Society
for the Preservation
of New England
Antiquities

Conservation Center
Lyman Estate
185 Lyman Street
Waltham, Massachusetts 02154
Tel: (617) 891-1985
Fax: (617) 893-7832

February 2, 1996

Mr. Carter L. Hudgins
President
Historic Charleston Foundation
P.O. Box 1120
Charleston, S.C. 29402

Dear Carter,

I am sending you the results of the paint study of the small group of samples I took from the central portion of McLeod Plantation in January. Please keep in mind that this was not intended to be a complete study of all the exterior elements, rather the goal was to get a sense of the variation in color on specific elements and to provide some guidance in selecting paint colors for repainting the exterior.

If at some point you decide to pursue a more complete and rigorous paint study of McLeod Plantation, this initial report can serve as a guide for selecting promising sample locations for all representative components of the building. There is still a substantial amount of the paint history surviving on the building, despite the weathered appearance of the current paint surface. That important paint history can be saved for future study if you direct your painters to dry scrape the peeling areas and feather the edges of the losses with sandpaper, leaving the well-adhered paint layers still in place.

Please feel free to give me a call with any questions. Hope you find the report interesting reading.

Sincerely,

Susan L. Buck
Conservator

SOCIETY FOR THE PRESERVATION OF NEW ENGLAND ANTIQUITIES
CONSERVATION CENTER
185 Lyman Street
Waltham, MA, 02154
Tel. (617) 891-1985
Fax (617) 893-7382

Client:	Historic Charleston Foundation
Object:	McLeod Plantation
Project #:	A-664
Conservator:	Susan L. Buck
Conservation Intern:	Doreen L. Alessi
Date:	January 26, 1996

SPNEA CONSERVATION CENTER
CROSS-SECTION MICROSCOPY REPORT

Introduction:

While Susan Buck, SPNEA Conservator, was working at the Nathaniel Russell House on a paint analysis project in mid-January 1996, she was asked by Carter Hudgins, Director of the Historic Charleston Foundation, to examine the weathered paint on the exterior of McLeod Plantation, and to conduct a limited paint study. This plantation house is currently painted with gray-blue clapboards and shutters, and white trim. The painted surfaces are extremely degraded and weathered, and the building has apparently not been repainted for several decades.

The building in its current state includes a number of alterations and additions. A complete paint study would include comparative samples from the wing and the porch additions to track the paint changes related to the architectural changes. This could help to date the specific exterior paint colors.

The goal of this limited study was to get a better idea of the early paint colors on the main part of the plantation house. For this initial examination, five samples were taken from protected areas (behind shutters, under protective porch roofs) for analysis. These samples provide some insight into the color changes over time in up to ten generations of paint. Assuming the building was painted every ten to twelve years, this paint history may represent up to 120 years of paint layers. So, it is conceivable we have found the earliest paints surviving on selected areas of the building.

Procedure:

On January 12, 1996, five paint and wood samples approximately 1/8th of an inch in size were

taken from representative areas of the exterior of McLeod Plantation by Susan Buck, Conservator, for cross-section paint analysis and color matching to the earliest surviving paint layer in each sample location. Sample flakes, approximately 200 to 300 microns in size, were cast in mini-cubes of polyester resin (Excel Technologies, Inc., Enfield, CT). In some areas the paint layers had separated from the wood substrate -- when this occurred the paint layers and wood substrate were cast together in the same cube for analysis.

The resin was allowed to cure for 24 hours at room temperature and under ambient light. The cubes were then ground to expose the cross-sections, and dry polished with 400 and 600 grit wet-dry papers and Micro-Mesh polishing cloths, with grits from 1500 to 12,000.

The cross-section samples were examined under visible and ultraviolet light using the SPNEA Conservation Center Olympus BHT Series 2 Ultraviolet light microscope at 125X and 250X magnifications.

The cross-sections were photographed with Kodacolor Gold Plus ASA 200 color print film, and the resulting photographs were labeled and laid out in sequence to allow direct visual comparisons. Photographs were taken at 125X and 250X, and all the UV photographs were taken with the UV filter in place (300 to 400 nanometers excitation with a 420 nm. barrier filter).

Please note that the colors of the paint layers shown in the photographs cannot be used for exact color matching, because of the variations in automatic color processing methods. The photographs are very helpful for general reference and for understanding the sequence of the paint layers.

Information Provided by Ultraviolet Light Microscopy:

When viewed under visible light, cross-sections which contain ground, paint and varnish may often be difficult to interpret, particularly because clear finish layers look uniformly brown or tan. It may be impossible using only visible light to distinguish between multiple varnish layers. Illumination with ultraviolet light provides considerably more information about the layers present in a sample because different organic, and some inorganic, materials autofluoresce (or glow) with characteristic colors.

There are certain fluorescence colors which indicate the presence of specific types of materials. For example: shellac fluoresces orange (or yellow-orange) when exposed to ultraviolet light, while plant resin varnishes (typically amber, copal, sandarac and mastic) fluoresce bright white. Wax does not usually fluoresce; in fact, in the ultraviolet it tends to appear almost the same color as the polyester casting resin. In visible light wax appears as a somewhat translucent white layer. Paints and glaze layers which contain resins as part of the binding medium will also fluoresce under ultraviolet light at high magnifications. Other materials such as lead white, titanium white and hide glue also have a whitish autofluorescence.

There are other indicators which show that a surface has aged, such as cracks which extend through finish layers, accumulations of dirt between layers, and sometimes a diminished fluorescence intensity, especially along the top edge of a surface which has been exposed to light and air for a long period of time.

