'Spot the Difference'
Technical Research into Two Versions
of *The Lamentation of Christ*,
attributed to Colijn de Coter

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I n 1875 the Nederlandsch Museum voor Geschiedenis en Kunst in The Hague bought a small painting of *The Lamentation of Christ* from the art dealer E.L. van Gelder (fig. 1).[1] That same year it was transferred to the Rijksmuseum in Amsterdam. The unsigned panel is attributed to the Southern Netherlandish artist Colijn de Coter (c. 1455-1538/39?). As part of the preparations for the reopening of the Rijksmuseum in 2013, *The Lamentation* was investigated in depth and restored, then given a permanent place in the display of fifteenth- and sixteenth-century art in the museum. During this research, photographs of another, virtually identical version held by a private collector were found in the archives of the Rijksmuseum and the Netherlands Institute for Art History (RKD) (fig. 2).[2] This article explores the relationship between these two paintings on the basis of technical research. Were they made in the same period and possibly in the same workshop, or even both by De Coter? Or is one a later copy of the other?

Art-Historical Background
Little is known about Colijn de Coter. The earliest trace of him that has been found dates from 1479. In that year he joined the brotherhood of St Eligius in Brussels and moved into a house there with his wife. It is usually inferred from this that he must have been born around 1455. We do not know when he began to paint or who trained him. He was certainly active as an artist from 1493 onwards, as the register of the Guild of St Luke in Antwerp lists 'Colyn de Brusele' as a master that year. The latest document in which De Coter is mentioned dates from 1511, but it is assumed, in the light of surviving works of art in his style, that he was active until at least 1525. The date of his death is unknown.[3] It is likely that he headed a workshop, standard practice for a sixteenth-century artist, although no hard evidence for this has been found.[4]

There are three surviving signed works by the artist – all altarpieces that he was commissioned to paint: *St Luke Painting the Virgin* (1493, parish church in Vieure), *The Holy Trinity* (c. 1510, Louvre-Lens) and *The Virgin Crowned by Angels* (c. 1490, private collection Düsseldorf). We know in any event that De Coter made two other works of art. He appears in the register of the Guild of St Luke in Antwerp in 1493 as the painter of a ceiling vault in the Church of Our Lady, which he decorated for the same brotherhood. An entry in the records of the Brotherhood of St Eligius states that De Coter decorated the doors of a tabernacle between 1509 and 1511. Neither of these works has ever been found.[5]

Fig. 1
COLIJN DE COTER,
*The Lamentation of
Christ,* c. 1510-15.
Oil on panel,
35.4 x 43.1 cm.
Amsterdam,
Rijksmuseum,
inv. no. SK-A-856;
after restoration.

Fig. 2
COLIJN DE COTER (?),
*The Lamentation of
Christ*, date unknown.
Oil on panel,
35.8 x 42.7 cm.
Private collection.

Over the past century several art historians have tried to establish De Coter's oeuvre around the signed paintings, and attributed another twenty to him.[6] When *The Lamentation* was purchased in 1874, it was credited to an anonymous artist. In the 1889 museum catalogue it is listed as a work by the 'school of Rogier van der Weyden'.[7] The panel was attributed to De Coter for the first time in 1934.[8] Although not everyone has necessarily been in agreement, this attribution, based primarily on stylistic characteristics, is now generally accepted. The painting is usually dated between 1505 and 1515.[9]

This painting is of five half-length figures. Four of them stand behind Christ's body, which lies parallel to the bottom edge of the panel. Mary Magdalene appears upper left. The Virgin stands in the centre and supports Christ's head. To her right is St John the Evangelist and beside him Nicodemus, identified by the nails from the Cross

in his hand. His strikingly individual features suggest that this is a donor portrait. Given the small size, the intimacy of the scene and the inclusion of a praying donor, the panel was probably used as a devotional object, a popular category on the sixteenth-century Netherlandish art market.[10] De Coter may have taken his inspir-ation from paintings of similar subjects by Hugo van der Goes, Hans Memling and Rogier van der Weyden.[11] There are two paintings that resemble *The Lamentation* in style, subject and composition, which are also attributed to De Coter – *The Entombment* in the Bonnefantenmuseum in Maastricht (fig. 3) and the *Bernatsky Triptych* in Madison, Wisconsin. All three focus on the profound grief of the bystanders and the suffering of Christ. And in each one, the figures are packed together into a tight space filling the whole picture, reflecting the late medieval *horror vacui* tradition.[12]

Technical Research

Catheline Périer-D'Ieteren's 1985 monograph included the only extensive published technical research into paintings by De Coter.[13] On the basis of stylistic examination, supported by the comparison of some under-drawings and x-radiographs, she divides his oeuvre into different groups. According to the art historian, similar-ities in composition and style put *The Lamentation* and *The Entombment* into a separate category within his oeuvre, which she describes as 'neo-rogeresque', in other words deriving from Rogier van der Weyden's manner. The distinguishing features of this group, she argues, are the sharply modelled outlines and the emphasis on the plasticity of forms. She also sees similarities between the under-drawings in these two paintings and in the three signed altarpieces referred to above. Périer-D'Ieteren also describes the private version of *The Lamentation* and wonders whether it is a later (work-

shop) copy of the Rijksmuseum paint-ing. She was unable to trace the owner at that time, commenting that compara-tive examination of the underdrawings would be the only way to detect whether they were by De Coter or a pupil.[14]

For the current investigation, contact was made through the RKD with the owner, who then brought his version to the Rijksmuseum's paintings conservation studio.[15] The chance to study two almost identical paintings side by side presented an ideal oppor-tunity to undertake in-depth compara-tive technical research into the way that they were made. Using visual analysis and analytical research techniques including UV fluorescence, infrared reflectography, x-ray fluorescence (XRF), x-radiography, dendrochronology and

paint sample analysis, the materials and techniques in both versions were examined and compared.[16] Since only a small oeuvre is attributed to De Coter and there has been little technical research into the materials and techni-ques used in his paintings, this com-parative study can shed more light on the artist's workshop practices.

It is important to note that the condition of both paintings somewhat hinders a comparative investigation. The private version, for instance, is covered with various yellowed varnish layers, fillings and overpainting (fig. 4), and as a result the original paint layers, particularly the colour nuances and details, are less visible. The Rijks-museum's version has been subjected to heavy-handed cleaning in the past

Fig. 4
UV photograph of the private version (fig. 2): later overpaint appears as dark areas.

that caused damage to some details, such as highlights, tears and drops of blood. Nevertheless, conclusions can be drawn from a comparison of the paintings.

Composition

The compositions of the two paintings largely coincide, even down to the details, most of which, such as eye-lashes and tears, are identical in shape and placement. There is, though, one striking difference – the figure of Mary Magdalene. The position of her head and hands, her robe, her expression and her headdress differ in both versions. The Magdalene's garments in the private painting led Périer-D'Ieteren to suspect that she could be a nineteenth-century add-ition.[17] This is an interesting obser-vation because, as we shall see later, there is indeed something going on with this Magdalene.

Aside from the Magdalene, there are only a few visible differences between the two paintings.[18] In the Rijks-

museum's version, for example, the bottom edge of the Virgin's veil is slightly rounder (figs. 16, 17), her index finger is longer, Christ's right nipple is lower and John's left thumb is slightly rounder than in the private version (figs. 18, 19). The position of the middle nail in Nicodemus's hand, the shape of the head of the nail on the right, the finish of his fur collar and the position of the thorn at the back of Christ's head also differ slightly in the two paintings (figs. 20, 21).

In other words, save for the figure of the Magdalene, the compositions differ from one another hardly at all. So how can the difference between the two Magdalenes be explained? The materials and painting techniques used in both versions were subjected to a very close comparison in a search for clues.

