FINISHES ANALYSIS REPORT

WILTON HOUSE, OUTBUILDING: INTERIOR FINISHES

AUGUST 30, 2013

Requested by:

Christopher Mills
Christopher Mills Conservation Services, LLC
135 High St
Becket MA 01223
646.270.0999

Prepared by:

Kirsten Travers
Conservator and Paint Analyst
214 W Duke of Gloucester St
Williamsburg, VA 23185
917.744.2759
kirstenetravers@gmail.com

Purpose:

Three fragments of interior finish (two from the plaster walls, one from the woodwork) from the Wilton House outbuilding were provided for analysis. This building is believed to have been used as slave quarters or a kitchen. Samples from both areas appeared to consist of one or more layers of unpigmented limewash on a plaster or wood substrate. The goal of this project was to select two samples and use cross-section microscopy techniques to examine the number and nature of extant finishes on the plaster and woodwork, and to determine the presence of organic media such as carbohydrates, proteins, and/or oils using fluorochrome stains. The results will aid in the preservation and possible replication of these finishes.

Procedures:

Sample Preparation:
In the laboratory, the fragments were screened at 30x magnification and smaller fragments of finish with substrate attached were removed using a microscalpel. Each fragment was cast in a mini-cube of Extec Polyester Clear Resin (methyl methacrylate monomer), polymerized with the recommended amount of methyl ethyl ketone peroxide catalyst. The resin was allowed to cure for 24 hours under ambient light. After cure, each cube was removed from the casting tray and sanded down using a rotary sander with grits ranging from 200 – 600 to expose the cross-section surface. The samples were then dry polished with silica-embedded Micro-mesh Inc. cloths with grits ranging from 1500 to 12,000, lending the final cross-section surfaces a glassy-smooth finish.

The following samples were cast:

Sample number	***Sample description***	***notes***
WO 1a	plaster and limewashes, south side, west wall, above and to the right of door	cast
WO 1b	plaster and limewashes, south side, east wall, left of window, 6' high	same as 1a, not cast
WO 2a	south side, wainscot, north wall, right of opening, 4 1/2' high	cast

Microscopy and Documentation:
Each cross-section sample was examined using a Nikon Eclipse 80i microscope equipped with an EXFO X-cite 120 fluorescence illumination system fiberoptic halogen light source. Samples were examined and photographed under visible and ultraviolet light conditions (excitation (EX) 330-380 nm, barrier (BA) filter 420nm), at 100x to 400x magnifications. Digital images were captured using a Spot Flex digital camera with Spot Advance (version 4.6) software. The following illustrated report was prepared with Adobe InDesign CS5.

Binding Media Analysis using Fluorochrome staining:
Fluorochrome stains adapted from the biological sciences were used to characterize the paint binding media (oils, proteins, carbohydrates), in layers within the cross-section sample. The following stains were used in this analysis:

Triphenyl tetrazolium chloride (TTC): 1.0% w/v in ethanol. Labeling reagent for carbohydrates (gums, starches, cellulosic thickeners). One drop of stain was applied to the surface of the sample, blotted dry, and allowed to sit for approximately 45 seconds before cover-slipping, (must be allowed to react with atmospheric moisture for reaction to move forward). The reaction is observed under reflected UV light conditions (EX 330-380 nm, BA 420nm). A dark red-brown color is seen where carbohydrates are present.

Fluorescein isothiocyanate (FITC): 0.02% w/v in anhydrous acetone. Fluorescent labeling reagent for proteins. One drop of stain was applied to the surface of the sample, blotted immediately, and cover-slipped with mineral spirits. The reaction was observed using the B-2A filter cube (EX 450-490 nm, BA 520nm). A positive reaction is a bright yellow-green fluorescence.

2,7 Dichlorofluorescein (DCF): 0.2% w/v in ethanol. Fluorescent labeling reagent for lipids, particularly drying oils. One drop of stain was applied to the surface of the sample, blotted immediately, and cover-slipped with mineral spirits. The reaction was observed using the B-2A filter cube (EX 450-490 nm, BA 520nm). A positive reaction is a bright yellow-green fluorescence.

Results:

The cross-section microscopy and fluorochrome staining results are discussed in the following report adjacent to relevant photomicrographs. The plaster finishes are discussed first, followed by the finishes on the wood paneling. Stratigraphies have been annotated according to the order in which a layer was theoretically applied. It should be noted that a single generation of limewash can comprise multiple layers. Therefore, the term "application' has been used in lieu of "generation", although the presence of dirt or grime suggests that some applications were presenting finishes.

