PRE-1850 PAINT IN HISTORIC PROPERTIES:

TREATMENT OPTIONS AND PROCESSES

by

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(Under the direction of Mark Reinberger)

ABSTRACT

This thesis addresses the problem of how administrators of historic properties should deal with early paint at their property. A history of paint making and application, as well as a discussion of paint color trends in America, what options are available to administrators of historic sites, and the process of paint analysis are included. Case studies are used as examples of different approaches taken at some historic sites. The recommendation is made that all historic sites should conduct thorough paint analysis before any changes are made to paint finishes, and any decorative finishes should be protected for future examination before any repainting is conducted. If a complete paint restoration is not feasible, the historic site should, at the very least, attempt a rehabilitation using historically accurate colors based on paint analysis.

INDEX WORDS: Historic preservation, House museum, Historic site, Paint, Paint making, Paint application, Paint analysis, Pigment, Varnish, Oil-paint, Water-based paint, Color, Monticello, Mount Vernon, Historic Carnton Plantation, Historic Stagville State Historic Site, House in the Horseshoe State Historic Site, Joseph Bell House

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CHAPTER 1

INTRODUCTION

Purpose of the Thesis

This thesis is intended as a source for administrators of historic properties that pre-date 1850, who are interested in preserving and recreating early decorative finishes found in their properties. It also seeks to give the reader enough information about historic paint and paint analysis to allow an educated decision to be made regarding the desirability and feasibility of such an endeavor. It will describe the options available to the reader and will identify those that are most sensitive to the preservation of the properties and finishes.

This thesis starts with a history of paint materials used in America from approximately 1650 to 1850, followed by a discussion of the application of these materials. The profession of house painting in this country is also touched on, but that could be a thesis all by itself. A good understanding of what is required to recreate historic paint finishes and about historic paint in general, is necessary to make an educated decision about what type of paint to use in repainting. It discusses color trends throughout this period, and gives a timeline for the introduction of paint pigments used to create those colors. Knowing the history of color usage in America can aid in paint research for one's building. An explanation of what paint analysis is, how it can be helpful to administrators, and the process of paint analysis follows. Options available to administrators considering repainting their building and case studies of historic buildings

that have already dealt, or are currently dealing, with these questions, are presented in an effort to show the reader how these decisions are made in different situations, and any consequences that have arisen due to those decisions.

Why the Interest in Paint?

There has been increased interest in the rehabilitation of historic buildings in recent years. Americans are becoming more interested in their past, and an increase in historic tourism is one of the manifestations of this interest. Visitors are curious to see how their ancestors lived. This has led to the saving of a growing number of historic buildings from neglect and destruction. Many of these buildings become house museums to support upkeep and rehabilitation costs.

The administrators of these museums are opting for historically sensitive rehabilitations that take into account more aspects of the historic fabric of a property than the floor plan and furnishings. Authentic detailing, including historic finishes such as wallpaper and paint, is starting to be considered equally as important to a site's interpretation. Smaller historic buildings are receiving careful paint reproductions that were previously thought to be unnecessary in all but the largest museums.

With better technology and a greater knowledge of past techniques and materials, very authentic paint restorations are now possible. There are several options available to those interested in returning buildings to the colors deemed 'historically accurate', but administrators currently will have to wade through a large body of information before being able to make educated decisions as to which option would work best for their building and their budget.

The largest amount of historic color information found focuses on Victorian homes. Color schemes for interior and exterior surfaces as well as historic color plates and information about the manufacture of paint during this period are readily available. In comparison, there is a scarcity of clear information related to the colors and paint used in the earliest periods of American history. This is due in part to a smaller number of surviving buildings to study, partly to less extant documentation, and partly to disagreement about findings. Regional differences in the amount of information also occur. For instance, researchers know much less about early Southern painting than that of the Northeast. There is information on paint analysis and how it is used to determine earlier paint types and colors in historic buildings, but the majority of this information is highly technical. Even less information is available regarding recipes used historically for paint making.

Many administrators with buildings built before 1840, might become discouraged by this lack of information, and decide that a nice Colonial Williamsburg color or a bright white would be close enough for historic accuracy. The design of this thesis is to prevent such frustration and inappropriate decisions.

CHAPTER 2

HISTORY OF PAINT

Materials

By the early part of the seventeenth century, the craft of painting, and in particular, house painting, had reached the level of sophistication at which it would remain until the middle of the nineteenth century. Paint making also remains the same throughout this period. From 1615 to 1830, there were three major categories of paint used for house painting: water-based paints, oil paints, and varnishes based on natural resins dissolved in a variety of organic solvents.[1]

Paints have three components: (1) pigment, to make the paint opaque and to add color; (2) a binder (such as oil, chalk for water-based paints, hide glue, or gelatin) to bind the pigment particles together; (3) and, a vehicle (or medium), which is the fluid component of paint (such as turpentine in oil paints, or water in water-based paints).[2]

Pigments

Pigments are the source of color in paints of all types. They provide some opaqueness, and enhance the protective qualities of oil in paint by giving it more substance and resistance to weathering. Pigments are classified as mineral (natural and artificial), organic [natural (animal or vegetable) and synthetic], and mixed. Natural mineral pigments are found in the ground in the regular geometric form of such things as

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[1] Ian Bristow, Interior House-Painting Colours and Technology 1615-1840 (London: Yale University Press, 1996), 3.

[2] Sara B. Chase, "Painting Historic Interiors." Preservation Briefs 28. (Washington D. C.: U. S. Department of the Interior, 1992), 2.

oxides, sulphides, carbonates, and sulphates. They are extracted, dried in the sun, roughly ground, sieved to eliminate impurities, ground to a powder, cleaned, and dried (See Figure 1). Artificial mineral pigments are chemical products obtained by the dry method (sublimation) or the wet method (through precipitation) of chemical solutions. The wet method produces higher quality pigments and finer granulation. Natural organic pigments are from substances contained in some part of an animal, and from the decoction or the maceration of wood, fruits, leaves, the bark, or roots of plants. The evaporation and desiccation of these substances produces coloring. Synthetic organic pigments may be dyestuffs, derivatives of aniline, phenols, and quinones, for example. Paint makers avoid dyestuffs because they are less resistant to light deterioration than mineral pigments. They are sometimes used as cheap adulterants, however. Mixed pigments, such as lake pigments, may contain both mineral and organic material. Lake pigments are made by precipitating an organic dyestuff on a colorless base, usually an oxide or hydrate, thereby giving its color to the base.[3]

Figure 1: Prussian blue (left) and yellow ochre (right)with their respective pigments.[4]

[3] Paolo Mora, Laura Mora, and Paul Philippot, Conservation of Wall Paintings (Boston: Butterworths, 1984), 56-57.

[4] (left to right) http://webexhibits.org/pigments/indiv/recipe/prussblue.html , http://www.fairweathersf.com/images/options%20images/color_swatches/fw_prussian-sw.jpg , http://www.paverpol.nl/shop_media/color_yellow_ochre.jpg , http://webexhibits.org/pigments/indiv/i/100groundPigment/yellowochrer.jpg

There are glazing pigments that become transparent in oil and, therefore, have little covering power, and body pigments that are opaque in oil. Some white pigments cannot be used in oil for opaque paint, but work well in water-based paints. There are variations even within a type of pigment, including tinting and staining strength. In such cases, pigments that are more expensive are often extended with less expensive pigments that color or cover a surface just as well as the purer form. The cost of pigments is affected by rarity, the distance traveled to acquire it, the cost of production, and the degree of preparation needed before the pigment can be used (especially with earths).[5]

Some pigments used historically have been replaced with substitutes that are more readily available, less expensive, safer to handle, less likely to deteriorate over time, or a combination of these (See Table 1). In some cases, however, substitutions produce a less satisfactory appearance or are less enduring.[6]

Pigments in oil paints were traditionally ground with the oil using a muller and slab to form a paste (See Appendix A). This tool had been in use since at least the early twelfth century, and continued to be used through the nineteenth century.[7] Hand-cranked paint mills were used when large batches of pigment were being made. By the 1740's, paint mills driven by horsepower were in use in London. Since many pigments used in paint making were very dangerous to the health of the maker and painter, especially lead,

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[5] Bristow, Interior, 3.

[6] Mora, Conservation, 56-57.

[7] A. P. Laurie, The Painter's Methods and Materials (London: Seeley, Service & Co., Ltd., 1960), 35.

Table1: Timeline of Pigment Use Until 1850[8]

( ) = name of chemical version --- = naturally occurring x = chemical

Color	Pigments	Pre-History	Ancient History	400 – 999	1000 – 1599	1600 – 1699	1700 – 1799	1800 – 1850
Reds	Iron Oxide Reds ('Mars')	--------	---------	------	--------	------- 'Mars'	-------- xxxxx	-------- xxxxx
	Red Ochres	---------	---------	------	--------	--------	--------	--------
	Minium (Red Lead)		---------	------	--------	--------	--------	--------
	Cinnabar (Vermilion)		Cin.--	--- Ver.	xxxxx	xxxxx	xxxxx	Xxxxxx
Yellows	Crocoite (Chrome Yellow)						1770--	1809xx
	Gamboge			---	--------	--------		
	Iron Oxide Yellow ('Mars')	---------	---------	------	--------	--------	'Mars'	Xxxxxx
	Yellow Ochres	--------	---------	------	--------	--------	--------	---------
	Litharge (Massicot)	--------- xxxxxx	--------- xxxxxx	------ xxxx	-------- xxxxx	-------- xxxxx	-------- xxxxx	--------- xxxxxx
	Naples Yellow						--------	---1820
	Orpiment (Realgar)		---------	------	--------	--------		
	Patent Yellow						1770--	--
	Lead-Tin Yellow				---x Silicon	xxxxx Non-S	x1750	
	Persian Berries Lake				-------			
	Quercitron Lake						1775--	--
	Weld Lake				--------	--------	--------	--
Blues	Azurite (Blue Bice)		--------- xxxxxx	------ xxxx	-------- xxxxx	-------- xxxxx		
	Blue Verditer				xxxxx	xxxxx	x	
	Indigo		---------	------	-------	----		
	Lapis Lazuli (Ultramarine)			---	-------	--------	--------	1828xx
	Prussian Blue						1704x	Xxxxxx
	Smalt				xxx	xxxxx		
	Woad				--------	-------		
Greens	Copper Resinate							Xxxxxx
	Emerald Green							1814xx
	Verdigris		xxx	xxxx	xxxxx	xxxxx	xxxxx	Xxxxxx
	Scheele's Green						1773x	Xx
Blacks	Bone Black (Ivory Black)	xxxxxx	xxxxxx	xxxx	xxxxx	xxxxx	xxxxx	
	Charcoal Black	xxxxxx	xxxxxx	xxxx	xxxxx	xxxxx	xxxxx	Xxxxxx
	Lampblack (Bistre, Soot)	xxxxxx	xxxxxx	xxxx	xxxxx	xxxxx	xxxxx	Xxxxxx
	Coal Black						--------	---------
	Manganese Black	---------	---------	------	-------	--------	--------	--------
Browns	Raw/Burnt Umber	---------	---------	------	-------	--------	--------	--------
	Ochres	---------	---------	------	-------	--------	--------	---------
Whites	Barium White							Xxxxxx
	Calcium Carbonate White	---------	---------	------	--------	--------	---------	---------
	White Lead		xxxxxx	xxxx	xxxxx	xxxxx	xxxxx	Xxxxxx
	Zinc (or Chinese) White						1790xx	Xxxxxx

[8] Mora, Conservation, 64 and Moss, Paint in America, 278-289.

paint mills were the preferred method for pigment grinding when dealing with the more toxic pigments in order to avoid physical contact.[9]

Binders

Without binders, the pigments in paint do not remain evenly distributed and settle to the bottom of the mixture. Binders can also affect the durability of paint. Animal glue binder (size), for example, can be added to make whitewash less susceptible to abrasion (friable) and insoluble after drying. [10]

Oil binder was one of the most commonly used binders due to the durability of oil-based paints. Oil paints, which include enamels and glazes, are more expensive than water-based paints, and work well for both interior and exterior painting, especially on wood trim and metal.[11] Oil paints harden by polymerization, a process that binds the pigments to themselves and the ground. The amount of unsaturated fatty acid present affects the drying. Molecules of unsaturated organic compounds can form chains, called polymers (linoxyn in linseed oil), which absorb oxygen from the atmosphere to produce a tough but flexible film.[12]

Most oil paint was based on white lead and linseed oil with other pigments mixed in. Linseed oil was the most common oil base, but walnut oil and poppy seed oil were also in normal use for house painting. Boiled linseed oil was also favored since it dried

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[9] Roger Moss, Paint in America: The Colors of Historic Buildings (New York: John Wiley & Sons, Inc., 1994), 45.

[10] Moss, Paint , 43.

[11] Chase, Preservation Briefs 28, 2.

[12] Bristow, Interior, 60.

faster than raw linseed oil, especially when boiled with metallic compounds such as red lead, litharge, sugar of lead (lead acetate), white copperas (zinc sulfate), and umber.[13]

All boiled oil was darker than raw oil, so it was not suitable for use in white paints or fine pastel tints. Paint makers sometimes used walnut oil instead since it caused little discoloration. When boiled oil was mixed with white, the paint became "stone color", which was a pale, creamy, off-white. It was good, however, for dark greens, browns, and exteriors where discoloration was acceptable. Boiled linseed oil as a binder also gives sheen to the paint. The addition of varnish, crude turpentine, or a layer of hot, weak size between the undercoat and finish also adds sheen to oil-based paint.[14] Conversely, the addition of oil of turpentine to oil paints decreases sheen, tends to discolor the paint, and makes the paint inappropriate for exteriors since it is more susceptible to weathering.

Vehicle

Water-based paints, including whitewashes, tempera, and distemper paints, are the least expensive types of paints, since the vehicle is water. These paints have a flat finish and dry to the touch as soon as the water evaporates, making dryers unnecessary. Water-based paints are moderately strong (especially hide glue distempers) but are easily abraded and are not washable. Unlike oil paints, water-based paints do not yellow.

Distempers are made from water, glue (natural glues, gelatin, and gums), and whiting with other tinting pigments added for color. Distemper is also known as calcimine (or kalsomine), and is used for interior painting and especially decorative work. Colored distemper paints usually last for thirty to forty years.

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[13] Bristow, Interior, 60.

[14] Moss, Paint, 47.

Tempera is paint made with pigment, egg yolk or white, and water. It is used almost exclusively for decoration.[15]

Whitewash, also known as "whiting" or "whitening", is made of water, lime, salt, and assorted other materials. If slaked lime (calcium hydroxide) is used, the finish is called "limewash" or "lime white". Pigments, usually ochre or another earth pigment can be added for color. Whitewashes were often used on interiors, frequently on plaster and in utilitarian spaces, as well as on exterior surfaces, and during the seventeenth and early eighteenth centuries, occasionally on interior timbers.[16]

A similar paint is milk paint, or casein, made with hydrated (slaked) lime, pigment, and milk as the base. It is not waterproof and, therefore is used predominantly on interiors. When mixed with oil it can be used with some success on exteriors, but requires more frequent re-paintings than whitewash. As an interior and decorative paint, milk paint is resistant to chipping and easily cleaned.[17]

Varnish

Although oil and water-based were the more common types of paint used in this period, varnishes were also quite common. They are much harder to classify since they could be made in several ways. Dissolving naturally occurring resins in organic solvents creates varnishes. These varnishes add gloss to oil paint and enhance the hardness of the paint. The addition of natural resin varnish to oil-based paint creates enamels (which give a hard, glossy surface) and glazes (which are the translucent layer used over the

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[15] Chase, Preservation Briefs 28, 3.

[16] Chase, Preservation Briefs 28, 3.

[17] The Old-Fashioned Milk Paint Co., Inc. http://www.milkpaint.com

paint to achieve a more uniform and glossy surface and, if pigment is added, color).[18] Varnishes were most often used on *faux* painting, such as graining and marbleizing, for gloss and protection. For example, during the second half of the seventeenth century, imitation oriental lacquer, or "japanning", was fashionable, for which lac-based spirit varnish could be used.[19]

Lac was the only varnish made from an animal source, the lac insect (*Laccifer lacca)*, and could be used to create shellac. "French polish" was the simplest of the spirit varnishes (or alcohol varnishes) and was made by dissolving shellac in ethyl alcohol (or spirit of wine). It was only used on interiors. Sandarac mixed with Venice turpentine and varnishes made from alcohol-soluble copal resins were also spirit varnishes. Harder resins, like copal, dissolved in linseed oil were good for interior and exterior surfaces.[20] Amber and fossil resins from the Baltic could also be used for very high quality varnishes.[21] Hard resins needed to be melted, or run, before use even when mixed in hot oil (See Appendix A).

If increased luster was desired, oil of turpentine was used as the solvent in the varnish before it was added to oil paint. Mastic was most often used for this type (See Appendix A). Damar could also be used in oil of turpentine, but its use in house painting has not been documented. Dyes and colored resins contributed to transparent but colored varnishes. Pigments were also used to make colored varnishes, but without

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[18] Chase, Preservation Briefs 28, 3.

[19] Moss, Paint, 51.

[20] Bristow, Interior, 3.

[21] Moss, Paint, 49-50.

transparency.[22] Colored transparent spirit varnishes, called "changing varnishes", were used in the seventeenth century to make silver leaf look like gold, because the reddish, orange-yellow tint caused by many types of resins and spirit-soluble dyes changes the appearance of the silver leaf.[23]

Application Techniques

Professional housepainters were not common until the turn of the eighteenth century. Instead, homeowners, and sometimes other types of artisans, such as masons and plasterers, did the work themselves. Painters, or "paint-stainers", were responsible for both the manufacturing of paint, and the application. Many of early and well-known professional painters in America studied with the London Paint-Stainers Guild. Many professional painters, however, were unskilled at producing a wide range of colors. Good color makers were thus sought after and well paid.

Paint requires a ground on which to attach. Interior painting was frequently done on plastered walls and ceilings. A well-plastered surface had three layers of plaster. The first layer was a coarse plaster, the second a finer plaster, and the final layer a smooth coat. When oil paints were to be used, the plaster must have dried (seasoned) for a year before painting or the oil from the paint would be absorbed, giving a mottled appearance.[24] In cases where paint was being applied to wood, "knotting" was often

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[22] Bristow, Interior, 3.

[23] Moss, Paint, 52.

[24] Roger Moss and Gail Winkler, Victorian Interior Decoration: American Interiors 1830-1900 (New York: Henry Holt and Co., 1986), 7-8.

applied to keep resin from bleeding through the paint. Red lead in size was the most common form, but red lead, litharge, or white lead in oil was also used.[25]

Painters applied paint with round, hog-hair brushes ranging in diameter from ¼" to 2". Painters applied an average of five coats of oil paint[26] and a minimum of three coats for new work, including priming, undercoat, and finish.[27] Since oil paints were hand mixed, with hand ground pigments, the pigments were unevenly and coarsely ground, and poorly distributed in the oil, giving the resulting paint an uneven color and an uneven surface. The oil and pigment paste had to be thinned with more oil and turpentine in order to be used, and the thickness of the oil affected the amount of shine produced. During the eighteenth century, glossy paint was favored, so thicker paint was desirable.[28] The roundness of the hog-hair brushes also affected the appearance of the paint by producing clearly visible brush marks (See Figure 2). To lessen this effect when painting wood, the last coat of the paint was usually applied with strokes following the grain of the wood.[29] Two coats were normal for recoating and were known as "second color and finish" or "clear coat and finish" for when the undercoat was size-bound distemper. "Clear coat and finish" is cheaper than two coats of oil paint, but unsuited for exterior work.[30]

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[25] Moss, Paint, 48-49.

[26] Moss, Victorian, 8.

[27] Moss, Paint, 49.

[28] Moss, Paint, 46-47.

[29] Chase, Preservation Briefs 28, 4.

[30] Moss, Paint, 49.

Figure 2: Round hog-hair brushes used traditionally with oil-based paints.[31]

Distemper paints and whitewashing could be applied immediately to new plaster or to cheaply finished surfaces. These paints dried quickly, had much less odor than oil paint, and required less skill to use. They were used by the average homeowner, and sometimes by the wealthy, as a temporary first coat until oil could be applied. Five coats of paint were still recommended, but usually an average of two was applied.[32]

Varnishes, like other paints, were applied with brushes, except in this case the brushes were flat. Varnish was polished between coats, using tripoli (a diatomaceous earth from North Africa), or rotten stone (found in Britain). The four step polishing process given by J. F. Watin, a French author consists of: (1) rubbing the surface with powdered pumice in water; (2) rubbing with powdered tripoli and olive oil; (3) polishing with a soft linen cloth; and (4) finishing off with starch of French chalk and the palm of the hand.[33]

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[31] Photograph courtesy of Jessica Dockery

[32] Moss, Victorian, 8-9.

