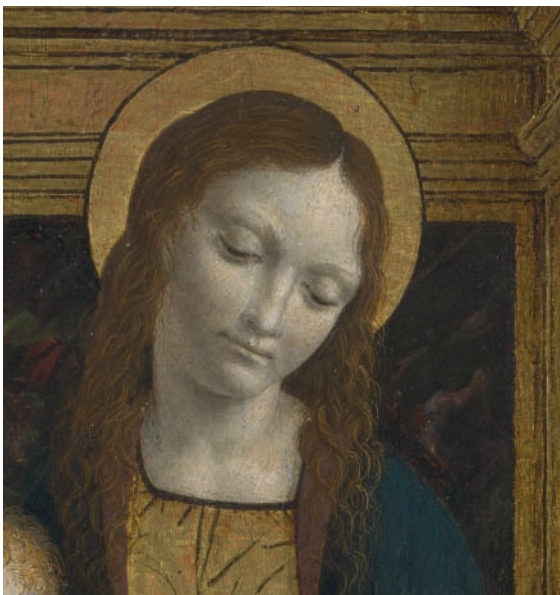
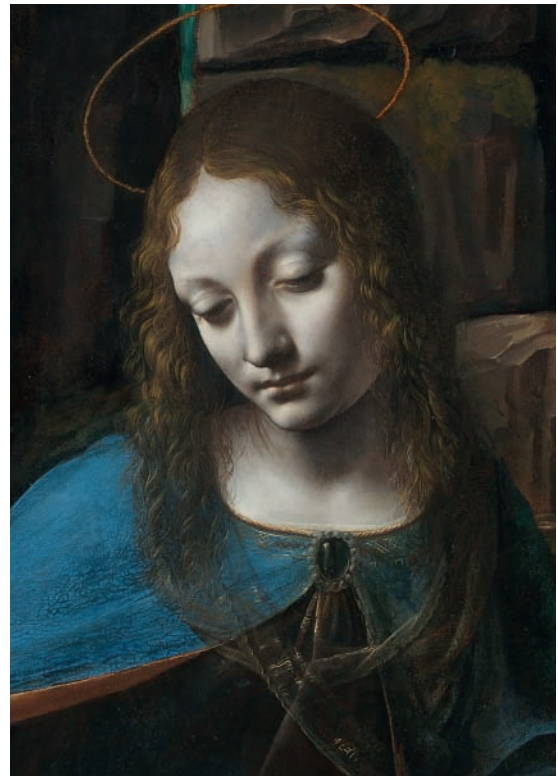


# National Gallery Technical Bulletin

VOLUME 32 *Leonardo da Vinci: Pupil, Painter and Master*



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#### FRONT COVER

Leonardo da Vinci, *The Virgin of the Rocks* (NG 1093), c.1491/2–9 and 1506–8 (detail).

#### TITLE PAGE

Top left: Andrea del Verrocchio, *The Virgin and Child with Two Angels* (NG 2508), c.1467–9 (detail).

Bottom left: Master of the Pala Sforzesca, *The Virgin and Child with Four Saints and Twelve Devotees* (NG 4444), probably c.1490–5 (detail).

Right: Leonardo da Vinci, *The Virgin of the Rocks* (NG 1093), c.1491/2–9 and 1506–8 (detail).

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# Altered Angels: Two Panels from the Immaculate Conception Altarpiece once in San Francesco Grande, Milan

RACHEL BILLINGE, LUKE SYSON AND MARIKA SPRING

The National Gallery's two panels depicting musician angels, *An Angel in Green with a Vielle* (NG 1661, FIG. 1) and *An Angel in Red with a Lute* (NG 1662, FIG. 2), were purchased in 1898 from Giovanni Melzi, Duca di Lodi, and came with a provenance from the church of San Francesco Grande in Milan.<sup>1</sup> It has never been doubted that they were part of the carved altarpiece created for the chapel of the Confraternity of the Immaculate Conception abutting that church, for which Leonardo da Vinci, in partnership with the brothers Ambrogio and Evangelista de Predis, was commissioned to work on the gilding and painting. The story of this commission and the subsequent history of the altarpiece (including the *Angels'* place in it) are, however, extremely complicated. Much ink has been spilled on this subject, but it has focused mainly on the status of the two great depictions of *The Virgin of the Rocks* (Musée du Louvre, Paris, and National Gallery, London) and, although they are always accommodated in art historians' attempts to reconstruct the ensemble, the *Angel* panels have been somewhat neglected.<sup>2</sup>

Both paintings have undergone a number of changes since they were created, which relate to the history of the altarpiece as a whole. They no longer appear as they would have done when first installed in San Francesco Grande. Not only have the supports been altered but (as has been insufficiently recognised) the grey niches behind the angels are not part of the original scheme. However, a considerable amount of their original backgrounds survives beneath the grey paint. One of the purposes of this article is to present the material evidence from technical examination to attempt to reconstruct as far as possible the sequence of changes that has occurred and to describe what can be deduced about the original appearance of the backgrounds. The different painting techniques used for the two angels are also of considerable interest, since they reinforce stylistic considerations which indicate that they are by different painters (neither of course Leonardo himself, but both seeking in some measure to imitate his style of painting). These technical variations are particularly clear in the different modes of underdrawing and manners of flesh painting.

The pictures have a long history of technical examination. Several X-radiographs of details of the panels were published by Ian Rawlins in 1940, with a very short commentary stating that the difference in technique between them was evident in these images.<sup>3</sup> Later, in his catalogue, Martin Davies described some of the changes in composition that are visible in the X-radiograph image of the *Angel in Red*, such as the shift in the position of the lute and in the angel's proper right arm.<sup>4</sup> When the paintings were cleaned in 1974 composite X-radiographs of each painting were made,<sup>5</sup> as well as infrared photographs. It was at this time, after removal of the thick, discoloured varnish, that it was noticed that the paint of the grey niches was rather coarse, leading to the suspicion that it was not original. A series of samples were examined, described in an account published by Joyce Plesters in 1975, which confirmed that the grey paint is indeed later repaint, since it lies on dirty, discoloured varnish. It was also established that in the *Angel in Green* the concealed original background includes blue and blue-green paint, which could be a distant landscape, while the original background of the *Angel in Red* was quite different, consisting of pinkish paint.<sup>6</sup> A new campaign of examinations was begun in 2003 in conjunction with a study of *The Virgin of the Rocks*. These included the first complete study of the *Angels* using infrared reflectography as well as additional examinations with a microscope. Further extensive investigation was made of the original back-grounds in 2005 in conjunction with some small cleaning tests.<sup>7</sup> This article amalgamates what has been learned from the earlier campaigns, and presents further work on the existing samples together with analysis with the more sophisticated techniques now available. These were interpreted in conjunction with new infrared reflectograms and close study of the surface of the paintings with a stereomicroscope.<sup>8</sup>



FIG. 1 Associate of Leonardo da Vinci (Francesco Napoletano ?), *An Angel in Green with a Vielle* (NG 1661), about 1490–9. Oil on poplar panel.



FIG. 2 Ambrogio de Predis, *An Angel in Red with a Lute* (NG 1662), about 1495–9. Oil on poplar panel.

## Historical origins of the paintings

The original contract for the gilding and painting of the altarpiece by Leonardo da Vinci and the brothers Ambrogio and Evangelista de Predis is dated 25 April 1483. The altarpiece had already been carved by the leading woodworker Giacomo del Maino, work that was commissioned in 1480 for the newly built and independent chapel of the Confraternity of the Immaculate Conception, adjacent to the church of San Francesco Grande. One part of the 1483 contract (the *lista*, in Italian) describes the ingredients of the work, beginning with a sculpted figure of the Virgin painted in expensive colours, now usually agreed to have been at the summit of the ensemble, and finishing with the predella and other parts at the base of the altarpiece. Three main areas were to be occupied by pictures. These included two pairs of musician angels – one duo singing and the other playing – which were to be painted on two ‘empty’ spaces or panels, perhaps already set into the altarpiece.<sup>9</sup> These are mentioned several items before the ‘Virgin and Child with Angels’, the picture that would be painted twice by Leonardo, in which he reduced the number of angels to one and added the infant Saint John. Hannelore Glasser has already suggested sensibly that the *lista* – whose elements otherwise appear curiously random – may describe the altarpiece from top to bottom, although she did not follow the logic of her suggestion to consider what this might imply about the position of the *Angels*. It can therefore be deduced that the *Angel* panels were positioned at a level above that of Leonardo’s painting of *The Virgin of the Rocks*, which occupied the centre of the main tier, and not on either side of it as is usually supposed. These spaces would have been occupied instead by a stacked series of small-scale reliefs of the Life of the Virgin, which in fact would have needed to be more visible than would have been allowed by the place in the upper tiers they are usually granted.<sup>10</sup>

The painters had received most of their fee by December 1484, but they seem to have realised they had underestimated the cost of the work and therefore appealed for further payment. Both the *Angel* panels and *The Virgin of the Rocks* seem to have been completed by this time,<sup>11</sup> since they were judged to be ready to undergo an estimate procedure, and the artists claimed they had identified a potential buyer for the ‘quadro de una n[ost]ra dona’ – the picture generally presumed to be *The Virgin of the Rocks* now in the Louvre. This appeal is not dated, but must have been written after the death of Evangelista,

who made his last will and testament in December 1490, since he is not mentioned. If *The Virgin of the Rocks* now in Paris was indeed sold, an explanation is provided of the need for a substitute picture by Leonardo. It is often assumed that the *Angel* panels were left over from this first phase of work, and since it was always clear that they are by different hands, it was reasonable to attribute them to Ambrogio and Evangelista de Predis.

It is immediately evident, however, that the panels now in the National Gallery do not represent pairs of angels as the contract stipulated. The wording in the appeal does not make it clear whether two panels, each of which depicted two angels, had been painted or, as is perhaps more likely, that the artists had departed from the contract with only one angel being painted on each. This would seem to be a possibility, since changes to the Confraternity’s desired iconography were instituted by Leonardo himself in *The Virgin of the Rocks*. In whatever way the musician angels were disposed across the two panels completed by the early 1490s, it is likely that they would have taken their stylistic cue from Leonardo’s Louvre *Virgin of the Rocks*. The panels now in the National Gallery are, however, stylistically more compatible with Leonardo’s second (London) picture than the first, and should therefore be considered to be works of the 1490s, made no earlier than about 1492–3. The possibility therefore needs to be considered that a first set of *Angel* panels was also sold off, with substitutes then needed.<sup>12</sup> The paintings in the National Gallery would therefore be those replacements – the first set having long ago disappeared.

