Natasha K. Loeblich
Winterthur / University of Delaware

Collaborative Efforts for Paint Analysis: Two Opportunities for Technical Examination of Major Works in Tandem With Outside Institutions

Technical study of Interior Finishes in the William Byrd, III House at Colonial Williamsburg

Figure 1: William Byrd, III House, c. 1760.

My technical study involved the analysis of the original interior finishes at the William Byrd, III house, one of the few relatively unrestored houses owned by the Colonial Williamsburg Foundation. The house was built in the 1760's by Colonel William Allen, but by 1771 it had been purchased by William Byrd, III. The Byrd family was the one of the wealthiest and most influential in the colonies. The men of the family were high ranking officers in the English army and well-educated, owning one of the largest libraries in the colonies. This building served as the family's stylish townhouse in Williamsburg. Because of the importance of the Byrds in Colonial Williamsburg the building is given their name, however, the family actually lived in this house only a few years. Burdened by huge debts and unpopular loyalist tendencies, in 1777 William Byrd, III was driven to commit suicide at the age of 49. At his death, Byrd had completely exhausted his large inheritance and his widow was forced to sell this house and the family's library to pay debts. Historians have attributed Byrd's bankruptcy to his opulent lifestyle, and he is known to have spent large sums on his architectural projects. For this reason, it is expected that the finishes in this house from the period of his ownership may have been sophisticated. Unlike other important Williamsburg buildings, the Byrd house has been subject to only one known restoration, so remains of the original finishes may survive today under layers of white paint.

For this project Colonial Williamsburg's Architectural Research department set forward three main goals. First, they wanted to identify the color, appearance, and composition of the eighteenth century finishes. The department is currently interested in repainting their historic structures with more accurate colors to aid

interpretation. They also wanted to identify items in the house that may have been changed or replaced during restorations. By comparing the paint history of different architectural features it should be possible to determine what elements are missing the original layers and consequently may be replacements. Finally, it was hoped that a study of the original finishes would yield socio-economic information about the house and its owners and perhaps their place in Williamsburg society as well as about the history of the house over time. For example, it is known that during the Civil War the impoverished widow who owned the house at that time used it as a school. In this period we would expect to see more institutional and less expensive finishes. In more recent times, Colonial Williamsburg has rented out the house to various business clients and consequently repainted the house several times in muted hues. The house is not currently open to the public or interpreted as a historic interior, but this may be done in the future.

My study of the finishes in the house was executed following a methodology developed by my advisor, Dr. Susan Buck in her 2003 University of Delaware dissertation titled "The Aiken-Rhett House: A Comparative Architectural Paint Study". After on-site consultation at the Byrd house with architectural historians, samples, approximately two to three mm wide, were taken with a scalpel from various architectural elements in each of the rooms. Sampling and on-site examination were aided by the use of a 30x magnification monocular microscope. The sample locations were recorded and photographed digitally. Each sample site was given a distinct number and the sample was placed in a labeled bag for analysis at Winterthur. Additionally, several bags of samples existed in the architectural research department files from previous finish studies. A portion of sample from each location was cast in polyester resin and polished with micromesh sanding papers. Each cast sample was then examined and digitally photographed under visible and ultraviolet light at 50x to 400x magnification. Selected samples were chosen for further analysis using fluorochrome stains and analytical techniques. Because of the large number of samples, a database was created containing over a thousand records of the appearance and composition of the different layers in each sample in Microsoft Excel.

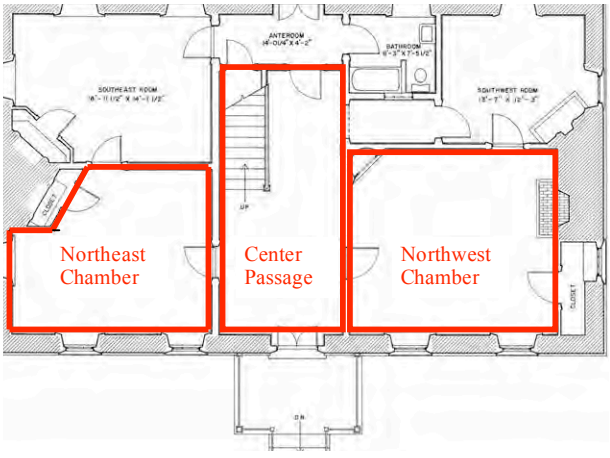


Figure 2: First floor plan; HABS Colonial Williamsburg Project, 1967.