[33] Moss, Paint, 51.

CHAPTER 3

COLOR TRENDS

In the absence of physical evidence or historic documentation of the color schemes used historically in a building, it is necessary to look at trends in color use. These are generalizations and usually only applicable to regions where the most evidence has been found, but they give some idea of which techniques and ingredients were available at a given period. Most of the colors and materials available in the early part of the seventeenth century were still available and, for the most part, used up until the 1850's.

Before the advent of mass-produced paint, paint making was a very time consuming and relatively difficult process. Even when the same process used for one batch of paint was followed precisely, the paint maker was never guaranteed the same results. Mixing different pigments together to create a certain color produced even less reliable results. Paint first appeared on the interiors of early American buildings, in the form of non-oil-based paints, especially whitewashes, or simple white paints tinted by white lead.[34]

Originally, whitewash was used on almost any interior surface, with color added for an artistic touch. It was used on plaster ceilings and on walls in less formal or service

[34] Moss, Paint, 14.

areas well into the eighteenth century when oil paints were common, and until the middle of the nineteenth century in rural areas.[35]

Distemper paints were the first in America to use paint pigments. Early extant examples can be seen in the Eleazor Gedney House, Salem, Massachusetts, built in 1654. Different binders, such as animal glue and gum binders were used in combination with simple pigments. Distemper paints remained popular, especially on ornate plaster moldings in the homes of the wealthy. The distemper paints were easily cleaned and readily removable with hot water, allowing old paint layers to be removed before repainting, thereby lessening paint build-up that can hide designs. The use of water-based paints on ceilings continued through the nineteenth century for the same reason.[36]

Oil paints were first seen as early as the 1670's and 1680's, and became widely popular by 1700 in wealthy, urban areas.[37] Oil paints made using natural pigments, such as ochres, umbers, and siennas, were frequently used. Earth pigmented paints were more durable than metallic paints, such as white lead, since the metals decomposed in the air within a year or two.[38]

Throughout the eighteenth century, only about three-dozen imported pigments were available in America. By the 1760's, stores in America selling pigments and painting tools were becoming common. Pigments used in oil paint were sold dry in barrels or, if ground in oil, in bladders that were pricked to release a desired amount. A

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[35] Moss, Paint, 14.

[36] Moss, Paint, 15-16 & 158.

[37] Moss, Paint, 18.

[38] Nina Little, American Decorative Wall Painting 1700-1850 (New York: E. P. Dutton & Co., Inc., 1972), 2.

listing of the offerings at a store belonging to John Gore, a painter-turned merchant, included "4 white pigments, 9 reds, 10 yellows, 7 blues, 4 greens, 5 blacks, as well as gold and silver leaf, oils, varnishes, chalk, whitings, driers like copperas and litharge (in the eighteenth century, a by product of red lead). Only three of these pigments were mined in America. Beginning in the 1760's, lampblack began to be created from the waste oils of New England fisheries and no longer required importing.[39] The average painter's palette included black, white, grays, buffs and tans, ochre yellows, iron oxide reds, greens (from copper compounds), and Prussian blue.[40]

By the mid-eighteenth century, most new urban buildings received exterior paint. On the other hand, rural buildings still tended to have unpainted exteriors. When exteriors were painted, in general only the trim was covered, rather than the flat, or plain, work. Color fashions rapidly changed in this century, especially on exteriors. Pre-Revolutionary War colors were strong and had contrasting walls and trim, especially on New England meetinghouses. In 1762, the meetinghouse in Pomfret, Connecticut was painted orange, with chocolate colored doors and bottom boards, and white windows, cornices, corner boards, and weatherboards. In 1767, the meetinghouse in Thompson, Connecticut copied this popular color scheme.[41]

Exterior paint colors for Colonial houses were mostly medium to dark tones, such as reddish browns and grays (See Figure 3). According to Roger Moss, colonial buildings were rarely white on the overall exterior.[42] Since it was a cheap and plentiful

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[39] Moss, Paint, 46 & 22.

[40] Chase, Preservation Briefs 28, 4.

[41] Little, American, 1.

[42] Moss, Paint, 70.

pigment, Spanish brown was commonly used as a first coat, or primer, or as a color for oil paints.[43] By the second half of the century, exterior colors had become light, such as white; yellowish-whites; very light grays, and sometimes, pale blue. Of these, whites were the most popular exterior color.[44]

Figure 3: Ross Tavern, Ipswich, Massachusetts, with paint colors restored. [45]

Due to the scarcity of linseed oil, the expense of pigments, and the lack of availability of pigments except in coastal cities, painting buildings with oil paint was considered a luxury. Until approximately 1725, most homes in America were not painted with oil paints on the interior. By the middle of the century, however, most city houses were painted with oils, as were the "best" rooms in many rural areas. In rural areas, back

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[43] Little, American, 2.

[44] Moss, Paint, 70.

[45] Moss, Paint, 24.

entries, kitchens, and unfinished rooms remained largely unpainted until the early part of the nineteenth century.[46]

Interior colors were the most varied in wealthy urban areas. Some homes had a different color in each room. In most cases, the use of a color was related to the function of the room. Service areas and lesser rooms were frequently painted a lead (gray) color. Rooms for public use were generally painted brighter colors, and sometimes, more than one color.[47]

The most popular color for interior rooms in the late eighteenth century was blue, especially medium blue (See Table 2). This color was used in all types of colonial homes and public buildings. Pale blue-green was also common. The second most popular color was green in a variety of shades, such as dark blue-green and dark green. Grass green was used in the entry hall of Thomas Jefferson's Monticello.[48]

Reds and reddish oranges were the brightest colors of the eighteenth century. According to Roger Moss, they were rarely used except in cupboard interiors. Red lead, Spanish brown, and vermilion created the darker reds, known as Indian red or oxblood that were seen frequently in the eighteenth century. This darker red was the first color discovered in use, at least in New England, as an overall interior paint. During this century, red was found mainly in the service areas of urban buildings, but was also a major color in rural house decoration. Pinks were also often used. The earliest known use of pink in America was in Philadelphia in the 1720's. In the later half of the century,

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[46] Little, American, 4-5.

[47] Moss, Paint, 27-28.

[48] Moss, Paint, 70-71.

a pale pink, made from white and red lead, was used as a primer for white or light interior colors.[49]

Yellow was popular for trim done in oil paint and in distemper paints for walls. This color was used in private, public, formal, and informal spaces. Moderate orange-yellow was the most popular of the yellow colors. At the end of the eighteenth and early part of the nineteenth century, medium yellow was always used as the ground coat for mahogany graining. An orange-yellow seen at Independence Hall, Philadelphia, is the darkest, and reddest yellow yet found by Roger Moss.[50]

Browns were usually made from red iron oxide and lampblack, but could be made from many other pigments. Browns were usually used for baseboards during this century, but could also be used for the cap moldings of chair rails, window benches, and the cap moldings of staircase railings. In other words, browns were desirable in any place with high traffic in order to disguise dirt. A reddish-brown color (Spanish brown) was used on a multitude of surfaces, including roof shingles.[51]

In the eighteenth century, blacks were used primarily for the vertical faces of baseboards (or mopboards), in order to disguise dirt. Dark brown was also popular for this, but by 1815, brown was no longer fashionable. Grays were especially popular in the early and mid-eighteenth century, with light grays in use mostly for interior trim.[52]

During the eighteenth century, *faux* finishes, such as graining (*faux bois*) and marbleizing (*faux marbre*), were used extensively. Extant examples show efforts to

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[49] Moss, Paint, 27-28, 48, & 77.

[50] Moss, Paint, 76.

[51] Moss, Paint, 72.

[52] Moss, Paint, 73.

imitate marble and wood closely, as well as stylized representations (See Figure 4). Marbleizing was used often for columns and pilasters, as well as baseboards and floors.[53] Woods that were more expensive were often simulated on less expensive woods, mahogany and cedar being the most popular grained finishes during this century.[54] "Wainscot color" is though[55]t to refer to graining resembling English oak. In rural areas, knotty pine was sometimes mimicked a phenomenon that was not seen in urban areas.[56] Besides its aesthetic beauty, *faux* graining helped to hide dirt on woodwork.[57]

Figure 4: Stylized marbleing on a mantel surround in the Pitkin House, East Hartford, Connecticut.[58]

[53] Moss, Paint, 29.

[54] Little, American, 7.

[55] Moss, Paint, 28.

[56] Moss, Paint, 29.

[57] Moss, Victorian, 10.

[58] Moss, Paint, 28.

Table 2: Popular Colors of the Eighteenth and Nineteenth Centuries[59]

Colors	Pigments
Blues	
Medium or Medium	White lead + Prussian blue White lead + Prussian blue + yellow ochre or charcoal black
Pale blue-green	Prussian blue + yellow ochre + red iron oxide + white lead + Calcium carbonate
Greens	
Dark blue-green	Verdigris in varnish with multiple layers over gray or blue-gray base
Dark green or Dark green	Verdigris + white lead + Prussian blue Verdigris in varnish
Grass green	White lead + calcium carbonate + verdigris + Prussian blue + yellow ochre + bone black
Reds	
Indian red or Oxblood (dark red)	Red lead Spanish brown Vermilion
Pink	White lead + calcium carbonate + vermilion or hematite or red oxide + charcoal black + yellow ochre + umber
Pale pink	White lead + red lead
Yellows	
Golden (Portland stone)	White lead + yellow ochre + Spanish brown
Moderate Orange-yellow (gravel)	Yellow ochre + white lead + calcium carbonate
Orange-yellow	Yellow ochre + red lead + hematite
Browns	
Medium	White lead + calcium carbonate + yellow ochre + raw sienna + raw umber + charcoal black + bone black + red iron oxide
Reddish –brown (Spanish brown)	Red iron oxide
Yellow-brown (fawn)	White lead + charcoal black + India red + yellow ochre
Dull yellow-brown (drab)	Raw umber + white lead
Blacks	
Gray	White lead + charcoal black White lead + charcoal black + iron earth pigments
Warm gray	White lead + ivory black
Medium gray	White lead + ivory black + lamp black or charcoal black + iron earth Pigments
Dark gray	White lead + calcium carbonate + tinting pigments (more blacks than other grays)
Cool gray	Lamp black + indigo
Light stone	Prussian blue + spruce yellow + umber + white lead
Dark stone	Yellow ochre + lamp black + white lead

[59] Moss, Paint, 27-28, 48, 71-73 & 77.

During the late eighteenth and early nineteenth century, new and improved techniques gave these *faux* finishes a boost in popularity. In earlier versions of graining, a ground color was often mixed with white, and usually had a second layer made of a darker version of the same color. This darker color was applied in a design to roughly resemble wood, with black used for highlighting. The newer technique employed a ground, usually an oil paint, of the lightest color of a specific type of wood, overlaid with a glaze of a darker tint. The second layer was manipulated with combs, sponges, feathers, and other tools used to move the glaze around or away in order to closely resemble the wood being imitated. The ground under the glaze was used for the highlights (See Appendix A). These graining designs were smaller in pattern than earlier graining, with details that were more exact. Examples such as bird's eye and curly maple done with a graining comb rather than a brush became common.[60] Fireplace surrounds and mantels made of wood, iron, or slate were also frequently *faux* finished and covered with a varnish coat. Ash, maple, birch, and oak were grained over yellowish-white bases, walnut over an orange base, and mahogany over a reddish base. Grained doors with plain frames were common.[61]

In marbleizing on plaster walls, the ground was usually distemper paint, and the glaze often made with a size or milk. If on an oil ground, stale beer or an oil-based "megilp" (made from linseed oil and beeswax) was used. Darker veins were drawn on the glaze with a small brush, or "pencil", to resemble marble.[62] When dry, the work was

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[60] Moss, Paint, 53 and Little, American, 7-8.

[61] Moss, Victorian, 23.

[62] Moss, Paint, 53.

varnished. A type of marbleizing, popular from 1750-1850, utilized a fine vein pattern in dark bluish-gray on an off-white ground (See Figure 19). This simpler style replaced the more complex patterns that became unpopular.[63]

At the end of the eighteenth century, another *faux* finish came to the fore. In order to emulate the fine stone and masonry buildings of Europe in the New World, the exteriors of some frame buildings were given a coating of paint made to resemble stone. Sand spread across a ground of wet oil paint with a bellows or by hand created these *faux* stone finishes. Sometimes crushed stone was used with similar results. The finished results, especially in conjunction with carving of the wood to resemble ashlar masonry, were often quite realistic; making *faux* stone finishes an economical and practical substitution for stone or masonry buildings. The finish itself was also durable, making it a good choice for exterior paint.[64]

Faux stone finishes of the nineteenth century became more refined. Instead of appearing like any stone or masonry, attempts were made to match specific types of stone, especially locally quarried stone. Lampblack and earth pigments were used with white to imitate gray English portland stone, buff-colored French Caen stone, or regional stone. In the new temple-fronted Greek Revival homes of this century, owners went so far as to make the wall behind the portico of flush siding to mimic marble, since the front was the public side of the building. (The other three sides of buildings were generally clapboard sided.) By the middle of the century, *faux* stone finishing was very popular due to Andrew Jackson Downing's influence. According to Downing, house colors

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[63] Little, American, 11.

[64] Steve Jordan, "The Story on Stone Colors: Exploring the Tradition of Earthy Exterior Paints and Schemes," Old House Journal May/June 2001: 48-59.

should copy the colors of building materials (See Figure 5). In his books, he suggested warm grays, similar to slate or bluestone, and brown or fawn colors similar to wood or mellow-colored stones. *Faux* stone finishes fit this ideal perfectly, and blossomed in popularity.[65]

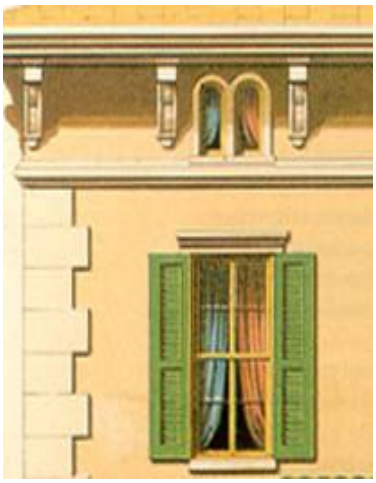

Figure 5: Example of an exterior color scheme influenced by Andrew Jackson Downing.[66]

Painted floors and floor cloths, made of painted oilcloth, also became very popular at the turn of the eighteenth century, and were most often seen in entry halls.[67] These cloths were expensive since most were imported from England, but by the end of the century, some were being made in America. Hezekiah Reynolds' pamphlet gave directions on how to make these floor cloths. Designs usually imitated tiles of different colored stones, or wooden floors in vestibules and hallways, and diamond or square patterns, Persian or Turkish carpet patterns, or marbleizing in formal halls or parlors.[68]

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[65] Jordan, "Stone Colors", 48-50.

[66] Moss, Paint, 54.

[67] Moss, Paint, 32.

[68] Moss, Victorian, 26 & 28.

Painted floors were a cheaper and easier method of decorating floors. Floors painted yellow, or with representations of dogs were popular, especially in Boston, as are those with black and white squares or diamonds, or borders.[69] This trend of painting floors continued well into the nineteenth century. Recommendations were made to paint the floor around the edges of carpets and to paint floors to resemble a carpet or stone. Floor cloths also continued to be used.[70]

During the early part of the nineteenth century, painting became a more formalized craft. Much more was recorded about prices, techniques and even some recipes, at least in urban areas. In rural areas, many exteriors were still unpainted, and much less, information was documented, possibly because the painting trade was less successful outside of the cities. The pamphlet written by Hezekiah Reynolds was the first American painter's guide to be printed and included native paint recipes.[71]

During the early nineteenth century, books directing homeowners, architects, and house painters on the current fashions in architecture and interior design began to be imported into America. A book like John Loundon's An Encyclopedia of Cottage, Farm, and Villa Architecture and Furniture (1833), Thomas Webster and Mrs. Parke's An Encyclopedia of Domestic Economy (1844), and "Godey's Lady's Book", a popular women's magazine, were all brought to America from England by 1850, to spread the "ideal". Downing, an American strongly influenced by Loundon, published his own book of fashion for architecture and interior fashion, Cottage Residences, in 1842, which

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[69] Moss, Paint, 30.

[70] Moss, Victorian, 26.

[71] Moss, Paint, 30 & 38.

was highly influential in this country. According to these books, the intended use of a space affected the color to be used. Stair halls were generally "sober", drawing rooms "gay", and libraries "grave".[72]

Gray, stone, and drab were considered appropriately somber for stair halls, as long as the color did not contrast with the color of any room opening onto the stair hall. Stone came in a light and dark color. Drab was a dull, yellowish brown. (These colors were also used as marbleizing bases.)[73]

Downing suggested light colors (with the exception of white and gilt) in "gay" drawing rooms, so the effect would be brilliant even in low light. He recommended "ashes of roses" (grayish-pink), pearl gray, and pale apple green with darker shades of the same color for the woodwork. Greens were very popular for these rooms, especially sea green, pea green, and olive green, according to Thomas Webster and Mrs. Parkes.[74]

There was some disagreement about the appropriate color for dining rooms. Loundon suggested somber and grave hues, but Downing favored strong, warm, rich colors, and great contrasts. Libraries were suitably subdued and grave. A favorite color for this room was fawn, a yellowish-brown.[75]

Bedrooms ought to be chaste, cheerful spaces with light colored walls, with the best rooms papered rather than painted, according to The Workwoman's Guide (1838) written by "a Lady", which also provided a list of recommended colors. According to this list, blue was considered pretty but cold; yellow was cheerful; pink was cheerful, but

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[72] Moss, Victorian, 3 & 5 and Moss, Paint, 60.

[73] Moss, Victorian, 5.

[74] Moss, Victorian, 7.

[75] Moss, Victorian, 7.

faded quickly and was a little too showy; crimson, claret, stone, buff (tan), and light green were good colors; and, dark green was refreshing, and therefore, good for light sunny rooms.[76]

The angle of the sun was also an important factor in color selection. North or east facing rooms were best with warm colors, such as yellow-green through yellow, gold, orange, or red. South or west facing rooms were best with cooler colors, like blue-green through blue, or violet and purple. Artificial lighting affected color choices as well. Dim light dulled colors and some light reflected certain parts of the color spectrum more than others, which caused some to stand out and others to disappear. Neo-Classical interiors of the early part of the nineteenth century utilized vivid colors with great intensity made from natural pigments and dyes. These colors were muted at night since the only light sources were candles and oil lamps. High gloss finishes helped reflect colors and available light. Classical Revival interiors at the end of the century used more pastel tints of the hues used previously, since gas and electric light showed the light colors clearly, leading to the popularity of matte finishes.[77]

Rather than one or two colors in rooms, color schemes then became very complicated. Downing suggested three separate values of color for ceilings, walls, and woodwork. The ceiling was the lightest, since the light color helped give the effect of height. Walls were darker than ceilings, and the woodwork was lighter or darker than the walls, but usually darker to hide dirt. The cornice was different from the ceilings and walls. Downing provided a wood stain recipe made from tobacco, but preferred painted

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[76] Moss, Victorian, 7.

[77] Moss, Victorian, 5 & 8-9.

woodwork, especially oil paint, since it was washable. He also felt that white trim was only appropriate with white walls.[78]

By the 1850's, aniline dyes made from coal tar, a by-product of the gaslight industry, were discovered by William Henry Perkins. This discovery was accidental, since Perkins was searching for artificial quinine, but it led to a greater range of colors in paint (the first was mauve), and less error in reproduction. Many of these new colors faded in sunlight and with cleaning, which led to the fashion during the nineteenth century of keeping the curtains of formal rooms closed.[79]

At the end of the Civil War in the United States, some ready-mixed oil paints were available. Before this time, efforts to mass produce oil paints had been unsuccessful due to shipping problems, a short shelf life, a lack of inventory variety, no appropriate container size, lack of advertising, and transportation limitations. In 1866, John Lucas and Company, of Philadelphia, had the first American success in this endeavor. The company began with the color known as "French Imperial Green for Blinds, etc." The invention of the paint can, patented in 1857, was the main reason for the availability of factory-made paints at a reasonable cost by 1875.[80]

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[78] Moss, Victorian, 20 & 22.

[79] Moss, Victorian, 8-9.

[80] Moss, Paint, 55.

CHAPTER 4

PAINT ANALYSIS

What is Paint Analysis?

