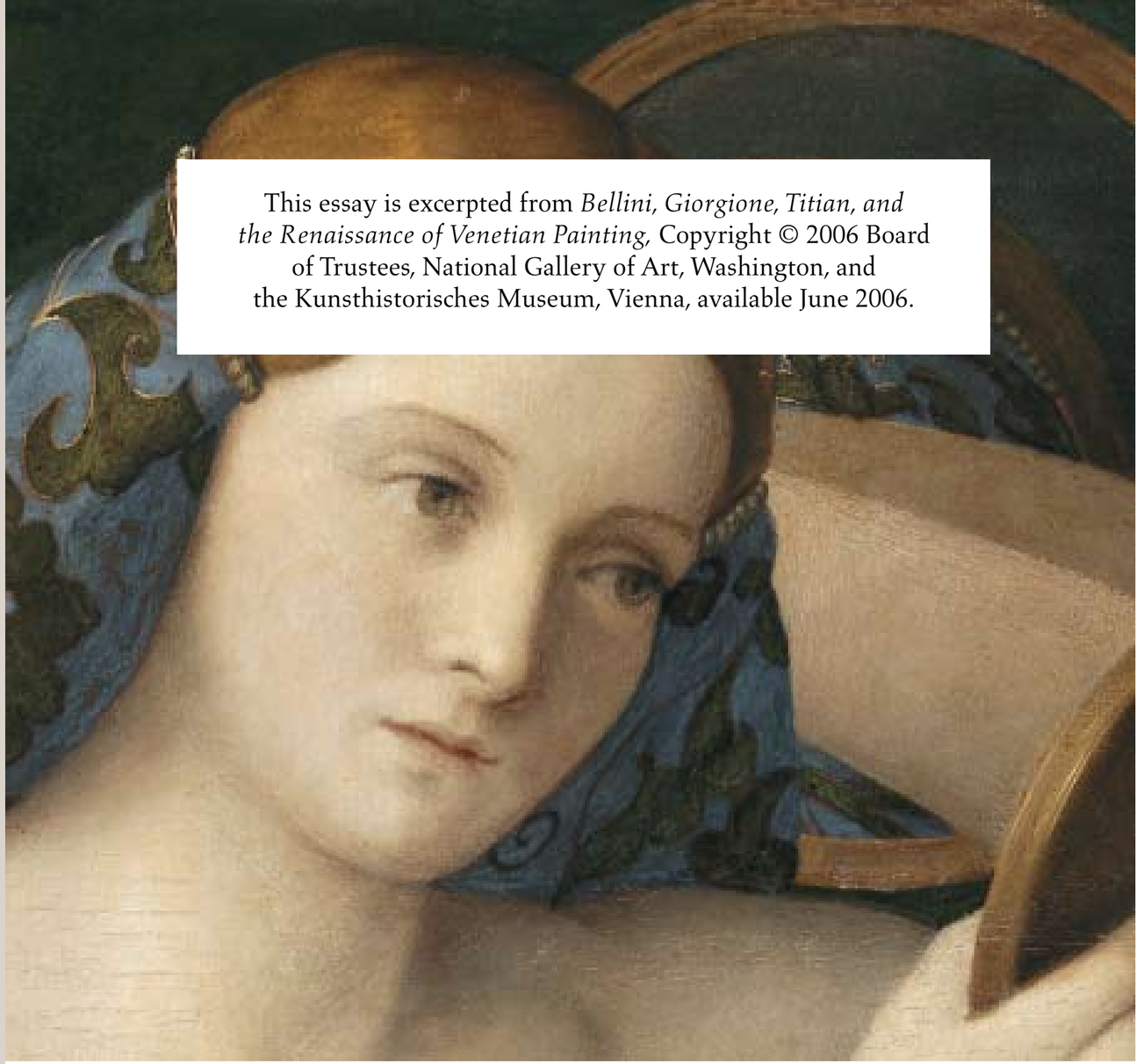


TECHNICAL STUDIES OF PAINTING METHODS ✳ *Elke Oberthaler and Elizabeth Walmsley*

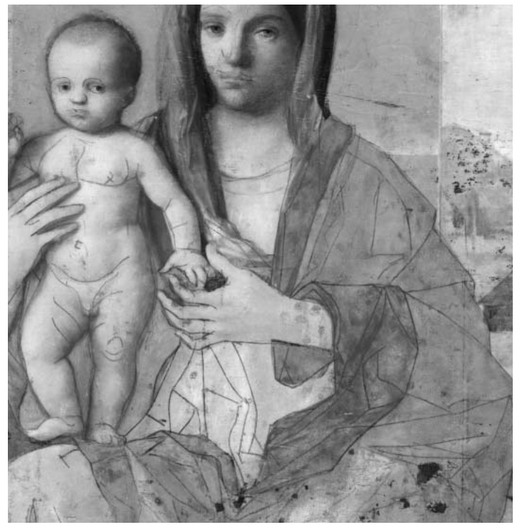
THE USE OF TECHNICAL EXAMINATION for art historical research has a long tradition. By the time the International Conference for the Study of Scientific Methods for the Examination and Preservation of Works of Art was held in Rome in 1930, x-radiography was already an established tool in the field.[1] One of the first attempts to explore its potential for the study of Venetian paintings was the 1932 article by Johannes Wilde, curator of the Gemäldegalerie at the Kunsthistorisches Museum, Vienna, about two paintings in the museum's collection: Giorgione's *Three Philosophers* (cat. 30) and Titian's *Gypsy Madonna* (cat. 2).[2] X-radiographs of the two pictures revealed that during the course of painting the compositions had been dramatically revised. With these insights into the artists' creative process, suggesting that Giorgione, Titian, and other Venetian painters developed their compositions directly on the canvas, Wilde and other early researchers hoped to resolve questions of attribution and subject matter. Wilde exchanged x-radiographs of these two paintings, as well as of Giovanni Bellini's *Lady with a Mirror* (cat. 41), with Alan Burroughs, curator at the Fogg Art Museum, Cambridge, Massachusetts. Burroughs' 1938 book, *Art Criticism from a Laboratory*, was the culmination of twelve years of compiling x-radiographs of paintings in both America and Europe.[3] A chapter on Giorgione and Titian summarized Burroughs' interpretation of their brushwork and working methods as illustrated by x-radiographs. Burroughs' views regarding the authorship of the *Three Philosophers*, the *Gypsy Madonna*, and Bellini and Titian's *Feast of the Gods* (cat. 32) varied in certain respects from Wilde's, demonstrating that the results of technical investigations are not objective, but require interpretation, and thus will always be open to revision.[4]

The use of underdrawing beneath the painted surface of a picture may be inferred from x-radiographs, but since the underdrawn lines cannot be visualized with this technique, infrared photography and infrared reflectography have now come to be used as the primary tools for investigating the graphic preparation in paintings. Infrared photography had been discussed at the 1930 Rome conference, but the first use of infrared reflectography to study Venetian paintings at the Kunsthistorisches Museum took place in 1989, when Charles Hope and J. R. J. van Asperen de Boer, inventor of the technique, discovered underdrawing in the *Three Philosophers*, the *Gypsy Madonna*, and the *Lady with a Mirror*.[5]

Since these pioneering studies, further investigations of underdrawing by Bellini, Giorgione, and Titian have been undertaken, as well as continued improvements in x-radiography and infrared imaging, particularly with the increased availability of inexpensive computers and software. The present exhibition provided an occasion for the Kunsthistorisches Museum and the National Gallery of Art to jointly assess the results of technical investigations of paintings from the two museums, focusing particularly on x-radiographs and infrared images, here referred to as technical photographs.