In 1976, detailed elevations and plans of the house were created for the Historic American Buildings Survey. These drawings were very useful in understanding the house and recording sampling sites. Figure 2 shows the plan of the first floor of the house and outlined in red are the three rooms that I sampled as part of my study. As the main public spaces of the

Figure 3: Center passage elevation; HABS Colonial Williamsburg Project, 1976.

house, it is assumed that these rooms will have the richest and most interesting finishes. For the purposes of this talk, I have selected three samples which show interesting original finishes from the Center Passage and the Northwest Chamber.

The vast majority of my samples fractured leaving incomplete stratigraphies. Often samples fractured right above the wood substrate leaving just a hint of the earliest paint layer attached. I tried using the X-ray fluorescence (XRF) and Fourier transform infrared spectroscopy (FTIR) on these simple samples. The XRF was useful in identifying the presence mainly of lead confirming that this is most likely a lead white paint layer as suspected. I also used an absorbance FTIR instrument located in the paintings lab at Winterthur on similar cast samples with few layers. We ran a background scan against the polyester resin and subtracted this from the final spectrum. This was sufficient to get typical peaks for lead white paint in linseed oil with some lead dryer. Both of these techniques were useful in confirming the presence of lead white in linseed oil in the majority of early paint layers. I also used some uncast samples of wood fragments with small amounts of paint attached for gas chromatography – mass spectrometry (GC-MS) analysis. Chris Petersen, a volunteer scientist in the Winterthur Scientific Research and Analytical Laboratory, was able to extract the paint components and identify the presence of oil paint with driers.

In order to get more detailed information about the layers I turned to scanning electron microscopy with energy-dispersive spectrometry (SEM-EDS) and transmittance FTIR analysis which I applied towards some of my more interesting samples with early layers and complex stratigraphies. The first sample was taken from the edge of a banister on the staircase in the Central Passage, as shown in Figure 3.

The vast majority of my samples showed only layers of white paint, so I was excited to find a sample with more decorative layers. The cross section shown in Figures 4-7 has a base coat at the bottom followed by a red paint layer and a black paint layer. Because the black paint layer is discontinuous, this build-up seems to suggest an early and simple faux graining scheme. However, there are no varnish layers present to support this hypothesis. The dull red paint, however, was a common paint finish in Williamsburg in the Colonial era used both as a primer and a cheap finish coat. This finish may correspond with the occupation of the house's builder Col. Allen. Next is a layer of black paint, which would have been useful for hiding dirt and wear in this high-traffic area, and then a thick layer of tan primer. Finally, there is a set of layers that appears to be an example of faux wood graining seen as repeated applications of varnishes and glazes. Early faux graining was simply applied using one or two paint layers, whereas later graining involved the build up of many more thin transparent layers.