Support and Ground

The two panels are nearly the same size and by far the smallest in De Coter's oeuvre.[19] The grain of the wood runs

Fig. 5
Reverse of the Rijksmuseum's version (fig. 1).

vertically in both of them. This is striking, because the grain usually runs horizontally in landscape formats like these.[20] The Rijksmuseum's panel is made of two planks connected by a glued butt-joint (fig. 5). Dendrochronology reveals that they came from the same tree with its origins in the Baltics or Poland, usual for sixteenth-century panels in the Low Countries, and could have been used as a support from 1432 onwards.[21] The private version, however, is made from three planks.[22] The original panel was thinned during an earlier restoration and is now only a few millimetres thick (fig. 6). A plywood sheet with oak veneer was attached to the back, and on top of that there is a cradle (fig. 7). Finally, wooden battens were nailed to the edges. Unfortunately, too few growth rings of the original panel can still be seen for dendrochronology to enable a comparison with the existing chronologies.[23] This means that no *terminus post quem* can be given for the panel. The edges of the
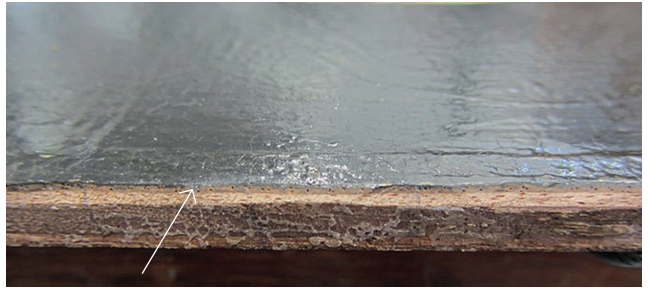

one in the Rijksmuseum were thinned down on the reverse to fit in the groove of the frame, a standard method of securing paintings in their original frames in the sixteenth century.[24] A similar lip was also found in the altarpiece *Donors with St John the Baptist and St Barbara*, which is attributed to De Coter's workshop.[25] If there originally was a lip in the panel of the private version too, it was removed during the earlier restoration referred to above.

Both the structure and the components of the grounds of the two paint-

Fig. 6
Top edge of the private version (fig. 2), detail: the original panel is only 1-2 mm thick.

Fig. 7
Reverse of the private version (fig. 2).

ings accord with sixteenth-century practice. There is a layer of chalk and glue, covered by a thin isolation layer containing oil to make the ground less absorbent to the subsequent paint layers, and to fix an underdrawing if there was one.[26] Comparing the isolation layers on both paintings is somewhat problematic, because they are not equally visible in all the paint cross-sections. The one in the Rijksmuseum's version is cream coloured and consists primarily of white pigment with some black and ochre-coloured particles (figs. 8a, b).[27] The equivalent layer on the private version seems to be a lighter colour and contains virtually no coloured pigment particles (figs. 14a, b). It can also be seen in the paint cross-section from the Rijksmuseum's version that the isolation layer was applied over the particles of black pigment of

the underdrawing, standard practice in early Netherlandish painting.[28]

The edges of both panels originally had no ground and were unpainted. Furthermore, the layers of ground and paint form a barbe – a small upstanding ridge – on all sides. This indicates that the panels were given their ground and painted in at the same time as their original frames, in the tradition of fifteenth- and sixteenth-century Netherlandish painting.[29] It also suggests that both are still the original size.

Underdrawing
Infrared reflectography revealed underdrawings in both versions, a standard element of the sixteenth-century painting process. The fact that the underdrawings show up with this technique points to the use of a material containing carbon, possibly

Figs. 8a, b
Paint cross-section SK-A-856-05 taken from St John's green robe (fig. 1).
a Daylight, bright field, magnification 200 times.
b UV light, magnification 200 times: the individual layers are clearly visible.

50 μm
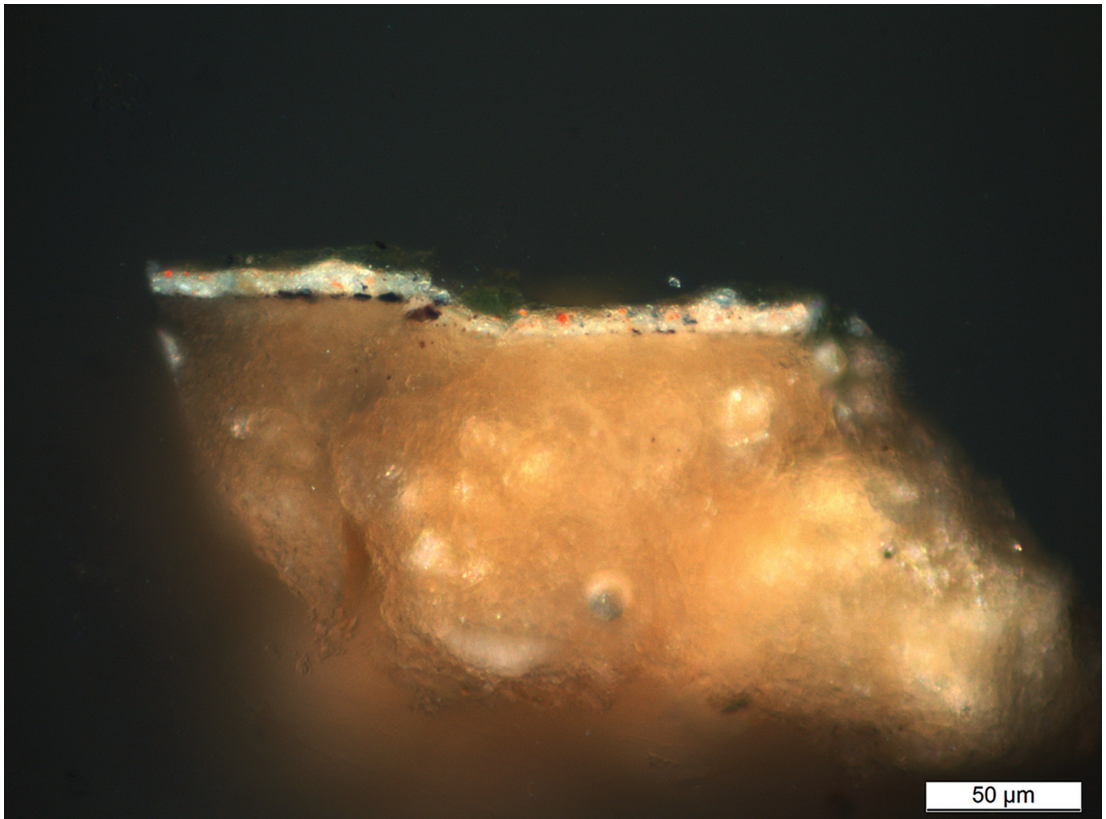
charcoal black. In both cases they were created with flowing lines with tapering ends, from which it can be inferred that they were done with a brush in a wet medium.[30]

The underdrawing in the Rijksmuseum's version seems to have been built up in different phases, a tried and trusted method also used by others in this period.[31] The artist began by indicating a few outlines with fine straight lines, as around the heads of Nicodemus and St John, in Christ's face and body and in the Virgin's white wimple. In a second phase he put in areas of shadow with thicker, short parallel hatching lines and sometimes cross-hatching, visible in the faces of the figures, Christ's body, the Virgin's wimple and robe and Nicodemus's hands (figs. 9, 10). The eyebrows, except Mary Magdalene's, were also

drawn in this second phase with a flowing horizontal line and short vertical lines at right angles to it. The underdrawing in the Magdalene's braid is strikingly different. Here the lines are thick, granular and sketchy, which suggests the use of a dry medium such as charcoal. They were not found anywhere else in the underdrawing.