For this study, we chose, in addition to the pictures mentioned above, Giorgione's *Laura* (cat. 38) and his *Adoration of the Shepherds* (cat. 17), all paintings completed in the narrow span from about 1500 to 1515, with the goal of comparing the working methods of their creators at this important moment in the development of Venetian painting.

1. Giovanni Bellini, *Lady with a Mirror* (cat. 41). Infrared reflectogram showing detail of underdrawing.



2. Giovanni Bellini, *Virgin with the Blessing Child* (cat. 1). Infrared reflectogram showing detail of underdrawing.

Cat. 41 Giovanni Bellini: *Lady with a Mirror*

Giovanni Bellini painted the *Lady with a Mirror* a year before his death at about the age of eighty. From their 1989 infrared examination of the picture, Hope and Van Asperen de Boer concluded that Bellini had followed traditional working methods, in which artists "worked out their compositions fully in advance, and used underdrawing as a means of recording the design on the gesso ground."[6] More recent technical investigations into Bellini's oeuvre have revealed that modifications in his working methods were made throughout his life. Examination of the *Lady with a Mirror* confirms Bellini's attention to contours and also reveals his innovative use of a textured, colored underpaint layer.

Although passages of faint black underdrawing are apparent to the eye, the infrared reflectogram captured in 2005 reveals the spare contour drawing more fully (fig. 1). The outer contours of the figure, defined in the underdrawing, were retained in the application of the paint layers. Although the major drapery folds were underdrawn, additional pleats and folds were added during the paint stage. In place of hatchmarked shadows, the underdrawing of the *Lady with a Mirror* includes several carefully outlined details, such as the drapery shadow beneath the woman's elbow, the line of her collarbone, and the swell of her shoulder, which were not modeled until the paint stage. The underdrawing of Bellini's *Virgin with the Blessing Child* (cat. 1) is remarkably similar both overall and in detail (fig. 2).[7] Much of the underdrawing in these two pictures, particularly the facial details and the outlines of the arms in the *Lady with a Mirror*, has a stilted quality peculiar to compositions transferred using "carbon paper" drawings, a technique in

which a drawing, or an interleaved sheet of paper, is blackened with charcoal on the reverse, then incised through the front to transfer the necessary contours onto a prepared panel. In this way, a design can easily be duplicated. Some of the underdrawn lines, such as the contours of the lady's neck and shoulder, and the fingers of her right hand, have a more unrestrained feel. Perhaps the main contours were transferred from a cartoon and the rest of the underdrawing was developed freehand.[8]

