles (160MICGBM002). In the closed right wing, for example, the brownish residue in the top left corner is quite prominent. The yellowed varnish and old residues have reduced the legibility of the painted surface. The aged varnish also lessens the strength of the contrasts since the dark paints appear lighter and less deep, and the light paints appear darker, and more yellowish.



Micrograph 162MICGBM008

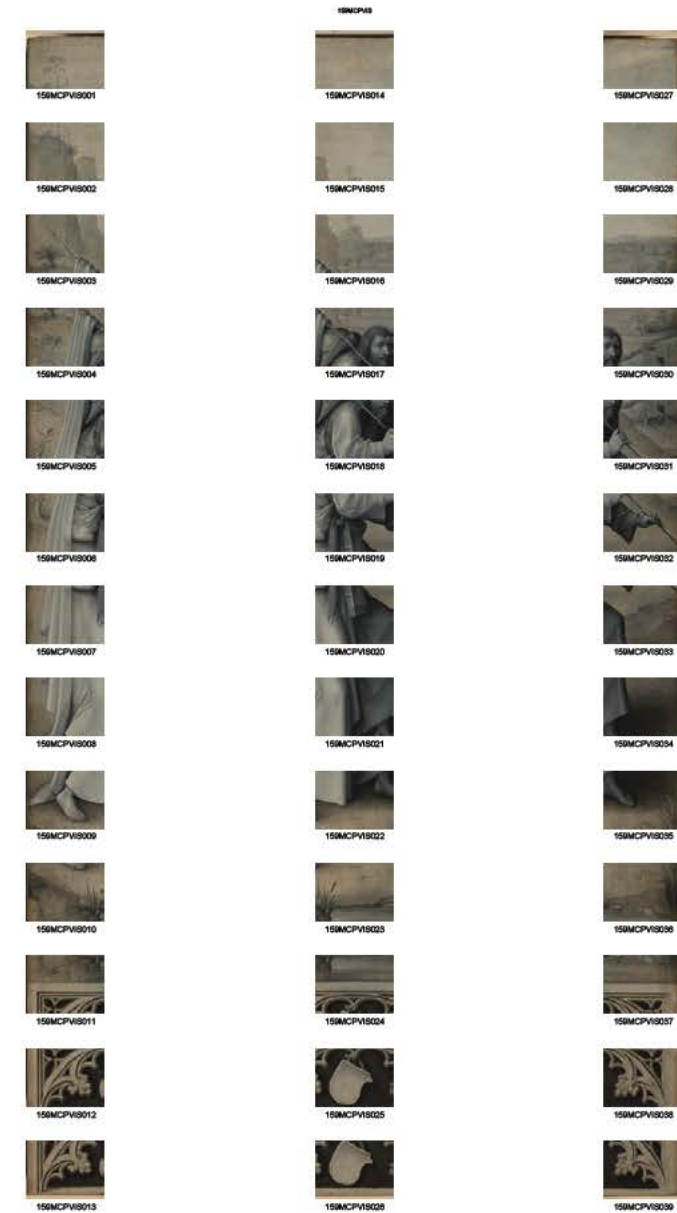