Although significantly less underdrawing is visible in the reflectogram of the private version, this also appears to have been made in different phases (fig. 11). Outlines, slightly thicker than those in the first phase of the Rijksmuseum's painting, can be seen around Nicodemus's face and head, Christ's body, in the Virgin's face and her blue robe and St John's hands. There are some parallel hatching lines to create shadow in Nicodemus's head and hands, Christ's neck and the Virgin's

1 Chalk and glue ground
2 Black pigment particles used for the underdrawing
3 Isolation layer
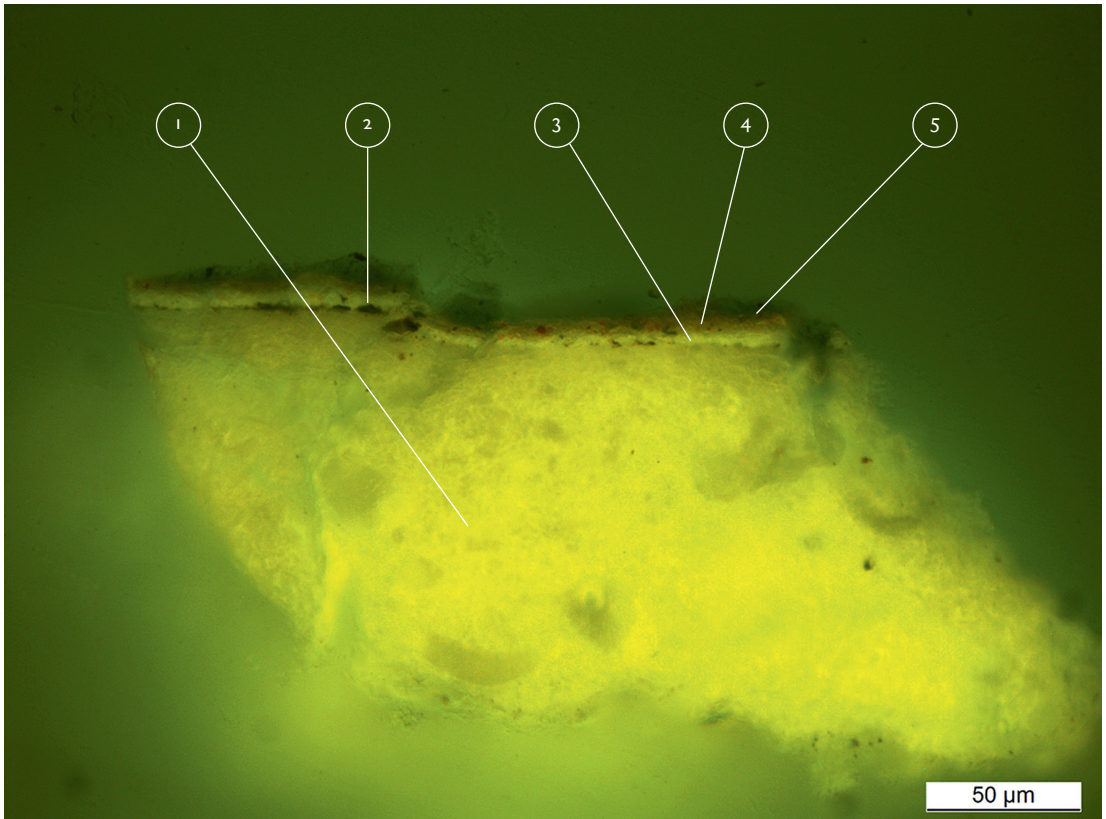4 Beige underpainting
5 Green paint layer

50 μm

Fig. 9
Digital infrared
reflectogram of
the Rijksmuseum's
version (fig. 1).
After removal of
non-original varnish
and overpaints,
before retouches.

Fig. 10
The Virgin's face and
wimple, detail (fig. 9).

Fig. 11
Digital infrared reflectogram of the private version (fig. 2).

white wimple and blue robe. The handling of the line and hatching manner, such as the length and thickness, the shape and the distance between individual lines, correspond with those found in the Rijksmuseum's version.

Another striking similarity between the infrared reflectograms of the two paintings is the locally thicker outlines that can be seen around the Virgin's white wimple and hand, and around Christ's body and head. Similar thick lines in other infrared images of sixteenth-century paintings have sometimes been associated with a tracing method. In a final phase, the artist would outline a composition copied from an existing workshop example (or part of it) more boldly to establish the placement of the elements as definitively as possible. Reusable

patterns and drawings were routinely employed in sixteenth-century artists' workshops so as to be able to produce faster for a growing art market. Compositions could be transferred to panels with the aid of pouncing cartoons or grid lines, or by tracing a drawing after coating the back with pigment.[32] No evidence of pouncing or grid lines was found in the underdrawings of either version, nor on other paintings attributed to De Coter.[33] It is quite possible that some outlines on the two *Lamentations* were transferred to the panels by tracing a drawing and then accentuated with a brush and black paint. The fact that the underdrawings are not very sketchy and that no adjustments were made in this phase may point to the use of a workshop pattern or a cartoon. In both versions only a

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small number of changes were made relative to the underdrawing during the painting process. In the Rijksmuseum's painting, minor corrections appear in the Virgin's upper lip, St John's thumb and nose and Nicodemus's head. These changes do not appear in the underdrawing or the final paint layer of the private version. The only alteration in the paint compared to the underdrawing in the private version occurs in the outline indicating the right side of Christ's neck. Conversely, this narrower outline is not found in the underdrawing or the final paint layer of the Rijksmuseum's version. The fact that the variations are very small and the adjustments only relate to the placement of outlines makes it likely that they were caused by a cartoon's slipping while the composition was being transferred.[34]

Périer-D'Ieteren and Micha Leeflang state that the underdrawing in the Rijksmuseum's version shows similarities to those found in other paintings attributed to De Coter, such as the signed *Holy Trinity* and *The Entombment* (fig. 12).[35] The types of lines, the hatching manner and the emphasis on rendering the shadows are indeed similar; the outlines and shadows are indicated with precisely placed thin, flowing lines and the parallel and cross-hatched shadows are short in some areas and in others longer so that they curve with the forms. It is striking that the eyebrows of some of the figures in *The Entombment* are drawn in the same distinctive manner as in the Rijksmuseum's painting. In *The Holy Trinity* and *The Entombment*, however, the underdrawings are much more accurate and extensive, in terms of both outlines and hatching, and moreover lack the thicker, reinforced contour lines that can be seen in both *Lamentations*. It is possible that the same artist made the underdrawings for all these paintings. If so, though,

he set about it differently in the two versions of *The Lamentation*. This may have had to do with their small sizes. It was probably not necessary to make such an accurate and extensive underdrawing, precisely because there was a workshop drawing that could be followed.

Paint Layers
Mary Magdalene

There is another interesting aspect in the infrared reflectogram of the private version. Both the face and the robe of the Magdalene appear darker than the other four figures. It can be deduced from this that Mary Magdalene was not left in reserve but was painted on the infrared absorbent black background. The black underlayer is also visible in damaged areas in her face and neck (fig. 13) and in both paint cross-sections taken from this figure.[36] In the one from her neck, it is clear that the black layer lies directly on top of the isolation layer and consists of various angular particles of black pigment. Two light paint layers were applied over this, setting up the Magdalene's face and neck (figs. 14a, b). Reserves were left in the black background for the other figures in the private version, so they show up lighter in the infrared reflectogram. In the Rijksmuseum's version, reserves were left for all the figures, including the Magdalene. This means that in the private painting she was not part of the original composition and must have been added at a later stage. As noted, Périer-D'Ieteren suspected that the Magdalene was a nineteenth-century addition, but no indications to support this were found in either of the two paint cross-sections taken from the private version. The paint layers of the Magdalene were applied directly on top of the black background and nowhere was a layer of dirt or varnish that would
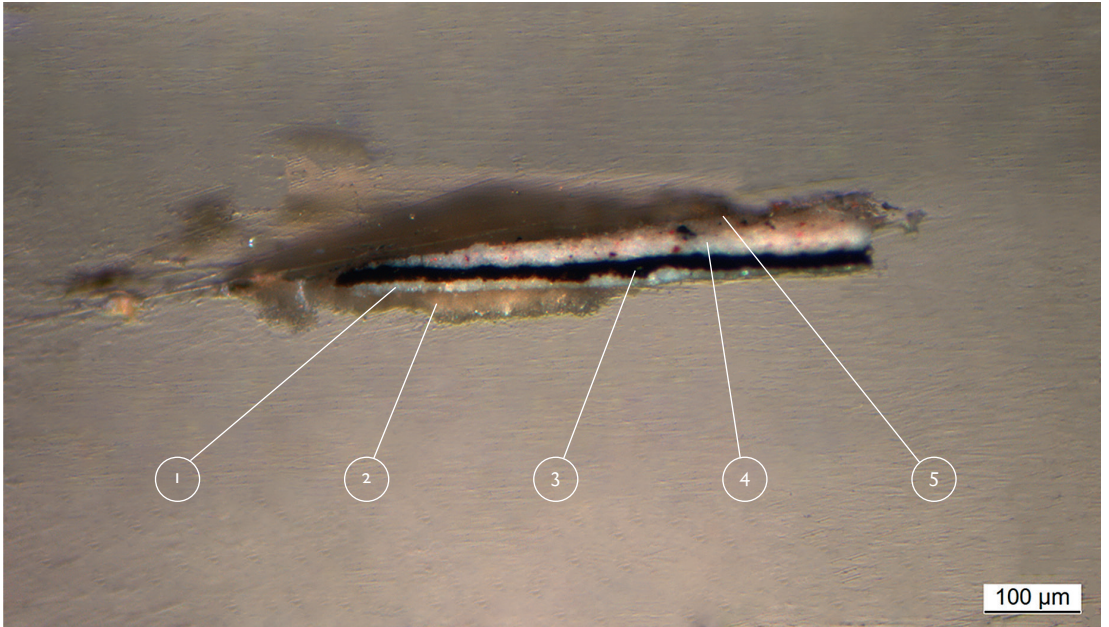
Figs. 14a, b
Paint cross-section
De Coter P.C.-01
taken from Mary
Magdalene's neck,
private version (fig. 2).
a   Daylight, bright
    field, magnification
    100 times.