Ambrogio certainly considered his part of the work finished by the time of a second financial dispute with the Confraternity in 1503, so if (as is generally believed) he is the author of the *Angel in Red* then it must have been completed by then. The only remaining question, therefore, is whether the *Angel in Green* was painted only after Leonardo returned to Milan to ‘finish’ *The Virgin of the Rocks* in 1506–8. This seems circumstantially unlikely, but from a stylistic point of view cannot be absolutely ruled out.

## Attributions

*An Angel in Red with a Lute* (NG 1662) has been consistently attributed to Ambrogio de Predis in recent years, by comparison with signed or documented works, or with pictures convincingly attributed to him.<sup>13</sup> *An Angel in*

*Green with a Vielle* (NG 1661) is perhaps best catalogued as a work by an associate of Leonardo da Vinci and Ambrogio de Predis. If it does indeed belong with the second phase of work it cannot be by Evangelista (although nothing by him that might provide a point of comparison is known to survive). It has also been attributed in recent years both to Marco d'Oggiono and to Francesco Galli (known as Francesco Napoletano). There are some similarities with the technique of paintings by Marco made after 1500, but this attribution is not entirely satisfactory, especially given the greater understanding of his oeuvre resulting from recent research by Antonio Mazzotta.<sup>14</sup> More convincing is the view that the *Angel in Green* was painted by Francesco Napoletano.<sup>15</sup> Doubts about this attribution have been raised, partly on the grounds that it bears little resemblance to *The Virgin and Child* in Zurich widely thought to have been signed by him.<sup>16</sup> The signature on the Zurich panel, however, reads 'FR. / [.]LIA.', and despite the general consensus, it is difficult to reconcile these letters with any way that Francesco might plausibly have signed his works. The painter of this picture may, therefore, be another artist. There are, nevertheless, similarities with more certain works by Francesco: the altarpiece of *The Virgin and Child with Saints Sebastian and John the Baptist* in Zurich and *The Virgin and Child* in the Brera, Milan – both seemingly of the late 1480s – as well as the signed *Saint Sebastian* panel from the Saint Nicholas of Tolentino altarpiece in Brescia (Pinacoteca Tosio-Martinengo) of 1495, an ensemble that was mostly painted by Vincenzo Civerchio.

It is possible to establish that there was some professional and perhaps personal connection between Francesco Galli and Ambrogio de Predis. Both could be found working for the Imperial Mint at Innsbruck in early 1494 (with one Accino da Lecco) and Ambrogio was trusted by the heirs of Galli to act in their interests after Francesco died in Venice in 1501. Galli therefore becomes a plausible choice of partner for Ambrogio after the death of Evangelista. If Francesco Galli is indeed the author of the *Angel in Green*, it must predate 1501, which is the year he died in Venice. It is likely to belong to the second half of the 1490s, since the angle of the head, the fall of the hair and the facial type all depend, as Brown has realised,<sup>17</sup> on the figure of Saint John the Evangelist in Leonardo's *Last Supper*.

## Later history of the paintings

The chapel was demolished in 1576 and the altarpiece was moved into the main body of the church, requiring complete disassembly and alterations to the structure.<sup>18</sup> The carpentry was much changed at this time, with those aspects that appeared particularly out of date, such as a canopy over *The Virgin of the Rocks* and reliefs of the Life of the Virgin, being sold. It was probably some time around 1579 that the musician angels were moved to the lower tier, to be seen flanking *The Virgin of the Rocks* by 1671, although, as we have seen, this was probably not their original position.<sup>19</sup> By 1781, however, all three painted panels had migrated to the upper tier, now placed above the statue of the *Immacolata*. The *Virgin of the Rocks* was subsequently removed, but in 1798 the *Angels* are mentioned as still in the church, on either side of the void left by the removal of Leonardo's painting ('Altri due quadri rappresentanti angeli dipinti sul legno pure incassati in detta ancona').<sup>20</sup> They were sold to Conte Giacomo Melzi (some time before his death in 1802) after which they hung as gallery pictures. There were therefore several moments which might have called for alterations to the size of the panels and also their backgrounds.

## TECHNICAL STUDY

### The panels

#### *An Angel in Green with a Vielle*

Overall size 117.2 (left) – 117.0 (right) × 60.6 (top) – 60.8 (bottom) cm

The panel is poplar<sup>21</sup> with vertical grain and consists basically of a wide board with two narrow strips of wood attached on the left. The main board is 53.2 cm wide and about 2.8 cm thick.<sup>22</sup> The pattern of the wood grain (visible along the top edge) indicates that the panel is a tangential cut from near the centre of the tree. The back shows marks resulting from finishing using a hand tool with a curved blade, such as an adze or curved chisel, and in places shows the uneven finish caused by splitting the wood, indicating that the panel is certainly still its original thickness.

The two narrow strips of wood, which have vertical grain, are both attached with large hand-made, square-

section nails (visible in the X-ray images); the inner strip is 4.4 cm wide, to which is attached a second piece of wood<sup>23</sup> 3 cm wide. The backs of these strips have also been finished using hand tools but, while the tooling on the main board is predominantly diagonal, that on the strips is in a vertical direction and nowhere do the diagonal strokes continue onto the additions. This might suggest that, although old, neither was part of the initial construction. However, while the outer piece of wood was probably added later (see argument below) examination of the ground and paint layers on the inner addition shows that the same priming has been used as on the main part of the panel. This piece of added wood, which makes the panel up to the same size as that for the *Angel in Red*, must therefore be part of the original construction.

The nails attaching the outer piece of wood on the left have been cut, implying that some wood has been trimmed from this edge. At the right edge is stuck a very thin sliver of wood (about 2 mm wide at the bottom) which tapers until it disappears at about 33 cm above the bottom edge. Its status is not clear, but its presence suggests that at some time more wood was attached to this edge, all but a trace of which has subsequently been removed. This theory is confirmed by the presence of several square-section nail holes in this edge.

Both vertical edges have therefore been altered more than once; more wood has been added, using similar carpentry techniques to the original panel – making the whole construction wider – and the extra wood has subsequently been totally or partially removed. A further change from the original state is indicated by the fact that the top and bottom edges show signs of having been sawn. This is not how the original panel would have been finished, implying that they have been cut later and, since the top of the arch of the grey niche is missing, the cutting must have occurred after the non-original backgrounds had been painted.

### *An Angel in Red with a Lute*

Overall size 118.0 (left) – 118.6 (right) × 60.9 (top) – 61.0 (bottom) cm

Like the *Angel in Green*, the panel on which the *Angel in Red* is painted is poplar,<sup>24</sup> with vertical grain. It consists of a broad piece of wood with a narrow strip attached on the left. The main panel is not strictly rectangular, measuring 57.6 cm wide at the bottom but 58.7 cm at the top. The thickness of the panel varies, being generally

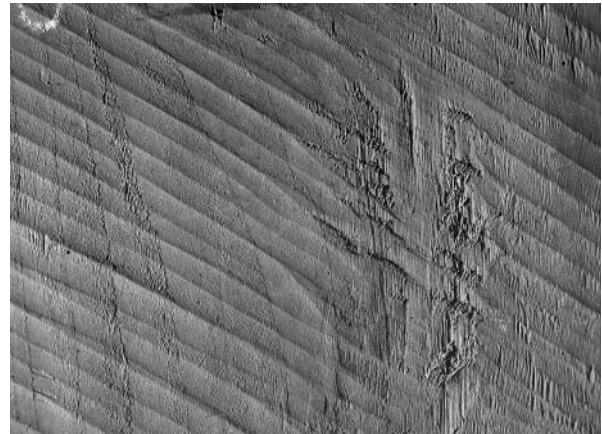


FIG. 3 NG 1662, *Angel in Red*, detail from the reverse of the panel showing the tooling.

about 2.8 cm thick but narrowing to only 1.8 cm in an area to the left of the middle near the bottom edge. The pattern of the wood grain (visible along the bottom edge) and the way the back has been finished (FIG. 3) are the same as those described for the *Angel in Green*.

The narrow strip at the left edge is 3.4 cm wide at the bottom, tapering to 2.2 cm wide at the top. It is attached and finished in a similar way to the additions on the *Angel in Green*, and the nails that were used have been cut, leaving remnants embedded in the wood. The remains of similar nails can also be seen embedded in the right edge of the panel, suggesting that more wood was once attached here too. Both edges have therefore been altered, but both have been finished using a hand tool, suggesting that the alterations were made some time ago. As with the *Angel in Green* the top and bottom edges show signs of having been sawn.

### Preparatory layers

Both panels have been prepared for painting with layers of gesso.<sup>25</sup> On both, the gesso is continuous to the top, bottom and right edges but the non-original outer pieces of added wood on the left have not been prepared for painting; the wood is left exposed. The grey paint of the niches is continuous to the top, bottom and right edges on both panels and up to the unpainted wood at the left, resulting in current painted widths of approximately 58.0 cm for the *Angel in Green* and approximately 58.7 cm at the top and 58.0 cm at the bottom for the *Angel in Red*.<sup>26</sup>

Over the gesso on both panels is a pale orange-pink oil priming consisting mainly of lead white, with small

amounts of red lead, lead-tin yellow and an even smaller quantity of verdigris (FIG. 4).<sup>27</sup> Verdigris seems to be a relatively unusual ingredient in a priming, although another example of a very similar mixture to that on the *Angel* panels has been found on the *Portrait of a Woman in Profile* (NG 5752) attributed to Ambrogio de Predis (see pp. 92–4 of this *Bulletin*) and on Boltraffio's *Virgin and Child* now in the Museum of Fine Arts in Budapest.<sup>28</sup> It is also mentioned as one possible component of primings by Armenini in his treatise of 1586 and by Leonardo in his notes for a treatise on painting.<sup>29</sup> Many large lead soap agglomerates have formed in the priming on the *Angel* panels due to reaction of the pigments with the binding medium. These protrude through the paint layers above, especially where the paint is thin.<sup>30</sup>