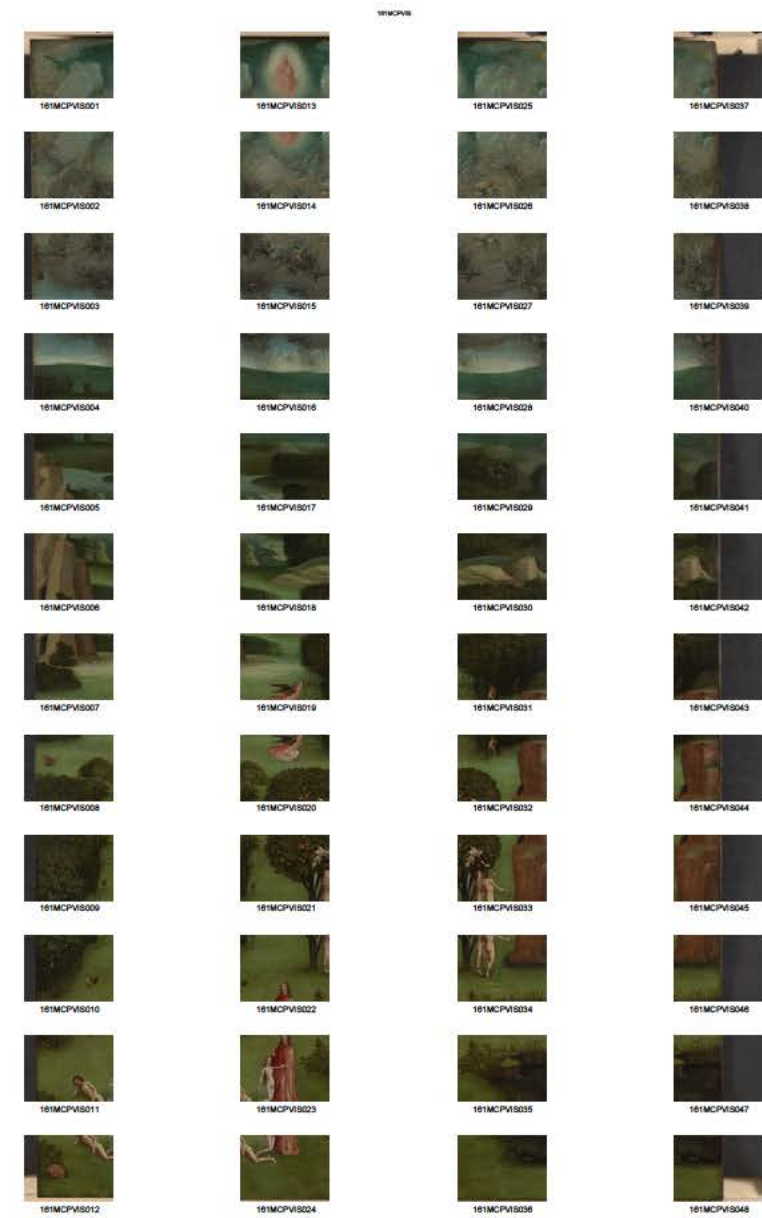
Micrograph 160MICGBM002

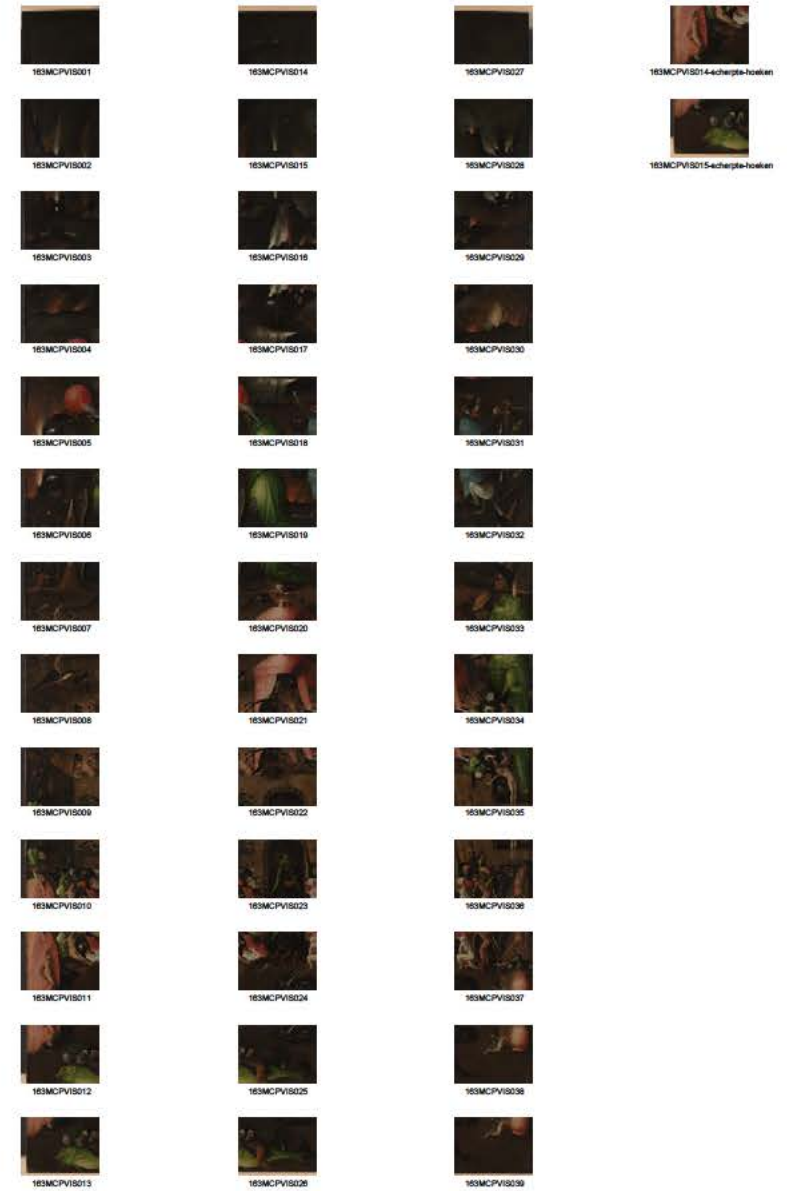
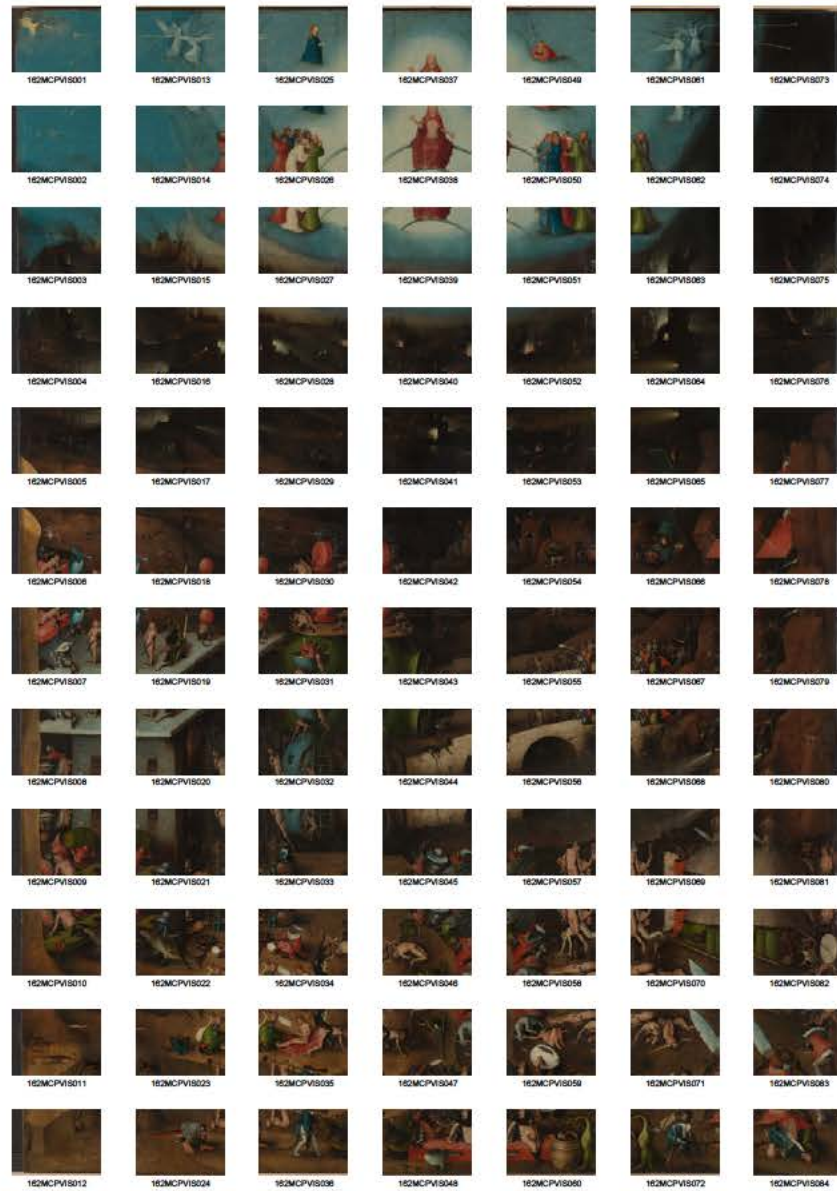
12 Visual documentation produced by BRCP

To document the entire triptych, the BRCP produced hundreds of macro photographs in visible light and infrared and dozens of infrared reflectograms. Furthermore, macro reflectograms were taken of some selected areas, as well as many micrographs and additional photographs.