b   uv light,
    magnification 100
    times: there is no
    visible varnish
    layer between the
    black paint and
    that used for the
    Magdalene.

1   Isolation layer
2   Chalk and glue ground
3   Black paint used for
    the background
4   First paint layer flesh
    tone
5   Second paint layer
    flesh tone
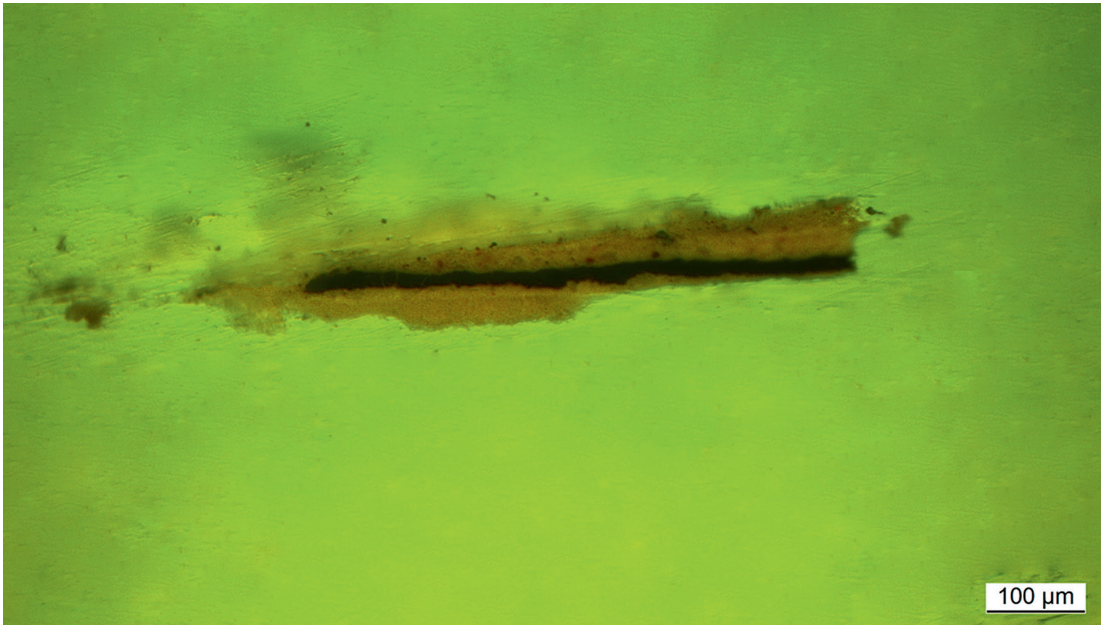
indicate a (much) later addition found. The pattern of the craquelure does not differ from that in the rest of the painting. The analysed pigments in the Magdalene, of which more later, do not indicate a later addition either and were, moreover, all standard in the sixteenth century. The Magdalene was therefore probably painted shortly after the black background was put on.

The fact that the Magdalene was not part of the very first composition of the private version in any event gives reason to assume that this is not a copy (workshop or otherwise) of the Rijksmuseum's variant. In workshop copies, the same reserves as in the original are usually followed.[37] This could even indicate that the private version was made earlier. The composition without the Magdalene must, after all, have already existed. It would not have been as crowded, but it is not inconceivable (fig. 15). Some time later someone, possibly after seeing the Rijksmuseum's version, could have painted in the Magdalene. Whether this was the same artist is difficult to say. The Magdalene seems to be slightly more coarsely executed than the other figures. This could also have been caused, however, by the fact that the paint used to portray her has abraded over time and the dark background has become visible in many places. In the light of all this, it seems in any event plausible that the two paintings were made at the same time or one shortly after the other. It has to be noted here that in art historical terms it is unlikely that a Lamentation scene would ever lack the figure of Mary Magdalene. She is usually present in similar pictures by De Coter and other artists of the same period (cf. fig. 3).[38]

Painting Technique
Both compositions were set up schematically from back to front (figs. 16, 17). Reserves were not left for features and attributes. The outlines of the figures and their clothes are sharply modelled

Fig. 15
Photograph of the private version (fig. 2) manipulated in Photoshop without Mary Magdalene.

and linear, and are also slightly thicker than the surrounding paint. In the Virgin's robe, for instance, the lines indicating the folds are thicker than the areas between them. Details such as highlights, drops of blood and tears were added in the final stage.

The paint was applied both opaquely and in transparent glazes, and both scenes are very finely executed. The figures' heads, in particular, are very detailed, the robes and hands a little less so. The paint has a smooth finish and the brushstrokes are almost invisible except in tiny details, for instance in Nicodemus's fur collar and in the hair and eyelashes of the figures. The paint was generally applied wet in wet and gently brushed out, so the transitions between different shades of colour and between shadows and lighter passages

Fig. 16
Border between the
Virgin's white wimple
and blue robe in
the Rijksmuseum's
version (fig. 1), detail
after restoration:

the blue robe shows
through the edge of
the wimple, indicating
that the composition
was set up from back
to front.

Fig. 17
Border between the
Virgin's white wimple
and blue robe in the
private version (fig. 2),
detail.

are very gradual. This is easy to see
in the faces (figs. 18, 19). The gradual
modelling of the details shows that
this paint, too, was applied when the
underlying layers were not completely
dry. Although the placement and form
correspond, the precise execution of
details and highlights sometimes varies
slightly (figs. 16-21). Some outlines
appear a little harder in the private
version and the colour and shadow
transitions not quite as subtle. The
condition of the painting makes it
difficult to conclude whether another
artist has been at work here.

Fig. 18
St John's face in
the Rijksmuseum's
version (fig. 1),
detail after restoration:
the paint was applied
wet in wet. The
transitions between
the various shades
are very gradual.
The highlights
and dark strands in
the hair were added
in the final stage.

Fig. 19
St John's face in
the private version
(fig. 2), detail.

Fig. 20
Nails in the Rijks-
museum's version
(fig. 1), detail after
restoration: the white
highlights on the
nails were painted
wet in wet in the
final stage.

Fig. 21
Nails in the private
version (fig. 2), detail.