There is, however, some difference in the preparation between the two panels in that the priming for the *Angel in Green* has been applied in two layers.<sup>31</sup> The lower layer is slightly more opaque and less strongly coloured, with the red lead pigment well dispersed, while the second layer is slightly more yellow in hue and the red lead seems to have formed larger agglomerates of pigment (see FIGS 25 and 28). The greater translucency of the upper layer may be due to more extensive lead soap formation, perhaps as a result of higher concentrations of lead-tin yellow and red lead. The single priming layer on the *Angel in Red* (see FIGS 31 and 32) seems to be most comparable

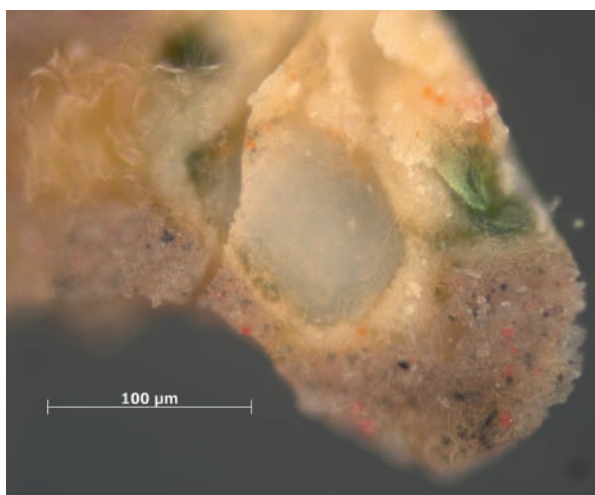


FIG. 4 NG 1662, *Angel in Red*, unmounted sample from the grey paint of the niche, to the left of the tip of the angel's proper left wing. The grey surface paint has cleaved from the layers below it, revealing the pinkish-brown paint of the original background (lead white, black and vermilion). In part of the sample the priming is exposed and can be seen to consist of lead white, red lead, lead-tin yellow and some large particles of verdigris. In the centre of the sample is a large lead soap pustule, which originates from the priming but has broken through the upper layers of paint.

to the lower layer on the *Angel in Green*, appearing more cream-coloured and less pink than the upper layer on the *Angel in Green*, as can be seen through cracks in the surface paint.

## Underdrawing

Infrared reflectography (IRR) shows underdrawing and changes made during the painting of the two pictures but, since the grey paint of the niche is not well penetrated, interpretation of the reflectograms remains difficult.

### *Angel in Green*

Infrared reflectography reveals underdrawing for the angel which is simple and linear (FIG. 5). The drawing is in a liquid medium and is of the type which can be associated with the reinforcing of a design which has been transferred mechanically (for example by the use of a pricked cartoon, or a tracing). In addition to outlines there is hatching for shadows, made with careful parallel strokes in the face (see FIG. 13), but freer and more scribbled in the drapery.

The drawing is followed closely; there are few changes apart from the sound holes in the vielle, which were first drawn higher. During the course of its execution, the angel's face was made slightly narrower by painting over part of the cheek.

### *Angel in Red*

In addition to drawing for the figure visible with IRR (FIG. 6) there is a network of straight lines which forms a grid. These lines are only visible in parts of the angel, but enough of each is clearly visible to make it possible to generate the whole grid (see diagram, FIG. 7). Parts of six horizontal lines can be seen and these are spaced about 16.5 cm apart (shown as white lines in the diagram). Parts of three vertical lines are also visible. At first sight these do not so clearly make a regular grid, since two around the middle of the painting are too close together. However, the distance between the two outer visible lines is again 16.5 cm (the white verticals in the diagram). A grid of 16.5 cm squares can therefore be completed (see the yellow lines in the diagram). The extra vertical line that does not fit this grid was drawn in what would have been the exact centre of the original panel





FIG. 5 NG 1661, *Angel in Green*, infrared reflectogram.



FIG. 6 NG 1662, *Angel in Red*, infrared reflectogram.

before the extra wood was added (the red line in the diagram). At the top and bottom of the panel (both of which we know to have been cut) the rows of 16.5 cm squares are not complete; the bottom would require another 4.5 cm of panel to complete the squares, while at the top more is missing and the panel would need another 11 cm. This would give a panel 132 cm tall and about 58.5 cm wide (red dotted line in diagram).<sup>32</sup> This seems a reasonable assumption since it gives more space to complete the painted niches, which, although not original, must have had panel to be painted on.

In the reflectograms the underdrawing for the angel is most easily visible in its right hand, drawn on the first position of the lute (FIG. 8). The lines of the underdrawing are quite narrow and sketchy looking but clearly in a

liquid medium, the slightly broken appearance of some consistent with brush drawing skipping over the texture of a swiftly brushed priming layer. It looks freehand and takes the form of many short strokes, feeling for contours and trying small changes. This description applies generally to all the underdrawing on this panel, although the drawing for the head shows fewer changes and seems to have been more carefully followed in the paint (perhaps suggesting that a separate detailed drawing for this part once existed). The squaring of the panel suggests that the overall design of the figure was copied freehand from a squared drawing, a method which enabled designs to be enlarged while still being copied accurately.

In the underdrawing, the figure holds the lute in a position to the right of and lower than where it now

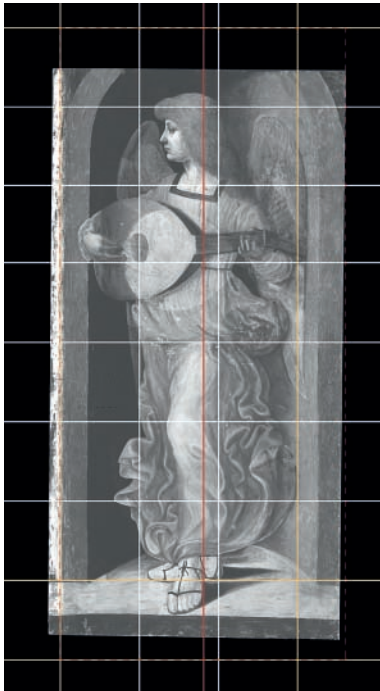


FIG. 7 Diagram to show the grid on the *Angel in Red*.

is. The right hand is angled more diagonally downwards, with the fingers straighter, and with the sleeve of the right arm over the front of the lute. Both IRR and X-ray images show that painting had begun with the angel holding the lute in the first position before the change was made. There is also some underdrawing for a lute closer to its final position, and for the sleeve and hand as they were finally painted, so this was clearly a problem the artist was working out as he went along.

Another change, perhaps associated with the shift of the lute, is that the angel's right wing seems originally to have been lower – a wing-shaped area, appearing lighter in the reflectogram, reaches up to the level of the angel's nose, suggesting that the darker background paint was blocked in around a wing in this earlier position. Paint for the background has also been laid in on the left, some of it quite dark, which is why the fingers of the angel's right hand (as it appears now) seem so strongly shadowed – they are painted over dark background



FIG. 8 Detail from FIG. 6 showing underdrawing for the angel's right hand on the lute in its first position.

paint up to the edge of the lute in its first position.

In the drapery the contours of the folds are under-drawn but there is no hatching. In addition to those necessary to accommodate the change in the position of the lute, some changes were made to the drapery during painting, the most obvious on the right near the bottom.

### Painting technique of the figures

The medium used for the original paint is walnut oil.<sup>33</sup> Both panels show areas where the paint has suffered from drying problems, causing disfiguring cracking or wrinkling. These occur in many of the darkest areas such as the hair and dark parts of the wings, in the red draperies on both angels, and in areas on the *Angel in Red* where changes have been made during painting, such as the repositioning of the lute.

Similar defects are seen in many works by Leonardo himself, including the London *Virgin of the Rocks*, and also in works by other artists of his circle.<sup>34</sup>

#### *Angel in Green*

The greyish hue of the flesh and the strong contrasts between light and shade are among the most distinctive characteristics of this painting. From the surface the flesh paint can be seen to contain an unusually high proportion of black – in the form of large particles with the splintery shape characteristic of charcoal – even in the highlights. Although an essentially opaque paint mixture of lead white with red lake, vermilion and the charcoal black already mentioned was used for the highlights and mid tones, it is rather thinly applied so that it has a greyish opalescence. The areas of deepest shadow seem to contain very little white, and in the one sample of flesh paint that exists (from the shadow of the angel's right hand) the paint can be seen to consist mainly of charcoal black and red lake. The particles of the red lake pigment are large and have a distinctive tabular shape, as well as an orange fluorescence in ultraviolet light that suggests that it contains madder dyestuff.<sup>35</sup>

The modelling of the flesh is achieved by blending different mixtures of the pigments (lead white, red lake, vermilion and black) into what becomes a single thin smooth layer of paint, with only a few touches super-imposed, such as the highlights and a very red stroke on the nose (FIG. 9). As a result, the original paint hardly



FIG. 9 NG 1661, *Angel in Green*, photomicrograph of the angel's nose.

registers in X-ray images; even the highlights in the flesh are barely visible. Not surprisingly, given the high proportion of black in the paint, the highlights in the face appear grey in IRR, with the shadows being far darker (FIGS 12, 13 and 14). At the top of the angel's forehead a small area of the pinkish priming has been left exposed which contrasts strongly in IRR with the adjacent flesh paint (although this is a light area of the face) demonstrating the highly infrared-absorbing nature of the paint. In some places the lighter strokes of flesh paint have been spread over adjacent colours, leaving a fingerprint-like texture in the paint,<sup>36</sup> suggesting that the artist was manipulating the paint with his hands so as to soften the contours (FIG. 10).

The green drapery of the angel is painted with thickly applied verdigris mixed with a little lead white and lead-tin yellow (FIG. 11). The strongest highlights are more opaque than the surrounding green paint as they contain far more lead-tin yellow. There is a dark modelled underpaint in warm greenish grey containing a high proportion of black mixed with some yellow earth and only a little lead white. It is this that is responsible for the modelled appearance of the drapery in IRR. The underpaint is exposed in the area between the fingers of the hand holding the bow, where little if any green has been applied to provide the deep shadows.<sup>37</sup>

The lower parts of the sleeves of the angel are dark red. The one cross-section from this area shows that here too there is a very dark underpaint, in this case consisting almost entirely of black pigment. The red paint on top contains what seems to be the same madder red lake seen in the flesh, some powdered colourless soda-lime glass, a little black (accounting for the slightly dull red tone)



FIG. 10 NG 1661, *Angel in Green*, photomicrograph of the edge of the angel's front foot showing a fingerprint in the paint of the highlight.