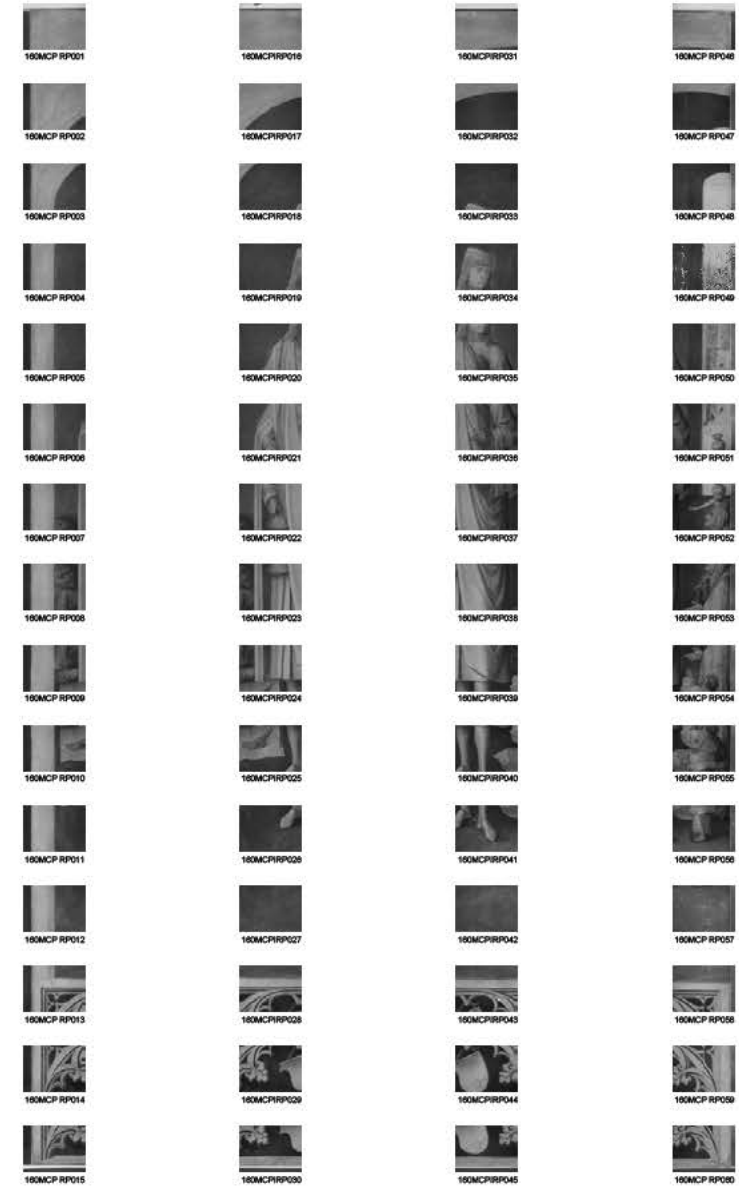
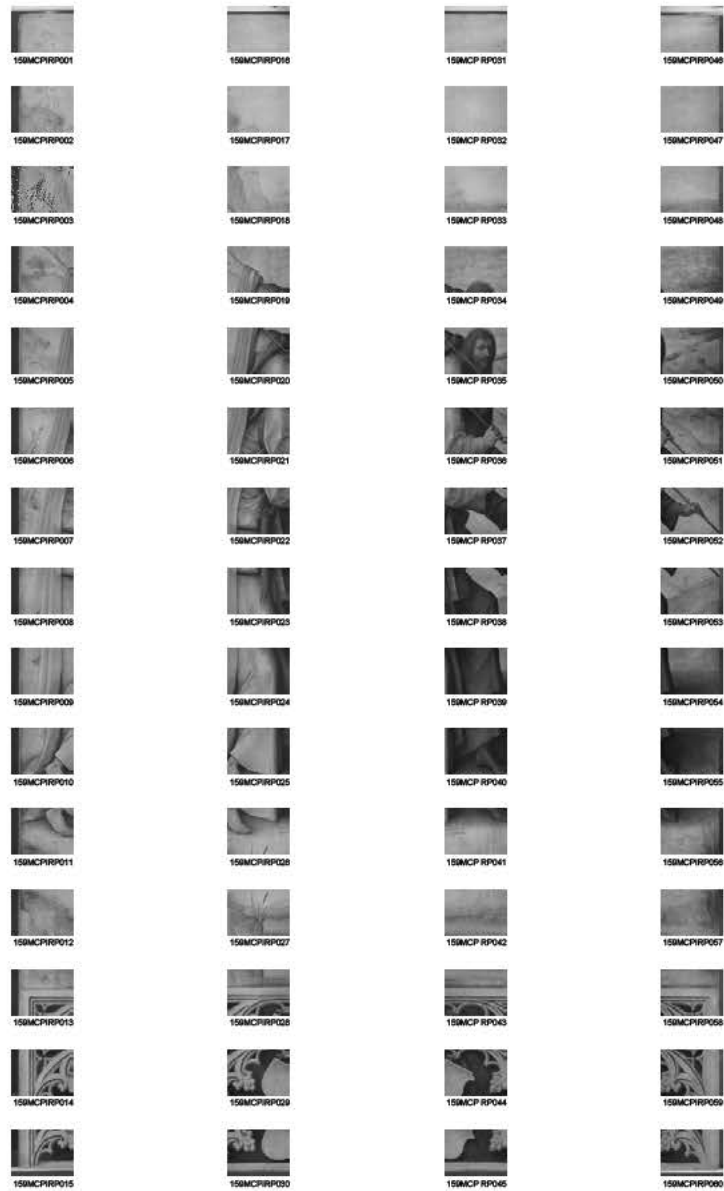
12.1 Visible light macro photographs