While many of Bellini's paintings have fingerprints texturing the surface or the *imprimitura*, the *Lady with a Mirror* has a stippled texture made with a paintbrush in all areas but the figure.[9] This texture, very subtle and hardly apparent on the surface, is visualized more clearly in the x-radiograph (fig. 3), which indicates that the stippling was applied to an opaque, light gray underpaint beneath the paint layers.[10] Bellini must have underdrawn the main features of the composition before he textured the gray layer, because the stippling, which includes areas of fleshtones covered by draperies, ends exactly at the boundaries of the fleshtones.[11] The juxtaposition of the almost marmoreal fleshtones against the stippled background of cloth and carpet was therefore an artistic choice made possible by the use of the slow-drying oil paint medium. The sculptural quality of the woman's body has been observed by previous authors, who have suggested that her pose is based on classical prototypes. The mirrors and the woman's reflection have also prompted them to interpret the painting in the context of the *paragone*.[12]

The textured underpaint layer also explains the broken appearance of the underdrawing for the red drapery on the ledge and the scored line for the window, which, unlike the underdrawing in the rest of the painting, seem to have been drawn on a roughened surface. Bellini used what appears to be a distinctive process of underdrawing. The underdrawing was first applied to the gesso and served as a guide for applying and texturing the gray underpaint in the background. Then, the folds in the lower left quadrant were (re)drawn on top of the textured layer. In the final stages of painting the picture, Bellini emphasized some of the contours—for example, the outline of the woman's elbows and the edge of the curtain—by reinforcing them with incised lines, possibly made with the end of a brush.[13] A compass was used to construct the round mirror, the outlines of which are both underdrawn and incised.[14] Thus, Bellini was able to retain the major contours of his composition through the entire painting process, a very different procedure than the one used by Titian in the *Gypsy Madonna*.

3.
Giovanni Bellini, *Lady with a Mirror* (cat. 41). X-radiograph showing detail of texture in background.

Cat. 32 Giovanni Bellini and Titian: *Feast of the Gods*

In 1956, John Walker published a composite x-radiograph (fig. 4) of the *Feast of the Gods* that revealed its original appearance as finished by Bellini, with figures seated in front of a forest with tree trunks extending across the entire width of the picture.[15] Walker was thus able to modify Vasari's claim that Titian completed Bellini's picture by demonstrating that the younger artist had actually repainted the left side of a finished landscape. Walker also proposed that Titian altered some of the figures by adding attributes and by lowering the necklines of some of the nymphs and goddesses. The presence of an intermediate landscape, seen on the left side of the composite x-radiograph and consisting of a mountain with architectural ruins, raised the possibility that another artist had previously revised that part of the composition before Titian intervened. Burroughs, who had already x-rayed the painting in 1930, focused on the silhouetting of the figures and trees, which he attributed to an "outlined preparation."[16]

The most substantial investigation of Bellini's working methods in the painting was carried out by David Bull and Joyce Plesters using the earlier x-radiographs, as well as an infrared reflectogram and cross sections taken during Bull's restoration of the painting begun in 1985.[17] They reexamined the alterations to the figures that Walker had attributed to Titian and found that they were made, instead, by Bellini. Bull further substantiated earlier proposals that Dosso Dossi was the author of the intermediate landscape and the pheasant in the tree by finding parallels in Dosso's painting technique. Operating under the same assumption as Burroughs—namely, that Bellini must have used an underdrawing for the complicated, multifigured scene—Bull and Plesters made considerable effort to determine the nature of the underdrawing, but no evidence of it was found using an infrared vidicon camera.[18] Later, a second attempt to detect underdrawing was made using transmitted infrared reflectography.[19] The "transmittogram" (fig. 5) of the top left quadrant reveals outlines along the tree trunks and intertwined branches. Instead of an underdrawing of fine lines, as expected, the freely drawn outlines are unusually wide and there are some brushy lines within the tree trunks.[20] This surprising image highlights the complexities of interpreting technical photographs. Do these wide brushstrokes reinforce an underdrawing that is invisible at these infrared wavelengths? Are the brushy lines part of the underpaint stage? Or is this, indeed, Bellini's

4.
Giovanni Bellini and Titian, *Feast of the Gods* (cat. 32). Composite x-radiograph.

underdrawing, not made with a small paintbrush or quill pen, but with a brush large enough to expedite covering a large area of canvas with the bold forms of the tree trunks? The picture was examined yet again several years later using a platinum silicide infrared camera (fig. 6).[21] The legibility of the infrared image increased, and several branches in the tree canopy on the right side of the painting and a few additional tree trunks on the left side were revealed. Most important, a compositional change was found, disclosing the first position of Lotis' foot, finely underdrawn to the left of the final version. The fine underdrawing of the foot thus makes it more likely that the wide brushstrokes in the trees were the reinforcement of a first underdrawing.