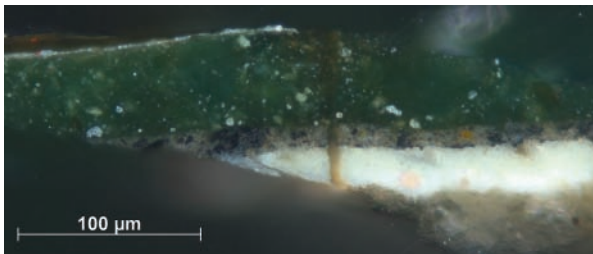


FIG. 11 NG 1661, *Angel in Green*, paint cross-section from an area of shadow in the upper green part of the angel's upper proper right sleeve. One or two thick layers of verdigris (mixed with a little lead white and lead-tin yellow) lie on top of a warm grey underpaint (black, yellow earth and lead white) which is modelled across the drapery. The two layers of priming can be seen on top of the gesso ground, the upper one being slightly more translucent. Overall the priming has a pinkish hue, but the tinting pigments are quite sparsely dispersed and here only lead-tin yellow can be seen mixed with lead white. Beneath is the gesso ground.



FIG. 12 NG 1661, *Angel in Green*, detail showing the head of the angel.



FIG. 13 NG 1661, *Angel in Green*, detail from infrared reflectogram (FIG. 5) showing the head of the angel.

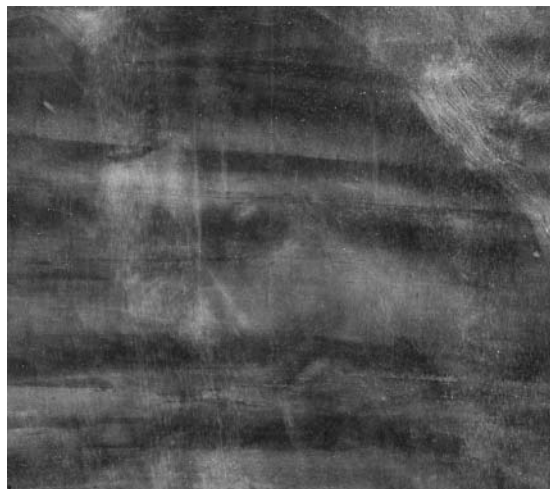


FIG. 14 NG 1661, *Angel in Green*, detail from an X-radiograph showing the head of the angel.



FIG. 15 NG 1662, *Angel in Red*, detail showing the head of the angel.



FIG. 18 NG 1662, *Angel in Red*, photomicrograph of the angel's nose.



FIG. 16 NG 1662, *Angel in Red*, detail from infrared reflectogram (FIG. 6) showing the head of the angel.



FIG. 17 NG 1662, *Angel in Red*, detail from an X-radiograph showing the head of the angel.

and a very little lead white (FIGS 19 and 20). This layer structure and the poorly drying, thick, medium-rich paint probably accounts for the bad drying cracks in this area.<sup>38</sup> Some details, such as the white puff of shirt issuing from the red sleeve at the angel's right wrist, and the bow on the strings of the vielle, were painted over the paint of the sleeve and the vielle respectively.

### *Angel in Red*

The flesh paint is quite different from that in the *Angel in Green*; the whole tonality is warmer and pinker. There seems to be a modelled layer providing a basic pink skin tone, and, unlike the flesh of the *Angel in Green*, there is only a little black mixed into the paint in shadows such as that at the side of the nose, and the darker areas are more brown than grey (FIG. 15).<sup>39</sup> A sample from the brown shadow of the foot of the angel confirms that the paint is a mixture of lead white, vermilion, red lake and a little black.<sup>40</sup> Over the base tone there is further modelling in brown for the shadows and a much paler pink which is thickest in the highlights (for example those on the chin, the upper lip, the tip of the nose and the eyelids). These thick unblended highlights, containing a high proportion of lead white, register strongly in the X-radiographs, resulting in an image with greater contrast in the areas of flesh than in the equivalent X-ray image of the *Angel in Green* (FIGS 16, 17 and 18).

The paint of the red dress has suffered badly from drying problems which have caused it to break into small islands, showing the orange-pink colour of the priming

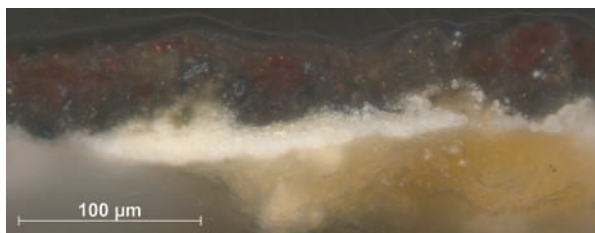


FIG. 19 NG 1661, *Angel in Green*, paint cross-section from lower red part of the angel's proper right sleeve. A thick cracked layer of red lake mixed with coloured powdered glass can be seen over the dark modelled underpaint, which here consists almost entirely of charcoal black. Two priming layers, with some transparent lead soap agglomerates visible in the upper layer, lie on the gesso ground.

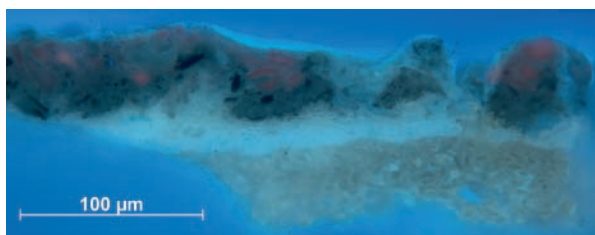


FIG. 20 NG 1661, *Angel in Green*, paint cross-section illustrated in FIG. 19 photographed under ultraviolet light. The red lake particles have a distinctive orange fluorescence which suggests they contain madder dyestuff. The jagged glass particles are also visible, including one that is particularly large at the left of the sample.

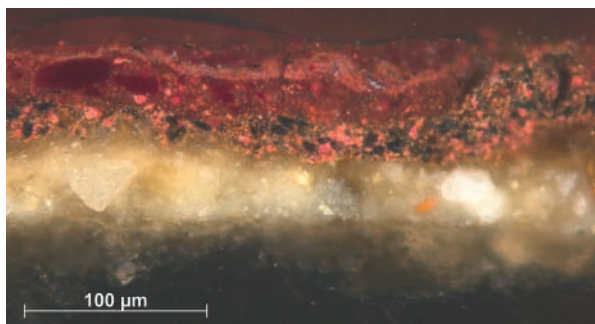


FIG. 21 NG 1662, *Angel in Red*, paint cross-section from the angel's red drapery showing the gesso ground and the orange-pink priming, followed by the opaque brick red underpaint consisting of black, red earth and vermilion. The upper red layers contain varying proportions of red lake and vermilion. The wrinkling that can be seen at the paint surface is also evident in the cross-section in the contours of the layers.

through the cracks.<sup>41</sup> Cross-sections show that there is a rather dull red modelled underpaint containing red earth, black and a little vermilion (FIG. 21). Over this layer is a brighter red paint based on vermilion and red lake, sometimes with a further red lake glaze. The underpaint contains pigments which absorb infrared and which therefore appear dark in infrared reflecto-

grams. From the reflectography it would seem that at least the underpaint for the dress was laid in before it was decided to change the position of the lute, the darker area carefully skirting the first position. Some highlights were included (these show better in X-ray images), but it is not clear how finished the dress was before this major change was made.

## Backgrounds

The most substantial alteration to the original appearance of both the musician angel panels was to the backgrounds, which are covered and concealed by the grey niches in which the angels now stand; these were themselves subsequently changed when the tops of the panels were cut, removing the apexes of the arches. As Plesters has already noted, the grey paint we see today, thick and coarsely applied with rather crude brushstrokes, is certainly not original.<sup>42</sup> In places this paint overlaps the original contours of the angels, or leaves original background exposed, altering their basic outlines (FIG. 22). Unfortunately neither the pigments nor the binding medium used in the grey paint have any characteristics which allow for exact dating,<sup>43</sup> but cross-sections show that it is applied over a layer of varnish which has had time to crack and to accumulate a significant quantity of dirt on its surface (FIG. 23).

This leads to the question of the original appearance of the backgrounds. Unfortunately the X-ray images are dominated by the pattern of brushstrokes from the later grey (lead white-containing) paint, while IRR gives only a limited idea as to what lies beneath, due to the thickness



FIG. 22 NG 1661, *Angel in Green*, photomicrograph of the non-original grey niche paint overlapping green drapery.

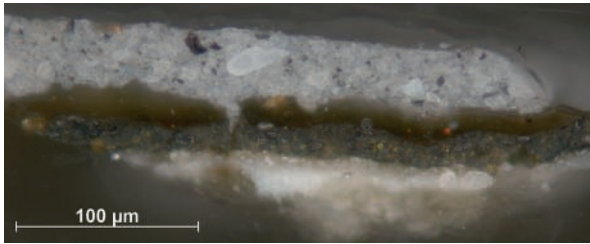


FIG. 23 NG 1661, *Angel in Green*, paint cross-section from the grey niche just to the right of the angel's head, showing the non-original grey paint running into cracks in a yellowed and dirty varnish layer below it. Beneath the varnish is the paint of the original background, which at this point is dark greenish grey (black and a little yellow earth and lead white).

of the paint and the high proportion of carbon black. Despite these hurdles, some features visible in these images give clues which, when combined with careful examination of the surface with a stereobinocular microscope (the lower paint layers could be seen through cracks in the surface paint) and information from paint cross-sections, permit some conclusions to be reached.

### *Angel in Green*

In the X-ray images incised lines can be seen running vertically just inside the incisions marking the inner edges of the front of the grey niche. At the top the incisions curve inwards to form the beginning of an arch, suggesting a niche, but one with a steeper profile than that used for the overpainted grey niche. The left vertical passes through the angel's right sleeve, while that on the right is continuous through the angel's wing, so if these do represent plans for a niche, the angel must have been standing in front of it.

Even though the grey paint of the later niche is not easily penetrated by infrared, some differences in the pattern of light and shade can be seen which seem to give further clues to the background's original scheme (see FIG. 5). Above the angel's wing on the right of the panel there is an area with a curved boundary which appears lighter (like an arched opening seen at an oblique angle). Much further down, below the area where the green drapery billows out to the right, a straight vertical boundary can be seen between a dark zone on the left and a lighter area on the right, which could be the bottom part of this opening. Looking through cracks in the grey surface paint above the angel's left wing, in what would be the upper part of this possible arched



FIG. 24 NG 1661, *Angel in Green*, photomicrograph of background near the top of the angel's left wing showing blue paint under non-original grey niche paint.