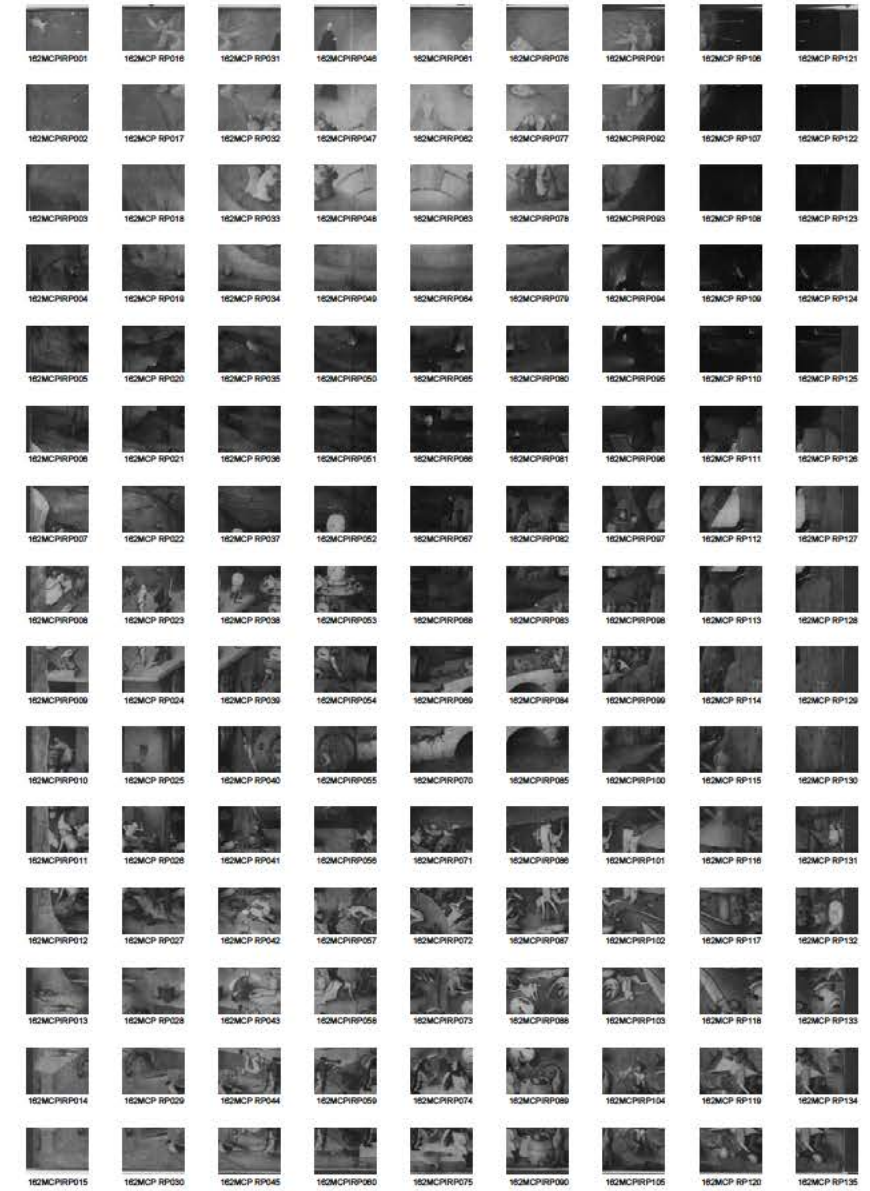






12.2 Infrared macro photographs







12.3 Infrared reflectograms





160IRREFL001



160IRREFL002



160IRREFL003



160IRREFL004



160IRREFL005



160IRREFL006



160IRREFL007



160IRREFL008



160IRREFL009



160IRREFL010



160IRREFL011



160IRREFL012



161IRREFL001



161IRREFL002



161IRREFL003



161IRREFL004



161IRREFL005



161IRREFL006



161IRREFL007



161IRREFL008



161IRREFL009



161IRREFL010



161IRREFL011



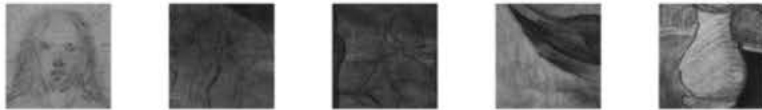
161IRREFL012



12.4 Infrared macro reflectograms



161IRREFX001.jpg 161IRREFX002.jpg 161IRREFX003.jpg 161IRREFX004.jpg 161IRREFX005.jpg

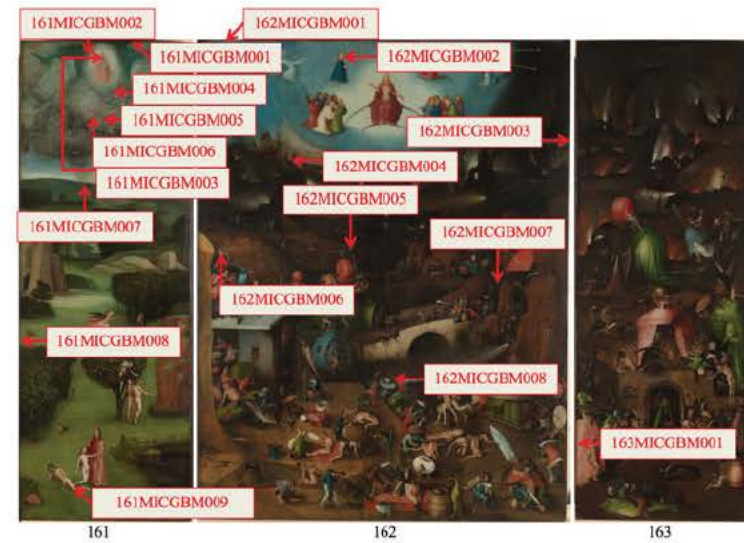
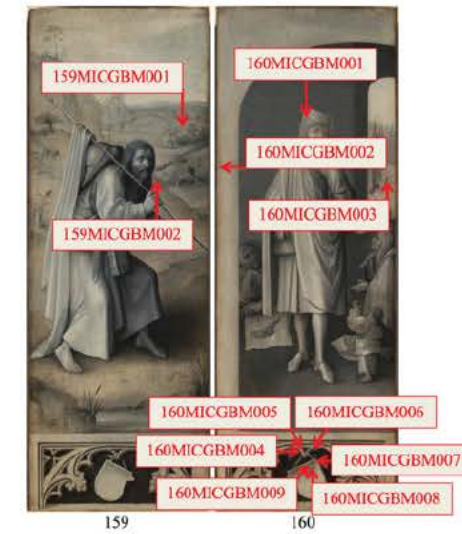