There are no generalizations to follow for the choice of paint colors. Color fashions do change from period to period, but the restoration of each building should be studied and treated individually. The best way to determine which colors were used in a historic building is to do an analysis of its paint finishes.

The analysis of historic paint involves the identification of layers and colors of paint, as well as the analysis and identification of the component pigments within these paints. Paint analysis is a specialized form of research that uses a variety of microscopic, chemical and ultraviolet techniques to analyze, determine, and evaluate the nature and original color of historical surface coatings.[81]

Paint analysis is a field that has expanded tremendously. It is no longer just scratching off layers of paint. Sophisticated techniques have been developed based on an understanding of paints and how they were used. Paint analysis has come to be recognized as a component of every major restoration. In the 1930's and 1940's, at Colonial Williamsburg, Virginia, restorers used razor blades to scrape away layers of paint, sometimes with the aid of a magnifying glass, to find what appeared to be the first finish coat. This primitive method, known as "scratch and match", led to several mistakes and subsequent misconceptions about paint use in America. The era of stereomicroscopic analysis only began in the 1950's, with the restoration of

[81] Frank Welsh, "Paint Analysis", Association for Preservation Technology Bulletin XIV, No. 4, 1982: 29.

Independence Hall in Philadelphia. Searching for original layers of paint, a National Park Service historical architect, Penelope Hartshorne Batcheler, was the first person to use a stereomicroscope to examine paint layers. Even with the use of this and other new technologies, paint analysis was still rather primitive. In the 1970's, the standard procedure for color matching required the exposure of relatively large patches (1"-2" square) of the original layer of paint. Today, technology used in paint analysis includes stereomicroscopes equipped with fiber-optic illuminators for paint examination and the polarized light microscope to analyze pigments, fibers, and media.[82]

Paint analysis is often very time-consuming. It seeks to determine first, the number of coatings (including primer and finish coats), the original colors used in a building (often recorded in notations of the Munsell Colors System, a standardized color identification system used commonly in the paint industry), and the types of coatings (i.e. oil or water-based paints, stains, glazes, varnishes, or wallpapers). Analysis can also reveal which colors and paint types are used where in the building, the presence of decorative painting (i.e. graining, marbleizing, stenciling), the physical characteristics (i.e. gloss, texture), and the appropriate date or period of each layer.[83]

Since paint is not a stable material, a paint analyst cannot simply scrape an area and find the original color as it first appeared. Paint often undergoes radical change. Paint analysts must be able to recognize these changes for what they are. Not

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[82] Frank Welsh, "Microchemical Analysis of Old Housepaints with a Case Study of Monticello", The Microscope 38, No. 3, 1990: 248.

[83] Welsh, "Paint Analysis", 29.

recognizing the changes historic paints are prone to undergo can lead to mistaken identification of colors and subsequent errors in restoration (See Table 3, Figure 6 & 7).[84]

Figure 6 (left): Small dining room at Mount Vernon before 1980 paint analysis.[85]

Figure 7 (right): Same room after repainting based on 1980 findings.[86]

Light and humidity are the main causes of changes in pigments. Light causes loss of color, but humidity causes chemical action that changes the composition of the paint, leading to changes in the color.[87] The oil base itself can cause discoloration and deterioration in paint. Linseed oil yellows due to moisture, especially in the dark, which changes the appearance of colors.[88] Pigments can change in the dark as well. When a room is repainted, the first colors are completely covered, causing the pigments to darken faster than when exposed to light.[89] Dust can leave staining even after cleaning since the

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[84] Matthew Mosca, "Historic Paint Research: Determining the Original Colors", Old House Journal April, 1981: 81.

[85] http://www.architectureweek.com/2002/0327/culture_1-2.html

[86] http://www.nbm.org/Exhibits/current/Mount_Vernon.html

[87] Mora, Conservation, 66.

[88] Moss, Paint, 182.

[89] Mosca, "Historic Paint", 81.

dust can attack the paint. The usual soiling over time can also alter the appearance of the paint color. Conversely, alkalis, such as weak basic detergents in cleaning fluid, can cause yellowing especially in varnish.[90]

When to Do Paint Analysis

Since no good administrator would knowingly destroy the historic fabric of their building, paint analysis should be completed before any stripping or repainting is done, especially if there is any evidence of early decorative finishes in the building. Because paint layers can help document changes in a historic building, it is essential to retain a record of the historic finishes present in a building. Stripping is sometimes necessary, particularly on exterior surfaces, but if this must be done, the administrator should hire a professional to do a complete paint analysis before the paint removal or, at the very least, collect paint samples for future examination. If, during the stripping process, paint remnants are made visible, these should be photographed, and samples taken for future examination.[91]

A complete paint investigation is usually recommended as part of a Historic Structure Report. This report is often done as a part of the National Register nomination process or for grant proposals for rehabilitation or restoration projects. Comparative microscopic paint and color analysis is an essential part of the investigation of a historic building. The concluding report and its recommendations provide a significant part of the documentation required for a complete Historic Structure Report.

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[90] Mora, Conservation, 208 & 67.

[91] Mosca, "Historic Paints", 83.

Table 3: Problems with Paint Pigments Commonly Used in the Eighteenth and Nineteenth Centuries[92]

Pigment Name	Catalyst(s) of Change	Effect of Catalyst
Iron Oxide Reds/'Mars'	Sulfuretted hydrogen	Turns black
Red Lead/Minium	Air	Darken to brown (formation of brown lead dioxide)
	Linseed oil	Lightens
	Sunlight, rain, and atmospheric carbon dioxide	Whitening
	Sulfur containing pigments (cadmium sulfide, vermilion, ultramarine) & Orpiment	
Antimony	Sulfuretted hydrogen	Turns black
Vermilion/Cinnabar	Light and moisture (Cinn.)	Black stains (physical modification of crystalline structure)
	Sunlight	Turns brown
	Residue of alkaline sulfides	Not safe with white lead
Chrome Yellow	Alkalis	
Raw/Burnt Sienna	Linseed oil (Raw)	Deeper tint over time
Naples Yellow	Sulfuretted hydrogen	Darkens
Orpiment	Any pigments containing lead or copper	
Patent Yellow	Atmospheric impurities	Discolors
Persian Berries	Light	Fades
Weld Lake	Light	Fades
Azurite/Blue bice	Water (Azurite)	Becomes greenish (partly converts to malachite)
	Salt (Azurite)	Changes to paratacamite
	Sulfur dioxide (Azurite)	Black Stains
	Acids	Decomposes
Blue Verditer	Time	Turns green
	Acid	Decomposes
Indigo	Oil medium	Discolors
Ultramarine	Unknown	"Ultramarine sickness" turns it gray (Nat.)
Prussian Blue	Light (Art.)	Fades
	Oil (Art.)	Darkens if thick paint
	Lime	Pigment is destroyed
	Oil medium	Yellowing of oil turns paint green
	Alkalis	
Green Verditer	Cadmium yellow	
	Acids	Decomposes
Verdigris	Alkalis	
Emerald Green	Alkalis	
Lamp Black	Oil paints	If greasy, can cause cracking
White Lead	Lead acetate during creation	Causes lead to badly yellow in oil or darken mixtures with white lead and ultramarine, cadmium yellow, or vermilion
	Sulfuretted hydrogen	Turns black
	Acids	Decomposes
Calcium Carbonate White	Acids	Decomposes
Zinc White	Oil medium	Yellows

[92] Bristow, Interior, 3; Mora, Conservation, 66-67 & 208; Laurie, Painter's, 47 & 84; Feller, Artists', 115-116; Mosca, Historic Paint, 81; and Moss, Paint, 278 & 282-283.

For buildings with little documentation, additions or alterations can often be identified and possibly dated through a paint analysis. Paint hidden behind woodwork can help to date the addition of said woodwork, as can the lack of earlier paint layers to match surrounding surfaces. The type and ingredients of paint can also date paint, making a first layer of paint a good indicator of the date of construction for an addition.[93] Some pigments can help date paint since they are more recently available. Titanium has only been commercially available since 1916-1919, viridian green since 1860, zinc since 1850, cadmium yellow since 1846, ultramarine since 1830, and chrome yellow since 1818.[94]

Residue left on paint finishes and found through paint analysis can also aid in determining historic uses for some rooms. The paint in kitchens, for instance, is often covered with a grease film produced during cooking. A carpenter's shop wall may have a fine layer of sawdust between two layers of paint.

The best time for the paint analysis to begin is after all historical (documentary) research is complete and the structure has been measured and drawn in sketch form. It is highly recommended that paint analysis be performed on an entire building at once. When any areas are studied in isolation or out of context with the whole, the benefits of comparing layering sequences and colors found on similar features (and possibly noticing overlooked or misinterpreted information) are lost. The potential misinterpretation and error is substantial if the analysis is not done comprehensively.[95]

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[93] Chase, Preservation Briefs 28, 7.

[94] Penelope Batcheler, "Paint Color Research and Restoration" History News, Vol. 23, No. 10, 1968: 2.

[95] Welsh, "Paint Analysis", 29.

Distance, time or financial constraints may sometimes make an on-site investigation by a consultant impossible. In such a case, paint samples can be taken by others and forwarded to the consultant for analysis. However, it must be realized that the samples sent may not be truly representative. They may be missing some paint layers, be poor samples for matching the original color or, as frequently happens, have no original paint evidence left on them at all.[96] Even professionals can damage samples during collection, rendering the samples useless, so great care needs to be used. The size of the paint samples sent to professionals should be at least 1/4" square, and the substrate must be removed with the paint layers.

The administrator faced with more dramatic problems (such as a leaky roof) may not wish to commit funds for a paint research report. Because of the great expense of the instruments used by professional analysts, the administrators of historic buildings are limited in the extent to which they can do an accurate paint analysis on their own. Very careful "scratch and match" analysis can be done, but the results are generally inconclusive and much less informative than an analysis that is more complex.[97] Professional analysis is always preferred especially since not all paint layers fall into an obvious color category and must be identified by their material names. In addition, dirt layers, wallpaper, wallpaper residue, and other types of finishes may confuse the issue, especially since shellacs, varnishes and other resinous finishes do not fall into any color category. At best, a non-specialist can make a rough approximation of the color of a coat

[96] Welsh, "Paint Analysis", 29.

[97] Frank Welsh, "Paint and Color Restoration", Old House Journal August, 1975: 9.

of paint that, because it is near the surface of the wood, stands a good chance of being the first paint color in a historic building.[98]

If the goal is a highly precise restoration of historic paint rather than an accurate match with modern paints, more expensive methods and more complex procedures (such as emission spectroscope x-ray diffraction, scanning electron microscopy with x-ray fluorescence, and thin-layer gas chromatography) may need to be used. These analytical procedures are costly and can be justified only for projects where the accurate identification of all paint, pigments, and media are required. A plan for repainting a room with modern paint materials mixed to match historic colors does not warrant this expenditure and effort. Analysis including complex pigment and binder identification is, therefore, uncommon.[99]

Paint Analysis Procedure and Process

The paint analyst needs to be provided with as much information on the building as possible. It is the responsibility of the consulting paint analyst to then take all of the technical data gathered in the paint analysis and present it in a concise format, which can be readily understood by the architect or client. This is an Architectural Paint Study Report, which can be included in a Historic Structure Report. Documentary support such as color photomicrographs taken of important samples and Munsell color samples of the recommended restoration period colors can be included in the final report, along with

[98] Moss, Paint, 179.

[99] Moss, Paint, 173-174.

recommendations about paint removal, methods for conservation and preservation of original finishes and types of paint for restoration repainting (See Figure 8).[100]

Figure 8: Two Examples of Munsell color samples.[101]

The individual conducting a comparative microscopic paint and color analysis should be knowledgeable and very familiar with current and past methods of paint manufacture and house and furniture painting practices and techniques of the eighteenth through the twentieth centuries. This extensive knowledge is essential for correctly and thoroughly interpreting the evidence, which is investigated *"in situ",* then removed and analyzed microscopically. Therefore, familiarity with American building technology, social and cultural influences, the art of house painting, paint chemistry, color, microscopy and conservation of historical finishes is required.[102]

On-site, the analyst will sketch the plan of the facade or room, and record where samples will be removed from the varying surfaces.[103] This sampling will be done on all types of surfaces and in all areas, including walls, ceilings, doors, windows, door and

[100] Welsh, "Paint Analysis", 30.

[101] George Fore, The Joseph Bell House, Beaufort, North Carolina Historic Finishes Analysis, n.p., 2001.

[102] Welsh, "Paint Analysis", 30.

[103] Mosca, "Historic Paint", 81.

window jambs, moldings, cornices, ceiling medallions, wood corner beads, s, paneling, baseboards, fireplaces, floors, stair treads and risers, balusters and handrails.[104] Samples are removed from the site using specific tools. Since scalpels can cause irregular edges or fracturing between layers of a poorly bonded paint sample, a microdrill is often used (See Figure 11). It produces samples with uniform edges and causes minimal impact vibration. The microdrill is especially useful for taking plaster samples and samples for polished cross-sections.[105]

Small samples (1/4" square)[106] are cut out from unobtrusive locations of the areas listed above. A simple sampling technique is to make a shallow dished scalpel cut through the layers, to the substrate (See Figure 9), and then sanding the sides with 200-grit wet/dry finishing paper until a smooth gradual slope is created (See Figure 10). The crater is then wiped clean and polished with 600-grit wet/dry paper until all scratches are eliminated. A coat of mineral oil applied to this crater will bring out the colors by eliminating diffuse reflections of light. The crater shows all of the layers in concentric circles (See Figure 12).[107] The cratered areas are photographed for the record, and additional samples are removed for treatment in the laboratory. A sufficient number of samples must be examined in order to ensure an accurate accounting of all layers of

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[104] Welsh, "Paint and Color", 8.

[105] Moss, Paint, 176.

[106] Welsh, "Paint and Color", 8.

[107] Morgan Phillips and Norman Weiss, "Some Notes on Paint Research and Reproduction", Association for Preservation Technology Bulletin Vol. VII, No. 4, 1975: 15.

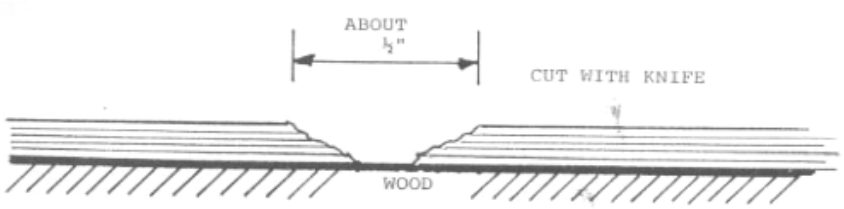

Figure 9: A cross-section view of a scalpel cut during paint sampling.

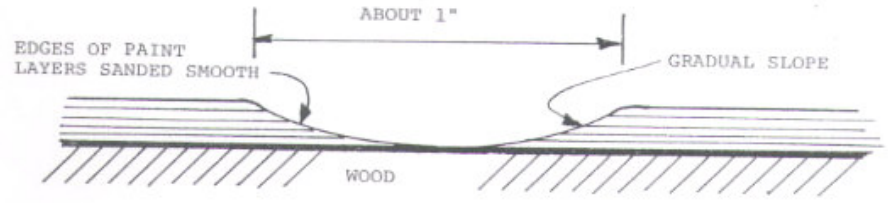

Figure 10: The same cross-section view after sanding and polishing. [108]

Figure 11: Sampling using a microdrill rather than a knife or scalpel. [109]

paint.[110] The samples are viewed under microscopes and tested to determine the nature of the paint finish (See Figure 13). For identifying architectural changes or dating intermediary paint layers, samples containing a full layering sequence are required. These samples are found on surfaces that are covered with each repainting and have not been damaged by abrasion.[111]

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[108] Phillips, "Some Notes", 16.

[109] http://www.phillipsmuseum.org/news.html

[110] Mosca, "Historic Paint", 81.

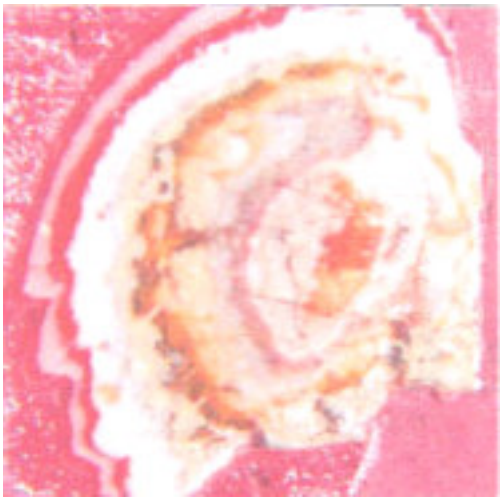

Figure 12 (left): View of sampling after sanding (17X magnification). Note that the concentric circles allow one to see the different layers.[112]

Figure 13 (right): View of a sample in resin seen in magnified cross-section view. [113]

Color matching is the greatest problem area encountered by the paint analyst. Discoloration problems necessitate very careful on-site investigations and sample-taking in order to locate hidden spots where paint has run or dripped into thicker patches when first applied. Finding such spots, usually in cracks or behind architectural details, is necessary if the analyst is to interpret the paint colors used accurately.[114] The interior of thicker paint layers is less affected by contaminants than the more exposed outer layers.

A microscope must be used for paint analysis, because many surface coatings (especially those made during the eighteenth century) are too thin or degraded to be

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[111] Welsh, "Paint and Color", 8.

[112] George Fore, The Joseph Bell House, Beaufort, North Carolina Historic Finishes Analysis, n.p., 2001.

[113] http://cml.upenn.edu/nola/14project/L1projectpgpaintanal.html

[114] Welsh "Microchemical", 249.

discerned by the naked eye or with a hand held magnifier (5x-8x). An inexpensive stereomicroscope (15x-30x) is usually taken along for on-site investigation to allow immediate examination of all removed samples to determine whether they have good paint evidence on them (See Figure 15). A complete microanalysis with a high quality binocular stereo zoom microscope (10x-70x) is done back in the laboratory (See Figure 14).[115]

At the laboratory, the samples undergo various tests and treatments under controlled conditions. Under a laboratory microscope, the analyst records all the layers and matches them to a system of color notation (usually the Munsell Color or the Plochere Color Systems). Through microscopic examination, the analyst can also

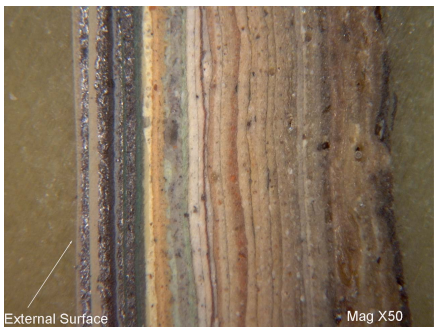

Figure 14 (left): Paint sample at 50x magnification. [116]

Figure 15 (right): Analyst doing *in situ* examination of a sample using a hand-held microscope. [117]

identify special finishes, such as graining and marbleizing, and can differentiate between primers and finish coats (See Figures 18-20).[118]

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[115] Welsh, "Paint Analysis", 29.

[116] http://www.stangermaterials.com/CaseStudies/CaseStudy.asp?id=152

[117] http://www.draytonhall.org/about/conservation.html

[118] Mosca, "Historic Paint", 81.

The stereomicroscope is perhaps the single most valuable tool to the modern paint analyst. It is typically used at magnifications of 20x-100x for the purpose of examining paint layers, and enables the analyst to count the number of coating layers seen in cross-section. A stereomicroscope is also useful to measure relative paint thickness and for observing accumulations of grime and soot between layers of finish paints. A stereomicroscope is especially well suited for finding sample areas that are the least discolored and, therefore, best for color matching.[119] Distinguishing primer coats from finish coats is impossible without the stereomicroscope, which enables the viewer to see: (1) any grease or dirt accumulation, which indicates a finish coat; (2) the lack of any grease or dirt accumulation, which usually indicates a primer coat; (3) large hand-ground pigment particles of eighteenth century paints; and, (4) glazing layers of either natural linseed oil, pigmented linseed oil, or varnish.[120] Lastly, the stereomicroscope is used to locate agglomerates within paint layers. Once removed with a tungsten needle, these agglomerates are mounted on glass slides under a cover slip for identification and analysis.[121]

Another instrument used by the paint analyst is the polarized light microscope. It is used to analyze and identify the pigments used in a paint film, in microchemical media tests, or to analyze wallpaper fibers found during investigations. The polarized light microscope is also used to photograph pigment particles or crystals found in a preparation. The cross-sections of paint are often embedded in a "tablet" of acrylic resin.