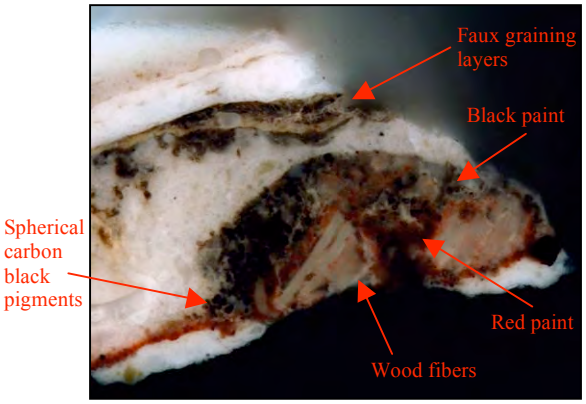


Figure 4: *Sample from stair banister; Visible light, 200x magnification*

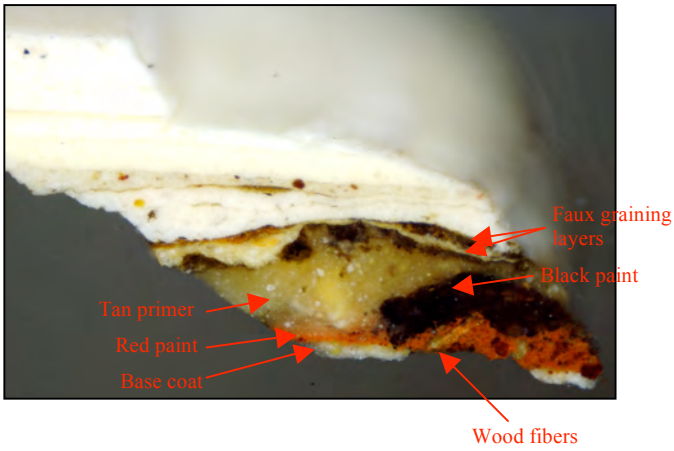


Figure 5: *Sample from stair banister; Ultraviolet light, 400x magnification*

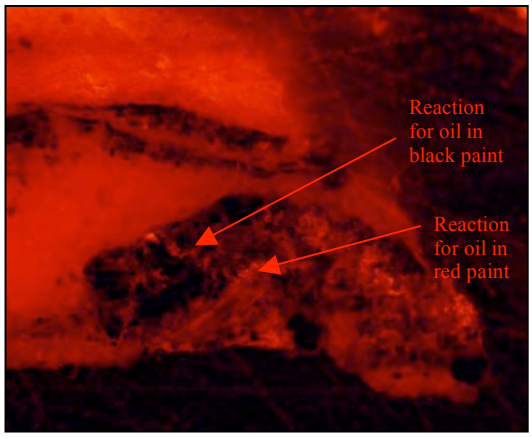


Figure 6: *Sample from stair banister; Stained with Rhodamine B, green filter cube 400x magnification*

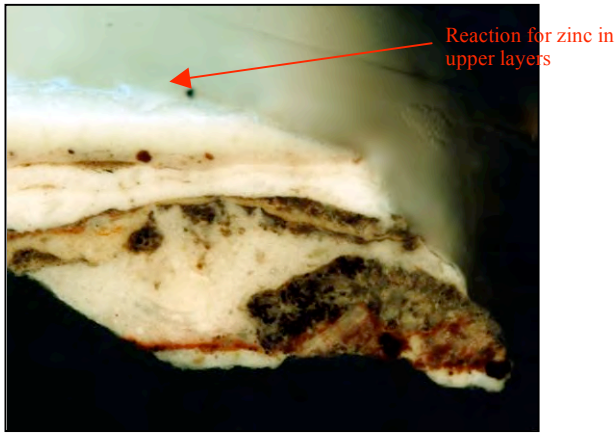


Figure 7: *Sample from Stair banister Stained with TSQ, blue-violet filter cube 200x magnification*

Despite its simplicity in Colonial times, faux graining was still an extravagant finish often costing more than imported fine hardwoods. Possibly, the graining layers correspond to the ownership of the Byrd family.

Under ultraviolet light, the graining layers have some autofluorescence, which suggests a possible resin or protein component. The small spherical shapes of the black pigment particles in the graining layer suggest a carbon black, such as bone black or lampblack. The cross section was stained with various fluorochrome stains to mark out the presence of proteins, carbohydrates, and oils. There were no reactions for proteins and carbohydrates, but the sample did stain positively for the presence of oil in the early layers. A positive reaction for the stain Rhodamine B is indicated by a significant brightening of the layer when viewed with a green filter cube. The cross section was also stained with TSQ (N-(6-methyl-8-quinolyl)-p-toluenesulfonamide) which can mark the presence of zinc in a layer. Since zinc was not generally used before the 1850's, its presence can help to date later layers. In this instance, the upper layers have a bright blue fluorescence that indicates a positive reaction

for the presence of zinc whereas the early layers do not. These layers of simple white paint may correspond to the Civil War period when the house was used as a school and presumably not richly furnished.

Pieces of uncast samples were kept in reserve for testing with the analytical equipment at Winterthur. The red paint layer was scraped off one sample with a scalpel for testing with absorbance FTIR. The resulting spectrum suggested the presence of a gum in these layers, possibly gum Arabic. The gum may have been added to the dry pigment to make a slurry before adding the oil to aid mixing and dispersion of the pigment. When the tan primer layer was also tested, no binder was detected, but calcium carbonate, kaolinite or clay, and gypsum were found. The inability of FTIR to detect a binder may indicate a low binder to pigment ratio in the paint, typical with a coarse primer layer. This tan primer layer, rich with calcium carbonate, is seen in samples throughout the house and used repeatedly for generations.

The cross section was also analyzed with SEM-EDS (*Fig. 8*). The tan primer layer had a concentration of calcium, which is consistent with the FTIR findings. The white paint layers above the graining had a concentration of lead, which is appropriate for their assumed age. The red and black paint and graining layers did not seem to be associated with any element that could be detected by the SEM-EDS. Carbon, for example, is not detected by Winterthur's detector, so this would explain why the spherical carbon-black pigments in the graining layer are not seen on the elemental maps shown below. The faux graining layers appear dark in the backscatter electron image which is consistent with a layer consisting mostly of organics, in this case probably natural resin varnish.