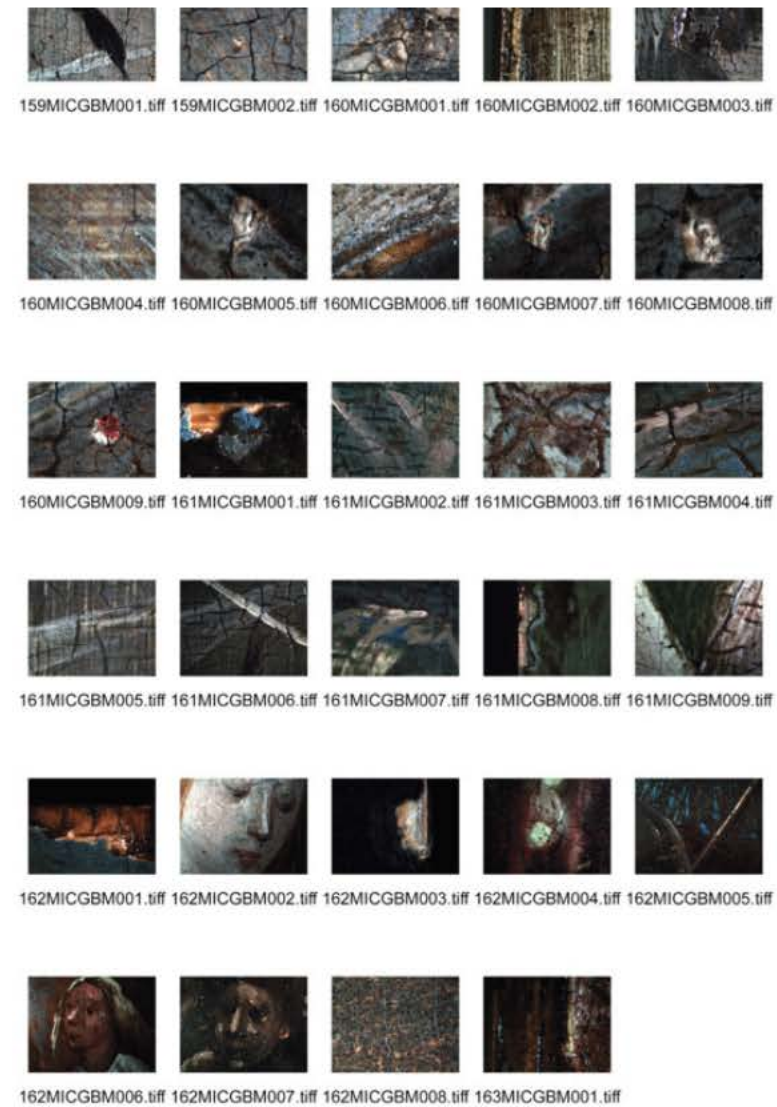
162IRREFX001.jpg 162IRREFX002.jpg 162IRREFX003.jpg 162IRREFX004.jpg 162IRREFX005.jpg