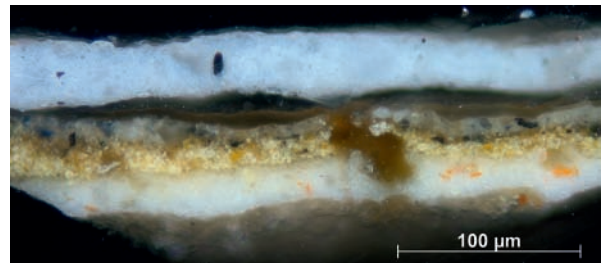


FIG. 25 NG 1661, *Angel in Green*, paint cross-section from the grey niche just above the area illustrated in FIG. 27. Two layers of varnish with dirt between them are visible here below the pale grey paint of the niche. The greyish blue paint of what appears to be a distant landscape contains ultramarine and a little lead white and black. Beneath are two greenish-yellow layers; a thin darker duller paint consisting of yellow earth and black and, immediately on top of the priming, a brighter yellower layer consisting of lead-tin yellow, yellow earth and lead white. The two layers of the priming on the gesso are evident, with some lead-tin yellow and red lead mixed with lead white and some translucent lead soap agglomerates.

opening, bright blue paint suggestive of a sky can be seen (FIG. 24). Further down, in the area below the wing which still appears light in the infrared image, the original background (seen again through the cracks) becomes a more greyish blue, perhaps suggesting distant hills, whereas near the bottom of the niche there is a relatively strong green colour, as might be expected in the foreground of a landscape. Paint samples confirmed these observations, identifying the bright blue paint as a mixture of ultramarine and lead white, while the greyer paint of what might be the distant landscape contains ultramarine with only a small amount of lead white and a little black (FIG. 25). The strong green paint lower down consists of verdigris mixed with lead-tin yellow, yellow

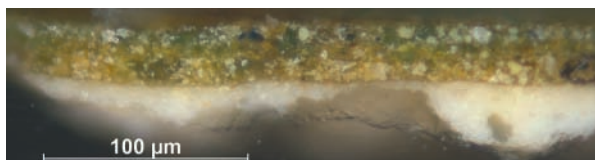


FIG. 26 NG 1661, *Angel in Green*, paint cross-section from the grey niche, towards the bottom right of the painting. The grey paint has been cleaved from the sample. Only the paint of the original background is present, which at this point is a strong green colour from what appears to be landscape (verdigris, lead-tin yellow, yellow earth and a little lead white and ultramarine).

earth, lead white and a small amount of ultramarine (FIG. 26). After the campaign of examination carried out between 2003 and 2005, a cleaning test was made to ascertain whether it might be possible to remove the grey paint safely, exposing a small part of the original background just above where the green drapery projects to the right at about knee level, where there is greyish blue paint which might be distant landscape (FIG. 27).<sup>44</sup> This gives a clearer idea of the possible original appearance in this area of the painting.

Further to the left, between the angel's left wing and its head, black paint is visible through cracks in the grey paint, which in a cross-section from this area can be seen to have been applied over a dark greenish-brown paint consisting of black mixed with some yellow earth. At the



FIG. 27 NG 1661, *Angel in Green*, detail from a photograph taken after an area of original background paint below the angel's left wing had been uncovered during tests in 2005, showing the original paint of a distant landscape.

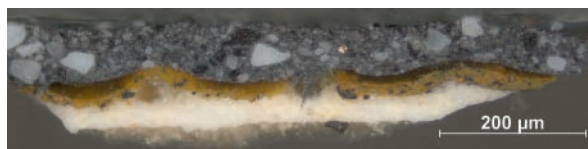


FIG. 28 NG 1661, *Angel in Green*, paint cross-section from a dark grey area of the niche, towards the bottom left of the painting (but within the incised line of the arch of the original background). The dark grey paint, on top of a varnish, contains distinctive large particles of white and black pigment that give the paint a granular texture. The paint of the original background is mustard brown at this point, consisting mainly of yellow earth with a little black. A lead soap pustule is pushing up this paint at the left of the sample.

very top of the panel, above the angel's head, the original background paint appears a rich chestnut brown, while further down to the left of the angel there seems to be a dark greenish brown. A cross-section from this area shows that there is a thin black layer over a rather more orange-brown paint composed of yellow and red earth with some black. Further down on the left and nearer the edge of the niche, the original paint appears to be a similar but brighter orange brown which can be seen from samples to consist of the same mixture of earths but with less black pigment (FIG. 28).

Under the angel's feet is a band which appears dark in the reflectograms, with very straight edges as though ruled; it extends diagonally from the curved bottom edge of the niche on our left towards the bottom of the panel, passing under the front foot (as if the angel was standing at the edge of a step set diagonally to the picture plane). This diagonal band can just be made out in the X-ray image and would appear to have incised edges. A cross-section from this area confirms that there is black paint in the area of this band, which in cross-section lies over a more brownish paint of yellow earth and black with a little lead-tin yellow and lead white. To the right of the angel's feet at the bottom of the panel the original background paint is a darker greenish brown (black and yellow earth) similar to that in the darkest areas behind the angel.

These observations, taken together, suggest that the first background for the *Angel in Green* placed the angel on a step in front of an arch, with a dark brown backdrop behind it which varied in tone (perhaps a curved niche), but that behind its wing on the viewer's right a view opened out to a landscape with sky, perhaps distant hills and a greenish foreground (see FIG. 34).



### *Angel in Red*

It is much more difficult to establish what is below the grey niche behind the *Angel in Red*. One unexpected finding, however, is that this angel had a halo, a simple curved line of gold leaf, now completely covered with the grey paint.<sup>45</sup>

As with the *Angel in Green*, in X-ray images vertical incisions are visible inside those made for the grey niche and finishing with arcs as though an arch or niche was planned for the original background. The incised vertical line on the left cuts across the angel's right hand, although before the lute was moved, the angel would just have fitted between the incisions. Also visible in the X-ray images are many scratches (or perhaps incisions) which do not obviously relate to the original composition and are difficult to interpret. Most interesting are a series of curved lines at shoulder level which cross the wings and some of the hair, although not the neck. These would seem to consist of a mixture of incisions and brush strokes (they also show in IRR) and they line up with the springing of the incised arch. What these are, and at what stage they were made, is impossible to determine for certain, but they were probably made before the angel's wing was painted and might suggest that the original background planned for this angel was a curved niche.

Exposed at the surface around the angel's foot (FIG. 29) and below the grey at the bottom of the panel (both the light grey of the floor of the niche and the dark grey at the edge) there is paint which has a salmon pink colour (not a single flat area but varying in intensity as though there is some modelling). The pigments identified in this mixture in a sample from this area were red earth and a small amount of lead white. Under the flat front part of



FIG. 29 NG 1662, *Angel in Red*, photomicrograph of paint below the angel's back foot showing original background colour.

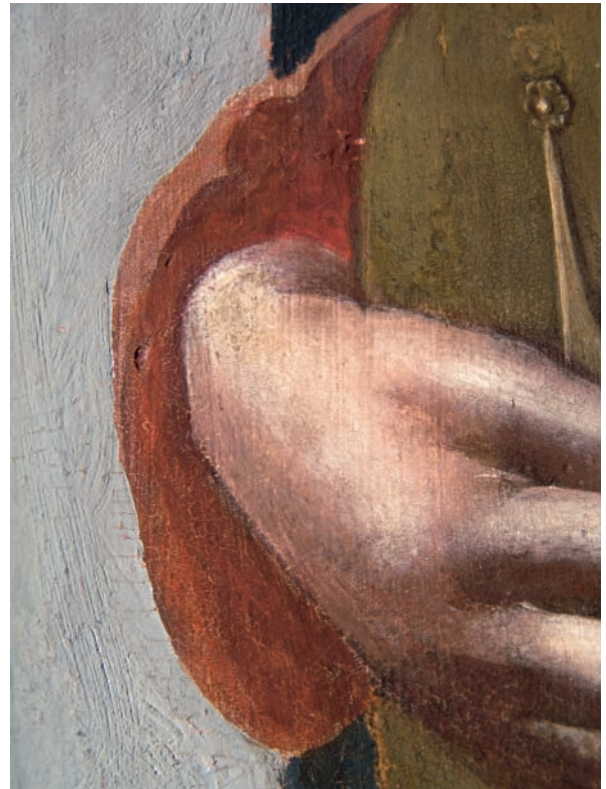


FIG. 30 NG 1662, *Angel in Red*, detail showing exposed background paint near the angel's right hand.

the grey niche, outside the incised lines seen in the X-ray image that seem to relate to the original background, the colour is similar but stronger, made with the same mixture of pigments but with some vermilion, red lead and a little black in addition.<sup>46</sup> This colour is most easily seen where grey niche paint has not been brought right up to the red drapery around the sleeve of the angel, leaving visible some original background paint which now reads as though it is part of the red drapery (FIG. 30). Within the curved part of the niche on the left the original background paint seems to be very dark brown. On the right this brown paint seems to be lighter in tone. Cross-sections from various areas confirm these observations, finding brownish and pinkish layers beneath the grey, sometimes two different colours over one another, made from mixtures of black, vermilion, red earth, lead white and sometimes a little lead-tin yellow (FIGS 31 and 32).<sup>47</sup>

Taken together, these observations suggest that the original background against which the angel was placed was also a niche, much the same as the grey one in shape but narrower and a different colour (see FIG. 33).

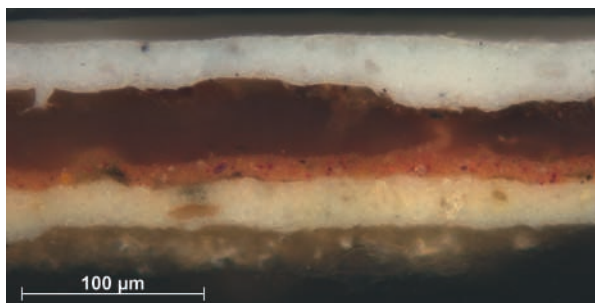


FIG. 31 NG 1662, *Angel in Red*, paint cross-section from the light grey of the niche to the right of the angel's feet showing orange paint similar to that visible in FIG. 29 directly on the priming (yellow and red earth with a little black and lead white). Between this original background paint and the light grey of the niche are two layers of varnish between which is a layer of dirt.