Results of the Cross-section Analysis:

The samples were removed with a microscalpel and were taken from the following areas:
Sample 1-- Shutter, back of house
Sample 2-- Clapboard behind shutter, back of house
Sample 3-- Window sill, back of house
Sample 4-- Window sill, front of house
Sample 5-- Clapboard behind shutter, front of house

Samples 1, 2, and 3 contained the most information and were mounted for visual reference.

The paint history of each sample is described individually in the following section:

The Shutter --(Sample 1): This sample contains six generations of paint. The most recent paint generations are missing from the mounted sample. It appears that the shutters were originally painted a dark gray color, possibly over a grayish primer (see sample 1, substrate). This paint is coarsely ground and the pigment particles are unevenly dispersed. The shutters were then repainted a very light gray or grayish-cream over a translucent primer. The third generation of paint is a medium-toned gray primer and medium-toned gray finish coat. Generations four and five consist of cream primers with cream finish coats. The only information contained in this sample about the sixth generation is a light gray primer. The rest of the information (the modern paint layers) is missing from this sample because the upper layers cleaved off during the sampling process.

The Clapboard -- (Samples 2 and 5): Both of these samples are very similar in terms of paint sequence. There is evidence of eight or nine generations of paint on the samples. Sample 2 was mounted for visual reference.

It appears that the first generation of paint on the clapboard is a coarsely-ground medium-to-dark gray with unevenly dispersed pigment particles, over a coarsely ground medium-gray primer (see Sample 2, at 250X magnification). This gray paint is slightly lighter than the earliest gray in the shutter sample. This is followed by a cream-colored primer and two generations of medium-toned gray paint. The fourth generation of paint on sample 2 is a dark gray which fluoresces brightly. This paint layer doesn't appear in sample 5. The clapboards were then reprimed with a coarsely ground cream-colored primer and repainted a cream white, matching the fourth generation in the shutter sample. The next two generations of paint also consist of coarsely ground cream-colored primers and cream-colored finish paints, which also appear to match the shutter sample (up to and including the sixth generation primer coat). The clapboards were then

repainted a light gray color and remained that way for one or two generations of paint. The last generation of paint on the clapboard sample is the current, dense, evenly-ground light blue-gray.

The Window Sill -- (Samples 3 and 4): Both of these samples are similar in terms of paint sequence, and there is strong evidence of mold growth (small black spores) in some layers on both samples. Sample 3 was mounted for visual reference, as the paint sequence was least disrupted in this sample. There appears to be ten generations of paint on the window sill, some of which vary widely in color. The first generation appears to be a creamy white. Evidence of this layer is less clear in the mounted photographs of the cast sample than in some of the uncast samples. The original cream paint is followed by a primer and a second cream color. This is followed by a cream primer and a comparatively thick, pea-green finish coat. This paint layer shows many small dark-gray spots indicative of mold spores. It is possible that this shift in color may coincide with the shift from gray to cream on the shutters and clapboards.

The window sill was then reprimed with a dark primer and repainted a dark green color. This is followed by a bright red paint with no evidence of repriming. Generation six is a brown primer and brown finish paint. The next three generations are medium grays. The current paint is a dense, finely ground white over a primer.

Conclusion:

It is difficult to reach a complete assessment about the paint colors on a building from a small group of samples. Ideally an exterior paint study would include samples from all types of trim elements, from protected clapboards in the first and second floor, and from all later additions to the main body of the building. This limited paint study does indicate, however, that the clapboards were painted in shades of gray up until the most recent (20th century) paint layers, and that the shutters were also painted in shades of gray early on. The window sill samples are quite different and indicate that the sills were painted a variety of colors after the first two cream colored paint layers. The paint layers found on the sills may or may not relate to other types of trim on the building. Documentary photographs may help in comparing the paint treatment on different parts of the building. Shades of black and white can show, for instance, whether all the trim elements are similar tones, and how dark the shutters are compared to the clapboards during different periods of time. This limited paint study can provide some guidance in choosing appropriate ranges of color for the building, or it could be the first phase in a more complete paint study of the exterior of this large plantation house.

Color Measurement:

After the target layer (the earliest surviving layer) in each sample was identified through cross-section analysis, the samples were carefully examined under a 30X binocular microscope to locate clean, relatively even areas of the earliest paint layer which could be measured.

Each sample was measured for a color match to the earliest paint layers using the Minolta Chroma Meter CR-241. This instrument is a tristimulus color analyzer with a color measurement area of 0.3mm. It has an internal, 360-degree pulsed xenon arc lamp and provides an accurate color measurement in a choice of five different three-coordinate color systems.

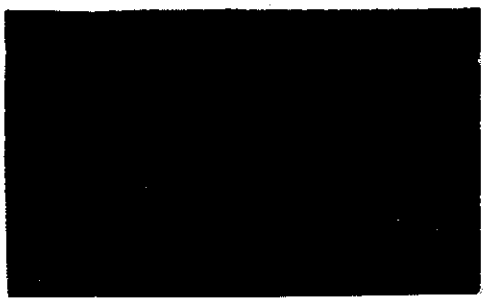
The sample was measured five times in five different areas of the exposed target layer. The measurements were first generated in the Munsell color system (a color standard used in the Architectural Preservation field), and after the measurements were taken the closest Munsell color swatches from a standard Munsell Book of Color (gloss paint standards) was compared under 30X magnification to the actual samples.

The color measurements generated for the samples are listed below.