Pigments

XRF analyses reveal that on the whole the same pigments were used for both versions, all of which are typical of sixteenth-century painting practice (tables 1, 2).[39] Azurite was used for the Virgin's blue robe, for instance, and the white passages consist of lead white. Nicodemus's red robe was painted with vermilion, a red lake and possibly a small quantity of azurite and lead white. St John's green robe seems to have been painted with verdigris and lead white. Lead tin yellow was used for

Overview of the Results of xRF Spot Measurements

Measurement	Location	Elements identified with xRF						
		Al	Si	Ba	S	K	Ca	
1	The Virgin's blue robe → 24.5 cm ↑ 21.6 cm			x			x	
2	Mary Magdalene's headdress, yellow detail → 3.3 cm ↑ 32.4 cm						x	
3	Mary Magdalene's headdress, orange detail → 3.5 cm ↑ 33.1 cm				x	x	x	
4	Mary Magdalene's headdress, orange detail 2 → 4.2 cm ↑ 33.1 cm				x	x	x	
5	Mary Magdalene's light purple robe → 1.6 cm ↑ 9.5 cm					x	x	
6	Mary Magdalene's light purple robe lighter area than 5 → 2.9 cm ↑ 7.9 cm					x	x	
7	St John's green robe → 32 cm ↑ 22.3 cm			x		x	x	
8	Nicodemus's red robe → 40.1 cm ↑ 18.7 cm				x	x	x	
9	The Virgin's purple sleeve → 29.8 cm ↑ 13 cm			x		x	X	

Table 1: Results of xRF analysis of the Rijksmuseum's version (fig. 1)

Mn	Fe	Co	Cu	Zn	Sr	Sn	Hg	Pb	Pigments that may have been used [45]
	x		X					x	Azurite ($2CuCo_3 \cdot Cu(OH)_2$) Lead white ($2PbCO_3 \cdot Pb(OH)_2$)/ lead oil Earth pigment (Fe) Chalk ($CaCO_3$) Barium – contaminant of copper
	x		x			X		X	Lead tin yellow (Pb_2SnO_4) Azurite ($2CuCo_3 \cdot Cu(OH)_2$) Earth pigment (Fe) Lead white ($2PbCO_3 \cdot Pb(OH)_2$)/ lead oil Earth pigment (Fe) Chalk ($CaCO_3$)
	x		x				X	X	Vermilion (HgS), Lead white ($2PbCO_3 \cdot Pb(OH)_2$)/ lead oil Azurite ($2CuCo_3 \cdot Cu(OH)_2$) Red lake precipitated on potassium substrate Earth pigment (Fe) Chalk ($CaCO_3$)
	x		x				X	X	Vermilion (HgS) Lead white ($2PbCO_3 \cdot Pb(OH)_2$) Azurite ($2CuCo_3 \cdot Cu(OH)_2$) Red lake precipitated on potassium substrate Earth pigment (Fe) Chalk ($CaCO_3$)
	x		X					X	Azurite ($2CuCo_3 \cdot Cu(OH)_2$) Lead white ($2PbCO_3 \cdot Pb(OH)_2$) (Red) lake precipitated on potassium substrate Earth pigment (Fe) Chalk ($CaCO_3$)
	x		X					X	Lead white ($2PbCO_3 \cdot Pb(OH)_2$) Azurite ($2CuCo_3 \cdot Cu(OH)_2$) (Red) lake precipitated on potassium substrate Earth pigment (Fe) Chalk ($CaCO_3$)
	x		X					X	Verdigris ($Cu(OH)_2 \cdot (CH_3COO)_2 \cdot 5\,H_2O$) Lead white ($2PbCO_3 \cdot Pb(OH)_2$) Red lake precipitated on potassium substrate Earth pigment (Fe) Chalk ($CaCO_3$) Barium – contaminant of copper
	x		x				X	x	Vermilion (HgS) Lead white ($2PbCO_3 \cdot Pb(OH)_2$) Azurite ($2CuCo_3 \cdot Cu(OH)_2$) (Red) lake precipitated on potassium substrate Earth pigment (Fe) Chalk ($CaCO_3$)
	X		X					X	Azurite ($2CuCo_3 \cdot Cu(OH)_2$) Lead white ($2PbCO_3 \cdot Pb(OH)_2$) (Red) lake precipitated on potassium substrate Earth pigment (Fe) Chalk ($CaCO_3$) Barium – contaminant of copper

Measurement	Location	Elements identified with xRF						
		Al	Si	Ba	S	K	Ca	
1	The Virgin's blue robe → 25.5 cm ↑ 22 cm			x		x	x	
2	Mary Magdalene's headdress, yellow detail → 2.7 cm ↑ 33 cm						x	
3	Mary Magdalene's headdress, orange detail → 8.7 cm ↑ 34.1 cm						x	
4	Mary Magdalene's reddish-brown robe, → 2.4 cm ↑ 10.2 cmX					x	x	
5	Mary Magdalene's reddish-brown robe, browner area than 4 → 2.9 cm ↑ 7.4 cm					X	X	
6	St John's green robe → 31.5 cm ↑ 22.4 cm			x		X	x	
7	The Virgin's purple sleeve → 30 cm ↑ 13.3 cm			x		x	x	

Table 2: Results of xRF analysis of the private version (fig. 2)

	Mn	Fe	Co	Cu	Zn	Sr	Sn	Hg	Pb	Pigments that may have been used [46]
		x		X					x	Azurite ($2CuCo_3 \cdot Cu(OH)_2$) Lead white ($2PbCO_3 \cdot Pb(OH)_2$)/ lead oil (Red) lake precipitated on potassium substrate Earth pigment (Fe) Chalk ($CaCO_3$) Barium – contaminant of copper
		x		x			x		X	Lead tin yellow (Pb_2SnO_4) Azurite ($2CuCo_3 \cdot Cu(OH)_2$) Earth pigment (Fe) Chalk ($CaCO_3$)
		x		x				X	X	Vermilion (HgS) Lead white ($2PbCO_3 \cdot Pb(OH)_2$)/ lead oil Azurite ($2CuCo_3 \cdot Cu(OH)_2$) Earth pigment (Fe) Chalk ($CaCO_3$)
		x		X					X	Azurite ($2CuCo_3 \cdot Cu(OH)_2$) Lead white ($2PbCO_3 \cdot Pb(OH)_2$) Red lake precipitated on potassium substrate Earth pigment (Fe) Chalk ($CaCO_3$)
		x		X					X	Azurite ($2CuCo_3 \cdot Cu(OH)_2$) Lead white ($2PbCO_3 \cdot Pb(OH)_2$) Red lake precipitated on potassium substrate Earth pigment (Fe) Chalk ($CaCO_3$)
				x					X	Verdigris ($Cu(OH)_2 \cdot (CH_3COO)_2 \cdot 5 H_2O$) Lead white ($2PbCO_3 \cdot Pb(OH)_2$) (Red) lake precipitated on potassium substrate Earth pigment (Fe) Chalk ($CaCO_3$) Barium – contaminant of copper
		x		X					x	Azurite ($2CuCo_3 \cdot Cu(OH)_2$) Lead white ($2PbCO_3 \cdot Pb(OH)_2$) (Red) lake precipitated on potassium substrate Earth pigment (Fe) Chalk ($CaCO_3$) Barium – contaminant of copper

the highlights creating pearls and other details in the Magdalene's headdress in both paintings. The more orange areas between them seem to contain a mixture of vermilion, lead white, earth pigments and, in the Rijksmuseum's version, a red lake. Azurite was also found in both the yellow and the orange parts. The robes of both the Magdalenes consist of azurite and a red lake. The layers of yellowed varnish make the robe on the private version look more reddish-brown than the light purple one in the Rijksmuseum's painting.[40]

As well as the pigment itself, the way it was used, the types of mixtures and the build-up of the layers can be typical of a particular workshop.[41] Here again, similarities between the two versions were found. All the paint cross-sections from both paintings show that the composition was built up in only one or two layers. The more transparent particles of red lake were mixed into the paint and not, as was often the case in paintings from the same period, applied as a separate layer on top.[42] Azurite appears to have been added to all the colours, except the green of St John's robe. Lead white was used to create lighter areas. The x-rays of both versions of *The Lamentation* show that the places where this was done correspond exactly.[43]

Conclusion

The materials and techniques used in both versions differ hardly at all and are in line with what was standard practice in early sixteenth-century painting in the Low Countries. The panels are virtually the same size and, apart from the figure of Mary Magdalene, the compositions coincide in detail. It is therefore likely that both came from the same workshop and the same preliminary study was used. The thicker outlines found on the infrared reflectograms of both versions may indicate that the compositions or parts of them were traced or copied from an existing model.