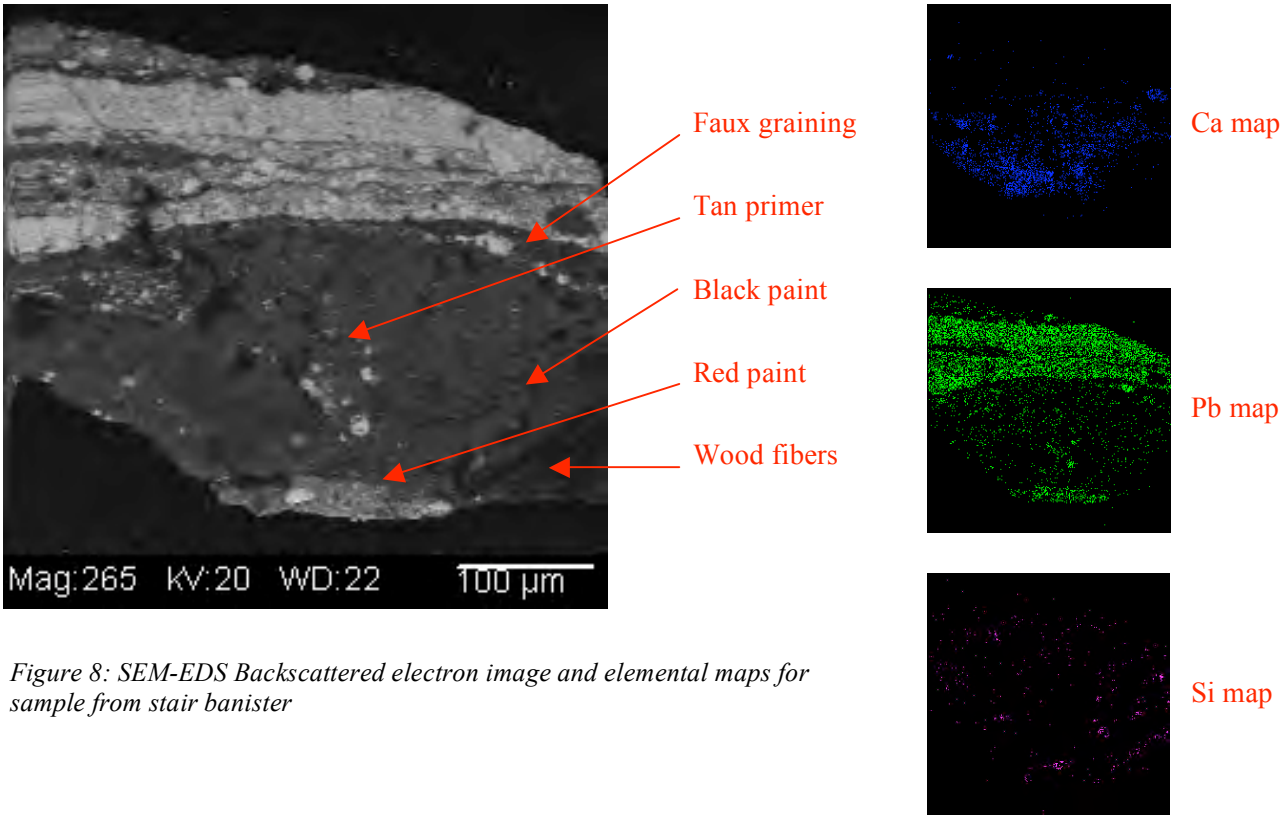


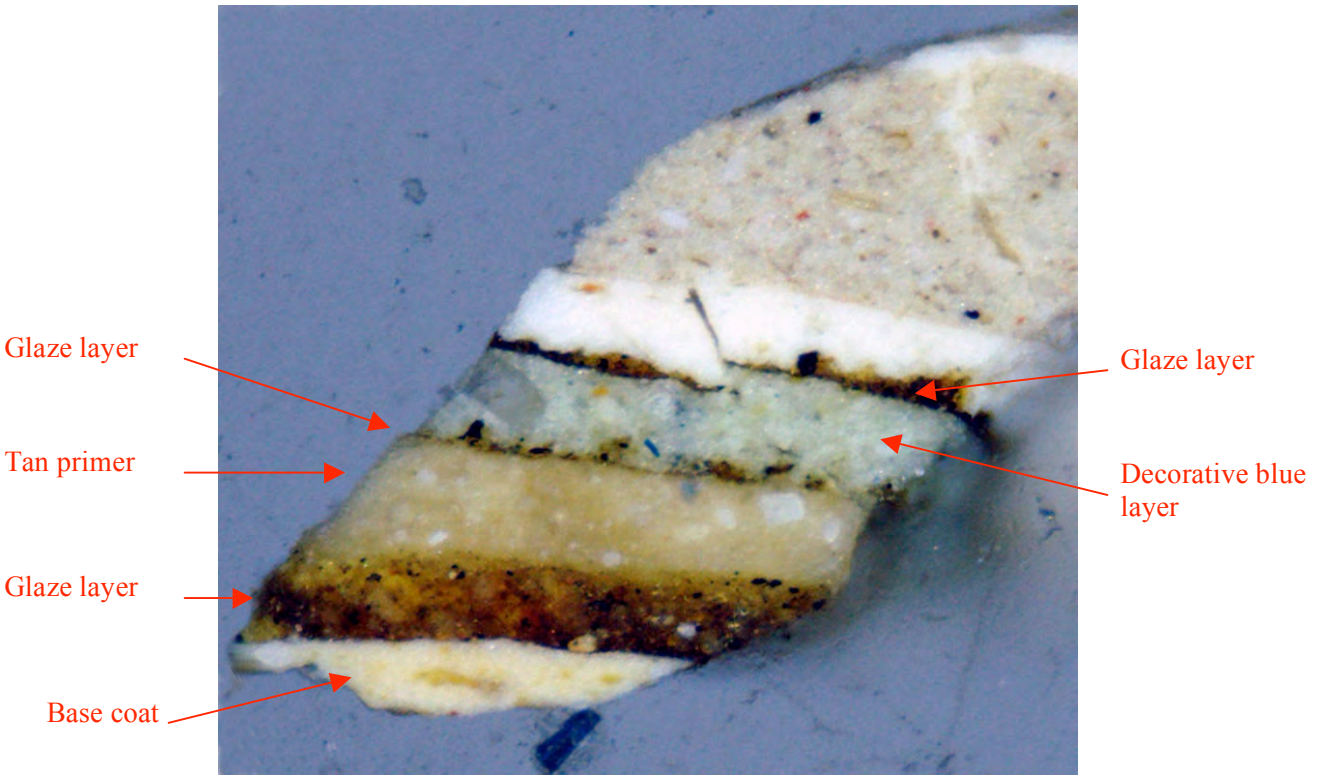
Figure 8: SEM-EDS Backscattered electron image and elemental maps for sample from stair banister

A spot analysis was done on the red paint layer with the SEM-EDS and this detected the presence of iron and lead. The lead may indicate the presence of red lead pigment, a lead dryer, or maybe a contaminant from the lead white paint layers above and below. The iron is likely to be red iron oxide pigments present in the layer. This was a cheap pigment that would have been in common use in the colonial period.

Though the paint materials are simple, mostly likely oil paint with inexpensive pigments, the fact that the staircase was faux-grained early on in its life is impressive, especially since this is a high traffic area that would have been exposed to wear. One further sign that no expense was spared is the presence of faux-graining even in samples taken from the stair handrail which would have received a lot of wear.

The next sample was taken from the ornate archway across the Center Passage from the stair as seen in Figure 9. This elaborate woodwork is quite unique in residential Williamsburg structures. The sample was taken from the pilaster which may have been picked out in a bold color to contrast with the other architectural elements. The cross section shows a coarse primer layer at the bottom covered by a pigmented glaze or toning layer. This is most likely the first generation of finishes. Next is a layer of the same thick tan primer as seen in the previous sample. Then there is a bright blue