Sample 1 -- Shutter, back of house -- Dark Gray Layer

Color System*	Coordinates		
Munsell	7.3 BG - 5.4 B	3.6V	0.1C

This paint layer is coarsely ground and the pigments are unevenly dispersed. Thus, the readings of the hue vary from blue-green to blue depending on the proportion of pigment particles in the measurement area. An *average* of the hue readings was used to select a representative Munsell match. The value and chroma coordinates remained consistent with each reading. The closest match in the standard Munsell color system swatch book to this dark gray layer is 10.0 BG 3/1. The closest match to this color in the Benjamin Moore commercial paint line is #1596. A swatch of# 1596 is attached to this report for reference.

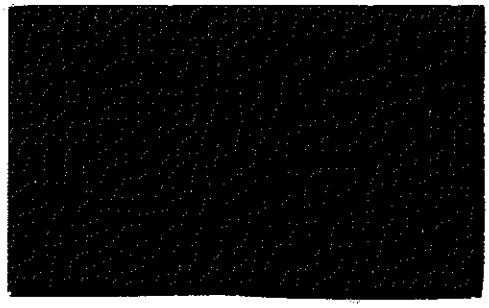


Sample 2 -- Clapboard behind shutter, back of house -- Medium Gray Layer

Color System*	Coordinates		
Munsell	8.6 G - 7.5 B	4.3V	0.3C

This paint layer is coarsely ground and the pigments are unevenly dispersed. Thus, the readings of the hue vary from green to blue depending on the proportion of pigment particles in the measurement area. An *average* of the hue readings was used to select a representative Munsell match. The value and chroma coordinates remained consistent with each reading. The closest match in the standard Munsell color system swatch book to this medium gray layer is 10.0 BG

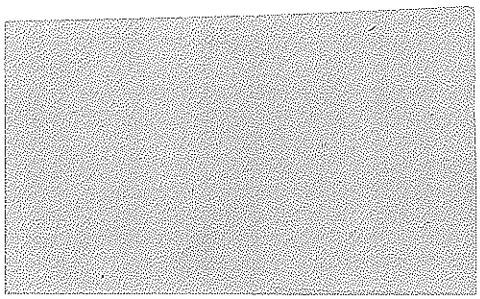
4/1. The closest match to this color in the Benjamin Moore commercial paint line is #1595. A swatch of #1595 is attached to this report for reference.



Sample 3 -- Window sill -- Cream-white

Color System*	Coordinates		
Munsell	3.8 Y	7.4V	1.9C

The closest match in the standard Munsell color system swatch book to this green layer is 5.0 Y 8/2. The closest match to this color in the Benjamin Moore commercial paint line is #957. A swatch of # 957 is attached to this report for reference.



---

* **COLOR SYSTEMS -- Derived from the Minolta CR-241 Instruction Manual and Minolta Precise Color Communication**

Chroma Meter CR-241 offers five different color systems for measuring absolute chromaticity: CIE Yxy (1931), L*a*b* (1976), and L*C*H* (1976); colorimetric densities DxDyDz; Munsell notation; and four systems for measuring color differences.

For two colors to match, three quantities defining color must be identical. These three quantities are called tristimulus values X, Y, and Z as determined by CIE (Commission Internationale de l'Eclairage) in 1931.

Color as perceived has three dimensions: hue, chroma and lightness. Chromaticity includes hue and chroma (saturation), specified by two chromaticity coordinates. Since these two coordinates cannot describe a color completely, a lightness factor must also be included to identify a specimen color precisely.

Munsell Color System: The Munsell color system consists of a series of color charts which are intended to be used for visual comparison with the specimen. Colors are defined in terms of the Munsell Hue (H; indicates hue), Munsell Value (V; indicates lightness), and Munsell Chroma (C; indicates saturation) and written as H V/C.

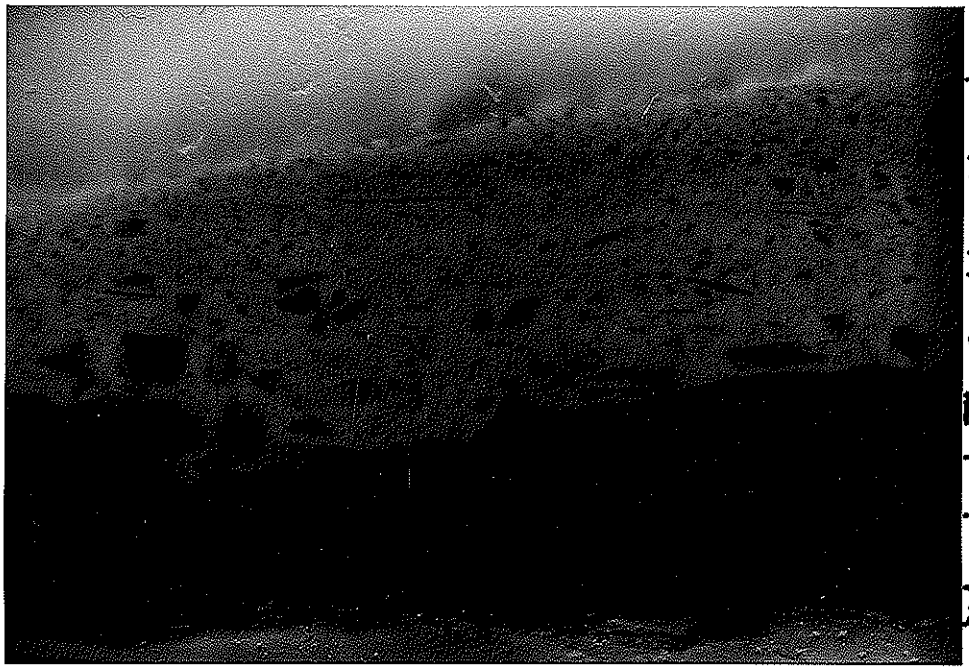
CIE Yxy (CIE 1931): In the Yxy (CIE 1931) color system, Y is a lightness factor expressed as a percentage based on a perfect reflectance of 100%. x and y are the chromaticity coordinates of the CIE x, y Chromaticity Diagram.