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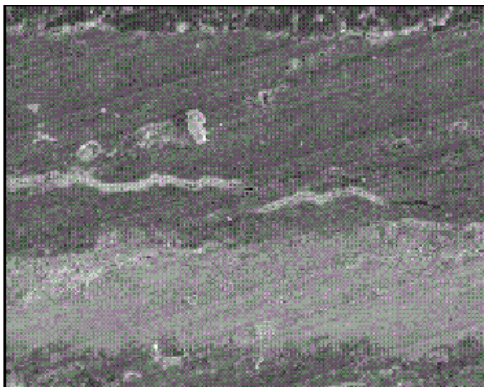
[119] Welsh, “Microchemical”, 248-249.

[120] Welsh, “ Paint and Color”, 8.

[121] Welsh, “Microchemical”, 249.

When wet and covered with a cover slip, the cross-section is ready for photography using the top light.[122] Polarized light microscopy (PLM) techniques allow for the identification of different pigment particles based on the characteristics of particle shape, color, refractive index, and optical properties. If PLM requires further confirmation, energy-dispersive x-ray analysis (EDX) may be carried out using a scanning electron microscope (See Figure 16 & 17). [123]



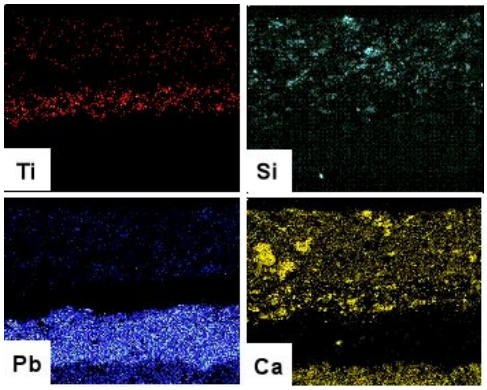


Figure 16 (left): Sample of scanning electron microscopic analysis.

Figure 17 (right): Sample of energy dispersive x-ray analysis. [124]

Ultraviolet light microscopy is also used, especially to identify media. Illumination of different materials with ultraviolet light causes them to auto-fluoresce, or glow, with characteristic colors. For example, shellac will fluoresce orange or yellow-orange, and some plant resins (amber, copal, sandarac, and mastic) fluoresce bright white. Exposing the paint layer to long-wave ultraviolet light can usually reduce the

[122] Welsh, "Microchemical", 250.

[123] Moss, Paint, 181.

[124] http://www.seas.upenn.edu/nanotechfacility/apps/paintchip_edsmap.html

discoloration of oil media. This effect is called “bleaching”. The length of exposure time required varies with different paints, and can be difficult to measure. Often a portion of

Figure 18: Example of a paint sample showing *faux* graining.[125]

[125] Fore, The Joseph Bell House.

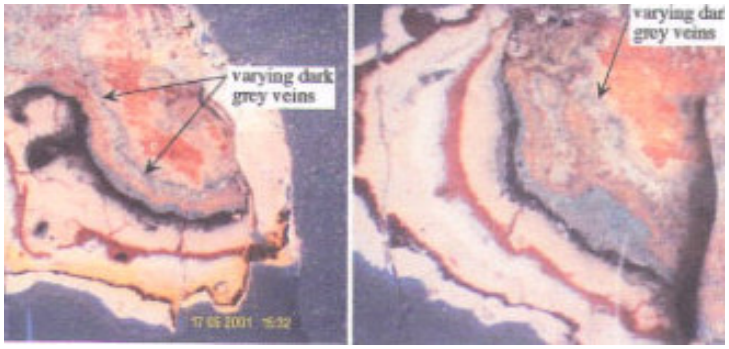


Figure 19: Example of a paint sample showing marbling. The veining can be seen in cross-section due the variations in paint thickness that they cause.[126]

Figure 20: Example of a paint sample showing wallpaper remnants.[127]

the sample is covered with an opaque material, which is moved slightly every 24 to 48 hours, until the coloration differences between the sections become negligible.[128]

[126] Fore, The Joseph Bell House.

[127] Fore, The Joseph Bell House.

[128] Moss, Paint, 181 & 183.

Chemical tests can be done in the laboratory to determine the actual pigment, or pigments, used as well as to determine paint media. For example, the presence of lead in paint samples is tested for by applying a tiny amount of diluted sodium sulfide reagent through a micropipette onto a specific paint layer or onto all layers in a cross-section. Any black sulfide discoloration reactions that occur clearly indicate which layers contain lead and which do not.[129]

A problem often encountered by architectural conservators is the difficulty of detecting early distemper paints on plaster walls. Frequently, these paints were washed off before repainting. They were also used alternately with wallpapers, making efforts to date distemper paint difficult even for professionals. The best way to identify distemper paints is to analyze the deep pores in the plaster layer's surface and corners, where these paints may have survived removal efforts.[130] Samples can be tested for distemper paints using a water solubility test, as well as fluorescent staining, which can identify many more media than simple solubility testing.

A thorough paint analysis is very lengthy and involved. Here is an example of a simpler analysis from an article by Frank S. Welsh:

> For example, if a white oil-paint film does not turn black during a sodium sulfide test for lead, the analyst can conclude that the white hiding pigment is not a basic lead carbonate. To determine its identity, the analyst typically mounts a tiny sample of the paint for examination under the polarized light microscope, and examines the pigments at 400x magnification. If an oil immersion objective is used to increase the magnification to 1000x, skeletal crystals, which look like X's and Y's, or like a two-pointed, curved shape similar to a boomerang, might be seen. These are characteristic shapes of zinc oxide white pigment. A simple microchemical test using $K_2Hg(SCN)_4$ can be used to confirm the

[129] Welsh, "Microchemical", 248.

[130] Moss, Paint, 177-178.

> presence of zinc oxide. Since zinc oxide was not widely used in house paint until the mid-1850's, the analyst can safely determine that the paint film in question does not date before the mid-1800's. Both the microscopical examination and the monitoring of the microchemical testing are done with the Polarized light microscope.[131]

This is just a sample. Analysts tend to each have their own way of doing each type of analysis.

All of the information is then organized in a paint seriation chart, which describes the chromo-chronology, literally the color history of the building. Finally, the paint analyst will recommend the type of modern paint, which may be used to create the correct surface and texture of the original or, in special cases; it may be desirable to mix the paints according to historic recipes, or to increase the paint's texture through the addition of sand. Once laboratory study is complete, samples are prepared for storage. They are numbered and labeled with the name of the building and sample locations. Slides are placed in slide boxes, Petri dishes in wooden boxes, and resin samples in plastic containers. The researcher retains all samples. At the conclusion of the project, an Architectural Paint Study Report is generated, which will typically include: (1) a brief architectural description of the structure itself; (2) a statement of the objective of the paint study; (3) an outline of the procedures used to study the paints.; (4) a summary of the information derived from the specific paint samples studied; (5) detailed descriptions, including layering chronologies, or samples documenting the study's findings; (6) color reference cards of historic paint colors; and, (7) possible integration with Historic Structure Report.[132]

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[131] Welsh, "Microchemical", 249.

[132] Moss, Paint, 82 & 185.

CHAPTER 5

WHAT TO DO IN YOUR BUILDING

Available Choices

According to Roger Moss, paint historian and analyst, treatments of historic buildings fall into three categories: (1) scientific, (2) appropriate, (3) and, boutique. Scientific treatments follow the historic color scheme of a building as set forth by a paint analysis completed by a professional paint analyst. Any paint treatment chosen for a historic building open to the public should be scientific. Appropriate treatments focus on recreating color schemes that have been researched and found to match the period and style of the building in question. Boutique treatments are generally based on an interpretation of the color scheme that is appropriate for that building, based on little or no research. An example would be using colors from the Colonial Williamsburg palette because the building to be painted dates to the eighteenth century.

According to the guidelines set forth by the United States Department of the Interior in Preservation Briefs 28, however, there are three choices when it comes to the question of what to do about the paint in a historic building: (1) preservation, (2) restoration, (3) and, rehabilitation. Unfortunately, the guidelines are geared towards homeowners, with an emphasis on rehabilitation, the least sensitive approach.

Preservation requires that existing historic finishes be maintained or repaired, saving as much historic material as possible. In many cases, cleaning or washing existing paint may be all that is done, or in some cases, a coating is applied to protect examples of

decorative art. If repainting is done, new paint must match the existing colors, using safer, modern formulations. If preservation is done, the goal is to stabilize or repair, not to recreate.

Restoration attempts to depict a building as it appeared during its period of greatest significance. This is determined based on research, on-site paint sampling, and laboratory analysis. Personal taste cannot be taken into account, and evidence should be followed. Historically replicated paint may be applied using techniques appropriate to the period of restoration. Restoration is often cost-prohibitive for homeowners, but it is what administrators of historic buildings should strive to achieve.

Rehabilitation is what most homeowners aim for, and is the least that an administrator should consider. This treatment is more flexible in color and paint type. Economy and durability of materials may affect paint choices. Paint and color choices should still be based on paint research or research that has been done in a building with similar date of construction and style, but can also reflect current tastes. If the building is to be adaptively reused, it is suggested that historic period colors often enhance the appearance of the building. Portions of any extant decorative work should be retained or restored, and some earlier colors matched to keep a sense of time and place.

Educated decisions must be made about which choice to make in your building. Your budget will affect your decision, but sensitivity to historic fabric should also play a large part in the decision making process. Most projects aim for preservation or rehabilitation, since restoration is expensive and hampered by modern laws restricting the use of toxic ingredients, such as lead, solvents, and thinners.[133] In all of these approaches, the focus should be on the preservation of any historic paint present,

[133] Chase, Preservation Briefs 28, 12.

especially if it is an example of early decorative arts. Paint analysis, or at the very least historic research, should always be done for your building before a decision is made regarding your approach to the project.

If paint analysis is inconclusive and historic research draws a blank, do not simply guess. Narrow your color choices to those that would be appropriate for your building in its context. First, look at the context that the building is in: surrounding buildings, lighting, natural setting. Second, look at "given" colors: color of the foundation, and color of the roofing material. Third, take note of the architectural style and date of construction for the building. The colors inside the building may be helpful in making decisions about exterior colors. The same colors can be used inside and out, or with changes in shade. Some paint companies sell paints in color groups that work well together if rehabilitation is your choice of approach (See Appendix B).[134]

Before starting a project, hire a reputable, experienced painting contractor, preferably one that has worked with historic buildings before. Make sure that the contractor is comfortable working with the paint type, or types, that you plan to use. You, or a less experienced contractor, may do paint preparations and priming, but save the final finishes for the trained professionals.

Keep in mind when priming, that paints that dry to a strong film are incompatible with those that are weaker. Latex paints are stronger than older oil/alkyd paints, but oil or oil/alkyd paints are stronger than water-based paints. A stronger paint applied over a weaker paint tends to peel off, especially if the bond between the older paint and the

[134] Patricia Poore, "Color in Context", Old House Journal July 2001: 65.

substrate has begun to weaken. Paint can also separate due to poor surface preparation or the hardening of earlier paint.[135]

Be sure to prepare carefully the surface to be painted before starting the painting. The main cause of paint failure is moisture; plaster walls being especially susceptible to water damage. The first step in preparing the surface for painting is to take care of any water problems such as leaky gutters or water pipes that can allow moisture to seep into the walls. The substrate should then be patched and repaired, since the surface must be sound in order to support paint.[136] According to Preservation Briefs 28, surface conditions fall into three classes: Class I surfaces have only minor blemishes and dirt and generally require no paint removal; Class II surfaces have failure in the top layer or layers of paint and require limited paint removal; and Class III surfaces have substantial or multi-layer paint failure requiring complete paint removal.

Class I problems include dirt (soot, pollution, cobwebs, insect cocoons), mildew, excessive chalking, and staining. In most cases, cleaning with ½ cup of mild detergent per gallon of water and a medium bristle brush can remove most of the dirt, mildew, and chalking. With stubborn mildew, the addition of a quart of bleach to the detergent will usually work for removal. Overhanging trees may need to be trimmed to stop the mildew from reoccurring. Staining caused by rusting nails or anchoring devices is rectified by sanding off the rust and coating the metal with rust-inhibitive primer, followed by two coats of finish paint. Countersinking nails and covering the holes with high quality wood filler is also recommended. Staining caused by color extractives in wood can be dealt

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[135] Chase, Preservation Briefs 28, 10 and Moss, Paint, 250.

[136] Chase, Preservation Briefs 28, 10

with by cleaning with a solution of equal parts denatured alcohol and water, followed with a stain-blocking primer.

Case II surface conditions include crazing, inter-coat peeling, solvent blistering, and wrinkling. Crazing needs to be sanded and repainted. Solvent blistering, wrinkling, and inter-coat peeling require careful scraping followed by sanding and repainting. If incompatible paints cause inter-coat peeling, the peeling layer needs to be scraped off, and the surface should be sanded then painted with a high-quality oil-type primer, so that oil and latex paints will stick to the surface.

Class III surface conditions are more serious. They include peeling, cracking, and alligatoring. Peeling is usually caused by moisture. Once the moisture problem is solved, and the wood has dried out, the paint needs to be scraped with a putty knife, sanded, primed, and repainted. Cracking and alligatoring on just the top layers can be scraped, sanded to the next sound layer, and repainted, but if the problem has reached the wood and the paint is flaking, all of the paint needs to be removed. The wood should be primed within forty-eight hours and repainted. Chemical strippers can be used in most cases. Only detergent and hot water are needed for water-based paints, and acetic acid (vinegar) can be used for calcimines and whitewashes. (If calcimine does not remove easily, coat the surface with shellac before repainting.) Caustic strippers or solvent strippers should be used with care, since they can damage wood. If alkaline paint strippers are used, thoroughly neutralize them, or the salts left in the wood can cause the new paint to peel. Air pressure of 200-500 psi can also be used to remove paint if done carefully. A flat nozzle is inserted between the paint and the substrate, and the paint is simply lifted off. Do not use heat guns or plates, since they may damage the wood or

plaster, create dangerous fumes if lead is present, and pose a fire hazard. If all of the paint is to be removed, cover a part of the original paint with sturdy, protective tape, then paint over the tape. This leaves evidence for future research (See Figure 21).[137]

Figure 21: Remnants of historic paint finish being preserved for later research. [138]

If you are working with painted metal, sand off any rust using emery papers. If the paint adheres over the whole wall, sand lightly to give the existing paint tooth for the new primer and paint. Garnet sanding-paper works well when sanding wood. Aluminum oxide and silicon carbide sandpapers also work for wood and most other surfaces as well.[139]

Once you have the preparation and priming done, it is time to start painting. The choices available in paints for purchase are oil-based/alkyd paints, acrylic water-borne paints (latex), calcimine or whitewash, and milk paint. Glazes can also be mixed easily

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[137] Chase, Preservation Briefs 28, 11.

[138] http://www.bldgconservation.com/images/hegler3-lg.jpg

[139] Chase, Preservation Briefs 28, 10.

with a purchased water-based paint. Make sure you pick one that is compatible with the primer used.[140]

Oil-based/alkyd paints are today's oil paints. The binder usually contains some linseed oil, but also contains synthesized oils, often soy-based, known as alkyds. The paints discolor less than linseed oil, but dry hard and flexible. They can be made to dry with a high gloss, and can hold enough color to make very deep colors. They are, however, illegal in some parts of the United States, and slightly dangerous since they need mineral spirits for clean up.[141]

Acrylic paints are synthetic resins in water. They have improved from earlier forms and now have better gloss characteristics and a larger palette of historic colors from which to choose. These paints are fade resistant, and are easy to work with since they clean up with water if not yet dry.[142]

Modern calcimines and whitewashes have an appearance similar to earlier forms, even though modern whitewash no longer leaves a ropy surface texture.[143] The National Park Service can simulate the ropiness by using flat white paint that contains a stippling compound (silica) on top of a primer. If the wall being painted is plaster currently covered with whitewash, a water-soluble glue size must be applied before the primer and topcoat.[144] Some companies such as The Old-Fashioned Milk Paint Company, Inc., in Massachusetts, sell milk-based paints as well. They come in a variety of colors,

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[140] Chase, Preservation Briefs 28, 12.

[141] Chase, Preservation Briefs 28, 12.

[142] Chase, Preservation Briefs 28, 12.

[143] Chase, Preservation Briefs 28, 12.

[144] Batcheler, "Paint Color", 4.

including some made with historic pigments, such as ochre, umber, iron oxide, and lampblack.[145]

Modern glazes can be water-based, unlike traditional oil and turpentine glazes, and are easy to apply with a brush. High gloss enamel may work as well as a glaze, and a good decorative painter should be consulted before choosing glazes for your project. Glazes, however, do provide protection and a more accurate historic appearance, including the depth of color associated with glazes.[146]

Paint analysts can recommend the type of modern paint that can be used to closely resemble the original paint in color, gloss, and texture. To get information about Munsell Colors or to have color standards specified in the paint analysis report for your building sent to you, contact GretagMacbeth LLC, 617 Little Britain Road, New Windsor, NY 12553, call them at 1(845) 565-7660, or fax them at 1(845) 565-0390. The painter, paint store, or factory can use these color standards to pick or create a paint color that will be a match for your sample, if you are planning to use modern paint in your building. If a color is found in your building that does not match the Munsell Color Book, estimates can be made in the numerical difference in hue, saturation, or chroma between the notations of the chart. Test samples on glass (for quick drying) can be used to compare the color of paint chosen to the original dry sample.[147]

If restoration is your goal, and the paints used will be hand-made, local laws need to be checked to identify forbidden ingredients. Modern substitutions, such as titanium

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[145] http://www.milkpaint.com

[146] Chase, Preservation Briefs 28, 12.

[147] Batcheler, "Paint Color", 3-4.

dioxide rather than white lead in oil paints, may need to be made.[148] Some ingredients may also be unavailable today, and appropriate substitutions will need to be made; for example, azurite is no longer available, therefore, a similar blue pigment will need to be used instead.[149] Most pigments today also produce different colors than their historic counterparts, since they are generally more pure.[150] Modifications and substitutions may need to be made. Specialists skilled in historic paint making should be hired for the making of these paints, since it is a very difficult and often dangerous process. All of those who may be exposed to toxic ingredients should take safety precautions.

Once the paint is selected or made, a large sample should be made in place, in order to ensure that the color is correct and that the paint is giving the desired gloss and texture. For exterior jobs, the sample should be at least four feet square where the body, trim, and accent colors come together (clapboard, corner board, and shutter). For interior jobs, paint on a primed wall or a scrap of Sheetrock or Masonite. If there is a problem, it will be easier to determine what it is if the paint is in place, rather than in a can.[151]

If the paint is acceptable, finish the project. Keep good records of which paints were purchased, or how the paints were made, as well as where the paints were used, since repainting will have to be done eventually. Most modern exterior paints should last between five and ten years in moderate weather conditions. Paints made by hand may need to be redone more frequently due to pigment discoloration, mildew, and other paint deterioration common to historic paints. Otherwise, oil-based paints have been known to

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[148] Chase, Preservation Briefs 28, 2.

[149] Laurie, Painters' Methods, 95.

[150] Moss, Victorian, 10.

[151] Poore, "Color In Context", 67.

last thirty years. Whitewashes or calcimine paints will need to be repainted every year or two if used on the exterior of a building. Interior paints have a range of endurance. Areas of the building with high traffic will need repainting sooner, as will areas where food is prepared, or rooms with fireplaces. Interior hand-made paints may need repainting due to the same deterioration as exterior paints. Since oil paints and milk paints are easily cleaned, they will need less repainting than water-based and flat paints that are harder to clean.

Given all of the time, money, and effort put into your project, the paint should be kept up. It is a lot of work, but it is worth it, because you will be the proud administrator of an attractive, historically accurate building the value of which was just greatly increased, both economically and historically.

Case Studies

The problem of how to deal sensitively with the paint in your historic building is a difficult one. Even with the best of intentions, one's budget may not always allow for large-scale projects. Even if done room by room over a long period of time, however, the project should be undertaken, and done well to preserve a piece of history.

The following are examples of how different historic sites dealt with the paint in their historic buildings, given different budgets and situations:

Historic Stagville, Durham, North Carolina

Historic Stagville is a historic site located in Durham, North Carolina. The North Carolina Division of State Historic Sites Department of Cultural Resources administers the site, which includes a Georgian-style plantation house, built in 1787 with a two-story addition added in 1799, four two-story slave cabins, a large barn, a family cemetery, and

several buildings from later periods (See Figure 22). The plantation house belonged to Richard Bennehan and his descendants who eventually owned 30,000 acres in North Carolina. The property was given to the state in 1976, and opened to the public in 1977.[152]

Figure 22: Historic Stagville State Historic Site.[153]

Since it is state funded, with some help from private donors and the Historic Stagville Foundation, Stagville has a small budget. The staff at the site has to be creative in order to make improvements to the site. The site was once set up as a learning facility for preservation, and a classroom building, built near the main house, held lectures and classes focusing on preservation topics. Hands-on courses were also periodically offered.[154] One such course was a historic paint and wallpaper institute, held in April of 1998. The parlor of the main house was chosen as an ideal subject for paint analysis and repainting.[155]

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[152] Historic Stagville at the Plantation Home of the Bennehan-Cameron Families, Division of Archives and History, North Carolina Department of Cultural Resources.