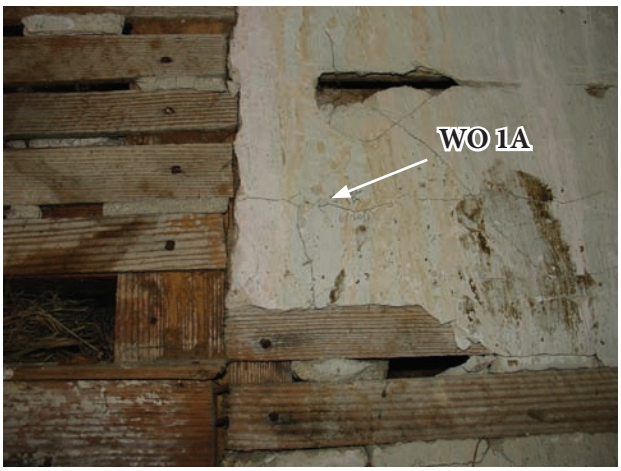
Building Photographs [C. Mills, 2013]

exterior

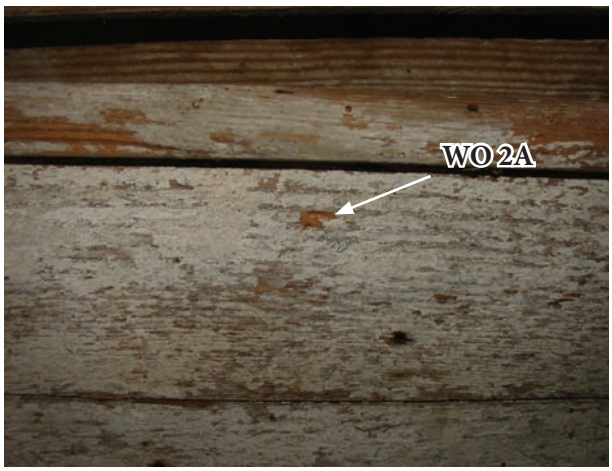
interior

interior

interior



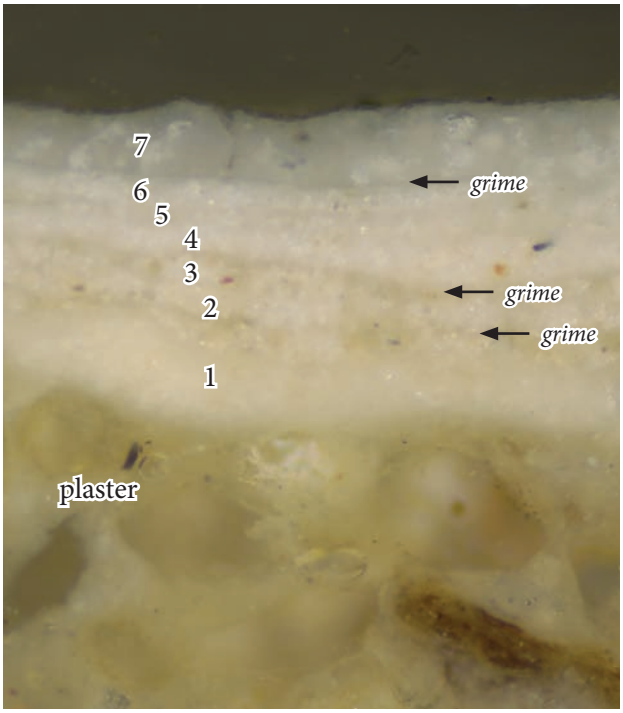
plaster and limewashes, west wall, sample location for 1A