CIE L*a*b*: Equal distances in the CIE x, y Chromaticity Diagram do not represent equal differences in color as perceived. The CIE L*a*b* color system, however, more closely represents human sensitivity to color ... Equal distances in this system approximately equal perceived color differences. L* is the lightness variable; a* and b* are the chromaticity coordinates.

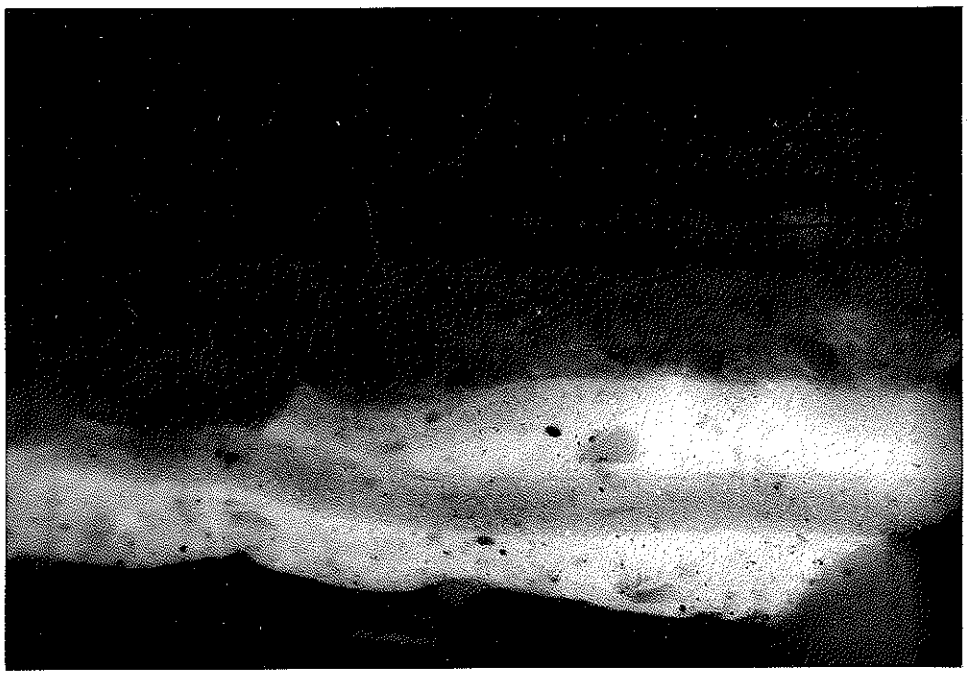
CIE L*C*H Color System: The CIE L*C*H color system uses the same diagram as the L*a*b* color system, but uses cylindrical coordinates instead of Cartesian coordinates. In the system L* is the lightness variable, C* is chroma and H is the hue angle.

SPNEA Conservation Center
Cross-section Sample Photographs
Historic Charleston Foundation -- McLeod Plantation
Sample 1 -- Shutter, back of house

