Paintings in the laboratory: scientific examination for art history and conservation
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"It is even possible that the patron supplied his own primed support for his portraits." This inconspicuous remark in an essay by myself and Ella Hendriks in Seymour Slive's exhibition catalogue Frans Hals (1989-90) could have useful implications for art history. It was our possible explanation for the untypical grounds used in two portraits by Frans Hals: his Man in a Slouch Hat in the Staatliche Kunstsammlungen, Kassel. We suggested that, since the priming on the supports was so different from other painting grounds used by Hals, the sitters themselves might have acquired the primed canvases from somewhere other than Haarlem. Indeed, according to contemporary sources, canvases were not always primed in painters' studios, and, in fact, the practice of preparing supports for painting existed as a separate industry during the seventeenth century in the Netherlands.

Most grounds found in paintings by Frans Hals are of a light pink or ochre color, made with lead white in an oil medium together with an admixture of small amounts of red, brown, and/or black pigments. The Cambridge and Kassel portraits were painted on a so-called double ground, the lower one being red and the next one gray. Such grounds were used, for instance, by Rembrandt during the 1630s in Amsterdam, and by Bloemaert and Ter Bruggen in Utrecht. While the analysis of the application and formulation of ground and paint layers will point to a certain painter only in exceptional cases, it can indicate a particular regional school of painting, although a primed canvas or panel might have been brought from a town other than the one in which the artist lived.

Comparison of grounds has proved useful in the examination of pendant pairs painted by Hals. Not only are the canvases on which they were painted identical, but the priming is as well. Supports for pendants were obviously made by cutting cloth from a large, single piece of canvas that was pre-stretched and primed.

Close comparison of grounds has also yielded interesting results in the case of a picture attributed to Rembrandt. During the "revolution" in Romania during December of 1992, the painting representing Haman before Esther (fig. 1) was damaged while it was being rushed to a place of safety. After this incident, it was brought to the Netherlands for restoration. Another reason for bringing the painting to the Netherlands was that extensive scientific investigation could be undertaken there to determine its authenticity. This was done in the context of the work of the Rembrandt Research Project (RRP) based in Amsterdam. The report on the restoration and examination of the painting, which was published in 1991 in a special issue of the Rijksmuseum Bulletin, has prompted the additional remarks made here.

In the Rembrandt centenary year of 1969, C. Benedict published an X-radiograph of the entire painting (fig. 2) in a Romanian art journal that showed another picture hidden beneath the present one. The underlying composition appeared to represent the same scene with three figures, but in different positions. In the RRP's third volume of their Corpus of Rembrandt Paintings (1989), the (top) painting was placed in category B: that is, one in which Rembrandt's authorship cannot be positively either accepted or rejected. The supposed date of execution of the picture was left vague, in the 1660s. The underlying picture, which was shown in the examination to be in an advanced state of execution, was tentatively dated from the X-radiograph to around 1635 and said to be possibly by Rembrandt's own hand. This was a surprising statement to make about a picture that had been painted out. However, in this case, Van de Wetering based his verdict on the head of the underlying Esther (visible on the X-radiograph), which was a type similar to that on four other works by Rembrandt. All four—Bathsheba in the National Gallery of Canada, Ottawa; Bellona in the Metropolitan Museum of Art, New York; Flora in the National Gallery, London; and Sappho in the Museo del Prado, Madrid—were painted in the first half of the 1630s.

The presumption of the possible date of execution and the authenticity of the hidden composition in the Haman before Esther (fig. 1) has been reinforced by my subsequent detailed technical examination of the painting, especially of the build-up and formulation of the ground layers. What follows here is a brief account of this examination, with an emphasis on the necessity of maintaining certain standard conditions for this type of investigation.

Small paint samples were taken from the Haman before Esther, cross-sections of which were then examined under the microscope. These showed that the underlying painting was in an advanced state of execution with the figures already in color. It was sometimes difficult to decide which layer belonged to the first picture and which to the second, since parts of the first composition were retained in the final picture. Also, the two compositions were not separated by a newly applied preparatory layer. For these reasons, it seemed most useful to analyze the formulation and the build-up of the ground layers, that is, the paint layers lying directly on the canvas, in order to try to date the underlying composition more precisely.
The ground consisted of two layers. Judging from their color and formulation, these layers were very similar to the preparatory layers used by Rembrandt for pictures in the first ten years of his life in Amsterdam, after he had left Leiden. The double, colored grounds used by Rembrandt in this period are comprised of a red paint layer with a gray one over it. Red earth, an inexpensive substance, was probably used for the first layer since a lot of it was needed to fill the interstices in the canvas weave before painting could begin. The second layer, which served as the ground on which to paint, consisted of the much more expensive lead white tinted with a little black, red, and yellow pigment.