Cat. 38 Giorgione: *Portrait of a Woman ("Laura")*

Giorgione's *Laura* was x-radiographed as part of the early campaign by Wilde.[22] The original support, a fine canvas glued to a fir panel, was cut down into an oval in the early eighteenth century. Later in the century, ten pieces of oak were added to regain the original rectangular format. The painting's complex structure obscures the legibility of the x-radiograph. But recently, the x-radiograph was digitally enhanced and significant changes in the background were revealed.[23]

Beginning in 1989, several attempts were made to detect the presence of underdrawing using infrared reflectography.[24] The infrared reflectogram (fig. 7) captured in 2004 again failed to reveal evidence of underdrawing. Nonetheless, it allows compositional changes in the background, already known from Wilde's x-radiograph, to be organized into a logical sequence.

5.
Giovanni Bellini and Titian, *Feast of the Gods* (cat. 32). Transmitted infrared reflectogram showing detail of top left quadrant.

6.
Giovanni Bellini and Titian, *Feast of the Gods* (cat. 32). Infrared reflectogram.

7.
Giorgione, *Portrait of a Woman ("Laura")* (cat. 38). Infrared reflectogram.

The laurel was included at the earliest stage: the x-radiograph (fig. 8) shows an area for the leaves that was left in reserve while a light-colored background was laid in. The mass of leaves was much wider than in the finished painting, and would have created a dense cluster around Laura's head (fig. 9, dark gray). Cross sections indicate that the background, at this stage, consisted of a pale blue sky and perhaps a distant landscape. Then Giorgione reconsidered

8.
Giorgione, *Portrait of a Woman ("Laura")* (cat. 38). X-radiograph.

9.
Giorgione, *Portrait of a Woman ("Laura")* (cat. 38). Diagram of changes in the laurel.

10.
Giorgione, *Three Philosophers* (cat. 30). Composite x-radiograph.

11.
Giorgione, *Three Philosophers* (cat. 30). Infrared reflectogram showing right side of painting.

8

9

the background; cross sections show a dark brown paint was used to block out the blue sky. This stage is shown in the infrared image (fig. 9, light gray): rather than a backdrop of leaves, there is a spray of leaves only on the right side of the painting, behind Laura's head. On the left side, the background was filled with a brushy application of dark paint, leaving an area in reserve for Laura's long side curls, but none for any leaves. The leaves on the left side are very faint in the infrared reflectogram because they were painted on top of the dark background paint, which means they were added next. In the final stage, Giorgione roughly merged the two earlier versions of the laurel behind Laura by adding leaves on the left side of the painting, on top of the dark background (fig. 9, black outlines). These changes indicate how Giorgione continued to develop the composition during the painting process, as noted long ago in the *Tempest* (page 44, fig. 3) and the *Three Philosophers*.

Changes, less dramatic than those in the background, were also found in the figure of Laura.[25] The infrared reflectogram and the x-radiograph reveal that adjustments were made to reduce the décolletage, while her features and hair remained unchanged. The white veil, as seen in the x-radiograph, was painted with sweeping brushstrokes that form a figure eight around her right breast. She may originally have worn a chemise instead of a veil. In a second stage, her left fur collar was narrower, exposing more of her bust; and the veil that took the place of a chemise wound around her breast and continued up to her shoulder. The infrared image shows a line indicating the original edge of the narrower collar. The wide, horizontal band of fur at the bottom of the picture, which truncates the décolletage, was added later by Giorgione.

10

11

Cat. 30 Giorgione: *Three Philosophers*

As one of the few secure works in Giorgione's oeuvre, the *Three Philosophers* has played a key role in the study of his working methods, as reflected by the literature interpreting the x-radiographs (fig. 10). The first x-radiographs, published in 1932 by Wilde, revealed extensive changes in the composition.[26] Since then x-radiography has continued to be used to clarify the still unresolved and much debated question of the subject matter of the painting. In 1991, Hope and Van Asperen de Boer published several infrared reflectogram details with underdrawing that corresponds to the earlier stages of the painting seen in the x-radiographs.[27]

The most important recent contribution made by technical study of the *Three Philosophers* is a new overall infrared reflectogram (fig. 11) that was captured with the INOA scanner in 2004.[28] It visualizes with great clarity an extensive amount of underdrawing throughout the painting and forms a touchstone for assessing Giorgione's underdrawing style in the absence of such evidence from other secure works.