Visible Light 250X

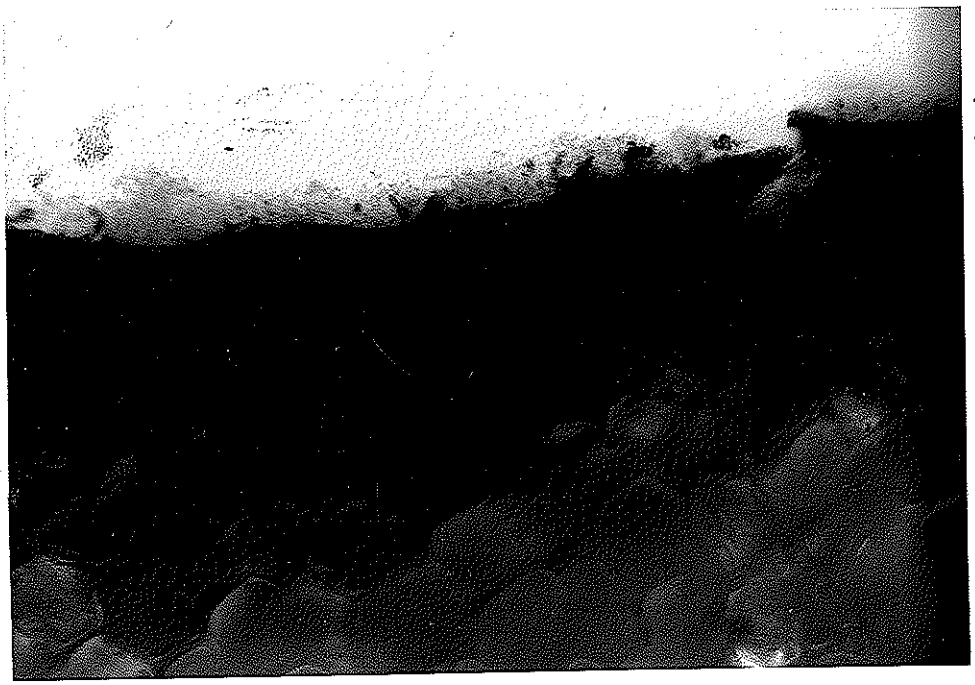


Ultraviolet Light 250X

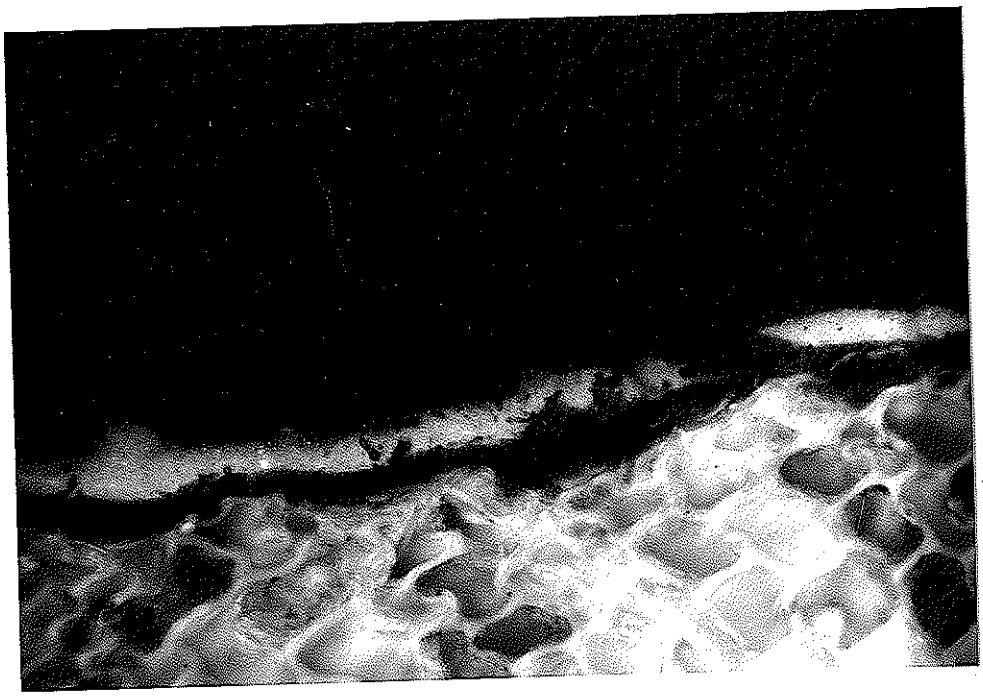


SPNEA Conservation Center
Cross-section Sample Photographs
Historic Charleston Foundation -- McLeod Plantation
Sample 1 -- substrate, Shutter, back of house