layer with a mixture of red and blue pigments that would have been highly decorative. The combination of bright blue and glaze layers suggests a possible faux marbling technique. These coarsely ground paints and glazes are of the late eighteenth and early nineteenth century and show that rather than simple paint layers, more sophisticated treatments were being used in the house. This buildup of paint and glaze or toning layers is very similar to a stratigraphy seen in the adjacent Northwest Chamber.

Figure 9: Sample from pilaster in Center Passage, visible light, 400x magnification.



The Northwest Chamber is likely to have been the main receiving room for guests and to have had rich finishes. In the southeast corner of the room, opposite the fireplace is a built-in corner cupboard. The arch and pilasters on either side of the cupboard are very reminiscent of the larger archway in the Center Passage.

Indeed, a cross section from the pilaster on the corner cupboard shows a similar stratigraphy to that of the pilaster from the archway in the passage. Again the use of paint and pigmented glaze layers suggests a sophisticated decorative surface. A tan primer layer at the bottom is covered by varnish layer, a beige base coat and glaze or toning layer. This was then covered over with a white primer and varnish. Next a tan primer and base coat are applied before a bright blue similar to that on the archway in the passage was applied. A detail of this sample exhibits bright autofluorescence from several of the layers under ultraviolet light suggesting a resinous or proteinaceous component.