The underdrawing is complex and the style is not consistent. The figures and most of the landscape features were indicated in bold outlines using a large brush. They vary from loosely drawn freehand to stiffer lines. The eyes of the middle philosopher were shifted; in the infrared reflectogram, the underdrawn lines reinforcing the second set of eyes are much darker than the first. Diagonal hatchmarks are found in his face (also faintly visible to the eye).[29] Above the older philosopher, the outlines of the trees and bushes in the upper right corner are underdrawn. The left side of this foliage is underdrawn in a series of short, scalloped lines, almost semicircles. The right side of the foliage and the tree trunk (at the extreme right edge of the painting) have a hard-edged outline, hinting at the use of a tracing or transfer technique.

Throughout the infrared reflectogram, the underdrawn lines do not register with equal strength because some of the lines are blocked by the paint layers; this depends on the pigments used and the number of paint layers on top. For example, the underdrawing in the middle philosopher is especially clear, because the paint is built up in thin layers that are transparent in this region of the infrared spectrum. It is even possible to differentiate between the stronger, darker lines for the neck and chin and the more fluent lines for the hatchmarks. In contrast, the paint used for the highlights of the red tunic cannot be penetrated and block parts of the underdrawing for the short hem in the earlier version.

Based on his interpretation of the x-radiographs, Wilde had proposed a first version of the *Three Philosophers* with headdresses worn by all three figures, a short tunic donned by the middle philosopher, and small buildings on a distant hill beyond the large tree trunks. As the x-radiographs show that these features had progressed beyond the underdrawing stage and had, at a minimum, been blocked in with paint, Wilde's assumption was that Giorgione had completed a first version, which he then revised to create the painting's present appearance, rather than making a succession of changes during the painting process. The most recent technical studies substantiate the latter, more complicated, working procedure, in which Giorgione experimented with a number of approaches to setting the figures in the landscape and several depictions of the foreground, middle, and far distance.[30]

Compositional changes apparent in the x-radiographs now can be reassessed, together with the underdrawing seen in the infrared reflectogram of 2004, to understand how the painting developed. Common elements include the small buildings in the distant landscape, the shorter tunic of the middle philosopher, and the headdress of the older philosopher and his earlier profiles. In the background, trees were added, then removed at different stages, perhaps to partially regain the open sky of the earliest versions; some of them are visible in the x-radiographs, others only in the infrared reflectogram. The foreground landscape was also revised in several stages. The figures were separated from the distant landscape by an additional hillock, at the level of the seated philosopher's shoulder. The hillock, though underdrawn, is not evident in x-radiographs. It may have been part of the underdrawing stage, or a late change during the elaboration of the present light green landscape next to the seated philosopher's hands. The middle, roughly hewn step was underdrawn with rounded corners. This shape was carried into the paint stage, and the sharp corner at the back was added on top. At the underdrawing stage, the standing figures' robes were longer, with the older philosopher's draperies underdrawn nearly to the bottom edge of the painting, and the middle philosopher's draperies extending to his toes. Even though the two left figures have multiple underdrawn attempts at locating their feet, the shorter length of the robes was determined by the time the paint was applied, as there are distinct boundaries in the x-radiograph. Other areas of fine underdrawing, such as the random lines in the seated philosopher's elbow, do not appear to correspond to any of the earlier compositions.

The middle philosopher's head underwent fewer changes than the others. There is a lower but abandoned position for the eyes in the underdrawing and an additional cloth covering his forehead beneath the turban, which is not underdrawn and was probably added later in the painting process. Between the first short tunic seen in the x-radiographs and the longer one seen in the finished painting, there is an underdrawn line slightly above his knees. This may have been intermediate step in determining the length of the tunic, and a characteristic intermingling of underdrawing and painting in the picture. The profile of the older philosopher was underdrawn and painted, as seen in both the infrared reflectogram and x-radiographs. Another underdrawn line slightly to the right suggests a third profile.

The x-radiographs reveal a pentimento in the seated figure, where the light underpaint of the sky cuts through his face. From this, Hope and van Asperen de Boer suggested the possibility of an early paint stage with fewer trees and just the two standing figures.[31] However, evidence that all three figures could have been included at this early stage is provided by the new infrared reflectogram, which reveals traces of underdrawing in the seated philosopher's draperies. Moreover, the distinct boundaries of the paint application seen in the x-radiographs imply that Giorgione followed some sort of preliminary sketch for this figure. The x-radiographs also reveal a headdress, now hidden by his curly hair.