Visible Light 250X

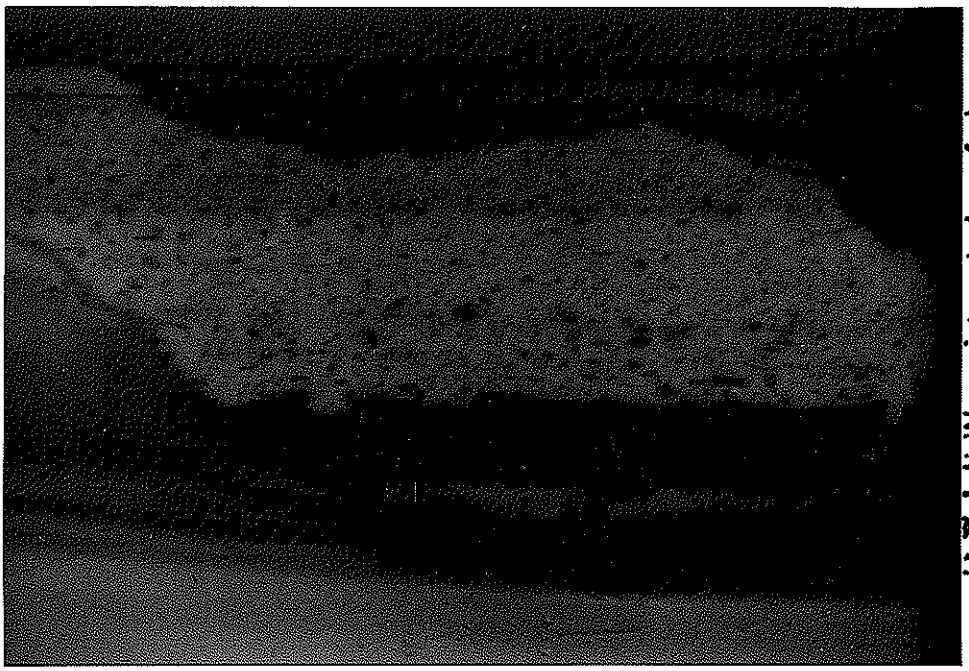


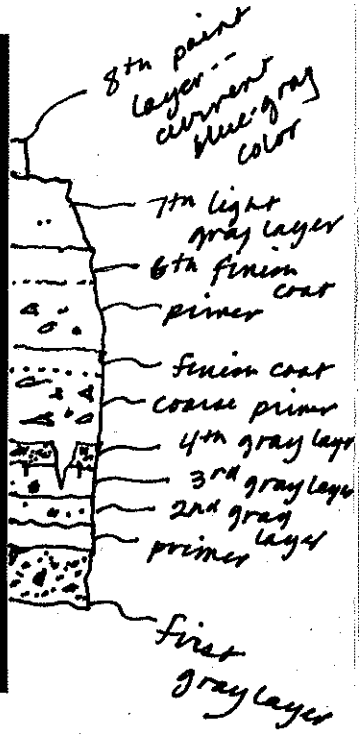
Ultraviolet Light 250X



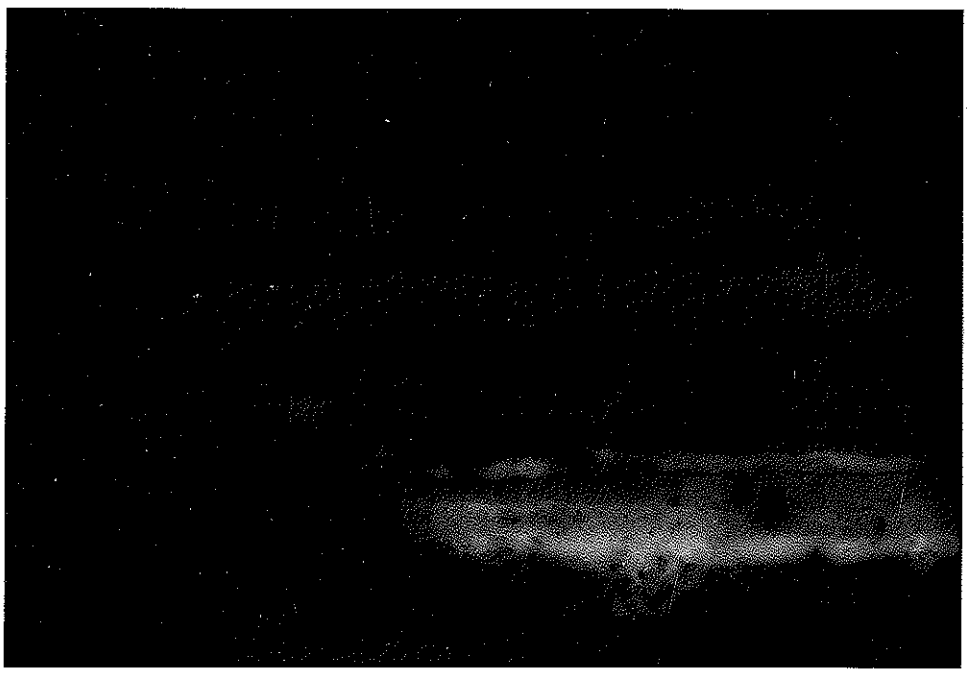
SPNEA Conservation Center
Cross-section Sample Photographs
Historic Charleston Foundation -- McLeod Plantation
Sample 2 -- Clapboard behind shutter, back of house

Visible Light 125X



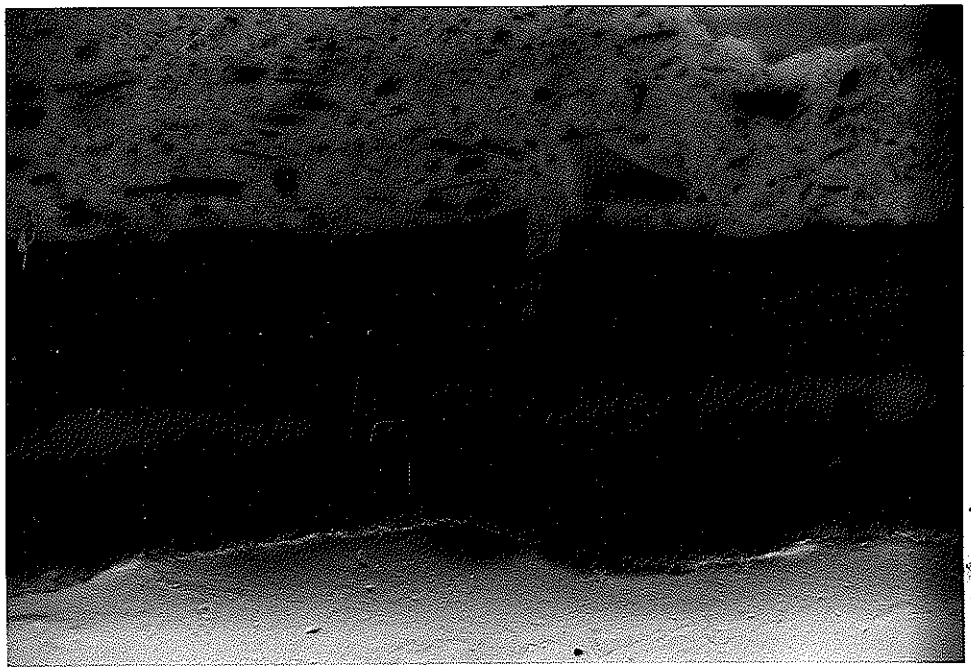


Ultraviolet Light 125X



SPNEA Conservation Center
Cross-section Sample Photographs
Historic Charleston Foundation -- McLeod Plantation
Sample 2 -- Clapboard behind shutter, back of house