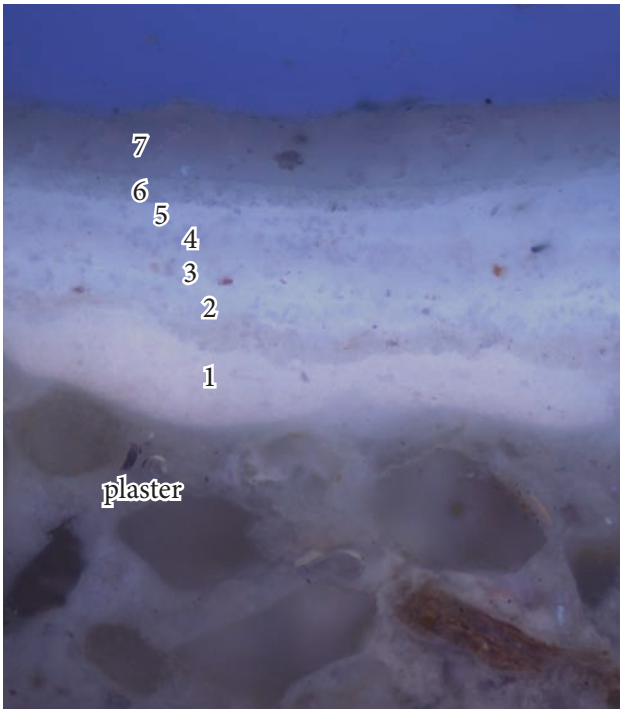
wainscot, north wall, sample location for 2A

Cross-section Microscopy Results - Plaster and Limewashes

Sample WO 1a: south side, west wall, above and right of door



WO 1a, visible light, 100x



WO 1a, UV light, 100x

Approximately seven applications of limewash were identified on the plaster walls. All appear to be unpigmented (white) limewashes. These were identified visually, as having a white or off-white color with consistent textures and no pigment particles visible, and possessing a translucent quality in visible light, with a relatively bright, usually bluish or purplish, autofluorescence in UV light. These qualities are consistent with limewash. In addition, examination of the uncast sample found that these layers were white, very thin, slightly chalky, and brittle- again consistent with limewashes. In cross-section, each layer has a slightly different autofluorescence color and intensity, which aided with the identification of layers.

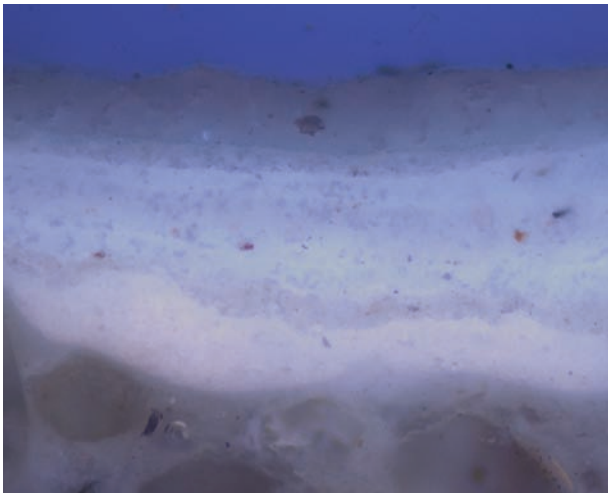
The first layer appears to have been applied shortly after the plaster was laid down, as there is no dirt or grime separating the plaster from the first limewash. The surface of this first limewash is slightly grimy and uneven, suggesting it was exposed for some period of time, although an exact length of time could not be determined. Some surface disruption and grime was also seen on the surfaces of layers three and six. The presenting finish, layer seven, appeared very grimy under low-power magnification.

Limewashes were very common, inexpensive, and readily available finishes that were usually refreshed often. In fact, some historic buildings contain very thick accumulations of limewash that eventually flake away due to the brittle nature of the material. Therefore, it is quite possible that sample WO 1a does not contain the complete finish history of limewashes over time in this interior.

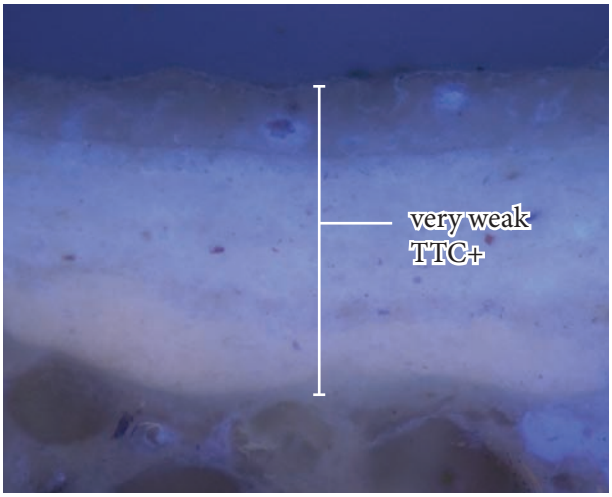
This sample was stained with fluorochromes to determine if organic media was present (see pages 5-6). The reaction for carbohydrates (TTC) was weak and inconclusive. Strong reactions for proteins (FITC) and lipids (DCF) were observed in all layers, suggesting that some type of proteinaceous and oil-based components were added to the limewashes to enhance their durability and working properties.