It is not possible to determine unequivocally whether one of the two paintings was made earlier than the other, and, if so, which, on the basis of the present investigation. The fact that more alterations were made in the paint relative to the underdrawing in the Rijksmuseum's version might suggest a more creative quest, or greater artistic ability. However, the small number and minimal nature of the changes makes it more likely that chance or the shifting of the cartoon could have played a role here. Less underdrawing was found in the private version anyway, making it harder to detect creative autonomy. The artist probably had less need of an underdrawing, because he had another version of the same composition to hand. It seems unlikely that this would have been the Rijksmuseum's version, since in that case he would also have planned the Magdalene in this composition and made a reserve for her. If the same workshop example was used for both paintings, Mary Magdalene was probably not part of it. This could also explain the anomalous and sketchy underdrawing of the Magdalene's braid in the Rijksmuseum's version. The artist may have had to invent this figure for himself.

The type of lines and the hatching manner in the underdrawings in both versions could be by the same hand and correspond with those found in other paintings attributed to the artist. This makes it likely that in any event the two *Lamentations* were made in De Coter's workshop. Because devotional scenes were popular in the sixteenth century, it seems logical that several versions of a small painting like this would have been made for the art market.[44] For the time being, it is not possible to say with certainty whether both *Lamentations* were made by De Coter himself. In the Middle Ages artists were employed in workshops, copying examples by or in the style of a master, under whose name the

paintings were sold. It was customary for pupils to copy works by their master, scrupulously following methods and materials, as in these versions of *The Lamentation*. For this reason, it is difficult to distinguish the work of an accomplished pupil from that of his master. It will only be possible to compare both more satisfactorily in terms of the quality of the painting technique once the concealing restoration layers have been removed from the private version.

Additional scientific research into other paintings attributed to De Coter, starting with the three signed altarpieces, is needed to gain more insight into his working methods. To start with, there needs to be dendrochronology of those panels in order to compare the dates, the material and the origin of the supports. For further investigation into the extent that certain pigments, pigment mixtures and the build-up of the paint layers are typical of De Coter's workshop, it is necessary to take paint cross-sections from these other paintings and carry out (macro) XRF analyses. The results presented in this article can serve as a starting point for further research into Colijn de Coter's workshop practices.

ABSTRACT

The small, unsigned panel *The Lamentation of Christ* in the Rijksmuseum's collection is attributed to Colijn de Coter and dated around 1510-15. There is another, almost identical version in a private collection. Visual analysis and analytical techniques including UV fluorescence, infrared reflectography, x-ray fluorescence (XRF), x-radiography, dendrochronology and paint sample analysis, were used to examine and compare the materials and techniques in both paintings in order to investigate the relationship between the two. Because only a small oeuvre is attributed to De Coter and there has as yet been very little scientific analysis of his paintings, this comparative investigation provides more information about the artist's workshop practices. This research has revealed that the materials and techniques used in the two versions differ hardly at all and, moreover, correspond to standard practice in early sixteenth-century painting in the Low Countries. The thicker outlines in the underdrawings in both cases indicate that the compositions were traced or copied from the same model. The underdrawings of the two *Lamentations* also correspond to those in other paintings attributed to the artist. This makes it likely that both versions came from De Coter's workshop.

NOTES

* This article derives from my Master's thesis for the conservation programme at the University of Amsterdam (2013). I am greatly indebted to the private collector who owns the other version for his generous cooperation. My thanks also to Gwen Tauber, Matthias Ubl, Willem de Ridder, Tess Graafland and Erma Hermens for their guidance and advice. And lastly to Manja Zeldenrust †, without whom this would not have succeeded.

1 Micha Leeflang, 'Colijn de Coter, *The Lamentation of Christ*, Brussels, c. 1510-c. 1515', in Jan Piet Filedt-Kok (ed.), *Early Netherlandish Paintings*, online coll. cat. Amsterdam 2010: hdl.handle.net/10934/RM0001. COLLECT.8180 (consulted 11 April 2019).

2 From the information printed on these photographs we learn that at the beginning of the twentieth century this painting was part of the collection of H. Hora Siccama. In 1950 it was sold by the auction house Mak van Waay to a Mr Scheer for 3,200 guilders. In 1959 the painting surfaced again in the catalogue of a sale at Christie's in London, where it was sold by A. Benson to the art dealer J.A. de Waart of The Hague. The present owner inherited the painting from his grandparents, who bought it from De Waart in the nineteen-seventies. On the back of the panel there is a red seal (fig. 7) with the arms of the Besier family of Overijssel. The wax seal dates from around 1880, indicating that the painting must have belonged to the family around that time. The Besier family is recorded in *Nederland's Patriciaat* 1952, vol. 38, https://cbgfamiliewapens.nl/zoeken?search=besier&collection=Familiewapens (consulted on 11 April 2019). The seal is mounted on a small piece of wood, probably from the original panel.

3 Jeanne Maquet-Tombu, *Colyn de Coter: Peintre Bruxellois*, Brussels 1937, pp. 12-14; Pamela Hibbs-Decoteau, *Colin de Coter and the Bernatsky Triptych*, diss. University of Wisconsin 1975, pp. 5-8 (microfilm copy); Catheline Périer-D'Ieteren, *Colyn de Coter et la technique picturale des peintres flamands du xve siècle*, Brussels 1985, pp. 8, 10, 55; Véronique Bücken et al., *De erfenis van Rogier van der Weyden: De schilderkunst in Brussel 1450-1520*, exh. cat. Brussels (Royal Museums of Fine Arts of Belgium) 2013, pp. 323-25.

4 This is suggested by Périer-D'Ieteren 1985 (note 3), pp. 46, 52. As well as paintings, De Coter also made designs for tapestries and carved altarpieces, see Bücken et al. 2013 (note 3), p. 325. On sixteenth-century painters' workshops see among others Rachel Billinge et al., 'Methods and Materials of Northern European Painting in the National Gallery, 1400-1550', *National Gallery Technical Bulletin* 18 (1997), pp. 6-55, esp. pp. 12-14; David Bomford (ed.), *Underdrawings in Renaissance Paintings*, London 2002, p. 41; Gunnar Heydenreich, *Lucas Cranach The Elder: Painting Materials, Techniques and Workshop Practice*, Amsterdam 2007, pp. 267-89; Dorien Tamis, *Van twee handen geschildert: Werkverdeling tussen schilders in de Nederlanden in de zestiende en zeventiende eeuw*, diss. University of Amsterdam 2016, chapters 1-2.

5 Maquet-Tombu 1937 (note 3), pp. 3-29; Hibbs-Decoteau 1975 (note 3), pp. 5-8; Périer-D'Ieteren 1985 (note 3), pp. 9-11, 55-78; Bücken et al. 2013 (note 3), pp. 326-27.

6 See among others Maquet-Tombu 1937 (note 3), pp. 43-50; Hibbs-Decoteau 1975 (note 3), pp. 228-29; Périer-D'Ieteren 1985 (note 3), pp. 53-128.

7 Abraham Bredius, *Catalogus van het Rijks-Museum van schilderijen te Amsterdam*, Amsterdam 1887, p. 190, no. 1628.

8 B.W.F. van Riemsdijk et al., *Catalogus der schilderijen, pastels, miniaturen, aquarellen tentoongesteld in het Rijksmuseum te Amsterdam*, Amsterdam 1934, p. 25, no. 340.

9 See among others Maquet-Tombu 1937 (note 3), pp. 43-50; Hibbs-Decoteau 1975 (note 3), pp. 138-39, 228-29, 254 (on the latter pages she refers to earlier attributions by other art historians); Périer-D'Ieteren 1985 (note 3), pp. 53-54, 78-79, 98-99; Leeflang 2010 (note 1).