[153] http://www.byways.org/library/display/5009/historic_stagville_z3.jpg

[154] Juliana Hoekstra, Telephone Interview, 8 May 2001.

[155] The Key: Newsletter of the Historic Stagville Foundation, Fall (1997): 1-4.

When the state acquired the site in 1976, the interior was already painted a blue-green color thought to be appropriate to the period in which the house was built. Unfortunately, this color was chosen based on the popular "Colonial Williamsburg colors", rather than any research. The workshop was a perfect opportunity to get professional paint analysis done for the cost of a teaching stipend. A labor force for the painting itself was also available for the cost of lunch.[156] While this is not generally recommended, in this case untrained labor worked well due to careful supervision.

According to the Paint Analysis Report written by Patrick Baty for Historic Stagville, the goal of the paint analysis was to identify the first paint scheme used on the woodwork in the parlor. Mitch Wilds of the North Carolina Department of Cultural Resources took paint samples from several places in the parlor, including a door surround, a wall panel, a wainscot style, a window sash, a baseboard, the , and a door style and panel; twenty-six samples in all, during two visits, one in January and one in February of 1998. Most of the first thirteen samples taken were distorted during the sampling process due to human error, but the next thirteen were all intact. Paint samples, varying in size from 5mm to 10mm, were removed with scalpel, craft knife or dental drill. Portions of each sample were kept for future testing, but the rest were cast in small cubes of clear casting resin, in silicon rubber molds. The resin were allowed to cure for 24 hours at room temperature, then cut in half to expose cross-sections which were wet polished with 240, 400, 600, and 1200 grade wet-and-dry papers. The cross-sections were examined with a Biolam metallurgical microscope at 200x and 500x magnifications. The cross-sections with a full range of layers (substrate to final scheme) were closely

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[156] Juliana Hoekstra, Telephone Interview, 8 May 2001.

studied and compared to less complete cross-sections. Photographs were taken with Kodacolor Gold Plus ASA 200 color print film and labeled to allow visual comparisons. Most photographs were taken at 200x and 500x magnification.

Samples of the pigments from specific paint layers were cast in Cargille Melmount (refractive index of 1.66) onto microscope slides. These pigments were examined at 500x and 1000x magnifications under transmitted and plane polarized light. Polarized light microscopy (PLM) was used to identify the pigments. Some of the samples required further confirmation, and energy-dispersive X-ray analysis (EDX) was done using a scanning electron microscope.

The parlor had been painted five times since 1799. The last scheme, the blue present when the state acquired the property, was no more than sixty years old at the time of the analysis, as ascertained from information given by the previous owners. The first scheme included gray paint and graining. Even the windows surrounds were gray. White lead mixed in oil with about 20% chalk (estimated from dispersion) and miniscule amounts of yellow ochre and red lead was used in priming throughout. An undercoat of white lead mixed in oil with about 10% chalk (estimated from SEM spectrum) and tiny amounts of carbon black (possibly charcoal black finely ground) was used under all but the graining [samples 18, 24, 25]. A topcoat of pure white lead and the same carbon black was applied above the undercoat [samples 15, 17, 20, 21, and 22]. The color was most likely a mid-gray, an approximate Munsell reference of 3PB 6/1. The graining, used on the baseboards, was a red ochre plus a little yellow ochre and black. An oil glaze was used, pigmented with red ochre and carbon black. The glaze and graining layers merged as if painted wet-in-wet.

The second paint scheme was gray and graining also, but with a white window, all still in oil. The chair rail was grained at that point. Some gray areas, such as the wainscoting [sample 20 and 21], were painted darker than others. This was probably to cause the other woodwork to stand out more clearly in contrast. There was no evidence as to what the door looked like in this scheme. Either the layer was later entirely removed leaving no trace (extremely unlikely) or the first scheme was retained with no new painting (also unlikely), so there may have been a problem in the sampling. The door was most likely grained in this scheme, however.

The third scheme was from the nineteenth century, which was shown by the large, square, silicate in the paint (Based on the analyst's observations over years).[157] No chalk was added to the white lead, but vermilion and a very small amount of Prussian blue were used as tinting pigments in this oil paint. The color was most likely a mid-warm blue. This color was everywhere except the white window, the grained door, and the black baseboards. (The fluted pilasters on the wainscoting panels may have been painted black as well, but the cross-sections were inconclusive.) The door was still grained, but at that time with a resin varnish, possibly to imitate a very pale wood. The graining streaks were on a nearly white ground, and were very thin.

In scheme four, all of the woodwork was grained, with the exception of the windows, which were painted with pure white lead in oil. The graining was done in three layers, with the first coat darker than the second (except on the door), which was unusual.

The last scheme used a paint, which contained a blue based on titanium white, with a pigment that was probably phthalocyanine blue/green. All of the joinery was painted this green color.

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[157] Patrick Baty, Internet Interview, 18 March 2002.

The color schemes for the plaster walls are not known. There was no evidence on the walls themselves, but later analysis may find samples on the edges of the paneling or moldings, since paint often overlaps during the painting process. It is suspected that wallpaper was in use at some point.

Patrick Baty, of Papers and Paints Ltd., London, Chris Orstrom, of Historic Paints, Virginia, and Derrick Tickle, of AB Technical Community College, all worked on this project, with Mr. Baty and Orstrom as the principal instructors.[158] After the paint analysis was done, the parlor was repainted to match the color of the first paint scheme used. The plaster walls were painted with a white whitewash, mixed by hand from an eighteenth century recipe (See Appendix A), using round hog-hair brushes similar to those used in the eighteenth century. The result has the ropey texture of traditional whitewash. The woodwork was repainted a mid-gray color using an eighteenth century recipe, hand-ground pigments, an old-fashioned oil paint base mixed with linseed oil, and again, the round brushes. Carbon black and a small amount of Prussian blue were used in place of the original charcoal black for a similar result. The pigments were ground into linseed oil with a muller and slab until the desired color was achieved, and then stirred into the paint base. Each student in the course was then given a round brush and assigned an area to paint. This type of paint is so viscous that the paint is almost smeared on. The round paintbrushes help to hold enough paint on the brush so that the paint can spread. The result was a very good match to the color seen in the samples. The paint shows distinct brush marks and has a high gloss.

The aim of this project was restoration and it was highly successful. The project had a low budget but student fees for the course went towards the cost of many of the

[158] The Key, 1.

supplies, and the labor force was unpaid for the most part. The instructors did receive stipends, but grants were applied for and received to pay for those and many of the other expenses.[159]

House in the Horseshoe, Sanford, North Carolina

House in the Horseshoe, like Historic Stagville, is part of the North Carolina Historic Sites Division Department of Cultural Resources. The house at this site, built around 1772 and named "Retreat" by its second owner, Governor Benjamin Williams, was one of the first big houses built in upland North Carolina frontier country (See Figure 23). The house is now known as the Alston House, and is important to North Carolina history for its part in the American Revolution. Whig colonel Philip Alston lived at the home in 1781 when it and his band of revolutionaries was attacked by a larger unit of Tories led by David Fanning. The house retains bullet holes from the skirmish that ended in Alston's surrender. In 1798, the 2,500-acre plantation was sold to Gov. Williams, who enlarged the house with the addition of two wings containing a kitchen and a master bedroom. He died in 1814 but the property remained in the family until 1853. After changing hands several times, the property was purchased and restored by the Moore County Historical Association before it was given to the state in 1955.[160]

[159] Juliana Hoekstra, Telephone Interview, 8 May 2001.

[160] House in the Horseshoe: Still Bearing the Scars of the American Revolution, Division of Archives and History Department of Cultural Resources.

Figure 23: Alston House at House in the Horseshoe State Historic Site.[161]

The Moore County Historical Association had painted the house at this site in colonial revival style colors but the colors selected were not based on paint analysis. The staff at the site questioned some of those color choices and desired accurate paint finishes to aid in interpretation at the site. Unlike Historic Stagville, House in the Horseshoe has had a professional paint analysis done in the entire house, which was funded by the Department of Cultural Resources. Some samples were sent to an independent laboratory for chemical analysis.

The analyst was George Fore, of George T. Fore & Associates, in Raleigh, NC. He was chosen because he had previously done other work for the Department of Cultural Resources. His findings were able to confirm the colors for several rooms that were in question as well as provide information on architectural alterations to the house and room usage in the eighteenth century.

The staff at House on the Horseshoe currently lacks the funding to repaint the house, but they hope to use the analysis to guide them during the next painting of the house. Original colors may be used throughout, with the possible exception of a room that was a bright red from floor to ceiling, on both the woodwork and the plaster. The

[161] http://www.sandhillsonline.com/history/horseshoe.htm

current site manager believes that the color would be too overpowering to visitors and is considering a less vibrant shade to be used only on the woodwork. This disregard for research findings in favor of personal taste is strongly discouraged, especially in a historic site open to the public where inaccurate interpretation is more likely to be accepted as fact. The staff does plan to protect original paint samples in several areas for archival purposes. They also hope to remove all later layers of paint in one room and restore the original appearance using the correct colors and graining techniques, leaving a small section as it is currently, again for archival and comparison purposes. [162]

Joseph Bell House, Beaufort, North Carolina

The Joseph Bell House is located in Beaufort, North Carolina. Joseph Bell was very important to Carteret County history making the house historically significant. It was purchased by the Beaufort Historical Association in 1964 and has been maintained by this group since that date (See Figure 24).

Figure 24: Joseph Bell House.[163]

In the summer of 2000, extensive repairs to the house began due to years of abuse by major hurricanes. During repairs, evidence of historic finishes was revealed. The

[162] Elizabeth Faison, Internet Interview, October 2002.

[163] http://historicbeaufort.com/bhanews4.htm

Beaufort Historical Association decided at this time to undertake a complete historic finishes analysis to ascertain a true date of construction, to identify any alterations of the property, and to determine the sequence of decorative finishes in the house.

As with House in the Horseshoe, George Fore & Associates were hired to undertake the paint analysis, and during the spring and summer of 2001, site investigations were conducted. Based on the construction methods, materials used, and stylistic details, a construction date of circa 1820 was suggested (local historians date the house to 1767). Paint analysis revealed highly decorative finishes in the principal rooms of the house in contrast with simple woodwork. Every surface of the two hallways and two first floor rooms was decoratively finished. Complete paint analysis was made difficult in five of the rooms in the house by an earlier removal of nearly all of the finishes from the woodwork.

George Fore utilized on-site microscopy and stereomicroscopy, as well as laboratory examination. The initial samples were smaller than 1 centimeter. A micro-scalpel was used to remove each layer and the substrate, and samples to be used for color matching were scraped to the desired color then treated to maintain the index of refraction of their pigments to that of a paint layer. Cross-sections were edge polished with surgical scalpels, and samples that were to be examined at higher magnification were prepared in resin cubes.

In situ microscopy was helpful in finding intact samples that showed the full range of finishes and overlapping paint layers between adjacent elements to show contemporary finishes. More than ten samples were taken from many elements in the house. After *in situ* microscopy, the samples were examined in the laboratory with a

stereo zoom table microscope at 12X to 60X. Color matches were done using the Munsell Universal Color System, Glossy, Matte or Nearly Neutral Collections, matching prepared samples in the laboratory due to the closeness of hue and value in many adjacent layers found *in situ*, and to avoid possible deterioration of paint samples.

The paint analysis report included text, drawings, illustrations and color standards. Chromo-chronology worksheets for each element were included and showed photomicrographs of prepared samples, drawings and photographs of sample locations, and Munsell Color Standards.

The clapboards, the door, and the door surround of the upper east gallery produced the best samples of exterior paint since many original exterior elements were missing or the finishes were too weathered to be useful. The original paint scheme for the Joseph Bell House was a near-white clapboard color and a dark-green architrave color (See Figure 8). The stiles and rails of the doors were grained with imitation tiger maple and the center field of the door panels were grained in imitation bird's eye maple, both with a bright yellow base and a light amber colored glaze. The mold surrounding the door panels and a one-inch perimeter on the panels were grained with imitation mahogany on a light tan base coat with a translucent medium red graining glaze. Without definitive proof, it was assumed that the window sashes were white, the dark-green used on the architrave was also used on the corner boards, roof rake boards and the cornice, and that the gallery elements were the near-white color used on the clapboard. Fore recommended that the handrails be painted the dark green and the window blinds medium green.

The degree of certainty of paint analysis varies from room to room on the interior due to some earlier paint removal. The downstairs hall was the most intact, and included at least five *faux* wood graining patterns, marbling, two highlight colors, and wallpaper. The stiles and rails of the wainscoting, the molding beneath the cap mold, the stiles of the panel on the side of the stair, and the door and window architraves were grained to imitate a subtle, light colored wood, probably birch or satin wood. The back band on the architrave and the chair rail were grained with a bolder version of this wood.

The molded edge of the stiles and rails surrounding the wainscoting panel and the panel on the side of the stair was painted a medium blue. The one-inch wide perimeter of the flat wainscot panels and the panel on the side of the stair was grained in imitation walnut with a light tan base coat and a dark red-brown glaze.

The field of the wainscot panels, door panels, and the panel on the side of the stair was grained imitation bird's eye maple with a bright yellow base coat and a light amber glaze. The cap mold of the chair rail was black to imitate ebony. The baseboards were painted to imitate a light gray marble with dark gray and off-white veins and shading with a light gray base coat.

The stiles and rails of the doors were grained to imitate a figured maple with a light tan base coat and an amber glaze. The molded edge of the stiles and rails surrounding the door panels was a medium dark blue. A one-inch wide perimeter surrounding the door panels was painted a bright yellow-green.

The stair's wall stringer, outer stringer, risers, balustrade, newel post, and handrail were grained imitation mahogany with a light tan base coat and a translucent medium red color. The plaster walls were covered with paper but only tiny remnants of wallpaper

fiber were found, making pattern or color reproduction impossible. These fibers were found using *in situ* microscopy on the edges of the door and window architraves. The fibers were between the first architrave finish and the second woodwork finish. No samples of the original ceiling or sash were found.

Nearly all of the original finishes in the downstairs parlor were removed. A small panel of wainscot finishes on the south elevation was retained during a 1960's restoration project. The finishes in the rest of the parlor were established using small remnants found in molding recesses and paint elsewhere in the house for comparison. The original finish was mostly two *faux* finishes and a bright highlight color. The stiles of the wainscoting, the chair rail cap mold, the molding beneath the cap mold, the door and window architraves, and the door and wainscot panels were grained with an imitation of a subtle, light colored wood, probably birch, maple, or satin wood. The graining was probably a medium-figured grain, such as satin wood or maple, the architraves and wainscot stiles were more subtle in pattern, and the architrave back bands and s were bolder, but still the same wood species. The door stiles and rails were darker and bolder graining. All of this graining had a light tan base and light to medium amber colors for glazes. The edge of the door stiles and rails surrounding the panels was a medium blue. The perimeter of the door panels and the wainscot rail beneath the chair rail were a yellow-green color.

The mantel's flat fascia, pilasters, and frieze were grained in light-colored graining patterns similar to those of the doors and wainscot but the remnants of the finish were too small to determine the pattern of the graining. It is likely, however, that the mantel was grained in imitation of various cuts through maple, birch, or satin wood with

a light tan base coat and light to medium amber translucent glazes. The mantel's moldings on the shelf, cornice, frieze, and pilasters were the same yellow-green as elsewhere in the room.

The baseboards were painted with light gray marbling with dark gray and off-white veins and shading, on a light gray base coat. The plaster walls were wallpapered, but the samples, taken from the edges of the architraves, were not large enough to determine color or pattern. No samples of the original ceiling or sash were found.

The back room of the first floor had few original finishes extant except for small remnants. The stiles and rails of the wainscoting, the cap mold, the molding beneath the cap mold, the door and window architraves and the mantel were grained in a pattern similar to the light colored wood found in the hall and parlor, with varying boldness within the room. The base coat was a light tan color and the translucent glazes ranged from light to medium amber.

The molded edges of the stiles and rails surrounding the wainscoting and door panels and the field of the door panels were grained with imitation mahogany using a light tan base coat and a dark red translucent glaze. The narrow perimeter of the wainscot panels was painted a medium Prussian blue. The field of the wainscot panels was a medium dark blue. Small remnants of off-white shading were found over the blue color in the field of the panels, indicating a possible marbling with blue base coat. The baseboards were marbled in the same manner as in the parlor and hall. Wallpaper was also used on the plaster walls of this room, as shown by small remnants. No samples of the original ceiling or sash survived.

The finishes in the second floor hallway were less ornate than those found in the first floor rooms, but as on the first floor, most of the paint was removed except for small areas left by the 1960's project. The door and window architraves, the stair outer stringer, and the s were grained in different patterns of maple with light tan base coats and translucent glazes ranging from light to medium amber in color.

The doors, stair wall stringer, the stair newel posts, and the balustrades were mahogany grained. The stair risers may also have been mahogany grained but the evidence was not clear. A light tan base coat and a dark red, translucent, figured glaze were used.

The baseboards were painted with the same light gray-based marbling as on the first floor. The plaster walls and plaster wainscoting were papered, as shown by the very small remnants of the paper's cotton fibers found on the adjacent woodwork. The color and pattern could not be determined from these samples. No samples of the original sash or ceiling survive.

The front bedroom on the second floor contained only one panel with surviving finishes for the woodwork. Remnants were found on the south elevation and on the mantel. The original finishes in this room consisted of a graining and a principal color. The door architraves, chair rail, and mantel were painted a medium rose-cream color. The south door and baseboards were mahogany grained with a light tan base coat and a dark red, translucent glaze. The plaster walls and plaster wainscoting were papered, but the fibers were too small to determine color or pattern. No samples of the original sash, window architraves, or ceiling survive.

The rear bedroom on the second floor was originally divided into two smaller rooms by an east-west partition as shown by mortises in the center wall location of the west elevation and the outline of the missing partition seen on the floor. The only remnants of the original finishes were found on the south elevation of the present room. The door architraves and chair rail were a glossy light tan. The south door was a medium green translucent glaze over the light tan color. The baseboards were painted the same light gray as elsewhere in the house, but it could not be determined if the baseboards in this room had marbling. The plaster walls, and probably the plaster wainscoting, were papered. No samples of the original sash or window architraves survive. The room currently has a fireplace with a 1960's mantel, but the original divided room most likely did not have a fireplace originally.

The two third floor bedrooms were more utilitarian than the rest of the house. The window architraves and jambs were a glossy light tan color. The door architraves and jambs, the balustrade in the first bedroom, and the baseboards were painted a glossy medium red. The plaster walls were exposed white plaster. No samples of the original door or sash survived.

According to George Fore, due to the lack of intact original finishes, the re-creation of those finishes will require experimentation. The *faux* graining and marbling can be estimated, however. He recommended that several different sample boards be created to choose from.

The Joseph Bell House has undergone structural stabilization and re-plastering. The exterior re-painting has been done, using Benjamin Moore Exterior Soft Gloss Brilliant White 09601 plus "2 black" added to match the original glossy near-white and

Soft Gloss 2040-10 plus "8 yellow" to match the original dark green trim. The window sashes were painted white and the gallery elements were painted the same near-white as the clapboard, using the same type of paint.[164]

Before interior painting was done, the original historic finishes that have been exposed were protected with a coat of clear shellac. All of the interior woodwork, except for the baseboard, was painted with Benjamin Moore Premium Interior Latex Flat Finish Wall Satin mixed to match the original colors. White Dove 215-06 matches the light tan, but the yellow color needed to be specially mixed. The baseboards were painted in an oil paint, Benjamin Moore #2120-70. The *faux* graining was done by Croxson and Ward out of Locustville, Virginia (See Figure 25). This company provided the Beaufort Historical Association with detailed instructions for the paint preparation to be done by the painters before they could begin their repainting.

Figure 25: Interior faux finishes found in main hall of Joseph Bell House.[165]

The graining process used two types of glazes. The first type is a water-based glaze that uses beer as a medium, mixed with dry pigments. This type of glaze is traditional; especially for maple and bird's eye maple graining. Oil glazes, made from an

[164] Patricia Suggs, Internet Interview, 20 March 2002.