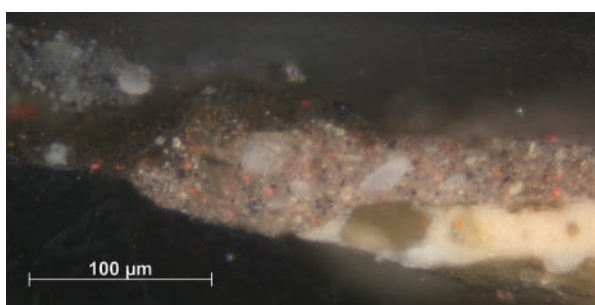


FIG. 32 NG 1662, *Angel in Red*, paint cross-section from a dark grey area of the niche on the left and just below the angel's lute. The original background paint, on top of the pale pinkish priming, consists here of two pinkish brown layers (vermilion, black, lead white and a little lead-tin yellow). The first is similar in tone to that visible in the sample in FIG. 4 but the second is much darker, containing hardly any lead white.

## Conclusions

The documentary evidence on these two panels and their companions gives rise to a number of questions relating to their history after the altarpiece was first installed. Some of these are answered, to some extent, by the technical examinations described above. It is clear that the significant alterations made to both panels during the five centuries since they were painted were several and probably took place at different times. It is now possible to give some idea of what the pictures might have looked like before they were overpainted and cut down.

The original poplar panels on which the *Angels* are painted are both about 58 cm wide; that for the *Angel in Red* was fashioned from a single piece of wood, while that for the *Angel in Green* from a slightly smaller board made up to the same width by attaching a narrow strip

of wood. The panels retain their original thicknesses; their reverses, which have been roughly finished using a hand tool, have never been decorated and would never have been intended to be visible. The idea that has been proposed in the past, that the two *Angels* were once front and back of a single panel, or that one was the front and the other the back of different movable double-sided wings, can therefore be firmly rejected.

The paintings are confirmed as the work of two artists – in addition to their different styles, they have different types of underdrawing and painting techniques – but they also have aspects in common. It has long been recognised that the two angels are the same size and that their poses, in particular the swirling draperies and the feet, are very similar. These observations have led to suggestions that one was copied from the other: usually, since the style of the *Angel in Green* is more like Leonardo's and therefore might have been painted later, the *Angel in Green* is assumed to have been copied from the *Angel in Red*.<sup>48</sup>

The results of infrared examination might seem to confirm this theory, since the underdrawing of the *Angel in Red* has been executed freehand, with the help of a grid, while that for the *Angel in Green* is based on mechanical transfer from a cartoon (or cartoons). However, although the distinctive patterns of some of the main folds do occur in both pictures, there are nonetheless significant differences between the draperies. By overlaying images of both, it becomes evident that the correlation is not as close as would be expected if a tracing made from the finished draperies of the *Angel in Red* had in fact been used for the *Angel in Green's* costume. Repaints on the red drapery and the grey niches have, as we have seen, substantially changed the surface appearance of the pictures, so a second overlay was made comparing the infrared reflectogram of the *Angel in Red* with that of the *Angel in Green*. This confirmed the differences in the draperies and produced another – unexpected and significant – finding. When the images are overlaid so that the feet of the angels are lined up as well as the drapery, the right hand of the *Angel in Green* (holding the bow) was found to be in exactly the same position as the right hand underdrawn for the *Angel in Red* in its first position, before the lute was moved. The right shoulders and the angle at which the arm descends also correspond closely.

We can therefore conclude that the *Angel in Green* was not copied from the finished *Angel in Red*. Nonetheless there is clearly a relationship between the two. Of the several possible scenarios, the one that seems best to



FIG. 33 NG 1662, *Angel in Red*, diagram to show, in simplified form, what is known about the structure and colours of the original background.



FIG. 34 NG 1661, *Angel in Green*, diagram to show, in simplified form, what is known about the structure and colours of the original background.

accommodate all the new facts is that the two different painters were supplied with the same design for a standing angel and then allowed to adapt it and work it up to full size independently so that the angels would have different heads and instruments. They each used a different method, one choosing to copy the design using a grid and to make the necessary modifications on the panel, the other making a cartoon. This relationship between the two paintings requires that they were painted at much the same time, and certainly excludes proposals made in the past that they differ widely in their dates of execution.

Stylistically, we are forced to conclude that these *Angels* are very unlikely to date from the time of the first commission. This view is now supported by aspects of their painting technique which they share with other Milanese paintings of the 1490s.<sup>49</sup>

We therefore need to consider how the *Angels* now in London came to replace whatever pictures were installed before the artists made their first unsuccessful appeal to the confraternity. The technical examinations discussed above revealed no signs that there was ever an earlier painting on either panel. The musician angels

must therefore have been painted afresh in a style that better matches the second (London) version of *The Virgin of the Rocks*. Although they appear from the *lista* to have been intrinsic to the original structure, it is possible that the first angel panels were extracted and sold when Leonardo's Louvre *Virgin of the Rocks* found a buyer. The whereabouts of the first set of *Angels* remains a mystery that is unlikely ever to be solved.

From the clues available it is possible to make some tentative suggestions as to the appearance of the original backgrounds of the National Gallery panels (FIGS 33 and 34).<sup>50</sup> On both there are incised lines marking the inner border of an arch which is narrower and more pointed than the arches of the grey niches (shown as white lines in the diagrams). In both cases the angels slightly overlap these incised lines, suggesting that they were originally depicted standing in front of arch-topped structures. All the colours seen through cracks or in paint samples from the background of the *Angel in Red* are variations of pink, orange or brown, ranging from quite bright colours, similar to the strongest flesh tones in the angel, to dark browns. The distribution of the various colours tends to match the variations in light and dark of the grey niche, suggesting that the original background was also a niche, similarly lit but made from red-brown stone. The results from the *Angel in Green* remain harder to understand. Behind and to the left of the angel there seems to have been deep shadow, but to the right was an opening that probably had an arched top (not incised) where brighter colours were found: blues, blue-greens and bright greens, which can be interpreted as a view of distant landscape. It has not been possible, however, to determine what colour the flat part of the niche (the incised structure) was painted, as so little of the original background survives beneath the grey paint in this area.<sup>51</sup> The infrared image suggests that the angel may be standing on an angled step, so the niche may also have been at an angle.

Some time after they were first installed in the altarpiece more wood was glued and nailed to both the lateral edges of each panel. Where they are still extant (at the left) these additions are unpainted. Why it should have become necessary to add extra unpainted wood to the edges of the panels is not clear, but it is known that the *Angel* panels were moved at least once, probably twice, to different positions within the altarpiece and it seems likely that one of these moves demanded their enlargement to fit a different-sized frame, or to allow a new frame to be attached.<sup>52</sup>

After the varnish applied over the paint had had time to crack, and a layer of dirt had formed over it, the backgrounds of both *Angels* were overpainted with the grey niches seen today, making them look more similar than they would have originally. Some time after this intervention, the top and bottom edges of both panels were cut with a saw, making it impossible to gauge their original height. It seems likely, however, that they would have been tall enough for the non-original grey niches to be complete at the top. Based on the grid found on the *Angel in Red*, it is possible that the panel might have been 132 cm high (that is, eight rows of squares each 16.5 cm high).

None of the results from the technical examination solve the question of where the two angel panels were originally located in the altarpiece, but if they were in an upper tier it might explain how the two artists escaped censure for these rather dissimilar backgrounds. The documentary evidence indicates that they were later brought down to the main tier, flanking *The Virgin of the Rocks*; in this position the discrepancy in their ill-matched backgrounds would have become more unsettling, suggesting that it was probably then that the grey niches were added. The changes in carpentry described above could also have happened at this time, since it would probably have been necessary to make new frames or fit the panels into different spaces in the altarpiece, but the subsequent sawing of their tops is more likely to have taken place when the panels were moved back to an upper tier.

Many questions remain to be considered. In particular, the two musician angels in their grey niches do not make a very good pair, and what has been found about the original backgrounds suggests that they were even less well matched when first painted. How they worked, together and within the whole altarpiece, therefore continues to be unresolved and is still an open subject for further discussion. Future considerations of these issues can now, however, be informed by a more complete understanding of the physical evidence offered by the paintings themselves.

## Acknowledgements

This article draws on work done by many current and former colleagues at the National Gallery going back to the 1940s. Much of this is already published, but we are particularly grateful to Ashok Roy and Helen Howard

for sharing their unpublished work on the samples taken in 2003–5 as well as some re-examination of the older samples that took place at that time. We would also like to thank David Pegg for carrying out some further medium analysis supplementary to that already published.

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[http://www.nationalgallery.org.uk/technical-bulletin/billinge\\_syson\\_spring2011](http://www.nationalgallery.org.uk/technical-bulletin/billinge_syson_spring2011)