162IRREFX006.bmp 163IRREFX001.jpg 163IRREFX002.jpg

12.5 Micrographs

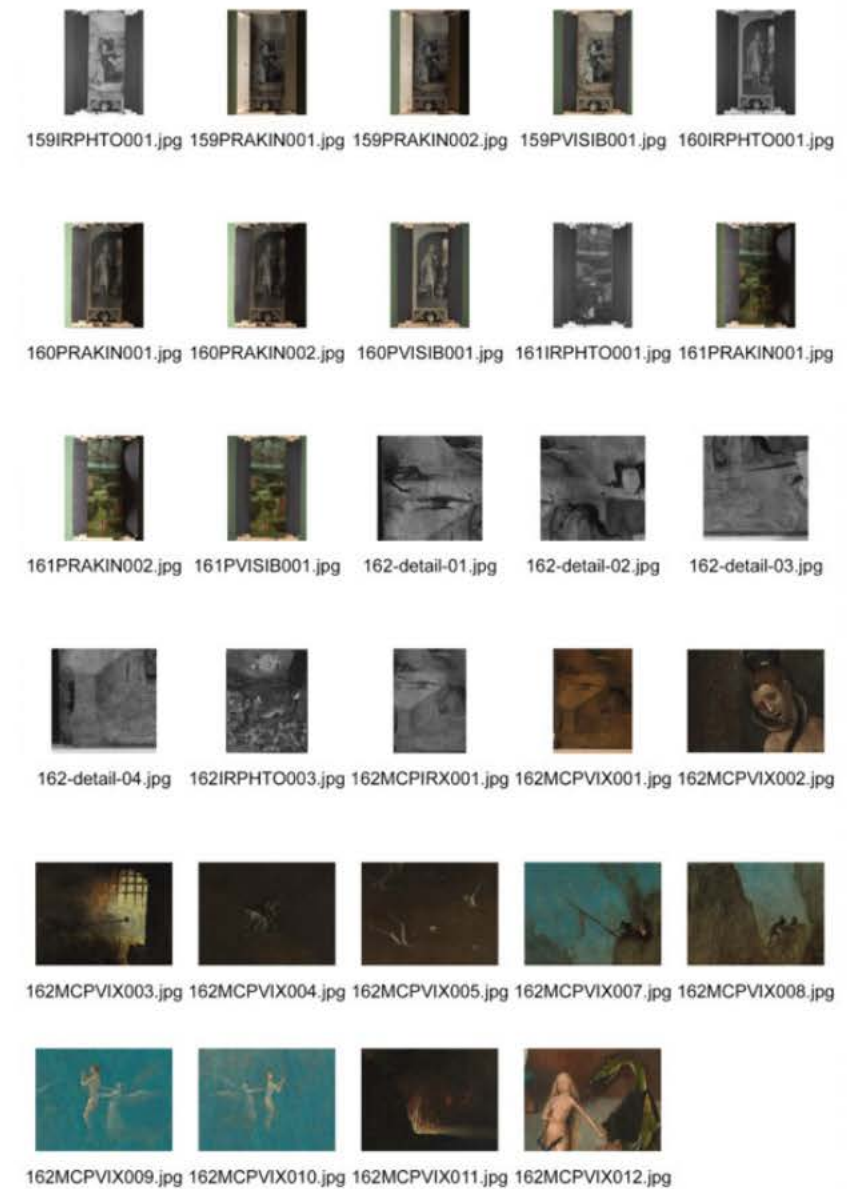




12.6 X-radiographs

n.a.

12.7 Additional photographs





162MCPVIX013.jpg 162PRAKIN001.jpg 162PRAKIN002.jpg 162PVISIB003.jpg 163IRPHOTO00



163PRAKIN001.jpg 163PRAKIN002.jpg 163PVISIB001.jpg Lijst-159_160.jpg Lijst-161.jpg



Lijst-162.jpg Lijst-163.jpg

13 Equipment used

13.1 IRR equipment used

Queen's University's Osiris infrared camera (Opus Instruments)
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 25% overlap: 30×30 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)

13.2 Photography equipment used

VIS macro camera set-up
Hasselblad H5D-100-IR, modified for IR, CMOS sensor:
 11600×8700 pixels

Lens: Hasselblad HC 4/120 II mm
 Filter: lighter version of BG-39 from Optic Makario GmbH⁴⁸
 Resolution: 1250 ppi
 Photographed area on object: height 8700 pixels @ 1250 ppi = 7.0 in. = 17.7 cm; width 11600 pixels @ 1250 ppi = 9.3 in. = 23.6 cm
 Net surface area per capture, with 25% overlap: 13 × 18 cm
 Working distance: 510 mm object to lens

IRP macro camera set-up

Same as VIS, but filter replaced with 830 IR filter

Camera movement/grip

Specially designed x-y-axis camera movement device, the Tiling Rig, set parallel to painting with laser measurement device

Lighting and exposure

2 Broncolor monobloc flash units, Minicom 160, 1200J with softboxes

With Hasselblad: flash used for both visible and IR, preferred aperture f/13

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 Hasselblad Phocus integrated calibration tool, on X-Rite ColorChecker® Digital SG

Output colour space: eci-RGBv2 16-bit, Hasselblad visible

Output colour space: Grey Gamma 2.2, 16-bit, Hasselblad IR

Output colour space: sRGB 8-bit bitmap, OSIRIS

Raw files processed in Phocus, raw data stored as well

TIFF 16 bits/channel

JPEG 8 bits/channel sRGB

13.3 Microscopy equipment used

Olympus stereo microscope SZ61TR/45: working distance 110 mm

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, 150W adjustable with a fibre-optic illumination system

Leica EC3 high-speed digital colour camera, TIFF 16 bits/channel, RGB

14 References

See the endnotes below.

Reference list

Cappa et al. 2015a

Federica Cappa, Valentina Pintus, Johannes Ofner, Manfred Schreiner and Bernhard Lendl: Raman imaging for cultural heritage investigations (Poster). In: ICAVS8 [8th International Conference on Advanced Vibrational Spectroscopy, Vienna, 12.–17.7.2015] Poster Abstracts. Vienna 2015, 246–247.

Cappa et al. 2015b

Federica Cappa, Manfred Schreiner, Johannes Ofner, Bernhard Lendl, Astrid Lehner and Renate Trnek: The green paints in the paradise wing of the triptych »The Last Judgement« by Hieronymus Bosch in the Paintings Gallery of the Academy of Fine

Arts Vienna (Presentation). In: RAA2015 [8th congress on Application of Raman Spectroscopy in Art and Archaeology, Wrocław 1.–5.9.2015] Book of Abstracts. Eds. von Monika Czarnecka and Barbara Łydzba-Kopczyńska. Wrocław 2015, 48–49.

Colagrande et al. 2014

Maria Daniela Colagrande, Federica Cappa, Astrid Lehner, Renate Trnek and Manfred Schreiner: Current research on Hieronymus Bosch's triptych »The Last Judgement« from the collection of the Gemäldegalerie der Akademie der bildenden Künste Wien (Poster). In: ChemCH2014 [3rd international congress on Chemistry for Cultural Heritage, Vienna, 1.–5.7.2014] Book of Abstracts. Eds. Rita Wiesinger and Manfred Schreiner. Vienna 2014, 193–195.

Colagrande and Schreiner 2014

Maria Daniela Colagrande and Manfred Schreiner: Report of the FWF-project P23848-G2, Institute of Science and Technology in Art, Academy of Fine Arts Vienna. Vienna 2014 (unpublished).

Eikema Hommes 2004

Margriet van Eikema Hommes: Changing pictures. Discoloration in 15th to 17th century oil paintings. London 2004, 51–89.

Genbrugge 2016

Aline Genbrugge: The conservation of Bosch's »Saint Jerome at Prayer«, from the Museum of Fine Arts, Ghent, at the Royal Institute for Cultural Heritage in Brussels. In: Jheronimus Bosch, His Life and His Work: 4th International Jheronimus Bosch Conference, April 14-16, 2016, Jheronimus Bosch Art Center, 's-Hertogenbosch, The Netherlands. Ed. Jo Timmermans. 's-Hertogenbosch 2016, 90–104.