Visible Light 250X



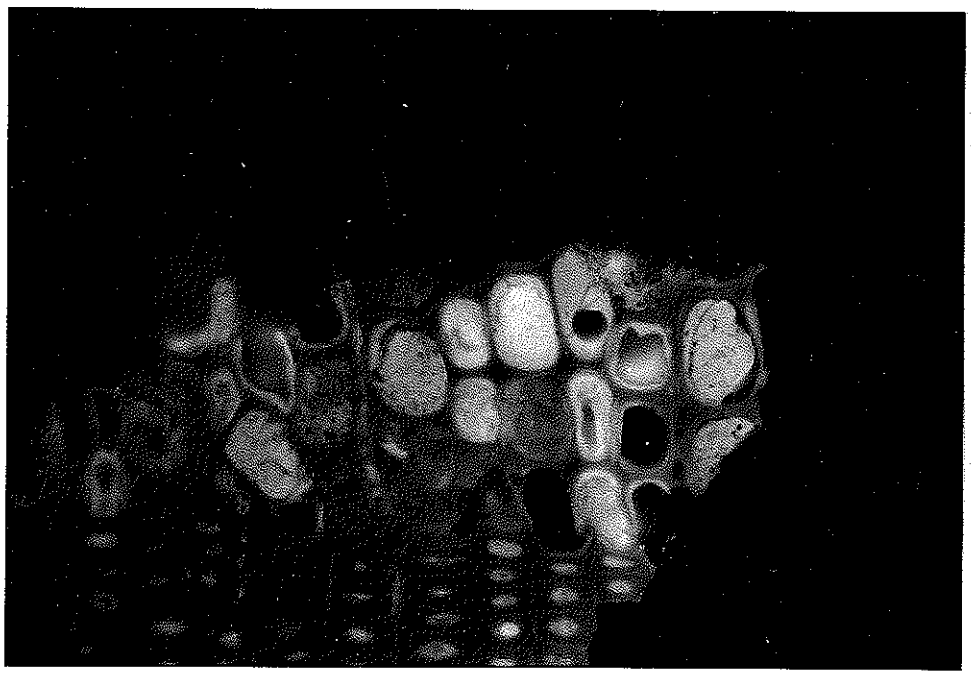
← earliest gray layer

Ultraviolet Light 250X

SPNEA Conservation Center
Cross-section Sample Photographs
Historic Charleston Foundation -- McLeod Plantation
Sample 2 -- substrate, Clapboard behind shutter, back of house