10 On the identification of the figures and the function of the painting see Maquet-Tombu 1937 (note 3), p. 45; Hibbs-Decoteau 1975 (note 3), pp. 223, 225-28; Leeflang 2010 (note 1); Bücken et al. 2013 (note 3), pp. 323-24; Matthias Ubl, 'Nr. 42 The Lamentation of Christ', in Frits Scholten (ed.), *Rijksmuseum 1100-1600,* Amsterdam 2015, pp. 126-27. On the function of devotional scenes in the sixteenth century, see among others Sixten Ringbom, *Icon to Narrative: The Rise of the Dramatic Close-Up in Fifteenth-Century Devotional Painting*, Doornspijk 1965, pp. 93-106; Micha Leeflang, *Joos van Cleve: A Sixteenth-Century Antwerp Artist and his Workshop*, Turnhout 2015, p. 70.

11 Leeflang 2010 (note 1); Ubl 2015 (note 10), p. 127.

12 Ringbom 1965 (note 10), p. 48; Leeflang 2010 (note 1); Bücken et al. 2013 (note 3), p. 324.

13 Périer-D'Ieteren 1985 (note 3). Brief scientific information about the altarpiece *Donors with St John the Baptist and St Barbara* in St Martin's Cathedral in Bratislava attributed to De Coter and his workshop, is published in Ingrid Ciulisovà, 'Two Donors with Saint John and Saint Barbara', in Hélène Veroughstraete and Colombe Janssens de Bisthoven (eds.), *The Quest for the Original: Underdrawing and Technology in Painting. Symposium XVI Bruges 21-23 September 2006*, Leuven 2009, pp. 42-47.

14 Périer-D'Ieteren 1985 (note 3), pp. 98-101 and note 117.

15 The painting was examined in the Rijksmuseum in 1999 by Arie Wallert and Micha Leeflang. No records have survived: Leeflang 2010 (note 1), note 12.

16 Two paint cross-sections taken from the Rijksmuseum's version were examined with Scanning Electron Microscopy with Energy Dispersive X-Ray Analysis (SEM-EDX), see note 26.

17 Périer-D'Ieteren 1985 (note 3), p. 98. In correspondence between the owner of the private version and the art historian Henri Defoer, a specialist in historical jewellery, Defoer writes that Mary Magdalene's headdress in the private version has more Renaissance-like characteristics than the late medieval headdress in the Rijksmuseum's version. However, Sara van Dijk (junior curator of textiles, Rijksmuseum) and Suzanne van Leeuwen (junior curator and conservator of historical jewellery, Rijksmuseum) suggest in e-mail correspondence with the author that the headdresses of the two Magdalenes are fantastical creations derived from fifteenth-century fashion with some additional ornaments. This was a popular conceit in painting and sculpture in the first half of the sixteenth century. They say that it is impossible to date such accessories exactly, and precisely because the works hark back to earlier fashions, the presence of late medieval characteristics is of little relevance. See also Turner Wilcox, *The Mode in Hats and Headdress*, New York 2008, pp. 48, 77-78 (cf. the different drawings of headdresses in the chapters *Medieval Europe* and *Renaissance Europe*).

18 Tracings of both paintings were made on sheets of silicone Melinex. The differences described here can be seen when one is placed on top of the other.

19 All the other paintings attributed to De Coter are significantly larger: Périer-D'Ieteren 1985 (note 3), pp. 141-53.

20 Billinge et al. 1997 (note 4), p. 18.

21 This investigation was carried out by Peter Klein on 5 June 2012. Dendro-chronological analysis involves counting the growth rings in the wood and comparing them with existing chronologies for oak in the past centuries, see Peter Klein, 'Dendrochronological Analysis of Panel Paintings', in Kathleen Dardes and Andrea Roth (eds.), *The Structural Conservation of Panel Paintings: Proceedings of a Symposium at the J. Paul Getty Museum 24-28 April 1995*, Los Angeles 1998, pp. 39-54. On panels in sixteenth-century painting practice see among others Billinge et al. 1997 (note 4), p. 17; Jorgen Wadum, 'Historical Overview of Panel-Making Techniques in the Northern Countries', in Dardes and Roth 1998 (above), pp. 149-77.

22 Private version: left plank 18 cm, middle plank 11.5 cm, right plank 13.2 cm wide. Rijksmuseum version: left plank 23.2 cm, right plank 19.9 cm wide. The latter panel is 0.8-1.9 cm thick.

23 This investigation was carried out by Peter Klein on 18 June 2012. Klein (June 2018) and Marta Dominguez Delmas (March 2019) also tried in vain to count the growth rings on the x-ray.

24 Billinge et al. 1997 (note 4), p. 19; Heydenreich 2007 (note 4), p. 76; Christina Currie and Dominique Allart, 'Pieter Brueghel as Copy-ist after Pieter Bruegel', in Erma Hermens (ed.), *European Paintings 15th-18th Century: Copying, Replicating and Emulating. CATS proceedings I 2012*, Copenhagen 2014, pp. I-II, esp. p. 2.

25 Ciulisovà 2009 (note 13), p. 45.

26 Panels were usually given one or more coats of animal glue first to make them less absorbent, before the ground was applied. These layers are usually so thin, however, that they cannot be identified in paint cross-sections. For information on grounds in the sixteenth century see Billinge et al. 1997 (note 4), pp. 23, 25; Bomford 2002 (note 4), p. 28; Anne Haack Christensen et al., 'Christ Driving the Traders from the Temple: Painting Materials and Techniques in the Context of 16th-Century Antwerp Studio Practice', in Erma Hermens (ed.), *On the Trail of Bosch and Bruegel: Four Paintings under Cross-Examination*, London 2012, pp. 23-43, esp. pp. 27-29. An SEM-EDX spot measurement of paint cross-sections SK-A-856-01 and SK-A-856-06 (not published here) shows that the layer contains calcium. Given the provenance and dating of the painting, the

ground probably consists of a mixture of chalk and animal glue. Specifications SEM-EDX: Thermoscientific Ultradry Silicondrift detector, Peltier cooled (without nitrogen) and JEOL JSM 6910LV Scanning Electron Microscope. Settings: Low vacuum, working distance: 10 mm, voltage: 20 kV, low vacuum, BES signal, pressure: 28 Pascals, not vacuum metallized, spot size: 40 micron, owner: RCE. Analysis done by Jolanda van Iperen.

27 Six paint cross-sections were taken from the Rijksmuseum's version and two from the private painting. There is no isolation layer or only a very thin one in the paint cross-sections not published here. All the paint cross-sections were embedded in Technovit 2000 LC, dry polished with micromesh and photographed with a Leica DFC 420, software IM50-IM100.

28 Examples of sixteenth-century paintings where the isolation layer was applied over the underdrawing can be found in Billinge et al. 1997 (note 4), p. 25; Bomford 2002 (note 4), p. 28; Haack Christensen et al. 2012 (note 26), pp. 29, 42. The two paint cross-sections taken from the private version came from an area where there is no underdrawing.

29 On integrated frames in the fifteenth and sixteenth centuries see among others Billinge et al. 1997 (note 4), p. 18; Heydenreich 2007 (note 4), pp. 86, 87; Currie and Allart 2014 (note 24), p. 2. The use of integrated frames also occurred in other European countries in the Middle Ages. The two paintings' present frames are not original.

30 A digital infrared reflectogram was made of both versions with the Osiris camera 110234 (Opus Instruments Limited), sensor: 09E 13331, lens: 6 element 150mm with focal length: F/5.6 – F45, calibrated at: 10, 8.3, 1 and 0.8 ms, distance: 1 metre, scale: 38, wave length: 0.9 - 1.7μm. The painting was irradiated with near infrared radiation (± 0.75-1.4 μm). The radiation that then came off the painting was recorded and converted into a contrast image. Materials that absorb infrared radiation appear as dark areas. This technique makes it possible to show underlying layers of the painting, such as underdrawings and *pentimenti.* For information on infrared reflectography in late medieval paintings see among others Billinge et al. 1997 (note 4), pp. 25-29; Bomford 2002 (note 4), pp. 14-20, 29; Jörgen Wadum and Mikkel Scharff, 'Tracing the Indivi-dual "Handwriting" of Four 16th-Century Artists through their Under-

drawings', in Hermens 2012 (note 26), pp. 59-81, esp. 59-62.