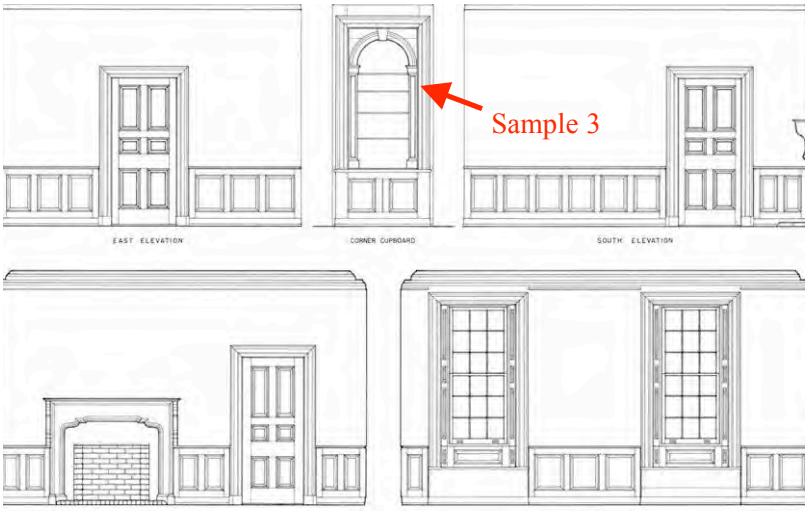


Figure 10: Northwest Chamber elevation; HABS Colonial Williamsburg Project, 1976

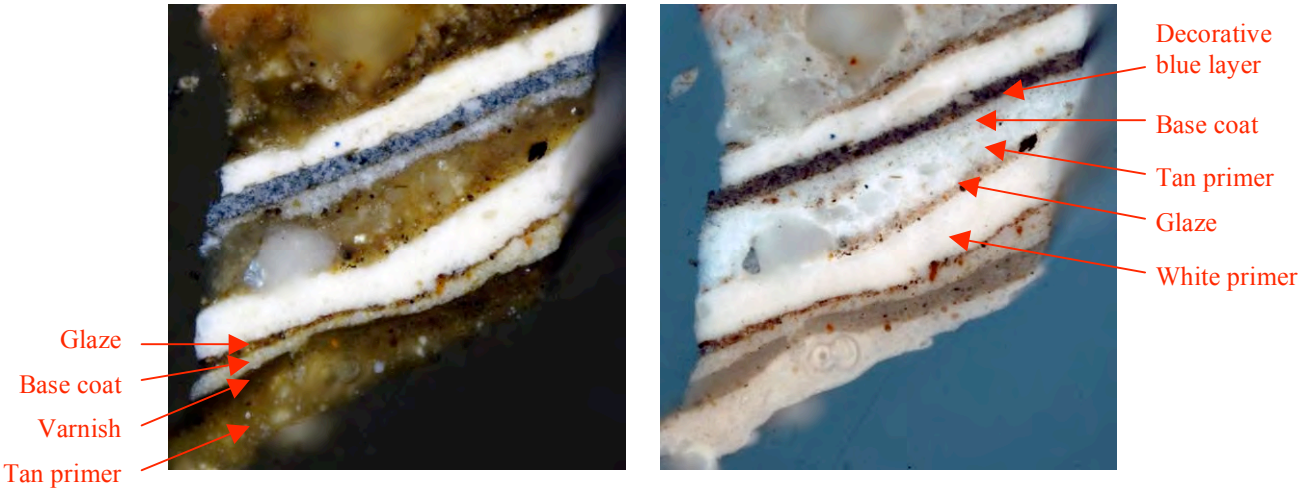


Figure 11: Sample from pilaster on corner cupboard, visible light and ultraviolet light, 400x magnification.

The cross section showed no reaction for proteins, carbohydrates, or zinc when stained with fluorochrome stains. There was a positive reaction for oils however, in the majority of the layers when stained with Rhodamine B. The images below show the staining reaction viewed with a green filter cube selected for the specific wavelength of the Rhodamine B stain's fluorescence.