Binding Media Analysis - Sample WO 1a

TTC for Carbohydrates (starches, gums)



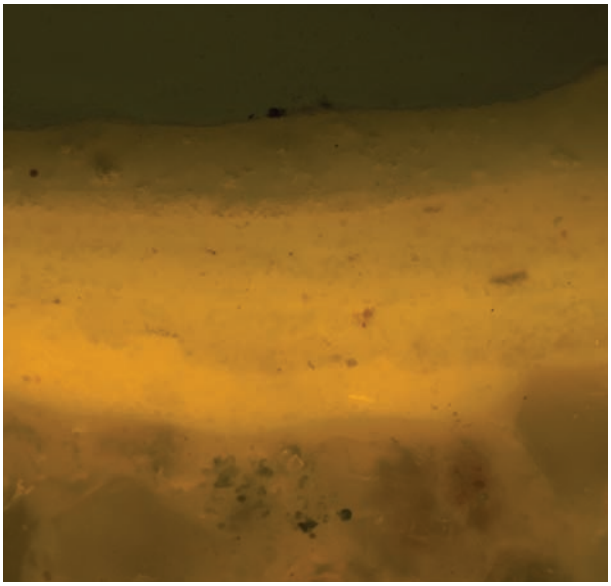
WO 1a, UV light, 100x. Before TTC stain.



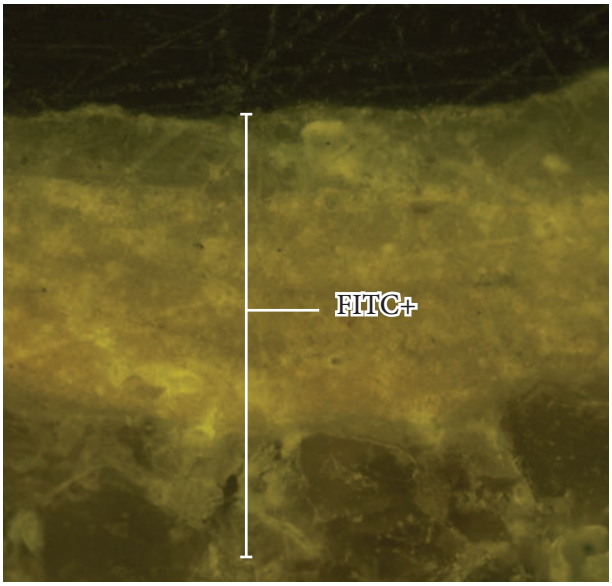
WO 1a, UV light, 100x. TTC reaction.

Sample WO 1a was stained with TTC to detect carbohydrates in the stratigraphy. A positive reaction is a dark reddish-brown color, but only a slight darkening was observed throughout the sample, so the results are inconclusive.

FITC for Proteins (animal glues, casein)



WO 1a, B-2A filter, 100x. Before FITC stain.

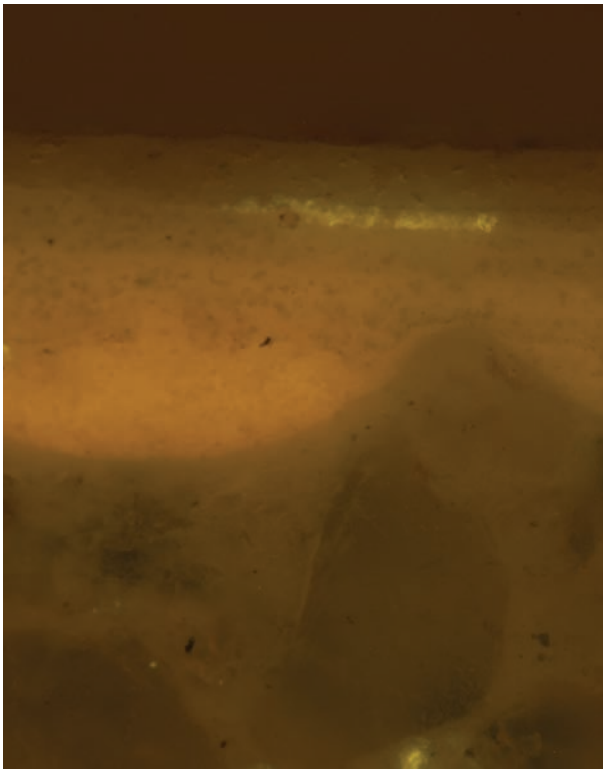


WO 1a, B-2A filter, 100x. FITC reaction.