By a lucky coincidence, the underlying picture can be dated more precisely than "from around 1635." Over the years, the RRP has examined and analyzed many paint samples of Rembrandt paintings from different collections. Some of these samples are still in the Amsterdam laboratory, and were available to compare with those taken from the Haman before Esther. To make such a comparison is more difficult than it would seem, since the number of pigments used by artists in the seventeenth century is not very extensive and those employed for grounds is smaller still. Therefore, not only were the types of pigments examined and compared, but also their relative concentrations in the paint mixture, their sizes, and the presence of small admixtures of pigments other than the main components.

In conducting such scientific research, it is generally understood that the circumstances under which tests are done must be identical for the results to be comparable. For a valid, accurate comparison of paint cross-sections, where the main constituent of the paint in different samples is the same and the comparison relies on minor variations, it is important that: 1) the person who makes the comparison takes the paint samples him or herself; 2) the paint cross-sections of different samples are examined under the same microscope; 3) illumination of the microscope is the same; 4) the samples are examined using the same objectives and magnification; 5) a high magnification is used; and 6) the different samples are evaluated by the same researcher. This last requirement is vital since observed data can be differently interpreted by two or more people, and people can differ about the relevance of sets of observations.

Paint samples can be found, like the pictures they derive from, in different locations, and they are not always easily available for examination by other researchers. A photograph of the desired sample will not suffice for the comparative investigation, since the circumstances under which the samples were photographed (lighting, magnification, type of film used, and so forth) are unlikely to be identical to the circumstances under which the examination was made.

For the comparison of the ground layers of Haman before Esther with those of other pictures by Rembrandt, paint samples from the Metropolitan Museum of Art in New York were available, among them paint cross-sections from Bellona. These samples had been taken earlier for the purpose of evaluating the technique of neutron activation analysis (autoradiography) of paintings. Although Bellona and Esther before Haman both have double grounds (first, orange-red; second, gray), the grounds turned out not to be identical when scrutinized in the way described above. A comparison with the London Flora was possible by consulting the 1988 National Gallery publication, Rembrandt. Art in the Making, which states that the upper ground layer in Flora has wood charcoal mixed in with the lead white. In Esther before Haman, the black mixed in is a very fine soot. No samples were available for comparison with Bathsheba and Sophonisba.

Further comparative investigation revealed that the application and formulation of the ground layers in Haman before Esther are entirely identical to those used for the authentic Rembrandt picture Portrait of a Woman in an Armchair of 1633 in the Metropolitan Museum (fig. 3). In the Corpus, this portrait is placed in category A: "Paintings by Rembrandt." Even when seen under the optical microscope with a very high magnification of x500, the paint mixtures in the two pictures cannot be distinguished from each other (figs 4, 5). One pot of paint appears to have been used to prime both canvases. The absolute affinity in the way the limited number of pigments were used in the two paintings cannot be explained otherwise than that the canvases were primed close together in time and in space. Thus, the paintings on these two supports are probably also very close in their date of execution.

Thus, comparison of paint samples from the ground layers of the two paintings confirmed the above-mentioned hypothesis based on the X-radiograph (fig. 2), that is, that the underlying composition in Haman before Esther (fig. 1) was made at a much earlier date than the upper, visible one, and that it is possibly by Rembrandt. The earlier investigation had also shown that the hidden picture was in an advanced state of execution when the head of Ahasuerus was painted out with a blue paint. From our accurate microscopic examination of paint samples, then, the conclusion can be drawn that Haman before Esther stayed in Rembrandt's studio in an unfinished state.
NOTES


9 An adventitious circumstance is that the Portrait of a Woman in an Armchair is one of a pair of pendants: the painting showing the sitter's husband is in the Cincinnati Art Museum. The ground of the Cincinnati picture remains to be examined.

FIGURES, pp. 315-316

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Fig. 1. Rembrandt (?), *Haman before Esther*, c. 1633. Bucharest, Muzeul de Arta al Republicii Socialiste România.

Fig. 2. X-radiograph of *Haman before Esther*.
Fig. 3. Rembrandt, *Portrait of a Woman in an Armchair*, 1633. New York, The Metropolitan Museum of Art.

Fig. 4. Cross-section of paint layers in *Human before Esther*.

Fig. 5. Cross-section of paint layers in *Portrait of a Woman in an Armchair*. 