The Working Methods of Degas: *The Milliners*

Project Overview

Edgar Degas's *The Milliners* (JPGM 2005.14) was acquired by the J. Paul Getty Museum in March 2005. Previously in a private collection, the painting had been exhibited only twice in the past century —at sales—and had never been the subject of a scientific study.

Figure 1: Degas's *The Milliners* (JPGM 2005.14)

The painting, begun by the artist in 1882 and completed before 1905, depicts two women seated together at a cramped table working on hats. In the foreground, three hat stands obstruct our view of the figures; one woman gazes off into space while the other exists merely as a shadow.

The X-radiograph of the painting clearly shows that Degas reworked the painting, perhaps numerous times. The woman seated at the left appears to have originally worn a hat and fancier dress, suggesting that she likely was initially conceived as a customer. In addition, the table looks as if at one time it was covered with hats for sale, rather than being made, and facial details of the woman to the right once appeared more discernable.

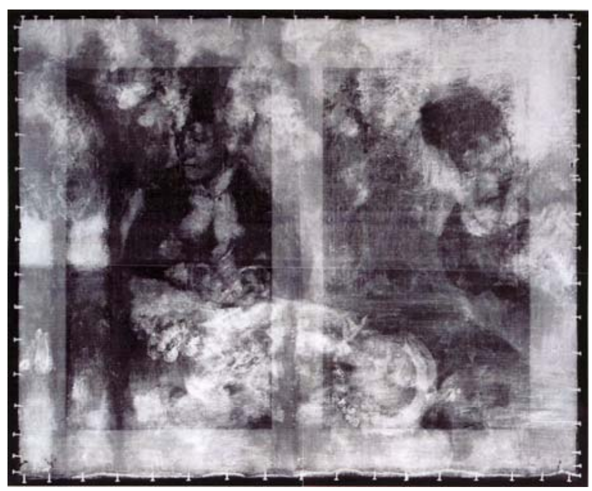

Figure 2: X-radiograph of *The Milliners*

Because the X-radiograph yielded such interesting results, further scientific investigation was undertaken in order to learn about Degas's working methods.

Methodology

The initial investigation into the painting was conducted using X-ray fluorescence spectroscopy (XRF). XRF is a non-invasive, non-destructive technique that can detect the majority of elements commonly found in mineral-based pigments.

Because XRF is an X-ray technique, information is gathered simultaneously from all the paint layers; therefore, elements may be detected from a ground layer, together with those from overlying paint layers. If the painting has a complicated layer structure (as the X-radiograph indicates is likely the case for *The Milliners*), it is usually necessary to remove small samples for additional analysis in order to more fully understand the painting's construction. Samples taken from paintings are barely visible to the human eye (their size is less than 1 mm, typically on the order of only several hundred microns). Working under a microscope and in collaboration with a conservator, the scientist will take samples using fine surgical tools. Sometimes merely a scraping is required, but more frequently samples of all the paint layers are taken and mounted to reveal a cross-section of the painting's stratigraphy. An ideal cross-section sample will contain all the layers of a painting from the ground layer to the final varnish.

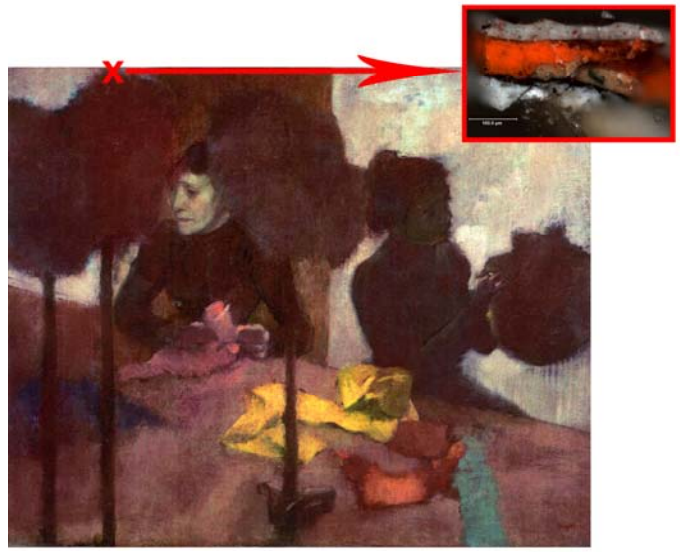

Figure 3: Location of sample removed

After a sample is removed, it is mounted in a clear resin and then either polished or cut with an ultramicrotome to prepare it for analysis. The resulting cross-sections are then viewed and photographed under high-power microscopes using visible and ultraviolet illumination (see Polarized light microscopy). Under visible light, many organic materials—such as resins, varnishes, and certain binding media—will simply appear as dark regions. But under ultraviolet illumination, they may fluoresce, thus enabling them to be seen more easily.