[165] http://historicbeaufort.com/bhanews1.htm

old-fashioned recipe using linseed oil, turpentine, and varnish, mixed with artists' oil paints in tubes, was also used. Both types of glazes will be covered with varnish, rather than the more traditional shellac, since shellac turns black and is does not last as long as varnish.[166]

The Joseph Bell House project is similar to the one done at Historic Stagville, in that the budget was low and based mostly on grant money. The Beaufort Historical Association decided to complete the entire house over the period of one year, using the project as a public exhibit of preservation in progress. The decision to use modern paint matched to historic colors does not take the scientific approach that is most appropriate for historic museums, but in this situation given a limited budget and a large body of historic *faux* finishes to reproduce, it was not a bad decision. If the *faux* finishes had to be sacrificed in lieu of using more historic paint finishes elsewhere, then the house would lose much of its historic character, thereby negating the decision to use the historic paint finishes for greater historical accuracy. Obviously, the best situation would be to use historic paint finishes everywhere in the house, but that would be cost prohibitive even for a larger site.

Historic Carnton Plantation, Franklin, Tennessee

Carnton, the Randal McGavock House, dates to approximately 1826-1828 (See Figure 26). It was built in two stages and styles. The first stage was a three-story, center hall, Federal style house without a front porch or rear veranda, probably designed by a Virginia architect named Swope. The second stage is Greek Revival in style, with the addition of a front porch, with second-floor verandas, and a rear veranda. Some interior changes include the replacement of the original single-door front entrance with a double

[166] Linda Croxson, Telephone Interview, 19 March 2002.

door, and the removal of the original mantels in the two front rooms and subsequent replacement with Greek Revival, pylon-form mantels, and the removal of the chairs in some of the rooms. The second-story verandas also necessitated the alteration of three second-story windows to allow access. The rooms most affected by the style change were the entrance hall and principal parlor which were the most likely to be seen by visitors.

Figure 26: Historic Carnton Plantation.[167]

In 1979, Building Conservation Technology, Inc. of Nashville, Tennessee, completed a Historic Structure Report (HSR) for the Carnton Association, Inc. and the Tennessee Historical Commission in preparation for restoration. The report was funded by a matching Grant-in-Aid from the Department of the Interior Heritage Conservation and Recreation Service. A complete paint analysis was done as part of that report. The HSR suggested the 1860's as the restoration period due to the house's connection to the Battle of Franklin and the fact that all significant changes to the house had been made by

[167] http://para4.org/photo/carnton.jpg

the 1840's. Since most of the changes made to the structure after the 1860's were cosmetic and easily reversed, the restoration was deemed easy. [168]

The analysis was done using samples taken from areas in the house with the least amount of exposure to extensive wear, weathering, abrasion or light, since the paint exposed to these conditions have generally altered significantly making them unreliable as references. Shallow bevels were cut through the layers. Each layer was then scraped back to expose at least a half inch square area then cleaned with alcohol. The exposed paint was studied *in situ* using a handheld microscope (7x) to verify the presence of dirt between layers. The presence of dirt indicated prolonged exposure to the air. The dirt between layers was also indicated by the fragility of the subsequent paint layers. The longer the earlier layer was exposed to the air, the more fragile the later layers. The paint samples were compared to the Munsell Color Book with careful attention paid to the light used while making comparisons. The report suggested that the same type and amount of light should be used when comparing the mixed paint to the Munsell chips. If this is not possible, both the paint and Munsell chip need to be brought into sunlight to compare. The report also suggested that enough paint for the entire project needs to made at one time to ensure the same color throughout.

The paint analysis showed that the house was likely decorated by a professional well versed in current fashions, as shown by the quality and variety of the finishes present. The center entrance hall, the first room that visitors would have seen, was originally extravagantly colored. The doors were mahogany wood grained with burled panels, the baseboards had blue marbling that extended to the third floor landing, and the

[168] Building Conservation Technology, Inc. Carnton: The Randal McGavock House, Franklin, Tennessee, Historic Structure Report, The Carnton Association, Inc. and The Tennessee Historical Commission, 1979.

columns of the center arch had gray marbling with red capitals and gold leaf trim. The rest of the wood paneling was off-white. An original chair rail had been removed early on, a fashion in Tennessee in the 1840's, and the report suggested that it not be replaced.

The front parlor contained a Greek Revival mantel, a later replacement of the Federal style mantel still extant in the connecting rear parlor (See Figure 27). It was recommended that it be kept as an example of a legitimate taste change and point of interest in the house's interpretation. The analysis showed that after restoration of the fireplace, the hearth should be painted red and the mantel black to match the original fireplace found in the second floor front bedroom.

Figure 27: Formal parlor of Carnton Plantation.[169]

The second floor hall originally had floors, which were grained to resemble golden oak, but the report suggests that repainting would be impractical due to visitor traffic. The door to the front bedroom was originally wood grained as well and one panel had been stripped to show the mahogany graining with holly or boxwood string inlay graining around the panels. The report suggested that the restorers should strip the entire

[169] http://www.rvtravelog.com/franklintn.dir/franklin.htm

door to the graining layer and left as an exhibit with little or no restoration, and that the other doors on the hall should be re-grained to match the original finish. The fireplace in this room showed the original brick hearth, painted red. The original parging finish would have been pink, but with the Greek Revival remodeling, it was changed to a realistic yellow Italian marbling. Since the right, rear room had been converted to a bathroom and kitchen area, the report suggested that it did not need to be restored to historic colors if it was to be used as an apartment but should be completely restored if this was to change. The sewing room at the front of the hallway had oak-grained floors, which the report suggested should be cleaned and covered with a protective coat.

The third floor contained two rooms connected by a doorway. Due to significant deterioration of the original plaster, the report suggests that this be replaced with drywall and that the drywall be painted with simulated whitewash. The woodwork retained its original paint finish and subsequently, the report suggests cleaning but not repainting. Remnants of three layers of wallpaper were found to the left of the dividing door. The first layer was the same paper likely used in the first floor entrance hall and in hallways all the way up to the third floor in the 1840's. The next layer was probably installed just after the Civil War and the top layer dated to the turn of the century. The report suggested that large sections of each paper be retained for archival purposes and that the original layer is used to reproduce paper to be used in the restoration of the hallways.

Carnton is unusual in that it has had a second paint analysis done that is less professional than the first since it is student work. Most administrators make do with a less sophisticated analysis until funds are found to perform a more professional and scientific analysis. In the late 1980's, a Carnton Master Plan was created as a Public

Service Project for the Center for Historic Preservation at Middle Tennessee State University. The information found during the 1979 analysis was used to restore the second floor but more information was needed before restoration of the first floor could be done. Nine students from Middle Tennessee State University completed a more detailed analysis for this purpose as well as to confirm new findings since the earlier report.[170]

The students used the same technique as the previous analysis, scraping back the paint layer by layer, in this case to expose one-inch square sections. *In situ* analysis was then used to find dirt layers and the various paint layers. The students then matched the colors to the Porter Paints 800 Collection Color Chart and then compared to the Munsell Color System. Floodlights were used during comparison since their color temperature is close to natural daylight. Only non-laboratory methods were used during this analysis.

Colors found at Carnton during the second analysis included yellow, shades of blue and green, white, black, and gray. A "yellow ochre" color was found on the exterior of the front door. "Colonial aqua" was found on the third floor trim, and would have been made from the precipitate that resulted from combining prussic acid, copperas, and alum. A pale apple green, promoted by Andrew Jackson Downing in the 1840's, was found in two second floor bedrooms. The exterior brick wall of the rear of the house, the jib windows, and the exterior wood trim were painted white. The students found that fireplace mantels on the first floor were painted black during the 1840's renovations, but would have originally been painted a sandstone color, a break from the findings of the

[170] Jennifer Butt, Erin Beth Dower, Jane Laub, Debbie McCord, Jennifer Martin, Lisa Oakley, Lyn Oliver, Chris Richards, and Susan Skarbowski, Carnton Master Plan, Center for Historic Preservation, Middle Tennessee State University.

first analysis. Shades of gray were found throughout the house. Chemical make-up of these various paints could not be determined due to the lack of laboratory procedures.

The exterior columns, pediment, and door surround were originally painted "Sandstone" to imitate the stone lintels and sills used for the windows. The front door and the lower wood panels of the sidelights were painted "Apollo Gold" which has a yellow ochre base, making it a common and inexpensive color choice. The front façade was painted white during the 1840's, but it is unclear as to when the rear façade was first painted. The louvered shutters on both the windows and the rear door were originally painted "Jungle Green" or Copper Green as it might have been known as then. Andrew Jackson Downing also popularized this color during the 1840's.

The wallpaper for the first floor hallway was found during the first paint analysis, but the color of the column capitals has yet to be determined. A plum color was found but it would require laboratory research to verify that it is indeed the original finish color. The students suggested that the arch be treated in one of three ways; removing the paint to reveal the original gold leaf, reapplying gold leaf or simulated gold leaf, or repainting the arch with metallic gold paint. The first two choices required specialists but would be more accurate than imitation gold leaf paint. Peel-Away, by Dumond Chemicals, Inc. was suggested as a means of controlled paint removal if that option was chosen.

The original paint scheme in the first floor front parlor could not be determined, leading to the recommendation that the color scheme be chosen in keeping with the rest of the house. An aqua color on the walls and "Pastel Pewter" on the window trim was suggested. Replicated wallpaper to match the hall and library was also suggested. The students suggested "Sandstone" or the later black for the mantel in the parlor as long as it

was consistent with the rest of the first floor, but felt that the black would be more in keeping with the 1840's interpretation of the house. It was again suggested that the chair rail not be replaced. The recommendations for the first floor rear parlor were the same as those for the front parlor with the exception of "Shaker Blue" for the chair rail.

The rear room to the right of the main hall was the original dining room but was later divided into three rooms, including a bathroom. The students suggested that once it was returned to its original form, the built-in cupboards should be repainted "Shaker Blue" and the walls covered with period wallpaper or painted to match the overall scheme in the house.

The front room on the right side of the hall was a library and workspace. The suggestion is that the walls be covered with the replicated wallpaper, or other period wallpaper. The trim, baseboards, and window sash should be painted "Griffin Gray."

The second floor hall should have wall recovered with the reproduced wallpaper with marbled baseboards and stair risers. This marbling should have a light cream base coat and an aqua marbling coat. The doors should be re-grained, but the students agreed that re-graining the floors to resemble oak would be impractical. The front left and right bedrooms, rear right bedroom, and sewing room on the second floor had already been restored. It was suggested that the wainscot in the rear left bedroom be repainted from baseboard to chair rail and the window mullions repainted to their original white.

At the time of the second analysis, only one original plaster wall remained in the third floor rooms. The students recommended that the wall be removed and preserved in the visitor center, or preserved behind Plexiglas where it stood to act as a teaching tool.

Unlike the earlier analysis, it was suggested here that the woodwork with original paint be repainted a "Colonial Aqua" rather than leaving the paint as it was.

Carnton is very similar to the Joseph Bell House in that its finishes are very ornate and require specialists to reproduce them. Restoration projects are necessarily expensive. In both cases, private organizations and grants rather than state funding must supply funding. Allowing students to use Carnton as learning tool was an inexpensive way to get a paint analysis for the house, but it also meant that the work done may not be as scientific and professional as work done by a professional analyst.

Monticello, Charlottesville, Virginia

According to Frank Welsh's article, "Microchemical Analysis of Old Housepaints with a Case Study of Monticello", Thomas Jefferson's home, Monticello, in Charlottesville, Virginia was essentially completed by 1809, after nearly forty years of construction (See Figure 28). In the 1980's, the Thomas Jefferson Memorial Foundation decided to do paint analysis to authenticate the original finishes at Monticello, especially in the Dome Room, an irregular octagon with a vaulted dome, a skylight, six circular, and two semi-circular windows, rising over the central part of the house.

Figure 28: Monticello.[171]

[171] http://capitalregionusa.org/news/photos/vaimages/large/Monticello.jpg

Microscopical paint analysis and color matching was done by Frank S. Welsh, and the McCrone Research Institute. The goal was to restore the original colors and replicate the original calcimine wall paint. Extensive historical research was begun in 1980. It was determined that the Dome Room was ready for painting by 1804. The walls were plastered and painted, and then a tall baseboard was installed.

About 100 samples were taken from wood trim, plaster, and flooring. Stereomicroscope analysis revealed that the original color scheme included white, green, yellow, natural finishes, and decorative finishes. Oil and water-based paints and resin varnishes were used. The two sets of doors were grained (as were all of Monticello's doors) to mimic mahogany with an inlay and burl wood on the panels.

Documents show that the vaulted plaster ceiling was painted, stenciled, and gilded in the late nineteenth century. Cross-sections of paint samples showed a layer of dirt, followed by a layer of yellowed shellac primer, and on top of this, the first layer of oil paint with an artificial ultramarine tint. That layer post-dated Jefferson's lifetime since artificial ultramarine was not available until after 1826. It was decided that the ceiling was not originally painted because such a treatment was atypical for the eighteenth and early nineteenth century.

According to H. Andrew Johnson's paper, "A Summary of Historic "Distemper" Paint Finish Reproduction at Monticello", the Dome Room, the cornice, window trim, door trim, and baseboard were originally painted with two coats of white lead in oil paint, as was determined microchemically. Polarized light microscopy was also used, at 100x and 400x magnifications, revealing high refractive index, anisotropy, and birefringence,

which all help to identify the white lead. A microchemical test, using bromocresol purple as an acid/base indicator, was done to determine what medium was used in the paint. The yellow streaks moving away from the paint sample followed by a yellow halo around the paint indicated an oil medium, since oil is slightly acidic. The white paint was slightly yellow in color, but tests showed no yellow pigments, pointing to the yellowing of the paint medium over time.

The floor was originally painted a bluish-green with oil paint, according to Jefferson's papers. Little evidence was present due to sanding and varnishing in the 1950's. Polarized light microscopy at 400x magnification showed three pigments used to create that color. White lead was the main pigment, mixed with yellow ochre and a color resembling natural ultramarine for color. The blue was identified by its slightly mottled appearance in a sharp-angular matrix, and its refractive index of 1.56, as well as by a microchemical test using sodium hydroxide, which produced an orange brown discoloration reaction. The blue pigment was Prussian blue.

The walls were the most difficult to analyze. There were hints that the walls were yellow at an earlier date, but the yellow layer was missing. Pieces of original plaster found under the floor near the portico doors showed that the paint was yellow calcimine (distemper) paint. A section from the end of the large baseboard was also removed and revealed original plaster with yellow calcimine paint. This coat was a thin coat (25 micrometers thick), and retained brush marks. It had grayed with age. The evidence of that paint was missing from elsewhere in the room because it was typical during the nineteenth century to wash off calcimines before repainting. A good sample was sent to Macbeth County to be tested with a spectrophotometer. The sample was permanently

mounted on a microscope slide under a cover slip of Aroclor® 5442. At 100x magnification, a low refractive index, and anisotropic, white calcium carbonate pigment particles were revealed. At 400x magnification, it was shown that the calcium carbonate was mostly limestone with biological calcite, distinguished with crossed polars by the black crosses shown by coccoliths. At 400x magnification, particles similar to those of yellow ochre could be seen. Oil immersions were used to increase magnification to 1000x, and the pure, uniformly sized, high refractive index particles of Mars yellow were seen. Since Mars yellow was seen at the end of the eighteenth century in England, it is possible that the Mars yellow pigment was delivered to Jefferson in 1805.

To prove that the paint was calcimine paint, the paint was moistened. The paint media softened showing that the paint was water soluble, and therefore, calcimine paint rather than casein. The paint was also tested with potassium iodide, which looks for starch as a medium, and Amido Black Abl to establish the presence of proteinaceous material such as animal-hide glue or casein. There was no discoloration reaction in the first test, meaning that there was no starch present. In the second test, there was a very slight sky blue color reaction, indicating the use of hide glue. A negative sodium azide test showed no possibility of casein. A final test using a sodium azide/iodine solution run under a paint particle on a cover slip, released no nitrogen gas in the form of bubbles. This indicated that there were no sulfur-containing casein or tempera paints present. This means that Richard Barry, Jefferson's painter, made calcimine paint in a manner typical for the nineteenth century using calcium carbonate, water, and tinting pigments bound with animal hide glue.

The Dome Room was painted and restored in 1988 to its original appearance, complete with white trim and ceiling, yellow calcimine walls, a skylight and circular windows. Mars yellow pigment that is available today varies depending on the supplier, as it did in Jefferson's time. Several samples were purchased from different sources for the paint replication. The pigment sample, a bright yellow that most closely matched the original sample was from a supplier in Norristown, Pennsylvania. It was mixed with a small amount of a warmer Mars yellow made by Tricon, which can be purchased at art supply stores. A recipe for yellow paint from 1825, written by Rufus Porter, and entitled "A Cheap Method of Painting Walls of Rooms," was used, with the replacement of the yellow ochre with Mars yellow (See Appendix A).

Adding them slowly to distilled water and then soaking them overnight hydrated glue granules. They swelled and the mixture was stirred while heating in a pan of water to 100 degrees Fahrenheit until the glue dissolved. "Reliable" brand whiting, specially ordered from a hardware store because tests indicate the brand produced results closest to the original sample, was also added while stirring.

Dry Mars yellow pigment (approximately 4 Tbsp. per gallon of paint) was dispersed in water on a slab with a putty knife to make a thick paste, to which water was slowly added. The paste was pressed and slid on the slab until smooth and even. The Tricon and Norristown pigments were made into pastes separately, and then mixed with small amounts of calcimine base to make thinner mixtures. The Norristown paste was slowly added to the main batch of base (with a portion of base as a reserve in case the color became over-saturated), with stops to compare dry samples (samples were dried quickly with a heat gun) to the original since the colors changed quickly as they dried.

When dry samples of the Norristown color nearly matched the original sample, the Tricon color was slowly added until the match was perfect. The result was a translucent paint that was best over a uniformly painted surface. Originally, the calcimine was the first coat of paint applied to the plaster, probably before it had cured, so that they cured together, making the paint insoluble over time. The walls were not stripped in order to preserve the historic paint record on the walls. Instead, the walls were painted with a flat white oil base paint (Benjamin-Moore Sani-flat, painted, not rolled, to avoid orange peeling or texturing on the surface) for a uniform ground as a prime for the calcimine. The calcimine was applied with a 4" polyester wall brush rather than the 6" china bristle brush likely used by Jefferson's painters. Tests were done with both types of brushes, and the results were very similar.

The paint was very thin so it had to be brushed out to prevent running. It also had to be applied carefully but quickly so the surface would not have too much contrast, or too many brush marks. The paint was applied in 3'-4' sections, rapidly brushed in horizontal arcs, and then tipped off in a downward motion, working from the top of the wall to the bottom. It was difficult to brush out areas near dryer work, because overlapping could occur, requiring the rewashing of the paint and the restarting of the job.

After the Dome Room was painted, experiments were done to determine if modern acrylic paints could be substituted for hide glue with the same authentic appearance and washable surface for use on the first floor. The paint was made in the same manner as the calcimine paint except for the substitution, and the results were indistinguishable from the authentic paint (See Appendix A). Morgan Phillips at the

Society for the Preservation of New England Antiquities (SPNEA) used a similar substitution for whitewash binders, but he reported a graying, dirty appearance over time. This had not occurred with the calcimine samples. The reason may be that Phillips used lime in his recipe, and the calcimine paint used whiting.

Since the repainting of the Dome Room, water damage from a leaking room and from inappropriate cleaning has brought about the need for repainting. The same painters and process were used, but the color was more intense this time. This may have been caused by variations in application or paint mixing and have been left since they do not seem wrong. The first floor was also repainted in time for the 1993 250th anniversary of Thomas Jefferson's birth. Evidence was found of Mars yellow calcimine paint on the dado of the Entrance Hall walls, and indigo blue calcimine on the South Square Room walls. Authentic calcimine would be inappropriate for high traffic visitor areas, so modern substitutions were used.

The indigo color original to the South Square Room cannot be matched with modern indigo pigment since they are too purple. Modifications to modern commercially available paints were made so that the color mixing could be controlled. Acrylic latex paint is thinned with water and whiting was added (See Appendix A). Two coats of this paint give the appearance of one coat of calcimine. The whiting affected the paint color for which compensation was made. The same changes were used in the Entrance Hall, but the Mars yellow created was different than the one used in the Dome Room. The same 4" polyester brushes were used. Painters worked in teams of two, one to lay the paint, and the other to tip off before the paint set. The first coat was mottled and uneven, but the second coat dried very flat and had the chalky appearance of calcimine paint.