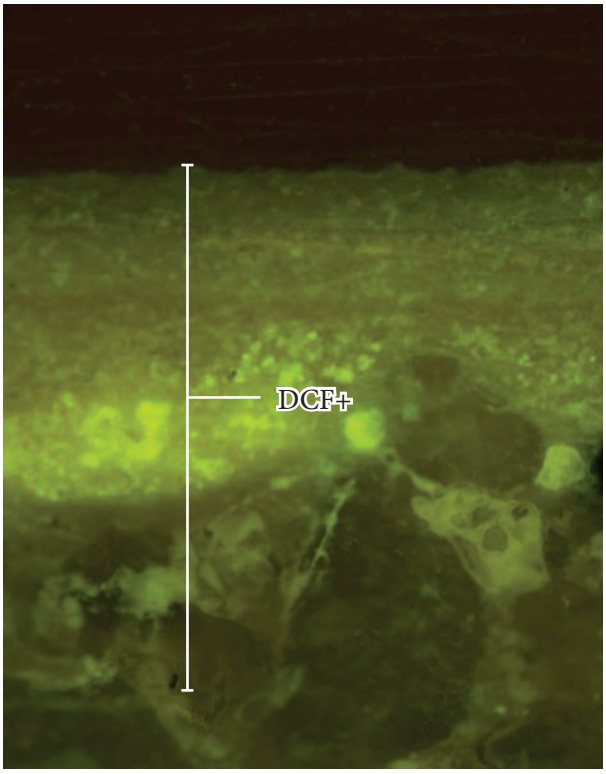
Sample WO 1a was repolished and stained with FITC to detect proteins in the stratigraphy. A strong positive reaction (a bright yellow-green fluorescence), was observed throughout the sample, including the plaster substrate.

Binding Media Analysis - Sample WO 1a

DCF for Lipids (oils)



WO 1a, B-2A filter, 100x. Before DCF stain.

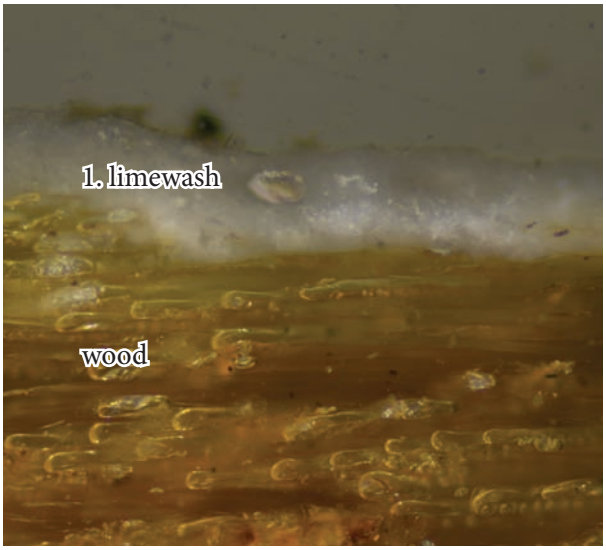


WO 1a, B-2A filter, 100x. DCF reaction.

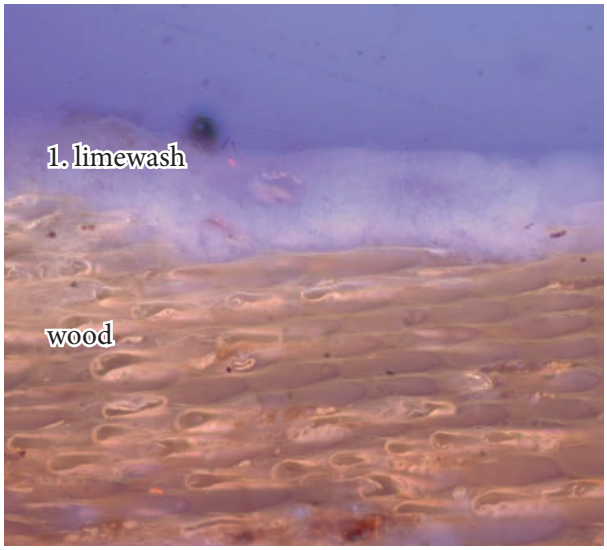
Sample WO 1a was repolished and stained with DCF to detect oils in the stratigraphy. A strong positive reaction (a bright yellow-green fluorescence), was observed throughout the sample, including the plaster substrate.