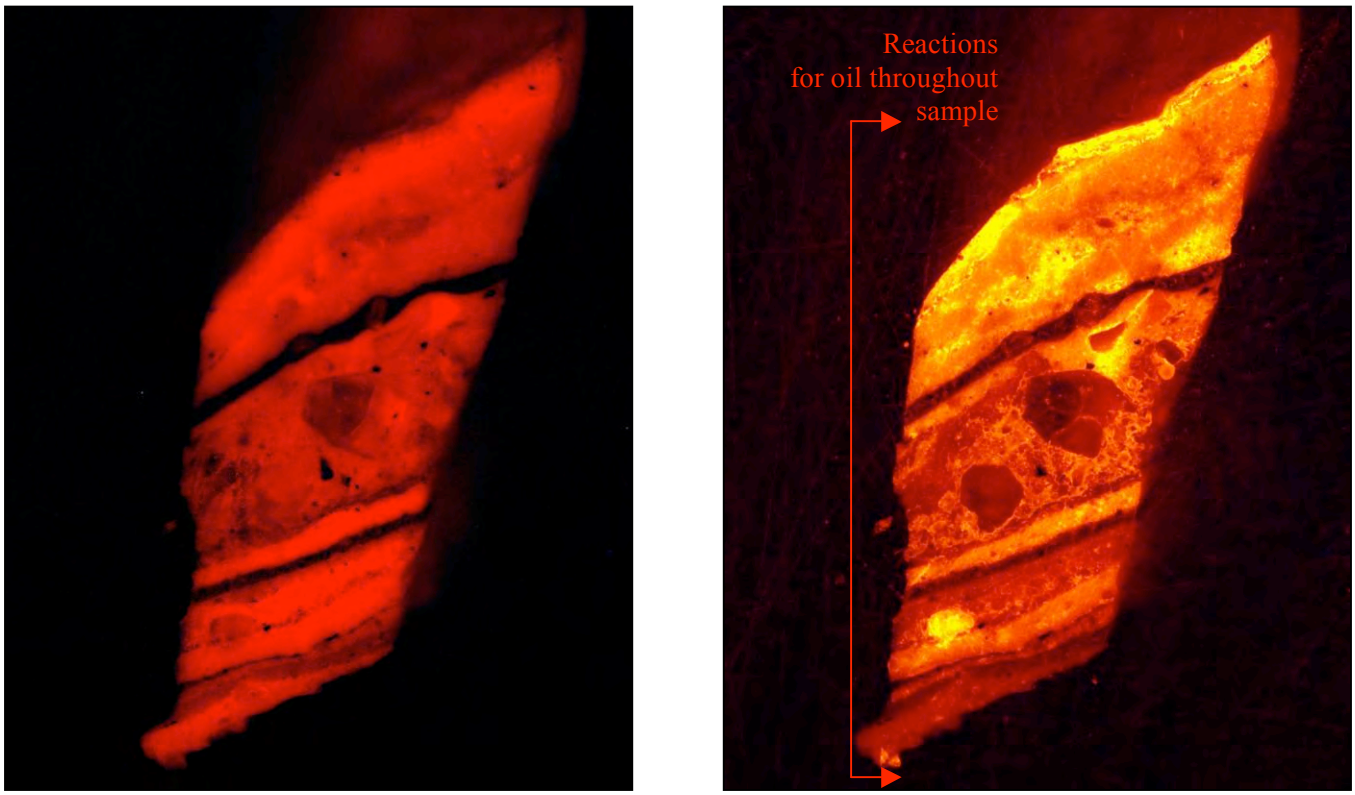


Figure 12: Sample from pilaster on corner cupboard, green filter cube, 200x magnification

An elemental map was created of the sample using SEM-EDS that detected primarily the presence of calcium, silicon and lead. Again, the tan primer layers, as seen on the previous samples, showed concentrations of calcium. The thicker paint layers had concentrations of lead.