31 This is mentioned by, among others, Bomford 2002 (note 4), pp. 28-29, 52; Wadum and Scharff 2012 (note 30), pp. 61-75; Catherine Metzger, 'The Saint Anne Altarpiece by Gerard David and His Workshop', in Maryan Ainsworth, *Workshop Practice in Early Netherlandish Painting: Case Studies from Van Eyck through Gossaert*, Turnhout 2017, pp. 86-93, esp. pp. 87-89.

32 On making versions and copies in sixteenth-century artists' workshops see among others Billinge et al. 1997 (note 4), pp. 26-27; Peter van den Brink (ed.), *De Firma Bruegel*, exh. cat. Maastricht (Bonnefantenmuseum)/ Brussels (Royal Museums of Fine Arts of Belgium) 2001; Bomford 2002 (note 4), pp. 38-39, 43-50; Molly Faries (ed.), *Making and Marketing: Studies of the Painting Process in Fifteenth- and Sixteenth-Century Netherlandish Workshops*, Turnhout 2006; Heydenreich 2007 (note 4), pp. 105, 280-84, 298-301; Haack Christensen et al. 2012 (note 26), p. 23; Wadum and Scharff 2012 (note 30), pp. 63-67; Erma Hermens and Greta Koppel, 'Copying for the Art Market in 16th-Century Antwerp: A Tale of Bosch and Bruegel', in Hermens 2012 (note 26), pp. 85-99, esp. p. 94; contributions by Eva de La Fuente Pedersen and Troels Filtenborg, Christina Currie and Dominique Allart, Maria Clelia Galassi, Sophie Plender and Polly Saltmarsh in Hermens 2014 (note 24); Leeflang 2015 (note 10), pp. 70-85.

33 Périer-D'Ieteren 1985 (note 3), p. 46. Such traces are usually difficult to see, however, and remnants of pouncing were usually brushed away after they had been traced over.

34 Indications that a cartoon had shifted a little were also found in the underdrawings in paintings by Joos van Cleve, see Leeflang 2015 (note 10), pp. 70-85.

35 Périer-D'Ieteren 1985 (note 3), pp. 89, 99, 125, figs. 85, 87, 141-45, 216-23; Leeflang 2010 (note 1), note 12; Micha Leeflang, unpublished paper on *The Entombment*, 1998, pp. 3, 32-34. The IRR analysis of *The Entombment* was carried out by SRAL, Maastricht, with a Hamamatsu C 2400-07 camera with an N2606 IR vidicon, a Nikon Micro-Nikkor 1:2.8/55 mm lens, a Heliopan RG 850 (or RG 1000) filter, with a Lucius & Baer VM 1710 monitor (625 lines). Digital documentation with a Meteor RCB frame grabber, 768 x 574 pixels, colorvision toolkit (Visualbasic). The IRR montage shown

here was made with a PanaVue Image Assembler and Adobe Photoshop.

36 The same black paint layer is also present directly over the isolation layer in the paint cross-section taken from the Magdalene's reddish-brown garment (De Coter P.C.-02); the robe was then painted on top.

37 Currie and Allart 2014 (note 24), p. 6.

38 For various fifteenth- and sixteenth-century versions of *The Lamentation* see Bücken et al. 2013 (note 3), pp. 104-05, 108-09, 160-61, 170-71, 292-93, 366-67; for similar subjects in De Coter's oeuvre see Périer-D'Ieteren 1985 (note 3), pp. 121, 98-99, 100, figs. 277 and 278. The Magdalene is part of the composition in every case. The Magdalene does not appear in *The Lamentation* by Quinten Massys (Museum M, Leuven), see http://vlaamseprimitieven.vlaamse-kunstcollectie.be/nl/collectie/de-bewening-van-christus (consulted 16 April 2019).

39 XRF specifications: Artax Element Analysis (Bruker), current: 398 µA, energy: 50.0 Kelvin, voltage: 50 kV, anode: Mo, live time: 120 sec., real time: 144 sec., optic: Lens 0.60, spot size 90µm, atmosphere: Helium, no filter. Analysis carried out by Arie Wallert. On the use of pigments in the sixteenth century see among others Billinge et al. 1997 (note 4), pp. 34-40; Heydenreich 2007 (note 4), pp. 132-68; Haack Christensen et al. 2012 (note 26), pp. 37-41.

40 XRF analysis and examination of paint cross-section P.C.-02, taken from the brownish robe in the private version show that it consists of a mixture of azurite and red lake particles. No paint cross-section was taken from the light purple robe in the Rijksmuseum's version. It is not clear whether the azurite and red lake were mixed in one layer here, or whether they were applied as separate layers, one on top of the other. In the sixteenth century, Northern European workshops often added a red pigment or lake to azurite in order to imitate the more violet tone of ultramarine, see Libby Sheldon, 'Palette Practice and Purpose: Pigments and their Employment by Native and Anglo-Netherlandish Artists in Tudor and Jacobean Painting', in Tarnya Cooper et al. (eds.), *Painting in Britain 1500-1630: Production, Influences and Patronage*, Oxford 2015, pp. 128-37, esp. p. 134.

41 Billinge et al. 1997 (note 4), pp. 34, 37; Libby Sheldon and Gabriella Macaro, 'Materials as Markers: How Useful are Distinctive Materials as Indicators of Master or Copyist', in Hermens 2014 (note 24), pp. 105-12, esp. pp. 108-09, 112.

42 Billinge et al. 1997 (note 4), pp. 36-38.

43 X-ray of the Rijksmuseum's version taken in 1976: Distance: 80 cm, 40 KV, 4 MA, 45 sec.; x-ray of the private version taken by René Gerritsen in 2007: Voltage: 30 KV, 2 MA, 60 sec. The two images were scanned and combined in Photoshop so that they could be compared.

44 Joos van Cleve often made two virtually identical versions of popular compositions for private devotions, see Leeflang 2015 (note 10), pp. 70-71.

45 The chemical compositions of the pigments are taken from Nicolas Eastaugh et al., *Pigment Compendium: A Dictionary and Optical Microscopy of Historical Pigments,* Oxford 2008, pp. 39-40, 46, 63-64, 88-92, 98-99, 124-25, 206-07, 216-17, 220-22, 238-41, 244, 250-51, 285-86, 338, 391-93, 406-07. XRF analysis in combination with paint cross-section analysis indicates that the pigments referred to here were mixed together in a single layer, aside from the earth pigments (Fe), chalk ($CaCO_3$) and lead (lead white ($2PbCO_3 \cdot Pb(OH)_2$)/ lead oil) measured at every location, which in any case also come from the ground and isolation layer respectively. The red lakes found could be identified in some cases in combination with paint cross-sections taken from corresponding areas. Where 'red' is given in brackets, it seems likely on the basis of the final colour that it is this colour lake. The pigment found in the greatest quantity per measurement is always listed at the top and marked with a large X.

46 The only paint cross-sections taken from the private version came from the Magdalene. For the moment, therefore, it is not certain whether the pigments measured in the other figures with XRF are mixed in a single layer or as separate layers one on top of the other. The red lakes found in the Magdalene's robe could be identified in combination with paint cross-sections taken from the same areas. Where 'red' is given in brackets, it seems likely on the basis of the final colour that it is this colour lake. The earth pigments (Fe), chalk ($CaCO_3$) and lead (lead white ($2PbCO_3 \cdot Pb(OH)_2$)/ lead oil) measured at every location in any case also come from the ground and isolation layer respectively. The pigment found in the greatest quantity per measurement is always listed at the top and marked with a large X.