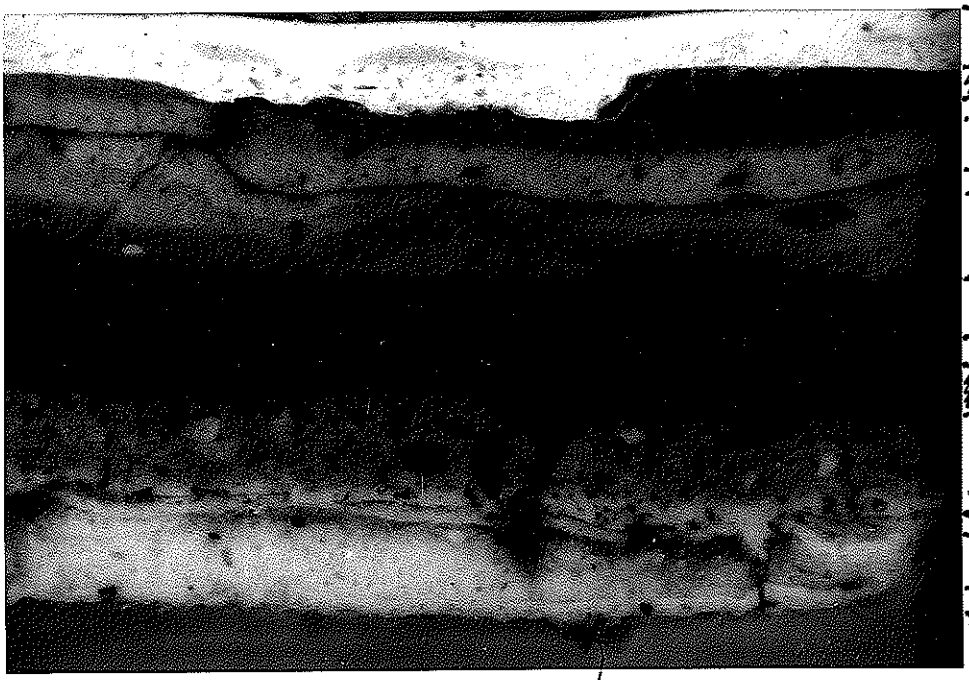
Visible Light 250X

Ultraviolet Light 250X

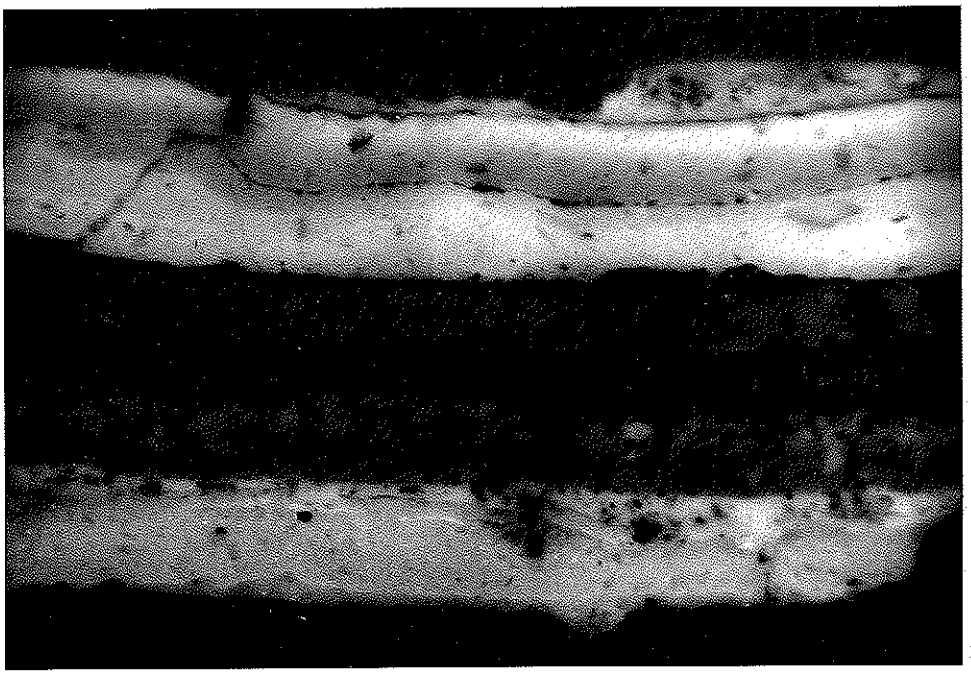


SPNEA Conservation Center
Cross-section Sample Photographs
Historic Charleston Foundation -- McLeod Plantation
Sample 3 -- Window sill, back of house

Visible Light 125X

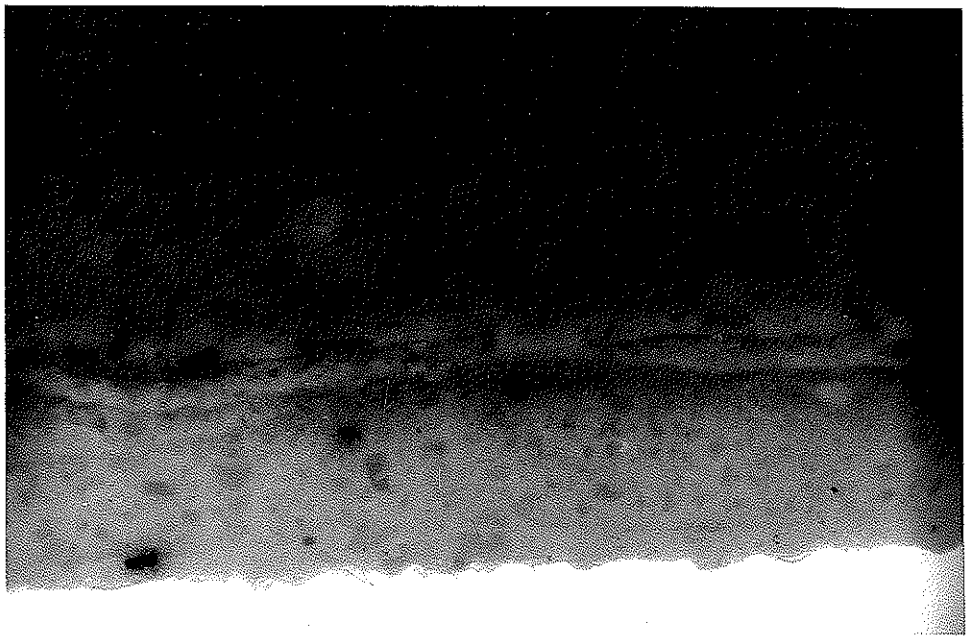


Ultraviolet Light 125X

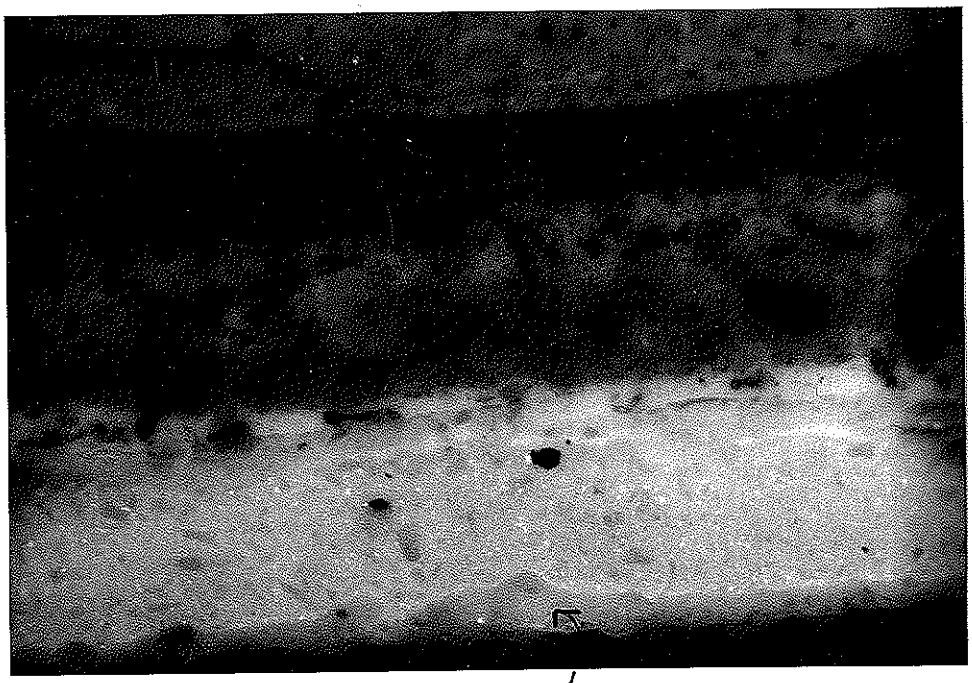


SPNEA Conservation Center
Cross-section Sample Photographs
Historic Charleston Foundation -- McLeod Plantation
Sample 3 -- Window sill, back of house

Visible Light 250X



Ultraviolet Light 250X



remnant of earliest cream-colored layer