12.
Giorgione, *Adoration of the Shepherds ("Allendale Nativity")* (cat. 17). Composite x-radiograph.

13.
Giorgione, *Adoration of the Shepherds ("Allendale Nativity")* (cat. 17). Infrared reflectogram.

Cat. 17 Giorgione: *Adoration of the Shepherds ("Allendale Nativity")*

Beginning in 1937, while the *Adoration of the Shepherds* was on the market, x-radiography (fig. 12) was seen as a tool to help resolve its attribution, whether to Bellini, Giorgione, Titian, or Sebastiano del Piombo.[32] By the time Jaynie Anderson discussed the infrared reflectogram (fig. 13), in her 1997 monograph, the painting was firmly attributed to Giorgione.[33]

Study of the x-radiograph of the *Adoration of the Shepherds* in conjunction with the infrared reflectogram shows how the composition evolved. The infrared reflectogram reveals that the contours of forms were underdrawn probably with a fine brush. In the figures, the most notable

addition is a roughly sketched head just above the standing shepherd, presumably indicating his first position. There is an extensive use of hatching in the landscape: the rocks in the center of the picture have small areas of hatchmarks, while the large rock has hatchmarks that create an effect like that of a topographic map. The landscape was revised during both the underdrawing and paint stages. At the underdrawing stage, the rock face comprised large rounded forms. Brushstrokes in the upper right corner of the x-radiograph show that Giorgione began to lay in the curved forms, but then revised the profile. He extended the rock face to the left, making the forms more blocky. Areas for the large tree and small branches growing out of the rock were left in reserve while he laid in the sky. The infrared image shows that the rock face was extended to the left a second time, covering some already painted trees and part of the sky, thereby dividing the painting in half. This procedure finds parallels in the *Three Philosophers*, where small branches left in reserve were hidden when the rock face was enlarged. In the middle distance of the *Adoration of the Shepherds*, the pond was surrounded by rocks underdrawn with rounded shapes that became more blocky during the paint stage. A similar development is seen in the foreground of the *Three Philosophers*, where the rounded hillocks at the underdrawing stage became large slablike steps in the finished picture.

The *Adoration of the Shepherds* is the only composition by Giorgione that exists in two versions. The version in Vienna (cat. 18) was attributed to Giorgone very early. The painting is usually judged to be unfinished, but its damaged condition complicates this issue. Furthermore, the relationship between the two paintings has never been fully clarified: Did they emerge simultaneously? Is one a copy?[34] Superimposition of tracings of the paintings shows a close, almost total, correspondence of the two compositions. Although underdrawing can barely be detected in the infrared reflectogram of the Vienna picture, a pentimento seen with infrared reflectography and x-radiography shows the tree on the left in the Vienna painting was originally very much like the one in Washington; this supports the idea that the two works emerged simultaneously.

Cat. 2 Titian: *Virgin and Child ("Gypsy Madonna")*

Technical investigation of the *Virgin and Child*, an early work by Titian, demonstrates how his approach differed from that of his former master Bellini.

Wilde's x-radiographs of the *Virgin and Child* revealed an earlier version of the composition, in which the Virgin was depicted with a different facial type and a downward glance to the left. Other changes, such as the diagonal line of the drapery across the Virgin's torso and the change in position of the Child's head, led Wilde to deduce a close relationship with Bellini's *Madonna with Christ Blessing* in Detroit, signed and dated 1509.[35] He used this observation to demonstrate how the young Titian moved away from Bellini to formulate his own artistic ideas. With the aid of infrared reflectography, Hope and Van Asperen de Boer in 1989 discovered passages of underdrawing in the head and right hand of the Virgin.[36] More recently, a technical study of the painting was undertaken in the context of a project, begun in 2003, to examine paintings by Titian at the Kunsthistorisches Museum.[37]

The infrared reflectogram captured in 2005 (fig. 14) revealed additional underdrawing, including a considerable amount in the body of the Christ child as well as in the drapery and hair of the Virgin. The underdrawing was

14.
Titian, *Virgin and Child ("Gypsy Madonna")* (cat. 2). Infrared reflectogram.

15.
Titian, *Virgin and Child ("Gypsy Madonna")* (cat. 2). Composite x-radiograph.

apparently made with a fairly wide brush. The Virgin's face shows fluent underdrawn lines that correspond closely to the finished painting, except for two lines indicating the chin, the curls above her left eyebrow, and the changed outline of her head with indications of a bow previously noted by Wilde. Thin washes to indicate shadows in the Virgin's face and neck were applied at the underdrawing stage. However, the facial features in the first version are hard to distinguish in the infrared reflectogram.

The underdrawn contours, revealed by infrared reflectography, served as a guide for the first version of the picture, known from the x-radiographs. For example, the early version of the Virgin's right hand, with outstretched fingers, is documented in both the infrared reflectogram and the x-radiograph composite (fig. 15). Close examination of the paint surface reveals a red paint layer beneath the present hand. This means that Titian applied the underdrawing for the outstretched fingers, blocked them in with paint, covered them with the red drapery, and finally painted the second version.[38] The infrared reflectogram also clarifies the pentimenti in the x-radiographs of the Christ child's body.