## Notes

- 1 M. Davies, *National Gallery Catalogues. The Earlier Italian Schools*, 2nd edn (rev.), London 1961 (1st edn 1951), p. 270.
- 2 For a reasonably complete and up-to-date bibliography on Leonardo's paintings see F. Zöllner, *Leonardo da Vinci, 1452–1519: The Complete Paintings and Drawings*, Cologne 2003, pp. 223–4, 229. For the extensive documentary evidence for the commission, see esp. L. Beltrami (ed.), *Documenti e memorie riguardanti la vita e le opere di Leonardo da Vinci in ordine cronologico*, Milan 1919, pp. 12–20, 73–4, 102–7, 124–7, nos 23–4, 120, 169–70, 195 and 199; G. Sironi, *Nuovi documenti riguardanti la "Vergine delle Rocce" di Leonardo da Vinci*, Florence 1981; W.S. Cannell, 'Leonardo da Vinci's Virgin of the Rocks. A Reconsideration of the Documents and a New Interpretation', *Gazette des Beaux-Arts*, October 1984, pp. 99–108.
- 3 I. Rawlins, *From the National Gallery Laboratory*, London 1940, Plates 31 and 33.
- 4 Davies 1961 (cited in note 1), p. 263.
- 5 For the present study these X-radiographs from 1974 were digitised and assembled into composite images.
- 6 An account of the analysis of the samples taken in 1974, as well as their interpretation by Joyce Plesters, is published in 'Appendix C. Some analytical results from the Scientific Department, Nos. 1661 and 1662, Wings of a Leonardo Altarpiece', *The National Gallery, January 1973–June 1975*, London 1975, pp. 67–8.
- 7 Further samples were taken in 2005 from the grey backgrounds and examined by Ashok Roy with the assistance of Helen Howard.
- 8 In 2003 full infrared reflectogram mosaics were made with the Hamamatsu Vidicon camera. In March 2005 IRRs were made of both the paintings using the INOA High Resolution scanner by a team from the Opificio delle Pietre Dure (OPD) and Istituto Nazionale di Ottica Applicata (INOA) that included Cecilia Frosinini, Roberto Bellucci, Luca Pezzati and Pasquale Poggi. We are most grateful for their assistance. New IRRs were made at higher resolution with the OSIRIS digital infrared camera in 2011 for this study, which showed better penetration of the grey backgrounds and some other areas of the paintings. The IRRs illustrated here are therefore prepared from these most recent images.
- 9 'Item li quadri, vodi, sieno, angelli. iiii. per parte differentiati del uno quadro e l'altro, videlicet. uno quadro che canteno et l'altro che soneno.' This description implies two panels rather than empty spaces.
- 10 This arrangement might have been comparable to that of the altarpiece of the Virgin in the church of San Maurizio at Ponte in Valtellina, with the *Angels* possibly being above the main tier in spaces that were equivalent to those occupied by the sculpted saints in niches in that altarpiece. Illustrated in L. Keith et al. 'Leonardo da Vinci's *Virgin of the Rocks*: Treatment, Technique and Display', in this *Bulletin*, fig. 33, p. 51.
- 11 "li v[ost]ri fidelissimi s[er]vidori Johanne Ambrosio preda et leonardo de vinci florentino se conveneteno cum li scolari de la c[on]ceptione de sancto fran[cesc]o de M[i]ll[an]o, de farli una ancona de figure de relevo misa tuta de oro fino et uno quadro de una n[ost]ra dona depinta a olio et dui quadri cum dui angeli grandi depinti similiter a olio ...", see Beltrami 1919 (cited in note 2).
- 12 This could perhaps have presented difficulties if the panels were indeed part of the altarpiece structure as the *lista* implies (see note 9), although complex altarpieces at this time were usually made in such a way that they could be dismantled. If these panels remained *in situ*, this implies that they must have been completely repainted to match Leonardo's later style more closely. In some measure this is suggested by Cannell although, as we shall see, there is no technical evidence to support such an assertion. See Cannell 1984 (cited in note 2), p. 104.
- 13 See argument by L. Syson, 'Leonardo and Leonardism in Sforza Milan', in S.J. Campbell (ed.), *Artists at Court: Image-Making and Identity, 1300–1550*, Boston 2004, pp. 106–23, esp. pp. 111–14 (albeit in which the *Angel* panels are assumed to belong to the first phase of the partners' work on the altarpiece).
- 14 Syson 2004 (cited in note 13) tentatively attributed the *Angel in Green* to Marco d'Oggiono on grounds that no longer seem to him convincing. For Mazzotta see L. Syson et al., *Leonardo da Vinci: Painter at the Court of Milan*, exh. cat., National Gallery, London 2011, pp. 130–33.
- 15 This was first proposed by David Alan Brown in 1984 (see 'A Leonardesque Madonna in Cleveland', in M. Natale (ed.), *Scritti di storia dell'arte in onore di Federico Zeri*, Milan 1984, I, pp. 291–302) and reiterated by him in D.A. Brown, *Leonardo da Vinci. Art and Devotion in the Madonnas of his Pupils*, Milan 2003, pp. 48, 83–4, note 89. It has been accepted by Janice Shell and Maria Teresa Fiorio (in G. Bora et al., *The Legacy of Leonardo, Painters in Lombardy, 1490–1530*, Milan 1998, pp. 126, 209).
- 16 Pietro Marani attributes both pictures to Giovanni Antonio Boltraffio and Marco d'Oggiono working together (for him the principal executors of the London *Virgin of the Rocks*). See P.C. Marani, 'La Vergine delle Rocce della National Gallery di Londra. Maestro e bottega di fronte al modello. "Se tu, pittore, te ingegnerai di piacer alli primi pittori, tu farai bene la tua pittura..."', *Letture Vinciana*, XLII, 13 aprile 2002, Florence and Città di Vinci 2003, p. 14, figs 4 and 5. He had previously dated the works in the last decade of the fifteenth century, associating them stylistically with the London picture (although unfortunately placing too much trust in the authenticity of the niches). See idem., *Leonardo: una carriera di pittore*, Milan 1999, pp. 149–50. His picture captions suggest that at this point Marani credits the attribution of the *Angel in Green* to Francesco Napoletano (albeit a question mark is appended to his name), while he already tentatively and most implausibly ascribes the *Angel in Red* to Boltraffio. Alessandro Ballarin also rejects the attribution; see A. Ballarin, 'Riflessioni sull'esperienza milanese dello Pseudo-Bramantino', in *Problemi di Leonardismo Milanese tra Quattro e Cinquecento. Le due conferenze degli anni ottanta*, Padua 2005 (a lecture first delivered in 1987), and Francesco Frangi remains studiously noncommittal; see F. Frangi, 'Qualche considerazione su un leonardesco eccentrico: Francesco Napoletano', in *I leonardeschi a Milano: fortuna e collezionismo, Atti del Convegno Internazionale Milano 25–26 settembre 1990*, Milan 1991, pp. 71–86, p. 74.
- 17 Brown 2003 (cited in note 15).
- 18 Documents cited by Martin Davies (cited in note 1), pp. 261–81, indicate that the first suggestion that the chapel might be moved was made in January 1576, the request to move it made on 4 April 1576, and documents record that the change had taken place by 11 August 1576. For references to documents and guidebooks cited below see also H. Glasser, 'Artists' Contracts of the Early Renaissance', doctoral dissertation, Columbia University, 1965, New York and London, 1977; Sironi 1981 (cited in note 2); M.C. Passoni, 'Nuovi documenti e una proposta di ricostruzione per l'ancona della Vergine delle Rocce', *Nuovi studi. Rivista di arte antica e moderna*, 11, 2004–5, pp. 177–97.
- 19 Even if the *Angel* panels now in the National Gallery are substitutions for those mentioned in the 1483 contract, they probably still initially occupied the same position in the altarpiece. They were described, however, as lateral panels in the guidebook

- of Agostino Sant'Agostino, *L'Immortalità, e Gloria del Pennello, Ouero Catalogo delle Pitture Insigni che stanno esposte al publico nella Città di Milano*, Milan 1671, p. 42 [reprinted Milan 1980, p. 44, M. Bona Castellotti (ed.)]; 'Nella Capella della Concettione vi è l'Ancona con la Beata Vergine, e S. Gio. Battista, & à lato due tauolette con due Angioli, che suonano, opere del Celebre *Leonardo da Vinci*... This is repeated in C. Torre, *Il ritratto di Milano*, Milan 1674, p. 386: 'Nel Frontispizio poi in questa Nave apresi la Cappella dell'Immachiata Concezzione di Maria. Ha sull'Altare una Vergine Madre dipinta da Leonardo da Vinci entro vaga Tavola con due Angeli dai lati dello stesso Pittore [our italics] ...'.
- 20 It is clear from the following description of 1798 that the *Angels* were at that time on an upper tier: 'nella sommità dell'ancona due pezzi di quadri rappresentanti due angioli'. Davies 1961 (cited in note 1), note 87, p. 279. Martin Davies wrongly thought this late description provided some confirmation of the continuous presence of all three works on the upper tier. Whatever remained of the original frame (probably very little by that date) must have long ago disappeared. This was certainly not what could be found in the Sormani palace in 1954, as has sometimes been claimed.
- 21 Letter from B.J. Rendle, of the Forest Products Research Laboratory, in the Gallery archives.
- 22 Although most of the panel is around 2.8 cm in thickness, it is not completely uniform. In places it is only around 2.5 cm thick, while in other areas it is around 3.0 cm thick.
- 23 Also identified as poplar by B.J. Rendle of the Forest Products Research Laboratory (letter in the Gallery archives).
- 24 Letter from B.J. Rendle, of the Forest Products Research Laboratory, in the Gallery archives.
- 25 Ca, S and O detected by EDX analysis of cross-sections, indicating that the ground layer consists of calcium sulphate.
- 26 From examination of X-radiographs there is a suggestion that at the bottom of the *Angel in Red* the original ground and paint stop before the left join, giving a painted width of approximately 57.0 cm, while on the *Angel in Green* the original paint may not have extended all the way to the right edge. However as these outer edges are damaged and have more modern overpaint than elsewhere, it is difficult to be sure. X-ray images of the *Angel in Green* also show a clear pattern of roughly horizontal lines which are more absorbent of X-rays (and so show lighter); these are probably the result of unevenness in the application of the ground and/or priming.
- 27 The tinting pigments are quite dispersed and therefore not all of them were seen in every cross-section. Verdigris was seen in samples from the background of the *Angel in Green* and from the red drapery and the background of the *Angel in Red*. It was also visible in a small loss at the bottom edge of the *Angel in Green* with a stereomicroscope, a method of examination that gave a better idea of the distribution of the tinting pigments. The pigments were identified by EDX analysis on cross-sections. The presence of lead soaps and verdigris was confirmed by FTIR microscopy in transmission mode in a diamond compression cell.
- 28 Cross-section analysis was carried out by Alan Phenix, Getty Conservation Institute, while the painting was undergoing conservation treatment at the J. Paul Getty Museum. We are grateful to him for making his report available to us. The priming on the Budapest painting contains a higher proportion of red lead, although this is ascribed by Alan Phenix to remineralisation following lead soap formation.
- 29 Giovanni Battista Armenini's discussion of primings states that 'some make it with white lead, massicot and terra di campana; others make it with verdigris, white lead and umber.' Later he says 'But among the tinted primings, one that is held to be good is that which tends towards the colour of very light flesh and has a certain brilliant quality due to the fact that there is more varnish in it than in the others.' This is a description that could well apply to the priming on the *Angel* panels. A few sentences further on he states that 'the priming should be almost entirely of white lead, with one sixth varnish, and a little red that dries at the same rate.' See E.J. Olszewski (ed. and trans.), *Giovanni Battista Armenini on the True Precepts of the Art of Painting*, New York 1977, p. 192. Leonardo mentions a priming containing a copper green pigment (*verderame*) and yellow, although the mixture proposed seems unfeasible in practice as it contains a very high proportion of green. The exact meaning of this quote has been much debated since it seems rather confused and difficult to follow, which might in part be the result of mistranscription of the original, but the word *verderame* seems a clear reference to a copper green. The text is quoted and discussed in note 48 of the article by Jill Dunkerton in this *Bulletin*.
- 30 Red lead, lead white and lead-tin yellow are known to react regularly with fatty acids in the oil binding medium to form lead carboxylates, or lead soaps, which agglomerate and migrate to form large pustules. See C. Higgitt, M. Spring and D. Saunders, 'Pigment-medium Interactions in Oil Paint Films containing Red Lead or Lead-tin Yellow', *National Gallery Technical Bulletin*, 24, 2003, pp. 75–95; J.J. Boon, J. van der Weerd, K. Keune, P. Noble and J. Wadum, 'Mechanical and chemical changes in Old Master paintings: dissolution, metal soap formation and remineralization processes in lead pigmented ground/intermediate paint layers of 17th century paintings', *ICOM-CC 13th Triennial Meeting, Rio de Janeiro*, London 2002, pp. 401–6; Lead soaps are always found in oil paint containing lead-tin yellow, but lead-tin yellow itself ( $Pb_2SnO_4$ ) is less reactive than red lead ( $Pb_3O_4$ ) and lead white, and it is probably PbO that is present in the pigment from incomplete conversion during preparation that is reacting with the oil. Red lead can also contain PbO, depending on how long it was roasted during preparation. See D. Saunders, M. Spring and C. Higgitt, 'Colour change in red lead-containing paint films', *ICOM Committee for Conservation, 13th Triennial Meeting, Rio de Janeiro*, London 2002, pp. 455–63. Lead white is often cited as the cause of lead soap agglomerates, but although it does certainly react with the oil, it is to a lesser extent than these other lead pigments.
- 31 It has not been possible to ascertain the significance of this. The two layers are almost indistinguishable and have been applied very quickly one after the other. There is no evidence of one being applied later to cover something already begun. It is more likely that a second batch of paint for priming was mixed and applied over the first, perhaps to make it thicker or more even.
- 32 The fact that across the width there is not room for four complete squares might suggest that the original panel was wider, but the presence of the extra line at the centre of what is present of the original wood seems to confirm that this was the original width – and that the painter squared up both the painting and the drawing from which it derives, starting at the left edge. There is no proof that enough wood to complete squares top and bottom was originally present, but both edges have definitely been cut, so at least some is certainly missing.
- 33 Analysis of samples of original paint from the *Angel in Red* (brown from the edge of a wing and red-brown paint under the grey of the niche) by gas chromatography indicated that the binding medium is walnut oil (see J. Mills and R. White, 'Analyses of Paint Media', *National Gallery Technical Bulletin*, 1, 1977, pp. 57–9). These early results do not provide any indication as to whether the oil was heat-bodied.
- 34 See L. Keith, 'In Pursuit of Perfection: Leonardo's Painting Technique' in Syson et al. 2011 (cited in note 14), pp.54–77 and M. Spring et al. 'Painting in Practice in Milan in the 1490s: The Influence of Leonardo', in this *Bulletin*, pp. 78–112 for a discussion of drying defects in paintings by Leonardo and the 'Leonardeschi'. Although walnut oil is slower drying than linseed oil, a factor that is likely to be at least as important in the development of drying cracks and wrinkling is the tendency of these artists to use dark underlayers containing very little lead white, therefore applying faster drying upper layers over those that will dry more slowly.
- 35 ATR-FTIR imaging on this cross-section indicates that the red lake particles contain protein. This is indicative of preparation of the pigment using dyestuff extracted from wool fibres, with some of the wool being incorporated into the pigment during manufacture. This was a common method of manufacture of madder lakes at this period. For a discussion of this type of red lake pigment see J. Kirby, M. Spring and C. Higgitt, 'Insight into the Technology of Red Lake