Other research done by Frank Welsh at Monticello has determined the pigment content of the original paint in several of the rooms. As has already been discussed, the paint on the Dome Room walls contained whiting, Mars yellow and hide glue; the floor in this room contained white lead, calcite, yellow ochre, Prussian blue, and bone black. The South Square Room walls were painted with indigo and calcium carbonate. The Entrance Hall dado used yellow ochre, burnt sienna, and coal black; the baseboard in this room, white lead, calcium carbonate, Prussian blue, bone black, and vermilion; and the floor white lead, calcium carbonate, verdigris, Prussian blue, yellow ochre, and bone black. The North Stairwell was painted with white lead, lampblack, red iron oxide, and burnt sienna. The interior wood trim in the house was painted with white lead, calcium carbonate, yellow ochre, raw umber, and charcoal black.[172]

Monticello had a much larger budget and staff than Historic Stagville. This makes paint projects somewhat easier to undertake. On the other hand, this site had to take into account its high visitor traffic. The sheer multitude of visitors greatly affects how Monticello approaches historic finishes at the site. Even with their budget and the interest in the restoration of earlier finishes, it would be impossible to give all of the rooms an authentic restoration.[173] The decision to try similar substitutions is a good compromise. Rooms were given an appearance similar to the original so visitors can see Monticello as Jefferson did, but the new finishes stand a better chance of surviving with more durable and washable finishes. Modified paints have the added benefits of being

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[172] Frank Welsh, "Listing of Paint Pigments at Monticello", n.p.

[173] H. Andrew Johnson, "A Summary of Historic "Distemper" Paint Finish Reproduction at Monticello," (n.p. 1994), 1.

made of safer and cheaper ingredients, and of needing slightly less skilled and knowledgeable paint mixers.

Mount Vernon, Virginia

Mount Vernon, the home of George Washington, was built sometime around 1740 (See Figure 29). Washington leased it in 1754 and expanded the acreage and main house until he died in 1799. Ann Pamela Cunningham, the founder of the Mount Vernon Ladies' Association of the Union, rescued Mount Vernon from decay and destruction in 1858. She solicited money, mostly from other women, purchased the property from the current owner, John Augustine Washington, Jr., and began restoration. That restoration has continued to the present. In 1980, the Association hired Matthew Mosca to analyze every painted surface in the Mansion.[174]

Figure 29: Mount Vernon.[175]

Mosca found up to twenty-six layers of paint, in 2,500 samples, from three stories of the house. The chemical compounds were analyzed and the pigments studied carefully. It took nearly a year to create a complete chromo-chronology for each room

[174] Wendell Garrett,ed., George Washington's Mount Vernon, (New York: The Monacelli Press, 1998),46, 223-224 & 231.

[175] http://fotot.jarvenpaa.net/arkisto/web/0000000093.jpg

dating from 1754 to the present. According to Mosca's report, Washington preferred vibrant blues and greens rather than the muted colors most Americans expected from an eighteenth century house. The first floor rooms were painted with variations of Prussian blue and verdigris. Later research done on a Palladian window in the large dining room revealed three shades of verdigris in this room used in order to emphasize the details of the plaster and wood decorations.[176]

According to Matthew Mosca's article, "The House and Its Restoration", Washington worked on the interior of Mount Vernon at three different periods: 1757 to 1760, 1775 to 1787, and, 1797 to 1799. The house is restored to 1799, the time of Washington's death, but the paint in the house was already fifteen years old at that time, and had changed with time (nearly the entire house, interior and exterior, was repainted during the 1780's). The decision was made to make the paint as close to the original as possible, and then let the paint age naturally to resemble the 1799 paint.

The restoration started in Washington's study and it took four years to finish a complete restoration of the colors found. The paint restoration here prompted a change of thought about paint restoration throughout the country. By making the paints as close to the original as possible, people were able to view rooms, as Washington would have, complete with brush marks and irregularities of color.

During the paint restoration, pigments were ground by hand in oil and walls were painted using round eighteenth century brushes. The finish paints were brighter and more uneven in intensity and level of gloss than expected. Prussian blue was especially surprising. This pigment was used in various shades in fourteen rooms at Mount Vernon between 1775 and 1787. It was an expensive pigment, and using it was a sign of wealth

[176] Garrett, George Washington's, 231-232.

in the eighteenth century. Only the highest quality pigments were used at the site, providing the brightest blues possible at the time. Prussian blue was mixed with resin varnish and linseed oil to make a very thick paint, which had to be pushed along the wall. The pigment deepened in color as pressure was applied to the brush, resulting in a streaked finish.

Verdigris colored paint was also very vibrant. A translucent glaze was made of distilled verdigris in a varnish medium, and was used over a light colored undercoat. The end finish was similar to stained glass in intensity of color and translucence. Microscopic examination showed that the painters had difficulty grinding the verdigris sufficiently in the oil and varnish medium, as evidenced in the west parlor and small dining room.

During the remodeling from 1757 to 1760, a new staircase was installed in the first floor passage. The older staircase was moved to the second floor. Paint analysis on this older stair revealed burnt-sienna brown paint. Sometime in that period, wood paneling was added to the first floor passage, and was painted with yellow ochre. In the 1780's, the paneling was painted with Prussian blue, and the doorframes were painted light grey. The mahogany graining on the interior doors dates to the same period. The graining of the entire passage was done in 1797. This graining had a light red base coat, made from red ochre, red lead, and white lead, followed by layers of translucent glaze simulating wood grain.

Washington's study was part of the south addition completed between 1774 and 1775, and contained a fully paneled fireplace wall until it was partially replaced by a bookcase in 1786. The study's first color scheme was whitewash for the plaster walls, burnt-umber brown paint for the doors, and blue-gray paint, made with white lead and

lampblack, for the rest of the woodwork. The room had to be repainted around 1780 due to a smoking fireplace, and was done in a stone color that can be seen behind the bookcase that was later added. The floors in this room were unfinished, as shown by the floor revealed when the bookcase was moved. In 1786, stylized light English walnut graining (probably done from memory) was applied to the woodwork. In 1820, the woodwork was painted gray to cover the much worn graining. Malcolm Robson, using an original panel as a model, redid the graining in 1980. This room is open to visitors today, so lead-free, titanium based paints were used for the graining restoration. The graining glaze was made with natural earth pigments, but the glaze medium was made using lead-free modern driers. Three coats of varnish were applied to protect the paint from soil and abrasion (See Figure 30).

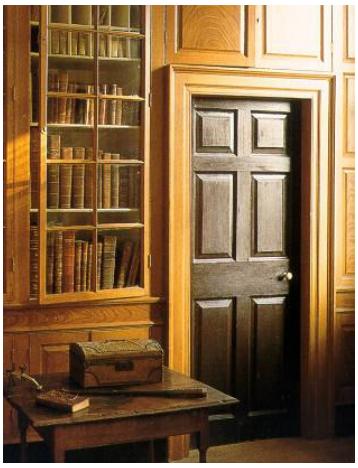

Figure 30: Washington's study at Mount Vernon showing wood graining.[177]

The paneled west, or front, parlor was also redecorated between 1757 and 1760. Of the nearly 300 samples taken in this room, only a quarter had eighteenth century finishes remaining and most of these only fragments, due to a removal of most of the

[177] Garrett, George Washington's, 136.

paint in the late nineteenth century. The first color scheme included red mahogany graining on the chimneypiece, doors, and doorframes, as well as stone-colored paint for the paneled walls, made from ochres and umbers mixed with white lead. This lasted until some time after 1776, since a door added for access to the northern addition was grained to match the others at this date. During the changes in the 1780's, the entire room was repainted with a mixture of Prussian blue, white lead, and a small amount of yellow ochre, and the ceiling was given a cast-plaster decoration. The Prussian blue pigment was insufficiently ground, as shown by the unevenly dispersed pigment in the white-lead based paint, and the uneven finish. When this color was recreated, the paint was purposely made imperfectly in order to more closely resemble the original paint. Titanium dioxide white, zinc oxide white, and modern driers were used instead of leads because of the latter's toxicity, but the original method was otherwise followed. The pigments were ground in linseed oil. Several samples were compared to find a match of the original pigment disbursement pattern, and several Prussian blue pigments were tried. Fifteen minutes of grinding matched the original the closest in pattern and color. When painting, the painters followed the grain, as was typical, and were left with the same vertical and horizontal marks of the original paint. The paint was glossy and uneven like the original paint as well. This paint has aged since the repainting, and now has a gloss level similar to a modern eggshell finish. The loss of gloss was caused by pigment particles pushing through the paint film, and could be counteracted with the use of glazes (possibly prepared with natural varnish) on the finish coat, but glazes were rarely used in Mount Vernon.

The small dining room was given woodwork sometime between 1757 and 1760, but the carved wood and plaster decorations are from 1775. The fireplace smoked in this room as well, so the walls were whitewashed every year until around 1782, when the room was painted bright verdigris green. An undercoat of white lead with a small amount of yellow ochre, verdigris, and lampblack was used to achieve a light gray-green finish, and was then coated with a resin-varnish paint of distilled verdigris green with a small amount of white lead. This was one of the few glaze-like finished rooms, chosen probably for easy cleaning because of the smoking fireplace, to preserve the varnish, and because this was the most intense green that could be made in the eighteenth century. This room posed special restoration challenges. The plaster walls were failing under the weight of twenty-four layers of paint. Before paint restoration could begin, the plaster had to be stabilized. After the stabilization, tests were run to find a paint that would dry slowly to postpone eventual repainting, one with a vehicle that was easily removed, appeared like an oil-varnish paint of the eighteenth century, and was made of materials available to Washington. A glaze-like paint made with Liquitex Acrylic Gloss medium and pigments ground in gum-arabic solution was decided on. Liquitex was added for the required texture and correct gloss when dried, with an extra Liquitex gloss medium layer applied over the glaze to protect the pigment. This paint is still bright green today. The over-mantle in this room required a paint that will be reversible in a solvent that will not affect the plaster stabilizer (acryloid resin). Polyvinyl Butyral B-98 (alcohol-soluble thermoplastic varnish) was chosen. It created a clear, flexible film that is resistant to heat and sunlight. The original paint color was matched with modern solvent-based materials:

titanium-dioxide white and viridian green (Guignet green transparent). This paint remains stable, with the same color and gloss level.

The large dining room was built in 1776. It takes up the entire north addition and was not completed until 1788. In 1787, the wood trim and some of the ornamentation in the room were painted using white lead, yellow ochre, yellow lead (litharge), and verdigris to make the white, buff, and green paints used. Its color scheme incorporated colors and themes made popular by Robert Adam. This room had wallpaper as well as paint, and the skill level of the painter of this room was much greater than that of those who painted the rest of the house. The paint coats here were much thinner and there was much less surface texture. There was also discoloration in the colors in this room caused by the yellowing of the oil medium used in the paint, and the verdigris had turned gray. This room was repainted with titanium dioxide based modern paints, and the wallpaper has been recreated. The original green coating for the paper was a distemper base of whiting and water-soluble glues, usually made from rabbit skin or fish (isinglass). Verdigris was well preserved in this medium. The paper was difficult to replicate due to content and sizing differences between historic and modern paper, but adjustments were made. The paper was hung with traditional horizontal joints, and coated in place (this was historically done in the wallpaper shop). The coating used was more durable than the historic water-soluble gouache, since it was made with acrylic binder and Liquitex matte medium.

Mount Vernon also opted for restoration as its goal. This site, like Monticello, had a large budget and staff to help with paint restoration projects, as well as high visitation numbers. Mount Vernon's finishes were oil-based rather than calcimine; high

traffic was not as much a problem as at Monticello. In some of its rooms, Mount Vernon used ingredients such as red and white lead that are dangerous to anyone that is exposed to the paint. These rooms are not open to the public, since in most cases, historic buildings that are used for residential purposes or are open to the public are not allowed to use lead paint. In this case, historic accuracy was a higher priority than safety.

CHAPTER 6

CONCLUSIONS

It is very important for administrators to have as much information about their historic building as possible. In-depth research should always be done in order to give the best and most complete interpretation of a site. A complete paint analysis can, and should be a vital part of that research. The research done on a building should be used to write a detailed Historic Structure Report documenting the current condition of your building and its evolution over time.

For years, the preservation community has ignored historic paint and historic landscapes. It is only recently that the idea of the historic landscape as a whole has been widely accepted. Paint is just as important a part of that historic whole as the building itself. The residents who built a historic building put thought into how to enhance and protect their environment. What paints were composed of and how they were applied tells a lot about the period of the building, the people that inhabited that building, and the building itself. Paint analysis often aids in the dating of a building, additions, and other changes throughout the building, and the pigments and mediums used can give a good idea of the economic status of the residents. Paint analysis may also reveal the historic use of a room.

Given the importance of historic paint, it is essential that good decisions are made regarding the paint in one's building. Before any changes are made to the finishes, be it interior or exterior, repair or removal, a complete paint analysis should be done.

Obviously, the budget of the site will effect how an analysis is conducted. Remember, while it is possible and inexpensive to take samples and attempt to analyze them oneself, this approach is strongly disapproved of and is likely to be inconclusive. At the least, your samples should be professionally analyzed. However, professional site visits, sampling, and analysis are always the best choice. In the unlikely event of a complete lack of paint evidence, documentary research needs to be done focusing on historic paint usage and the paint evidence found in buildings similar to the one in question. After the analysis is completed, the information gathered should be taken into account before a paint project is tackled.

The very fact that there are several options open to administrators dealing with historic paint at their sites points to disagreement within the preservation field. Many preservationists feel strongly that only scientific paint reproductions should be done, but there are many that think that matching historic colors using modern paints is acceptable, especially since it is better than nothing. All agree that evidence of historic paint should be preserved at the site for posterity and future examination, especially samples of decorative work.

The case studies used in this thesis are good examples of how the paint in historic buildings is dealt with in different situations. Historic Stagville was a good example of a historic site that did paint analysis and repainting one room at a time, using historic techniques and materials as much as possible, given current safety laws. House in the Horseshoe demonstrated a site that had a professional analysis done but then chose to make refinishing decisions based on current and professional taste rather than documentation. The Joseph Bell House's rehabilitation as a house museum included a

complete paint analysis and repainting with the focus on decorative paint finishes found in the house. Paint finishes were dealt with using modern paints color matched to historic colors, but more effort was spent on the accurate reproduction of the *faux* wood and marbling finishes, using historic materials and techniques. Carnton showed how a site could have a basic paint analysis done inexpensively. Monticello has done paint analysis throughout the building as well as the repainting of several rooms. Highly accurate reproductions of paint finishes have been done in rooms that are not open to the public, but modified paint finishes have been used in public spaces. Historic techniques, such as using round brushes, were used to enhance the historic appearance, but modern ingredients were substituted to create paints that were safer and less susceptible to wear. Mount Vernon has done the most accurate recreations, using historic techniques in all of the rooms. Lead has even been included in some of the paint used in rooms closed to the public.

The available budget obviously affects paint treatments, but so do location and notoriety. Mount Vernon and Monticello had big budgets to work with, but they also had nationally important names attached to their sites and therefore high visitation. Exacting attention to detail is important to their reputation as historic sites. The Joseph Bell House, on the other hand, is connected to a person with relatively local notoriety. Visitors are not likely to visit due to name recognition, and will be more interested in what life was like for their ancestors than in historical accuracy in paint finishes. By repainting the house with matching colors and carefully recreated decorative finishes, visitors will get a very good idea of what a wealthy, local resident's home would have

looked like. This is less historic accuracy and more catering to your audience. It is, however, highly appropriate for the situation.

While paint analysis is disputed by some as being subjective and often inaccurate, and while there is dispute as to how analysis results should be interpreted, it cannot be disputed that a sensitive approach to historic paint in a historic property is imperative. This thesis should provide enough information about historic paint, the process of paint analysis, and the mechanics of appropriate repainting to help administrators of historic properties make educated decisions regarding the paint in their building. Knowing about historic paint, what is involved in the process of paint analysis, and why historic paint is important should lead to a project that will enhance one of the most important aspects of a historic property's interpretation.

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GLOSSARY OF TERMS

acrylic(or acryloid) resin - Any of a group of thermoplastic resins formed by polymerizing the esters of amides of acrylic or methacrylic acid: used chiefly where transparency is desired, as in methacrylate resins Lucite and Plexiglas

adulterant - A substance that debases by adding inferior materials or elements; using cheaper, inferior, or less desirable goods in the production or marketing of an genuine article

agglomerate - A mass of things clustered together

alkali - Any of various bases, the hydroxides of the alkali metals and of ammonium, which neutralize acids to form salts and turn red litmus paper blue

alligatoring - Cracking and acquiring the appearance of alligator hide, as from weathering or improper application to a surface

amido black ABL - Black created from amide, a metallic derivative of ammonia

ammoniac (or gum ammoniac) - Applied to a salt and a gum resin said to come from near the shrine of Ammon in Libya

aniline - A colorless, oily, slightly water-soluble liquid, $C_6H_5NH_2$, usually derived from nitrobenzene by reduction: used chiefly in the synthesis of dyes and drugs

anisotropic - Of different dimensions along different axes

architrave - 1. The lowest most member of a classical entablature, resting originally upon columns 2. A molded or decorated band framing a panel or an opening especially a rectangular one, as of a door or window

aroclor© 5442 - Cargill Labs Meltmount series of mounting media specially formulated optical quality trermoplastics for use in microscopre slide mounting and in other oprical coupling applications. Replaced by Meltmount 1.662

autofluoresce - To exhibit the phenomenon of emitting radiation, especially visible light, without outside influence

binocular stereozoom microscope - A microscope utilizing each eye (binocular), giving different aspects and, therefore, a stereoscopic effect