The landscape, which does not seem to have been underdrawn, also underwent revisions during the paint stage. It is difficult to interpret the changes in the sky due to its damaged condition. The x-radiographs reveal changes in the profile of the distant landscape, with two hills close to the Virgin's shoulder and a horizontal line at the left edge that might be a lake. Close examination shows the intense blue paint used for the distant mountains lies beneath the green hills, stopping at the bushes and the seated man. The tree, now at the left edge, was at first painted further in the middle of the landscape.

Examination with a stereomicroscope confirms a working method that relied much less on an underdrawn contour drawing than the examples described above. The red underpaint of the Virgin's dress extends, not only beneath her hand, but also beneath her blue and the green draperies, as well as the stone ledge on which the Child stands. The gray and white stripes on the cloth of honor were painted on top of the green underpaint. It seems that, for Titian, the underdrawing in the painting merely suggested the main forms and served as a guide for continuing his work with the paintbrush.

For the Kunsthistorisches Museum paintings, x-radiography of the *Gypsy Madonna* and the *Laura* was conducted by the Painting Conservation Department, with digital composites by Thomas Ritter. X-radiography of the *Three Philosophers* was done by the Painting Conservation Department and digitized by Paolo Spezzani and reedited by Ritter. Infrared reflectography of the *Laura* and the *Three Philosophers* with the INOA InGaAs scanner was by Spezzani.[39] Infrared reflectography of the *Lady with a Mirror,* the *Gypsy Madonna,* and the *Adoration of the Shepherds* with an Indigo Alpha InGaAs camera configured to 1.5–1.7 microns was carried out by Monika Strolz, E. Walmsley, and Michael Eder, with the composite by Eder.

For the National Gallery of Art paintings, x-radiography was by Kristin Casaletto. Infrared reflectography of the *Feast of the Gods* and the *Adoration of the Shepherds* was carried out with a Kodak 310-21x PtSi camera configured to 1.5–2.0 microns. Image capture of the *Feast of the Gods* was by J. K. Delaney, C. Fletcher, C. Metzger, and Walmsley, with the composite by Fletcher. Image capture and composite of the *Adoration of the Shepherds* was by Walmsley. Transmitted infrared reflectography of the *Feast of the Gods* was captured with a Hamamatsu vidicon camera with N2606 tube and Kodak Wratten 87A filter, with images on a Techtronix monitor. Image capture was by Metzger, P. Decristofaro, and Casaletto, with a digital composite of 35mm negatives by Walmsley.

With the exception of the infrared reflectograms of the *Virgin with the Blessing Child* and the *Adoration of the Shepherds,* and the x-radiographs of the *Feast of the Gods,* the *Adoration of the Shepherds,* the *Three Philosophers,* and the *Laura,* the technical photographs of the works discussed are published here for the first time.

1. Rome 1930, 162–170; Stout 1964, 126; Burroughs 1938, vii–x; Wolters 1938; Bridgman 1964; Posse 1931; Wilde 1931; Rothschild 1932.

2. Wilde 1932.

3. See also Spronk 1996; Keyser 1999; Bewer 2001.

4. See also Anderson 1997, 83; Luber 2005, 4.

5. Hope and Van Asperen de Boer 1991.

6. Hope and Van Asperen de Boer 1991, 135.

7. Zanolini 1986, 24; Olivari 2001, 38–44.

8. On methods used by Venetian painters to duplicate compositions, see Vasari/Maclehose 1907, 215, 231; Spezzani 1992, 50–51; Galassi 1998; Bambach 1999, 338; Goffen and Nepi Scirè 2000, 82; Falomir 2003; Kasl 2004. A privately owned copy of the *Lady with a Mirror,* sometimes given to Giovanni Bellini and/or Vincenzo Catena and reproduced in Bernardini 1995, 177 and 242–243, is similar in size and coloring, but there are slight variations in the landscape and it lacks the *cartellino* and vase. Interestingly, these elements were not underdrawn in the Vienna painting.

9. On fingerprints in Venetian paintings, see Vasari/Maclehose 1907, 231; Zanolini 1986; Fletcher and Skipsey 1991, 7; Dunkerton, Foister, and Penny 1999, 219; Dunkerton 2004, 315–316, note 66.

10. Bellini occasionally used a gray *imprimitura* according to Merrifield 1849, ccxcv–ccxcvi. Cross sections from the *Lady with a Mirror* analyzed by Martina Grießer, head of the Kunsthistorisches Museum Scientific Department, reveal a slight variation in the gray color beneath the draperies as compared to the flesh-tones. This suggests the use of an underpaint layer beneath specific areas, rather than an *imprimitura* applied over the entire surface. See also Dunkerton and Spring 1998.

11. This appears to be an unusual technique, since previous cross section analysis has found that Bellini executed the underdrawing directly on the gesso unless an *imprimitura* was present, in which case it was applied on top of this layer; see Lazzarini 1983, 134–155; Lucas and Plesters 1978, 39.