Hoogstede et al. 2016

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

Ilsink et al. 2016

Matthijs Ilsink, Jos Koldeweij, Ron Spronk, Luuk Hoogstede, Robert G. Erdmann, Rik Klein Gotink, Hanneke Nap and Daan Veldhuizen: Hieronymus Bosch. Painter and Draughtsman. Catalogue Raisonné. Brussels; London and New Haven CT 2016.

Koldeweij 2014

Jos Koldeweij: St Bavo on the Vienna Last Judgement unmasked as St Hippolytus. In: Jheronimus Bosch, His Patrons and His Public: 3rd International Jheronimus Bosch Conference, September 16–18, 2012, Jheronimus Bosch Art Center, 's-Hertogenbosch, The Netherlands. Ed. Jo Timmermans. 's-Hertogenbosch 2014, 400–433.

Koldeweij et al. 2018

Jos Koldeweij, Luuk Hoogstede, Matthijs Ilsink, Koen Janssens, Nouchka de Keyser, Rik Klein Gotink, Stijn Legrand, Julia M. Nauhaus, Geert Van der Snickt and Ron Spronk: The patron of Hieronymus Bosch's »Last Judgement« triptych in Vienna. In: The Burlington Magazine. London 160 (2018), 106–111.

Poch-Kalous 1967

Margarethe Poch-Kalous: Hieronymus Bosch in der Gemäldegalerie der Akademie der bildenden Künste in Wien. Vienna 1967.

Trnek 2014

Renate Trnek: Patron lost. First insights into the underdrawings of the Last Judgement Triptych by Jheronimus Bosch in Vienna. In: Jheronimus Bosch, His Patrons and His Public: 3rd International Jheronimus Bosch Conference, September 16-18, 2012, Jheronimus Bosch Art Center, 's-Hertogenbosch, The Netherlands. Ed. Jo Timmermans. 's-Hertogenbosch 2014, 264–79.

15 Colophon

The Bosch Research and Conservation Project is an initiative of the Foundation Jheronimus Bosch 500; the Noordbrabants Museum, 's-Hertogenbosch; and Radboud University, Nijmegen; in collaboration with Queen's University, Kingston (Ontario); and Stichting Restauratie Atelier Limburg (SRAL), Maastricht.

The BRCP consists of an international network of participating museums, universities, and other research institutions. The aim of the BRCP is, by the collective endeavour of researchers, curators, and conservators, to gain a better understanding of Bosch's work as a whole and to help improve the state of preservation where necessary.

To achieve this, paintings and drawings are documented in extreme resolutions with macro photography in visible and infrared light, and with infrared reflectography, following standardised set up. X-radiographs, when available, are digitised. The individual macro photographs are stitched, registered, and made accessible online.

The first stage of this project (BRCP 1) ran from 2010–16, as part of the preparations for the groundbreaking retrospective exhibition of the works of Jheronimus Bosch in Het Noordbrabants Museum (*Jheronimus Bosch – Visions of Genius*: 13 February – 8 May 2016). The photographic documentation of BRCP 1 can be found on bosch-project.org.

The project's second stage (BRCP 2) started in 2017 and will run through 2023. The website jheronimusbosch.org offers the preliminary results of BRCP 2. As part of the second stage of the project a focus exhibition was organized by The Noordbrabants Museum (*From Bosch's Stable, Hieronymus Bosch and The Adoration of the Magi*: 1 December 2018 – 10 March 2019). Photographic documentation of the *Adoration of the Magi* paintings can be found on <http://jheronimusbosch.org/paintings-driekoningen/adoration-of-the-magi>. Photographic documentation of the Vienna *Last Judgement* and the copy attributed to Lucas Cranach the Elder can be found on <http://jheronimusbosch.org/paintings-driekoningen/the-last-judgement>.

15.1 Research team

Luuk Hoogstede – Panel paintings conservator, art historian.
Stichting Restauratie Atelier Limburg (SRAL), Maastricht⁴⁹

Matthijs Ilsink – Art historian. Formerly Radboud University, Nijmegen (Department of Art History)

Rik Klein Gotink – Photographer. Rik Klein Gotink Fotografie, Harderwijk

Jos Koldeweij – Art historian. Radboud University, Nijmegen (Department of Art History)

Ron Spronk – Technical art historian. Queen's University, Kingston, Ontario (Department of Art Conservation and Art History), and Radboud University, Nijmegen (Department of Art History)

- 1 For information on the project, see section 15. Luuk Hoogstede compiled this BRCP report in the context of his PhD project on the conservation of Bosch's paintings.
- 2 Ilsink et al. 2016, 290–307, cat. no. 17; Koldeweij et al. 2018.
- 3 Measurements of the painting were taken by the conservation team of the Belvedere Museum, Vienna, in July 2017. The slightly damaged outer corners have been squared using a try square and measurements were taken up to the try square instead of the physical panel edge.
- 4 Measurements of the frame were taken by Jos Koldeweij and Matthijs Ilsink of the BRCP-team.
- 5 See Ilsink et al. 2016, 35, 301–03.
- 6 Contrary to the wings, this panel could not be turned at the time. Ample data on the central panel reverse were however provided by the Academy and the reverse was partly accessible during a preliminary investigation by Luuk Hoogstede in December 2016.
- 7 The triptych and the central panel reverse were studied to better assess the painting's stability. On 9 April 2019, this assessment was conducted by Bernd Euler-Rolle, Luuk Hoogstede, Julia M. Nauhaus, Elke Oberthaler, Iris Schaefer and Michael Vigl. On 25 and 26 November 2019, Jean-Albert Glatigny and Luuk Hoogstede studied the painting, aided by Veronika Laurer, Julia M. Nauhaus and Georg Prast.
- 8 Poch-Kalous 1967, 17, 25.
- 9 The FWF project *Das Weltgerichtstriptychon von Hieronymus Bosch in der Gemäldegalerie der Akademie der bildenden Künste Wien* saw the collaboration of art historians, conservation scientists and conservators: Federica Cappa, Maria Daniela Colagrande, Astrid Lehner, Bernhard Lendl, Johannes Ofner, Manfred Schreiner, and Renate Trnek.
- 10 Trnek 2014.
- 11 Cappa et al. 2015a.
- 12 Cappa et al. 2015b.
- 13 Colagrande et al. 2014.
- 14 Colagrande and Schreiner 2014. This report was not made available to the BRCP. The current location of the 53 paint samples is unknown.
- 15 In a letter of 22 May 2017, Renate Trnek informed the Rector's Office of the Akademie der bildenden Künste that the FWF Research Project P23848-G21

concerning the Vienna *Last Judgement* had been terminated and no further scholarly output was to be expected from it.