- Pigment Manufacture through Study of the Dyestuff Substrate', *National Gallery Technical Bulletin*, 26, 2005, pp. 71–87. We are grateful to Satoko Tanimoto, Imperial College London, for carrying out this analysis.
- 36 For example, in the left hand of the angel the paint of the highlight along the thumb/palm of hand is spread onto the instrument, the highlight on the front foot spreads over the shadow on the back foot and, although it is less clear, something similar can be seen on the neck of the angel.
- 37 This has led to the picture being described as being unfinished, but it was probably just a pragmatic decision on the part of the artist who saw no need to try to apply more dark green paint (which would have been difficult to handle) on the small spaces between the fingers when the underpaint was already providing a dark greenish tone, especially as the picture was to be placed high up in the altarpiece so would not be easily seen.
- 38 The cross-section was analysed by SEM–EDX. The low proportion of Al in the red lake suggests that as in the flesh paint (which was analysed by ATR–FTIR imaging) a proteinaceous lake pigment prepared from dyestuff extracted from wool has been used. For a discussion of this type of red lake pigment see Kirby et al. 2005 (cited in note 35). The red lake has an orange fluorescence in UV light which is characteristic of madder. In addition angular particles that have the characteristic composition of soda lime silica glass were identified. For discussion of glass see M. Spring, 'Pigments in sixteenth-century painting of the German School', in *The pictorial technique of Grünewald and his peers*, P. Béguerie-De Paepé and M. Menu (eds), Musée d'Unterlinden, Colmar and C2RMF-CNRS, 2007, pp. 136–144; and M. Spring, 'Raphael's materials: Some new discoveries and their context within early sixteenth-century painting', in *Raphael's Painting Technique: Working Practices before Rome*, Proceedings of the Eu-ARTECH workshop organised by the National Gallery and Eu-ARTECH, London November 11th 2004, ed. A. Roy and M. Spring, *Quaderni di Kermes*, Nardini Editore, 2007, pp. 77–86.
- 39 The presence of black in the shadows is borne out by the appearance of the face in IRR, although they are not as dark in IRR as the shadows of the flesh of the *Angel in Green*.
- 40 This paint mixture is quite different from that in the shadows of the flesh of the *Angel in Green*, where the paint consists almost entirely of charcoal black and red lake. In the *Angel in Red* the painter has relied more on increasing the proportions of the red pigments to give the darker shadows rather than adding large amounts of black pigment. In addition, it appears that a different red lake pigment was used, since instead of the orange fluorescence suggestive of madder dyestuff seen in the red lake in the *Angel in Green*, here the red lake has a pink appearance in ultraviolet light that points towards a pigment prepared from an insect dyestuff source.
- 41 As a result of this cracking a considerable amount of overpaint has been applied to hide the exposed priming, which means that some care needs to be taken when commenting on overall paint handling in the red dress.
- 42 Plesters 1975 (cited in note 6).
- 43 Analysis of samples from the grey niche of the *Angel in Red* by gas chromatography identified the binding medium as walnut oil (see Mills and White, cited in note 34). These early analyses did not provide any indication as to whether the oil had been heat-bodied, but recent analysis of a sample from the grey niche on the *Angel in Green* by gas chromatography–mass spectrometry suggested that the walnut oil binder had been at least partially heat-bodied [A/P 1.3; P/S 3.0; A/Sub 4.0]. The pigments in the grey niche are lead white and what appears to be a black earth pigment of some type (as well as carbon, Al, Si and K were detected in significant quantity by EDX analysis indicating the presence of a silicate which suggests a natural mineral pigment). When examining the surface with a stereomicroscope, some particles with the shape of charcoal black were also seen. In two samples, there were one or two particles of the dark grey mineral galena (lead sulphide, PbS, identified by EDX). As so little is present it may be an impurity associated with one of the other pigments in the paint. It has not often been identified as a pigment, but has been reported on two Italian paintings from around 1500 (one altarpiece that was begun by Maineri and finished by Costa, and one altarpiece by Marco Marziale), as well as later in southern Germany (see Spring (2) 2007 (cited in note 38), but it has not yet been identified often enough to be able to draw firm conclusions about a pattern of use.
- 44 Tests made in the Conservation Department concluded that the grey paint could not be removed with acceptable control, so no further treatment was pursued and the test sites were covered.
- 45 The gold seems to be applied with a thin mordant onto the original background paint, but without further research it is not possible to tell whether this is original or a later addition.
- 46 The pigments in both the salmon pink paint at the bottom of the painting and the brighter, more orange, paint at the edges were confirmed by EDX analysis on cross-sections from these areas.
- 47 Confirmed by EDX analysis of cross-sections.
- 48 See for example L. Syson and R. Billinge, 'Leonardo da Vinci's use of underdrawing in the 'Virgin of the Rocks' in the National Gallery and 'St Jerome' in the Vatican', *The Burlington Magazine*, CXLVII, 1222, July 2005, pp. 450–63, note 12.
- 49 See M. Spring et al. 'Painting in Practice in Milan in the 1490s: The Influence of Leonardo', in this *Bulletin*, especially the section 'General features of the technique and materials of the paintings', pp. 78–112.
- 50 These diagrams are highly simplified attempts to summarise, in visual form, the results of the studies of the backgrounds in the two paintings as described in the text. The colours used are based on those identified in cross-sections or seen with a microscope down cracks in the overpaint, but as these certain identifications can only establish colour at particular points the boundaries between different colours are for the most part highly speculative and should not be taken literally. It has not been possible to determine the colour, or colours, used for the area outside the incised lines on the *Angel in Green*, so this part of the diagram has been filled in with a neutral grey tone, which should not therefore be regarded as a representation of what was there originally. The positions of the current edges of the panels, including the later additions, are drawn in blue in the diagrams. Within these blue boxes the white lines indicate locations where incised lines, which relate to the original background, were found on the X-ray images. These have been continued to complete the arcs (drawn in white, although clearly there are no incisions to follow beyond the edge of the panel so the part above the blue line is speculative). The red outline in fig. 33 indicates the suggested original size of the panel for the *Angel in Red* as calculated from the grid (see fig. 7). On transposing this red outline onto the diagram for the *Angel in Green* it was found that the completed incised arch fitted exactly, so this same outline has been used as a suggested original panel size in fig. 34.
- 51 Three samples exist from the outermost part of the arched structure of the original background. However, they include only traces of what might be original paint; in one case this seems to be pale grey, in another yellowish and in the third greenish. These traces are so small that it is not possible to draw any firm conclusions from them.
- 52 Unfortunately the subsequent removal of most of this added wood means that any evidence to support such a theory, such as nails or dowels, has been lost.