Cross-section Microscopy Results - Wainscot and Limewashes

Sample WO 2a: Wainscot, south side, north wall, right of opening



WO 2a, visible light, 100x



WO 2a, UV light, 100x

Sample WO 2a did not contain as many layers of limewash as the sample from the plaster walls, and this was confirmed through cross-section microscopy. This sample was repolished numerous times to expose the best example of extant finishes in cross-section, but only one limewash layer was eventually exposed.

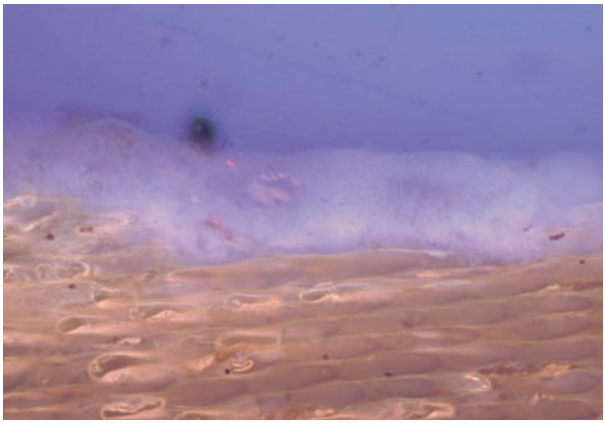
This limewash does not appear to be the same as the first layer of limewash on the plaster wall (sample WO 1a), which had a pinkish-colored autofluorescence. By contrast, the limewash in the sample above has a more light purple-colored autofluorescence, like layers 2-5 on the walls. However, limewashes are usually so similar in composition that it can be impossible to clearly align layers.

The absence of limewashes in this sample most likely results from the expansion and contraction of the wood substrate, which exacerbates the flaking and loss of these naturally brittle finishes.

This sample was stained with fluorochromes to determine if organic media was present (see pages 8-9). The reaction for carbohydrates (TTC) was negative. Strong positive reactions for proteins (FITC) and lipids (DCF) were observed in all layers, suggesting that some type of proteinaceous or oil-based components were added to the limewashes to enhance their durability and working properties.

Binding Media Analysis - Sample WO 2a

TTC for Carbohydrates (starches, gums)

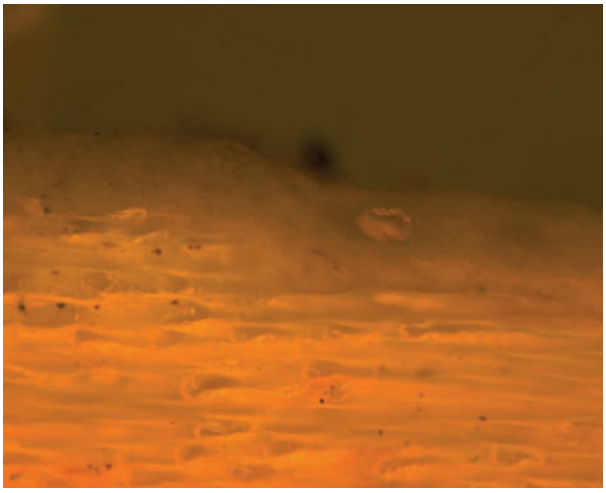


WO 2a, UV light, 100x. Before TTC stain.

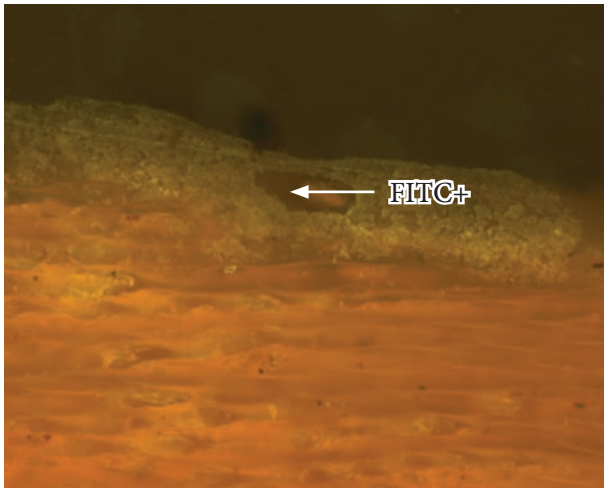
WO 2a, UV light, 100x. TTC reaction.