- 16 The participating members of the AXES (X-ray Analysis, Electrochemistry and Speciation) team were Koen Janssens, Geert Van der Snickt, Nouchka de Keyser and Stijn Legrand.
- 17 Koldeweij et al. 2018.
- 18 Poch-Kalous 1967, 12.
- 19 Ibid., 13.
- 20 A note in the Paintings Gallery files states that in 1954: 'Die beiden Außenflügel des Altars – grissaille – gereinigt, teils mit Putzwasser und mit Messer. Den Sprung in der Tafel des hl. Bavo ausgekittet und retuschiert – ebenso die übrigen kleinen Fehlstellen. // Innenseite: Das Paradies / Firnis abgenommen, Übermalungen an der Gestalt der Eva und des Adams vorsichtig entfernt, retuschiert // Innenseite: Die Hölle / Firnis abgenommen, alte störende Retuschen im unteren Teil entfernt und wieder ausretuschiert.'
- 21 As note 3.
- 22 The left plank of the exterior left wing appears not to have been perfectly cut radially.
- 23 There are also many non-original holes of different shape and size in the c. 8 mm thick top and bottom edges of the central panel.
- 24 The youngest or last-preserved ring on each of the six planks of the central panel dates from 1448 (I), 1455 (II), 1458 (III), 1465 (IV), 1453 (V), and 1304 (VI), respectively. On the left wing they date from 1449 (I), and 1456 (II), and on the right wing they date from 1458 (I), 1416 (II), and 1436 (III). Planks I and VI of the central panel come from the same tree. Central panel planks II, II, and IV come from the same tree. Plank I and II of the left wing and plank III of the right wing come from the same tree. Report by Peter Klein, 13 February 2001, archives of the Paintings Gallery of the Academy of Fine Arts Vienna.
- 25 Colagrande et al. 2014, 193. Chalk was also identified via recent MA-XRF.
- 26 The many reinforcements and overpaints in the open triptych limit the visibility of the original paint, particularly in the left wing, but also in the right wing, and to a lesser degree in the central panel (see section 10.5).

- 27 See, for example, the figure group to the left of the tent, and two monsters directly below: one sitting cross-legged in an opening in the wall with a harp, and the one below him playing a wind instrument attached to his body.
- 28 Colagrande et al. 2014, 193–94.
- 29 Eikema Hommes 2004, 51–89. Eikema Hommes has shown that purposely made copper resinate (verdigris dissolved in hot varnish) was most likely not used for paintings on panel or canvas.
- 30 Cappa et al. 2015a, 49.
- 31 The arms carried by Hippolyte de Berthoz are well known from the escutcheon below Saint Hippolytus in the Bouts/Van der Goes/Van den Bossche triptych in Bruges, and the one on the left exterior wing of the Hippolyte Triptych in Boston. See Koldeweij et al. 2018; Ilsink et al. 2016, 297–302; Koldeweij 2014.
- 32 The copy by Lucas Cranach only shows blue sky and angels lifting figures upwards.
- 33 Cranach not only depicted the man with a long grey beard and hair, but also set him looking at the viewer instead of the depicted scene.
- 34 Veronika Laurer, personal communication, December 2016 (Vienna).
- 35 Between 1822 and 1877 the painting was in the Saint Anne Convent, where the triptych may not have been displayed entirely or with frames. Veronika Laurer, personal communication, December 2016 (Vienna), Julia M. Nauhaus, e-mail communication, April 2019.
- 36 In 2017, the panel was positioned on cork strips, limiting the natural dimensional changes of the heavy panel.
- 37 The extent of cropping is based on what appears to be missing from compositional elements, such as the whip of the monster in the bottom left, and XR, VIS, and IRR comparison.
- 38 The cradle design is from Prague (comparable examples are found in the collection of the Kunsthistorisches Museum Vienna), but the hand-made cradle could well have been executed in Vienna. Georg Prast, personal communication, 25 November 2019, Vienna.
- 39 In November 2019, Jean-Albert Glatigny applied manual force to test the mobility of the cradle. The eight sliding runners are spread along the height of the panel. Several runners could well be blocked as a result of the

multiple knots and a few cases of wood locally planed against the grain in the flexible runners.

- 40 As confirmed by the conservators who unframed and moved the panels prior to the BRCP examinations, and the visually unchanged condition after transport of the triptych to the Theatrummuseum in Vienna (condition assessments by Flaminia Rukavina).
- 41 Considering the warp of the plank here, a slightly wider crack on the interior side would be expected. The absence of the corresponding crack suggests it was glued (?), filled and overpainted a very long time ago. Jean-Albert Glatigny, personal communication, 25 November 2019, Vienna.
- 42 In November 2019, the maximum deflection across the panel grain was measured at c. 1.2 cm, and along the grain at c. 1.3 cm.
- 43 In November 2019, the maximum deflection across the panel grain was measured at c. 0.5 cm, and along the grain at c. 0.4 cm.
- 44 In November 2019, the maximum deflection across the panel grain was measured at c. 0.5 cm, and along the grain at c. 1.2 cm. In April 2019, on the central panel reverse, the maximum deflection across the grain was measured at c. 0.3 cm in the left and right centre.
- 45 The coating also penetrated into the spaces intended to allow the runners to slide, and may hinder that movement.
- 46 Genbrugge 2016, 94–97.
- 47 ‘The identification of copper resinate green also in the overpaint suggests that the overpainting was executed within the 16th century.’ Colagrande et al. 2014, 194. On the use of copper resinate green as a pigment, see 6.5 above.
- 48 Hoogstede et al. 2016, 15, 28.
- 49 Please address correspondence regarding this research report to Luuk Hoogstede: l.hoogstede@sral.nl.