Biolam metallurgical microscope - A compound microscope (non-stereo) found in many amateur, scholastic, student, and professional environments. Lighting is typically placed beneath, but several versions allow for incident (top) lighting

birefringence - Double refraction, or the separation of a ray of light into two unequally refracted, plane-polarized rays of orthogonal polarizations, occurring in crystals in which the velocity of light rays is not the same in all directions

burgundy pitch - A resinous substance prepared from the exudation of the Norway spruce (Abies excelsa) by melting in hot water and straining through cloth. The genuine burgundy pitch, supposed to have been first prepared in Burgundy, is rare, but there are many imitations. It has a yellowish brown color, is translucent and hard, but viscous. It is used in medicinal plasters

calcareous - Resembling calcite or calcium carbonate especially in hardness; consisting of or containing calcium carbonate; also : containing calcium; growing on limestone or in soil impregnated with lime

calcareous soap - Soaps containing calcium carbonate

calcimines - A white or tinted wash of glue, whiting or zinc white, and water that is used especially on plastered surfaces

casein - A phosphoprotein of milk: as a one that is precipitated from milk by heating with an acid or by the action of lactic acid in souring and is used in making paints and adhesives; one that is produced when milk is curdled by rennet, is the chief constituent of cheese, and is used in making plastics

cellulosic - Of, relating to, or made from cellulose

chroma - A quality of color combining hue and saturation

coccoliths - A microscopic calcite skeletal plate that protects certain marine phytoplankton and in a fossilized state forms chalk and limestone deposits

color seriation chart - A chart used to record color - finish history. Usually arranged in a columnar fashion indicating periods of time

copal - "Any of several brittle aromatic yellow to red resins of recent or fossil origin, obtained from various tropical trees and used in certain varnishes

crazing - To produce minute cracks on the surface or glaze of; to produce a mesh of fine cracks

crude turpentine - The sticky mixture of resin and volatile oil from which turpentine is distilled

dammar - Any of various resins used in varnishes and inks and obtained chiefly in Malaya and Indonesia from several timber trees

decoction - An extract made by boiling down to concentrate

dessication – Drying

diffuse reflection of light - To subject a light beam to diffusion. To break up and distribute (incident light) by reflection (as from a rough surface)

dryer - A substance added to paint, varnish, or ink to speed drying

emission spectroscope - An optical instrument for creating and analyzing spectrographic information

energy dispersive x-ray analysis - A process in which an electron beam strikes the surface of a conducting sample. This causes X-rays to be emitted from the material. The energy of the X-rays emitted depend on the material under examination. The X-rays are then analyzed, and the materials determined

evaporation - To convert into vapor; also : to dissipate or draw off in vapor or fumes; to deposit (as a metal) in the form of a film by sublimation

fascia - A flat usually horizontal member of a building having the form of a flat band or broad fillet; as a : a flat piece used as a molding b : a horizontal piece (as a board) covering the joint between the top of a wall and the projecting eaves -- called also fascia board c : a nameplate over the front of a shop

fiber-optic - Thin transparent fibers of glass or plastic that are enclosed by material of a lower index of refraction and that transmit light throughout their length by internal reflections

fiber-optic illuminators - A bundle of fiber-optic fibers used in an instrument for lighting in small or tightly confined spaces

frieze - The part of an entablature between the architrave and the cornice; A sculptured or richly ornamented band (as on a building or piece of furniture)

graining - To give a grained appearance; especially faux bois

gouache - An opaque watercolor prepared with gum

granulation - The process of forming crystals or granules

gum arabic - A water-soluble gum obtained from several acacias (especially Acacia senegal) and used especially in the manufacture of inks, adhesives, pharmaceuticals, and confections

hide glue - A glue made from animal hides. Used as a binder in paints

hue - Gradation of color; the attribute of colors that permits them to be classed as red, yellow, green, blue, or an intermediate between any contiguous pair of these colors

hydrate - A compound formed by the union of water with some other substance

hydraulic cement - A kind of calcined limestone, or a calcined mixture of clay and lime, for making mortar which will harden under water

long-wave ultraviolet light - Radiation lying in the ultraviolet range; wave lengths shorter than light but longer than X rays

maceration - To cause to become soft or separated into constituent elements by or as if by steeping in fluid

marbleizing - To give a veined or mottled appearance to; esp. faux painting

mastic - An aromatic resinous exudate from mastic trees used chiefly in varnishes; any of various pasty materials used as protective coatings or cements

media - A surrounding or enveloping substance

megilp - Oil-base made from linseed oil and beeswax for marbelization

micro drill - Miniature precision drills available in sizes as low as .001 inches

microanalysis - Chemical analysis on a small or minute scale that usually requires special, very sensitive, or small-scale apparatus

micropipette - A pipette for the measurement of minute volumes; a small and extremely fine-pointed pipette used in making microinjections

oil of turpentine - An essential oil obtained from turpentines by distillation and used especially as a solvent and thinner -- called also gum turpentine; a similar oil obtained by distillation or carbonization of pinewood -- called also wood turpentine

paratacamite - Massive, granular crystals- Common texture observed in granite and other igneous rock. Common coloring is greenish-black, and dark green

petri dish - A small shallow dish of thin glass or plastic with a loose cover used especially for cultures in bacteriology

phenols - A corrosive poisonous crystalline acidic compound C6H5OH present in coal tar and wood tar that in dilute solution is used as a disinfectant; any of various acidic compounds analogous to phenol and regarded as hydroxyl derivatives of aromatic hydrocarbons

phthalocyanine blue/green - Any of several metal derivatives that are brilliant fast blue to green dyes or pigments

polarized light microscope - A microscope which utilizes light that is reflected or transmitted through certain media so that all vibrations are restricted to a single plane

precipitation - To cause to separate from solution or suspension b : to cause (vapor) to condense and fall or deposit

proteinaceous - Of, relating to, resembling, or being protein

quinone - Either of two isomeric cyclic crystalline compounds C6H4O2 that are di-keto derivatives of dihydro-benzene.; any of various usually yellow, orange, or red quinonoid compounds including several that are biologically important as coenzymes, hydrogen acceptors, or vitamins

reagent - A substance used (as in detecting or measuring a component, in preparing a product, or in developing photographs) because of its chemical or biological activity

refrative index - The ratio of the speed of radiation (as light) in one medium (as a vacuum) to that in another medium

resin - 1. Any of numerous clear to translucent yellow or brown, solid or semisolid, viscous substances of plant origin, such as copal, rosin, and amber, used principally in lacquers, varnishes, inks, adhesives, synthetic plastics, and pharmaceuticals. 2. Any of numerous physically similar polymerized synthetics or chemically modified natural resins including thermoplastic materials such as polyvinyl, polystyrene, and polyethylene and thermosetting materials such as polyesters, epoxies, and silicones that are used with fillers, stabilizers, pigments, and other components to form plastics

ropy surface texture - Forming sticky glutinous strings or threads, as some liquids dry

salt of tartar - The chloride of sodium, a substance used for seasoning food, for the preservation of meat, etc. It is found native in the earth, and is also produced, by evaporation and crystallization, from sea water and other water impregnated with saline particles

sandarac - A brittle faintly aromatic translucent resin obtained from a northern African tree (Tetraclinis articulata) of the cypress family and used chiefly in making varnish and

as incense; also : a similar resin obtained from any of several Australian trees (genus Callitris) of the same family

saturation - Chromatic purity. Freedom from dilution with white (1) : degree of difference from the gray having the same lightness -- used of an object color (2) : degree of difference from the achromatic light-source color of the same brightness -- used of a light-source color.

scanning electron microscope - An electron microscope in which a beam of focused electrons moves across the object with the secondary electrons produced by the object and the electrons scattered by the object being collected to form a three-dimensional image on a cathode-ray tube -- called also a scanning microscope

size - Any of several gelatinous or glutinous substances usually made from glue, wax, or clay and used as a glaze or filler for porous materials such as paper, cloth, or wall surfaces

solvent blistering - The blistering of paint or other substances caused by their exposure to solvents

spectrophotometer - A photometer for measuring the relative intensities of the light in different parts of a spectrum

spirit of wine - A mixture of ethanol and water that is usually 95 percent ethanol

stereomicroscope - A microscope having a set of optics for each eye to make an object appear in three dimensions

sublimation - To cause to pass directly from the solid to the vapor state and condense back to solid form

substrate - An underlying support : foundation: as a : substance that is a permanent subject of qualities or phenomena b : the material of which something is made and from which it derives its special qualities

summer beams - Wooden beams which support second floor joists, as a midway support

thermoplastic - Capable of softening or fusing when heated and of hardening again when cooled

thin-layer chromatography - Chromatography through a thin layer of sample mixture that is vaporized and injected into a stream of carrier gas (as nitrogen or helium) moving through a column containing a stationary phase composed of a liquid or a particulate solid and is separated into its component compounds according to the affinity of the compounds for the stationary phase

turpentine - A yellow to brown semi-fluid oleoresin obtained as an exudate from the terebinth; an oleoresin obtained from various conifers (as some pines and firs)

ultraviolet - Situated beyond the visible spectrum at its violet end -- used of radiation having a wavelength shorter than wavelengths of visible light and longer than those of X rays

varnish - A paint containing a solvent and an oxidizing or evaporating binder, used to coat a surface with a hard, glossy, transparent film; the smooth coating or gloss resulting from the application of this

venice turpentine - A regal oil painting medium. When added to color, it increases the paint's adhesive quality to the canvas and will impart an enamel-like gloss to colors when dry

water solubility test - The amount of a substance that will dissolve in a given amount of water and is typically expressed as the number of parts by weight dissolved by 100 parts of solvent at a specified temperature and pressure or as percent by weight or by volume

whiting - Calcium carbonate ground into fine powder, washed, and used especially as a pigment and extender, in putty, and in rubber compounding and paper coating

x-ray fluorescence - luminescence that is caused by the absorption of radiation at one wavelength followed by nearly immediate re-radiation usually at a different wavelength and that ceases almost immediately when the incident radiation stops

APPENDIX A

RECIPES FOR PAINT

From an 1812, a pamphlet entitled "Directions for House and Ship Painting: Shewing in a plain and concise manner The Best Method of Preparing Mixing and Laying the Various Colours Now in Use, Designed for the Use of Learners" published by Hezekiah Reynolds: [178] It revealed that interior and exterior paints were mixed differently. He made an exterior paint by grinding pigments in their dry form in a medium sized iron kettle with a suspended 12-24 pound ball. He then ground 6-8 pounds of ground dry pigment with oil that had been boiled with red lead to speed drying. For interior paint, small amounts of colors were ground in boiled oil that had been mixed with copal varnish or turpentine. White lead and oil were then ground with a muller on a marble slab. Colors were ground in oil separately then mixed together.

From J. F. Watin, a French author: A formula for mastic intended as a vehicle for pigment: "Four ounces of the resin dissolved in one pint of oil of turpentine, to which one half pound of crude turpentine of unspecified type is then added."[179]

From J. F. Watin, a French author: A recipe for copal varnish: [180] "Four, six, eight ounces of hot linseed oil were allowed for each pound of melted resin, and one pound of oil of turpentine was later added."

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[178] Moss, Paint, 38.

[179] Moss, Paint, 50.

From the accounts of Braverter Gray, of Hillsborough, New Hampshire, 1785:

A Varnish for All Sorts of Colours:[181] "Take of gum annimiac [ammoniac] 1 ounce, of mastic and gum sanderac of each 2 ounces. Reduce them to a fine powder, put them into a glass vessel and put a pint of the spirits of wine over them; hang them in the sun or set it by the fire till it is dissolved; then strain it through a clean cloth and keep it in a vial well corked; and then mix your paints with it."

Cedar Graining: "Take a white lead and India Red, Brown, or Red Pink, and make dark for the Nots and Grain. Add a Little white vitriol and make it dry. The Nots and Grain to be put on as soon as the ground, so that the Colours may mix together a little."

From the American editions of *Valuable Secrets Concerning Arts and Trades*:

To Make Transparent Colours:

For The Green: "Put in very strong vinegar, verdigrise, rue-juice, and gum-arabic. Set this in the sun for a fortnight, or, if you have not sun, boil it on the fire. Strain it, bottle and stop it. – Shake it well before using."

For The Red: "Make a lye with salt of tartar. In it, put to infuse for one night, some India wood, with a little alum. Boil all, and reduce to one third. Run it through a linen cloth, and mix some gum-arabic with it. –With more or less alum, you make it of a higher or paler hue."

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[180] Moss, Paint, 50.

[181] Nina Little, American Decorative Wall Painting, (New York: E. P. Dutton and Co., Inc.,1972), 2, 6, & 7.

For The Yellow: "Bruise Avignon seed, which we, in this country, call French Berries, and put it in a lye of salt of tartar to boil on the fire, to the reduction of two thirds. Run it, and boil it one bubble more. Then bottle and cork it. A small addition of saffron renders it more lively."

For The Blue: "Soak in chamber-lye, for one night, a certain quantity of German Palma Christi. Take it out and grind with a little quick lime. – More or less quick lime will raise or lower it in hue. And nothing more is required to dilute it than chamber-lye and gum-arabic."

Paint Milk (Elijah Bemis, The Dyer's Companion, New York, 1815):

2 quarts skimmed milk	4 ounces caraway, linseed, or nut oil
6 ounces fresh slacked lime	5 ounces Spanish white

"Mix lime and enough milk to make a smooth mixture. Add oil by degrees than the remainder of the milk, and finally, the Spanish white. Milk can be curdled but not sour. Spanish white must be crumbled and spread upon the surface of the liquid, when it sinks, must be stirred with a stick.

Use on plaster walls. Can be colored with charcoal, yellow ochre, etc.

For Outdoor Work: Add to above	2 ounces slacked lime
	2 ounces oil
	2 ounces white turpentine

Paint in late autumn so paint will harden on surface and the oil will not penetrate, as it will in the heat of the summer."

From the Colonial Williamsburg Research Files (Used in parlor at Historic Stagville, Durham, North Carolina):[182]

Inside Work	Outside Work
Skimmed milk 2 quarts	Skimmed milk 2 quarts
Fresh slaked lime 6-1/2 ounces	Fresh slaked lime 8-1/2 ounces
Linseed oil 4 ounces	Whiting 3 pounds
Whiting 3 pounds	White Burgundy pitch 2 ounces

"Put the lime into a stone vessel and pour upon it a sufficient quantity of milk to form a mixture resembling thin cream, then add the oil a little at a time stirring it with a small spatula; the remaining milk is then to be added, and lastly the whiting. The milk must on no account be sour. Slake the lime by dipping the pieces in water out of which it is to be immediately taken and left to slack in the air. For fine white paint the oil of caraways is best, because colourless, but with ochres, the commonest oils may be used. The oil, when mixed with the milk and lime, entirely disappears and is finally dissolved by the lime forming a calcareous soap. The whiting or ochre is to be gently crumbled on the surface of the fluid, which it gradually imbibes and at last sinks; at his period it must be well stirred in. This paint may be coloured like distemper or size colour, with lerigated charcoal, yellow ochre, etc. and used in the same manner (Sufficient for 27 square yards).

The same paint will do for outdoor work by the addition of two ounces of slaked lime, 2 ounces of linseed oil and 2 ounces of white Burgundy pitch, the pitch to be melted

[182] "Whitewash Formulas and Application", Prepared for the Stagville "Institute for Historic Paints and Wallpapers", n.p., 1998.

in a gentle heat with the oil and then added to the smooth mixture of the milk and lime. In cold weather it must be mixed warm to facilitate incorporation with the milk."

Whitewash recipe from an 1861 how-to book:[183]

Brilliant Whitewash "This bears a gloss like ivory, and will not rub off. Take of clean unslacked lime 5 or 6 quarts, slack with hot water in a tub, cover to keep in the steam; when ready, pass it through a fine sieve, and add ¼ lb. of whiting, 1 lb. of good sugar pulverized, and 3 pints of rice flour, first made into a thin paste; boil this mixture well, then dissolve 1 lb. of clean glue in water, and add it to the mixture, and apply while warm with a whitewash brush, except when particular neatness is required you may then use a paint brush; in both cases put it on warm. You may add colouring matter to give it any shade you please."

Whitewash formula given by Andrew Jackson Downing in *The Architecture of Country Houses*, 1850 (seems like a stucco or *faux* stone finish):

"CHEAP WASH FOR COTTAGES OF BRICK, STONE, STUCCO, OR ROUGH-CAST (concrete?) Take a barrel and slake half of fresh lime as before mentioned; (The before is: Take a clean barrel that will hold water. Put in it half a bushel of fresh quicklime, and slake it by pouring over it boiling water sufficient to cover it 4 or 5 inches deep, and stirring it till slaked.) then fill the barrel two-thirds full of water and add 1 bushel of hydraulic cement or water lime. Dissolve in water and add 3 lbs. sulphate of zinc. The whole should be of the thickness of paint, ready for use of the brush. This

[183] "Stucco Whitewash". http://forum.nationaltrust.org

wash is improved by the addition of a peck of white sand stirred in just before using it. The color is of a pale stone-color, nearly white.

To make it fawn color, add 1 lb. yellow ochre, 2 lbs. raw umber, 2lbs. Indian red.

To make it drab, add 1 lb. Indian red, 1 lb. umber, 1 lb. lampblack.

This wash, which we have tested thoroughly, sets and adheres very firmly to brick work or stucco, is very durable, and produces a very agreeable effect."

Recipe for calcimine paint by Rufus Porter, 1825, called *"A Cheap Method of Painting Walls of Rooms"* (Used in Dome Room at Monticello, Charlottesville, Virginia):[184]

"Dissolve ½ pound of common glue in one gallon of water, and mix therewith 6 pounds of Spanish Whiting. To this composition add a small quantity of yellow ochre (Mars yellow is used at Monticello), wet blue or any other cheap coloring ingredient. Stir these well together"

Proportions for modified yellow calcimine paint used in 1993 paintings at Monticello, Charlottesville, Virginia: Made the same way as paint above with substitution of modern acrylic binder:

Bocour's Aqua Tec Matte Varnish – ½ parts

Water – 1 part

Whiting – 1 part ("Reliable" brand)

[184] H. Andrew Johnson, A Summary of Historic "Distemper" Paint Finish Reproduction at Monticello, n.p. June 1994, 1, 4, & 6.

Proportions for 1993 modified repainting of blue South Square Room at Monticello, Charlottesville, Virginia:

1 part paint (Pittsburgh Latex Wallhide flat interior)

3 parts distilled water

1 part “Reliable Whiting” (Blue Ridge Whiting also works)

APPENDIX B

SOURCES OF MODERN PAINTS IN HISTORIC COLORS[185]

Interior Paint:

National Trust (U.K.) – licensed colors from England's Farrow & Ball; of interest to Victorian-house owners. Also distemper, casein. To-the-trade dealers: (888) 511-1121. Order color card and products online: farrow-ball.com

Colonial Milk Paint – for eighteenth and early nineteenth century houses: Old Fashioned Milk Paint Co. through distributors: (978) 448-6336, milkpaint.com

Interior and Exterior Paint:

American Tradition - Valspar's extensive line developed with the National Trust. Distributed in Lowe's stores. (888) 313-5569

Historical Color Collection – suitable for eighteenth and nineteenth century houses, from Benjamin Moore dealers. At benjaminmoore.com, click on 'architectural styles' at 'homeowner' page; order their helpful book The Art of Exterior Painting.

Colonial Colors Williamsburg Collection – documented. Martin Senour: (800) 677-5270, martinsenour.com

Historic Charleston Colors – developed around regional colors authenticated by Historic Charleston Foundation; sold through dealers in SC, or order card and products online from Lord & Evans, (843) 722-1056.

[185] Poore, "Color", 66.

Old Century Colors – are oil and latex paints in colonial and early nineteenth century colors; paint formulated to leave subtle brush marks in finish. Also simulated milk paints. Primrose Distributing, (800) 222-3092, oldcenturycolors.com

Historic Colors of America – breakthrough collection of eighteenth-nineteenth century colors especially suited to New England and East, sanctioned by SPNEA. Call Color Guild for regional dealers: (303) 751-5330

Specialty Finishes:

High-quality exterior opaque stains in period-complementary colors through dealers from Samuel Cabot, Inc., 9800) 877-8246, cabotstain.com

High-performance Schreuder Dutch exterior house paints and enamels, acrylic and oil, imported by Fine Paints of Europe, (800) 332-1556, fine-paints.com

From Australia: Lime wash (a Mediterranean finish for unglazed masonry). Interior paints include milk paint, distemper, fresco paint (for simulating aged plaster), and patina finishes. Also int./ext. historic colors from down-under. Sydney Harbour Paint Co., (818) 623-9394, sydneyharbourpaintco.com

Color washes, casein, solvent-free wall paint, etc. from Bioshield, (800) 621-2591. Online orders encouraged: bioshieldpaint.com

Later Period Paints:

Craftsman palette – solid and semi-transparent colors from Arts and Crafts homes; mail orders (818) 766-6384. (Inside paint only.)

Painted Ladies Collection – Victorian and late twentieth century Revival colors from Martin Senour (above). (Exterior and interior paint.)

Preservation Palette – features Arts and Crafts, 1920's Jazz Age, '30's/'40's Streamlined, '50's Suburban Modern colors, from Sherwin-Williams dealers. (216) 566-2000

APPENDIX C

TESTS FOR PAINT ANALYSIS

Microchemical tests to use in paint analysis:[186]

Test for Whitewash: "Whitewash layers contain calcium carbonate ($CaCo_3$). Particles of this completely dissolve in hydrochloric acid (HCL, 10% v/v)."

Test for casein paints, tempera, and distemper colors: "Casein paint contains proteins and so does tempera and distemper colors. As a test for proteins, sodium azide saturated with iodine is used (10mH NaN_3; J_2). It is toxic. If there is protein present in a paint coat, it develops bubbles if you add one drop to a sample. As a test for the reliability of the chemical, put a hair root into a drop of sodium azide. Under the microscope, bubbles should be perceivable if the medium is casein or tempera."

Test for white lead: "White lead was often used with an oil binder. If you add one drop of sodium sulphide (Na_2S; 2.5 N) to a paint layer, the sample turns black if it contains white lead as a pigment."

Test for Prussian blue: "A drop of sodium hydroxide (1M NaOH) is supposed to turn Prussian blue orange to dark brown."

Test for oil binders: " All oil binders are acidic. Bromocresol purple (0.04 wt. % solution in water) is used to determine whether a paint coat is acidic or an alkali. If the paint has an oil medium, the application of Bromocresol purple will turn yellow immediately around the sample."

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[186] Hildegard Kalthegener, "Chemical Paint Analysis", n.p., 1990.

To test for water-based paints made with lime or chalk (such as whitewashes and calcimine paints): [187]

A droplet of dilute hydrochloric acid is placed on a glass slide and a paint sample is placed into it. If there is lime or chalk in the paint, effervescence is observed.

Stains used to identify the presence of distemper paint: [188]

TTC (triphenyl tetrazoluim chloride), 4% in methanol, to identify the presence of carbohydrates (such as starch paste, gum-arabic, sugars, and cellulosics); FITC (flourescein isothiocyanate), 2% in acetone, to identify the presence of proteins (such as hide glues, casein, and gelatin); and, DCF (2,7 dichlorofluorscein), 2% in ethanol, to identify the presence of saturated and unsaturated lipids (fats).

To determine if the paint medium is an oil medium or whitewash medium: [189]

If a fragment of paint is dropped into muriatic acid a whitewash medium will totally dissolve but there will be no effect on the oil medium.

[187] Welsh, "Microchemical", 248.

[188] Moss, Paint, 181.

[189] Batcheler, "Paint Color", 2.