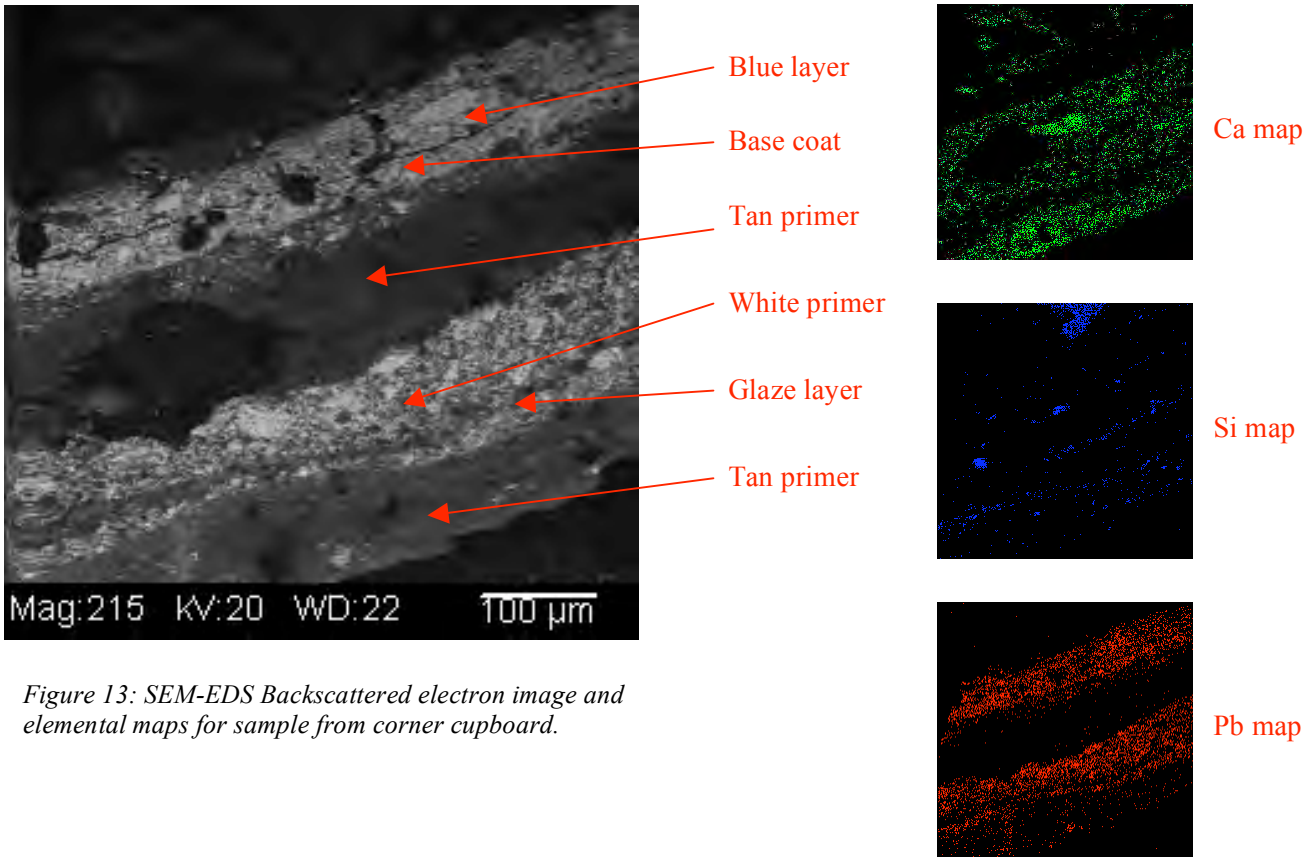


Figure 13: SEM-EDS Backscattered electron image and elemental maps for sample from corner cupboard.

None of the blue paint layers tested with SEM-EDS detected any elements other than lead or paint fillers. Under magnification, the blue pigment particles are very fine and appear most similar to the iron containing pigment, Prussian blue, which was in common use at the time. Since Prussian blue has a high tinting strength, there may not have been sufficient concentrations of iron for it to be picked up by the SEM-EDS.

Though I have only discussed a few samples, it is possible to see that the remains of rich decorative finishes still exist on the walls of the Byrd house. More than simple flat paints, the owners of the Byrd house were using glazes and a build-up of layers to create their finishes. The existence of early layers shows that the majority of the woodwork in the house has survived restorations mostly intact. The faux-grained stair and perhaps marbled archway must have made the Center Passage a very extravagant space for visitors. The bright colors seen on the corner cupboard and elsewhere in the Northwest Chamber suggest that this room was also highly decorated. The elaborate woodwork and paint work are consistent with the high social standing and expensive tastes of the Byrd family and this importance of this high style house in Williamsburg.

During my 3rd year internship with the Architectural Research department at Colonial Williamsburg, I hope to do further work on this house. I would like to continue my study with more pigment identification of

selected layers with polarized light microscopy as well as microcolorimetry to determine the original colors. This information will be useful to Colonial Williamsburg if they ever attempt to interpret the Byrd house and want to reproduce the original finishes in modern materials. I would also like to open a few windows in key areas to reveal the original layers. This is the only way to identify the patterns of faux marbling or graining and fully understand those finishes.

I would like to thank several people for their help beginning with my major advisors, Richard Wolbers and Dr. Susan Buck. Ed Chappell, Willie Graham and the rest of the staff of the Architectural Research department was very informative and supportive. This study would of course not have been possible without the staff of the Winterthur Scientific Research and Analytical Laboratory, including Catherine Matsen, Dr. Jennifer Mass, Dr. Joseph Weber, Dr. Chris Petersen, and Janice Carlson, who spent hours helping me operate the equipment and interpret the data. I would also like to thank the staff of Jamestown 2007, the current Byrd house tenants who allowed me access to the interiors. As always, I am very appreciative of the support of the Leo and Karen Gutmann Foundation and Larry Putterman and Connie Lowenthal. Finally, I would like to thank the many people at the University of Delaware who offered me assistance including Dr. Joyce Hill Stoner, Debbie Hess Norris, Brian Baade, Dana Melchar, and my other fellow WUDPACs.