12. Fletcher 1990, 173; Goffen 1991, 194 and 196.

13. These incised lines are dark in the x-radiographs, and, moreover, have a uniform width and appear to have been drawn. There are additional dark contour lines in the x-radiographs. But, when the painting's surface is examined, they have a different appearance. Some lines seem to be the result of the artist following the underdrawing accurately and not allowing the local color to overlap the boundaries. Other lines seemed to have formed during the drying process, due to different shrinkage rates in the various colors as a result of the different amounts of oil required to bind the pigments.

14. The compass point, which was used twice, is located to the right of the woman's forehead. The outlines of the round mirror are dark in the x-radiographs, an indication that they were made into the paint layer while the paint was still wet.

15. Walker (1956) published x-radiographs taken in 1947.

16. Burroughs 1938, 112.

17. Bull and Plesters 1990; Brown 1993; Bull 1993; Plesters 1993.

18. Bull and Plesters 1990, 58–59 and fig. 20.

19. In the usual method of capturing infrared reflectograms, an infrared camera is set up in front of a painting, with photoflood lights positioned so light reflects off the painting's surface. For transmitted infrared reflectography, the lights are positioned behind, so light is transmitted through the painting.

20. In a photograph of the *Madonna of the Meadow* (page 59, fig. 3) taken during transfer, a similar brushiness at an early stage of the painting process is seen in the tree at the right edge; see Ruhemann 1968, 155–162, figs. 42–45.

21. The camera was generously donated to the National Gallery of Art by Eastman Kodak. Walmsley et al. 1994, fig. 8; Metzger et al. 1995, pl. 88.

22. Wilde 1931, 91–102; Ballarin 1993, 724–729.

23. The corner spandrels, including most of Laura's hand, are modern reconstructions following an old copy. See Oberthaler 2004 for the full results of the technical study of the painting.

24. Hope and Van Asperen de Boer 1991 (presented at conference in 1989); Katie Crawford Luber and Sylvia Ferino-Pagden (unpublished report, 1989, in the conservation files of the Kunsthistorisches Museum, Vienna); Paolo Spezzani, using the INOA scanner, produced the infrared image reproduced here.

25. A dark line that curves below Laura's throat is barely visible as a pentimento on the paint surface. It is also faint in the infrared reflectogram, but registers more strongly in the infrared photograph; see Hornig 1987, 32. One possible explanation comes from the often-cited comparison of the *Laura* with Albrecht Dürer's *Portrait of a Venetian Lady* (Kunsthistorisches Museum, Vienna), painted one year earlier. Dürer's lady, also in three-quarter view, wears a similar hairstyle with long side curls and a more modest costume. Her necklace is recalled by the curved line of that in the *Laura*, but if intended as a placemark for a necklace, the idea was abandoned before the individual jewels were painted. Another possibility is that Giorgione considered clothing Laura in a round-necked dress, such as the one in his painting of *Judith with the Head of Holofernes* (State Hermitage Museum, St. Petersburg), but the x-radiograph reveals no evidence of reworking in this area, which shows little modeling, at any rate, in the thickly painted fleshtones.

26. The x-radiographs were made in 1931.

27. Hope and Van Asperen de Boer 1991.

28. The infrared reflectogram was captured in Venice, after the exhibition *Giorgione: Le maravaglie dell'arte* and before the painting returned to Vienna for the exhibition *Giorgione. Mythos und Enigma*. This infrared reflectogram was displayed with the x-radiograph composite, full-size, in the Vienna exhibition. An overall infrared vidicon composite by Manfred Shreiner and the x-radiograph composite, digitized by Paolo Spezzani from x-radiographs taken in 1977, were published in the exhibition catalogue, together with a technical analysis; see Oberthaler 2004.

29. Hope and Van Asperen de Boer 1991, 130, characterized the diagonal hatchmarks as a Quattrocento technique.

30. See also Steinberg and Wylie 1990, 70–77.

31. Though Hope and Van Asperen de Boer 1991, 130, commented dubiously that the "seated philosopher has probably the best claim to be the work of Sebastiano," Oberthaler 2004 firmly concluded that the figure was the work of Giorgione.

32. Morassi 1942; Mucchi 1978, 30–31; Brown 1979, 28–29; Strehlke 2003.

33. Anderson 1997, 109–114.

34. See Jaynie Anderson's entry in Ferino-Pagden and Nepi Scirè 2004, 173–175.

35. Technical photographs show that the figures' contours were underdrawn with a brush and retained through the paint layers with only very minor revisions. The painting was examined in the studio through the generosity of Alfred Ackerman, Paul Cooney, and Barbara Heller at The Detroit Institute of Arts.

36. Hope and Van Asperen de Boer 1991, 131.

37. This project is headed by Sylvia Ferino-Pagden and is funded by the Fond zur Förderung der wissenschaftlichen Forschung (FWF) of Austria.

38. This technique was found also in the Pesaro altarpiece and the *Bacchus and Ariadne*.

39. Materazzi, Pezzati, and Poggi 2002.