Sample WO 2a was stained with TTC to detect carbohydrates in the stratigraphy. No reactions (a reddish-brown color), were observed.

FITC for Proteins (animal glues, casein)



WO 2a, B-2A filter, 100x. Before FITC stain.

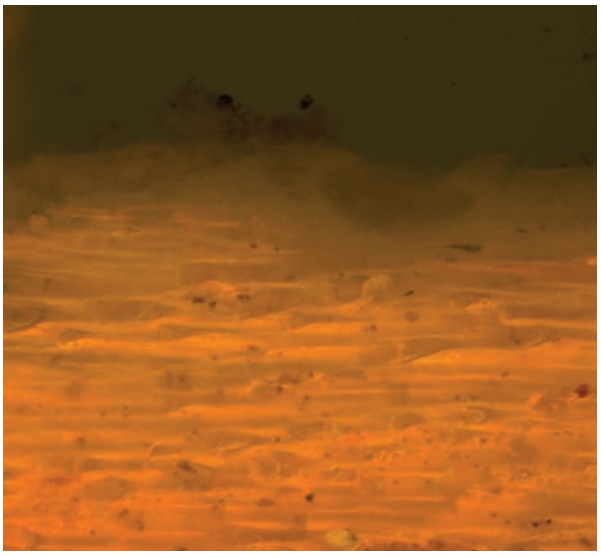


WO 2a, B-2A filtert, 100x. FITC reaction.

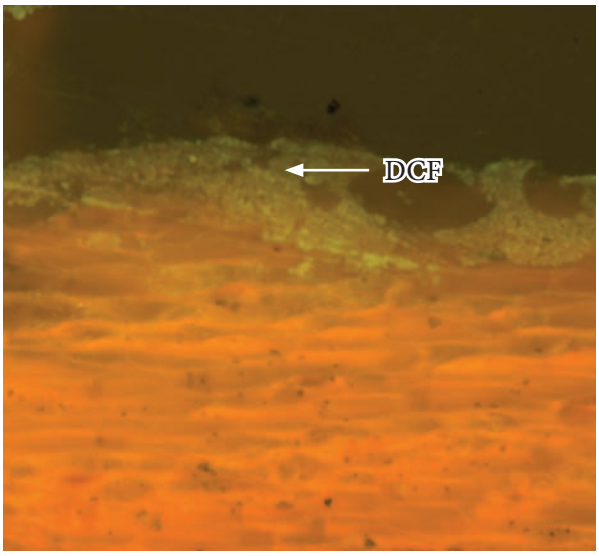
Sample WO 2a was stained with FITC to detect proteins in the stratigraphy. A positive reaction (yellow-green fluorescence), was observed in the limewash layer.

Binding Media Analysis - Sample WO 2a

DCF for Lipids (oils)



WO 2a, B-2A filter, 100x. Before DCF stain.



WO 2a, B-2A filter, 100x. DCF reaction.

Sample WO 2a was stained with DCF to detect lipids (oils) in the stratigraphy. A positive reaction (yellow-green fluorescence), was observed in the limewash layer.

Conclusions:

The study was able to gather important evidence relating to interior finishes from the Wilton House outbuilding.

The walls contain approximately seven applications of unpigmented (white) limewash, a common and inexpensive finish that was frequently re-applied to the interiors and exteriors of buildings. The earliest limewash appears to have been applied before the plaster substrate had completely cured, and would therefore be an early finish. Due to the brittle nature of accumulated limewashes, flaking and loss often occurs, and it seems likely that additional limewashes are missing from this sample. Fluorochrome staining determined that these limewashes may contain proteinaceous and oil-based additives. This would need to be confirmed with an instrumental technique for media characterization, such as Fourier-transform infrared spectroscopy (FTIR). The exact type of media (animal glue, casein, linseed oil, etc.), would need to be confirmed with a chromatographic technique such as gas chromatography-mass spectrometry (GC-MS).

Only one layer of limewash was found on the wood panelling. It was unclear how this limewash aligned with the walls. It seems likely that this sample is also missing the complete finish history. Fluorochrome staining determined that this limewash contained both proteinacous and oil-based additives. Again, this would need to be confirmed with FTIR or GC-MS.