In order to obtain information about the composition of the individual pigment layers in a cross-section, the samples may be analyzed with the GCI's environmental scanning electron microscope–energy dispersive spectrometer (ESEM-EDS). Using a beam of electrons to form the image instead of light, scanning electron microscopes can provide images at extremely high magnification (up to 100,000 times). In addition, ESEM-EDS can be used to identify the chemical elements present in each layer, or even individual pigment particles, thus allowing the pigments comprising each layer to be inferred.

Results

A sample taken from the hat in the foreground at the upper right edge of *The Milliners* shows six distinct layers when illuminated using visible light. At the bottom is a white ground layer, followed by a dark layer with bright red particles throughout. Next is a light brown layer, primarily seen at the right of the sample. This light brown layer is followed by a bright reddish orange layer. Above that central brightest layer is another white layer with green and red particles throughout. Finally, at the top, a very thin dark layer can be seen.

When this same sample is viewed using ultraviolet illumination at least two additional layers can be seen. These layers surround the central bright red layer. They appeared black when viewed with visible light, but ultraviolet illumination causes these layers, which are likely organic, to fluoresce. Fluorescent organic layers may be varnishes, or other isolating layers; these layers may indicate later additions or a reworking by the artist.

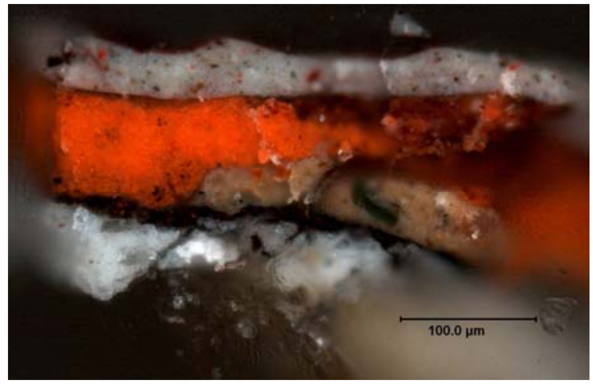

Figure 4: Cross-section viewed with visible light

Under the scanning electron microscope, a different image—a backscattered electron image (BEI)—of the cross-section can be obtained. This image shows differences in elemental composition: areas with high average atomic number (such as the lead-containing ground layer) appear light in the images, whereas areas with low average atomic number (such as the organic layers surrounding the bright red layer) appear dark. From elemental analysis of the individual layers, it was det that the ground layer is composed of lead white and barytes; the dark layer above it of lead white, bone black, and barytes, while the bright red particles are vermilion. The light brown layer towards the right of the sample is lead white and iron oxide earths (red ochre by visual examination), with associated minerals. The bright central layer is red lead followed by a lead white layer with chrome green and red ochre particles throughout. The thin dark layer at the top is lead white with iron oxide earths (again, red ochre by visual examination).

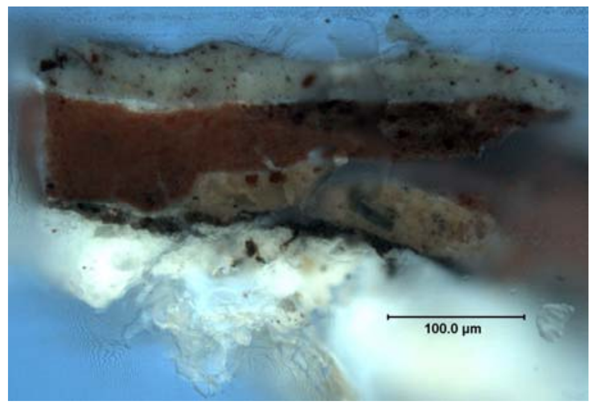

Figure 5: with ultraviolet illumination

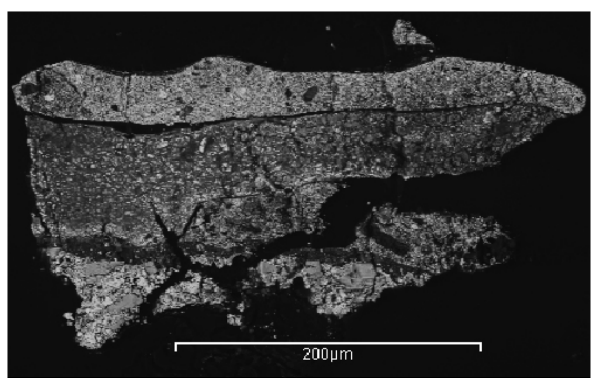

Figure 6: Backscattered electron image

Conclusions

Information from this sample (and several others like it taken from around the perimeter of the painting), in conjunction with the X-radiograph, confirm that this painting was heavily reworked by the artist. This is consistent with what is known of

Degas's painting style, particularly by the late 1880s and into the 1890s. He often rearranged compositions and reworked paintings, sometimes altering them intermittently over a twenty-year period by scraping down and repainting large areas, or reworking areas with layers of thick, muddy overpaint.

Project Participants

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Bibliography

Bomford, D., S. Herring, J. Kirby, C. Riopelle, and A. Roy, *Art in the Making: Degas.* London: National Gallery Company, 2004.

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For more information on the GCI Science program, visit
www.getty.edu/conservation/science/about/